# Operating manual

# Power Supply Tester model-800E


KEISOKU GIKEN CO., LTD.

# Warranty Information

KG (KEISOKU GIKEN CO., LTD.) certifies that this product met its published specifications in this manual at time of shipment from factory with rigorous product inspection.
KG hardware product is warranted against defects in material and workmanship for a period of one year from date of delivery.
During the warranty period KG will, at its option, either repair or replace products without charge which prove to be defective. Please contact a dealer you purchased from or KG directly for any request or questions of the warranty service and inform of product model number and serial number for the manufacturing traceability.
Regarding measurement accuracy, warranty period is six months from date of delivery.
The foregoing warranty shall not apply to any failure(s) or defect(s) resulting from improper or inadequate maintenance/handling by the Customer as listed below.
The repair will be charged in those situations.

1. Usage not in accordance to instruction for operations in manual.
2. Unauthorized repair, alteration, modification, or physical damage.
3. The damage caused by improper packaging or handling during transportation.
4. Acts of God such as temblor, floods, riot, and war.
5. The abnormal input or power surge voltage.
6. The repair with dispatching engineer from KG.

This warranty is valid only in Japan.

## Copyrights



## Read this manual before start using this product

This manual describes the contents corresponding to the factory functions of the power supply tester model-800E. Please read this manual carefully before using this product.
This manual should be kept in an accessible place.
Attach this manual to this product when you relocate them.

This manual is written based on the functions of this product when shipped from KG.
The specifications are subject to change without any notice.

## Registered trademark

Microsoft Windows, Microsoft Excel, Active X, Visual Basic, and Visual C ++ are registered trademarks of Microsoft Corporation in the United States and other countries.

# For your Safety Usage

For your safety reasons, you are requested to read this manual thoroughly first. Keisoku Giken shall not be responsible for any accidents which resulted from your improper use or something like that.

## About safety symbols (marks)

The following symbols are used in this manual and products to ensure the safe and correct use of this device. Please understand the meaning of the symbols and always keep in mind the safety.

This is a symbol that informs you of warnings, dangers, cautions, or the contents of the symbol label used in this instrument and this manual. If this label is displayed on the instrument, it means that you need to refer to the relevant part of Operating manual

**Danger**

This term indicates the possibility of causing fatal damage to an operator.

**Warning**

This term indicates the possibility of causing serious damages to an operator.

**Caution**

This term indicates the possibility of causing low-level damages to an operator.

**Note**

This term indicates what you want to know of product performance or operation method.

**Supplement**

Contains supplementary explanations such as operating procedures.

This term indicates a prohibited act.

## For using safely

This is a precaution to use this product safely. Please understand the contents and be sure to observe it.
Keisoku Giken is not responsible for accidents caused by inappropriate methods of use by the customer.

### ■ Installation environment


Do not use in environments where explosive and corrosive gases are in the surroundings.
Avoid using it in strong electromagnetic environment. Under a strong electromagnetic field environment, the noise induced in the input cable is measured as an input signal due to the characteristics of the instrument, so the measured value may be affected.

Avoid locations that are hot or in direct sunlight. Use under the specified ambient conditions. In case of condensation, please do not use this product until completely dry. Avoid places with high humidity.

Avoid using it in a dusty or dusty place, or in a tilted or vibrating place.
Avoid using it in a poorly ventilated place. For cooling, ensure sufficient space around the air intake and exhaust so that they are not blocked by objects.
When installing large equipment, use caster locks or anchor bolts to prevent the equipment from moving or falling due to vibrations including earthquakes.

## ■ Device connection

This unit can replace the fuse in the AC inlet. When replacing, use a fuse with a shape, rating, and characteristics that matches the instrument. (Fuse rating of this instrument 250 V / 3.15 A)

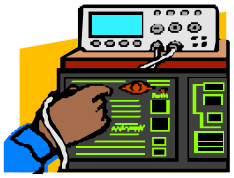
## ■ Disassembly

Inside this product, there are parts that risk danger to the body such as high voltage. Do not remove covers or panels.

## ■ Input power supply

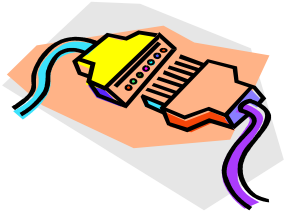
Be sure to use the input power supply voltage of this product within the rated range.
Use Power Cable which is suitable for your own country's safety standard.

## ■ Operator



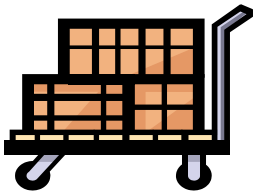
This product should be used only by a person who has enough knowledge of electronics.
In case the operator does not have enough electronic knowledge, use it only under supervision of knowledgeable person.

## ■ Connection / removal



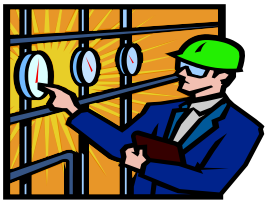
Before connecting cables and devices, be sure to turn off the power switch of each device.

## ■ Move



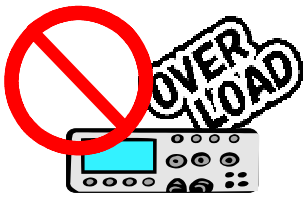
Turn off the power switch and remove all wiring cables. Attach the instruction manual when moving this product.
When transporting this product, be sure to use exclusive packing materials. When there is no exclusive packing material, please pack it after sufficiently protecting with cushioning material.

## ■ Maintenance / inspection



Always unplug the power cord to prevent electric shock accidents when performing maintenance and inspection.
Periodic maintenance, inspection and cleaning are recommended to maintain the safety of this product. Periodic calibration is recommended to maintain the performance of this product.

## ■ Overload




Do not apply voltages outside the specification range on the connector and input terminals of this product. Do not use the connector and input terminal of this product for purposes other than those described in this manual.

## ■ Calibration and repair

If calibration or repair is necessary, contact us or your dealer. Calibration and repair of this product is done by us

# Introduction

**About this book**

This document describes the power supply tester model-800E.

**Structure of this Operating manual**

This Operating manual is structured as follows.

### Chapter 1 Product overview

Introducing the outline and features.

### Chapter 2 Names and functions of each part

This section describes the names and functions of the terminal blocks and control switches.

### Chapter 3 Connection and operation

This section gives notes on the performance, connection, and operations.

### Chapter 4 Connection with Test Power Supply (DUT)

This section describes an example of connection with the DUT.

### Chapter 5 System connection

This section describes the connection method that controls both AC / DC of the input source.

### Chapter 6 Scanner unit

Describes the scanner unit.

### Chapter 7 About Ripple & noise

Describes the measurement of Ripple & noise

### Chapter 8 Ripple & noise measurement and error factors

Ripple & noise technical explanation of measurement and error factors.

### Chapter 9 model-800E specifications

Describes the electrical specifications, mechanical specifications, and general specifications of model-800E.

### Chapter 10 Maintenance and inspection

This section describes the maintenance, inspection and calibration of model-800E.

# Confirmation at the time of unpacking

After unpacking, check that there is no damage during transportation and that the accessories are attached correctly.
In the unlikely event that the instrument is damaged or accessories are missing, please contact your dealer or our company immediately.

## Accessories

The following accessories are included in this product.

| Product name | Model name | Quantity |
|---|---|---|
| CD-ROM | model-800E Operating manual | 1 |
| Power cable | 3P 2 m power cable | 1 |
| USB cable | 1.8 m USB cable | 1 |
| Signal cable | BM-58U-150KO | 5 |
| Remote box | SC-816A | 1 |
| OV connector | 17JE-23370-02D8A (DDK) | 1 |
| DVM connector | 17JE-13370-02D8A (DDK) | 1 |
| DI / DO connector | 57-30360 (DDK) | 1 |

**Note** Please check the contents as soon as it is unpacked.

- Check the product for damage during transportation.
- Make sure the accessories are delivered correctly.

## Precautions when moving

Observe the following precautions when moving the instrument.

| warning | There is a risk of electric shock. |
|---|---|
| | ◆ For your safety, be sure to turn off the power switch when moving.<br>◆ Even if the power is turned off, the device may still have voltage. Make sure that the voltage has dropped before starting work. |

| Caution | It may damage the equipment. |
|---|---|
| | ◆ When transporting this device, use the dedicated packing material (packing material at the time of delivery).<br>◆ If you do not have a special packing material, be sure to use a packing material of the same or better quality. |

# Table of contents

# Chapter 1. Product overview

## Overview

Model-800E is the power supply tester that can connect the output of a regulated DC power supply (DUT) to up to 5 channels and a measurement system required for testing.
It is controlled by the USB interface, which is a standard specification in current computers.

## Features

- The DC voltage measurement system can be selected from two types: standard measurement mode, which is not easily affected by commercial frequency hum, and high-speed measurement mode.
- Ripple & noise generated in a regulated DC power supply (switching power supply) can be measured by equipping our original measurement circuit RC-01A.
- Output voltage and general-purpose DC voltage measurement required for inspection of regulated DC power supply, input / output I / O by photo coupler, power supply for overvoltage test and scanner are standard equipment to support various inspections.
- If sequence measurement or relay contact is required depending on the inspection content, an optional unit can be added to the expansion slot (3 slots) to expand the function.
- When performing an inspection, it is also possible to connect a dedicated remote box and perform the inspection without using a keyboard.
- It is also equipped with a dedicated I / F for controlling the DC controller (model-519 / model-519A) and AC input source (model-502P).

## Precautions for use

- All measurement systems are designed for DC voltage measurement and can cause malfunction if AC voltage exceeding 2 Vrms (5.5 Vp-p) is continuously applied.

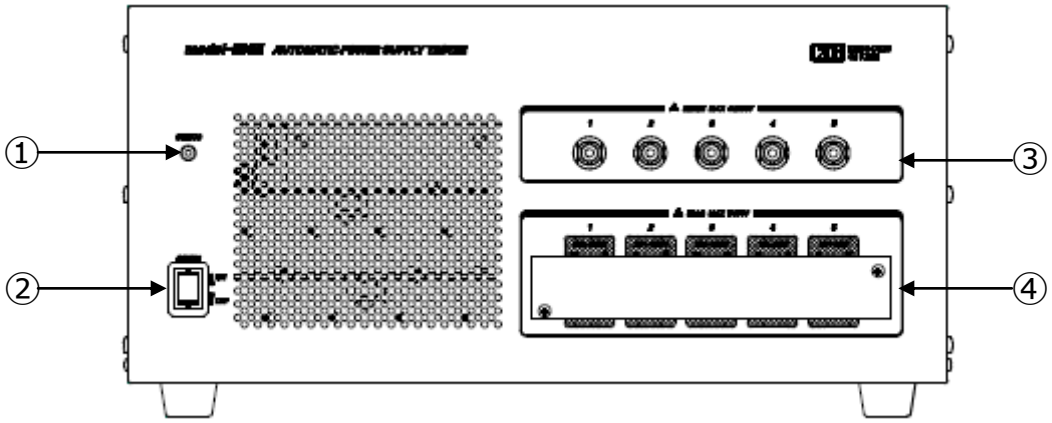
- Each load channel has a protection circuit and a warning circuit, but if a load that exceeds the rating of the load channel is connected incorrectly, it may cause a malfunction.
  **When inspecting, pay close attention to the rating and connection method of the DUT.**

- When using the expansion unit, pay attention to the address setting of the scanner unit and the connection between the units. Especially when using the internal power supply of this unit, be careful not to make a mistake in the load capacity and wiring. It may cause malfunction or failure.

- In the measurement of ripple noise of switching power supply, due to the complicated ripple noise generation mechanism peculiar to switching power supply, the measurement of ripple and noise may cause an error depending on the usage conditions such as the connection method of the signal cable.
  **Please see "Measurement of Ripple & Noise" before use.**

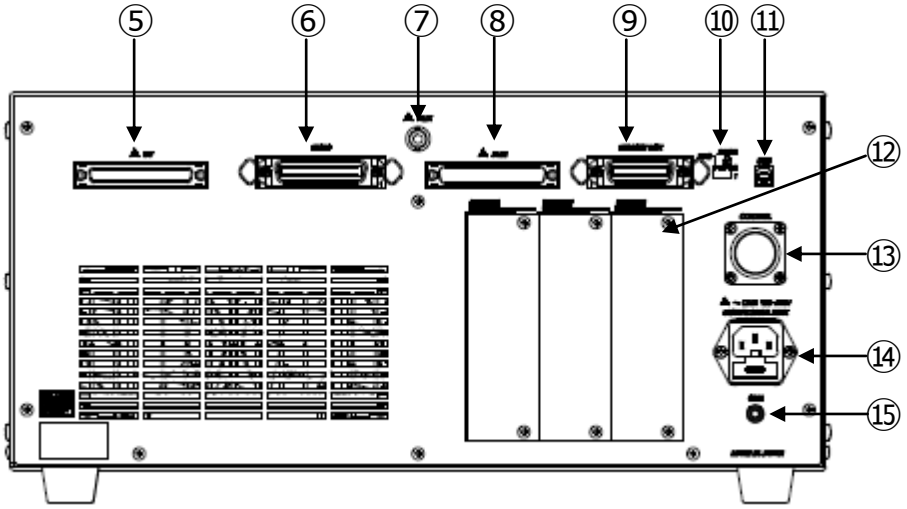
# Chapter 2. Names and functions of each part

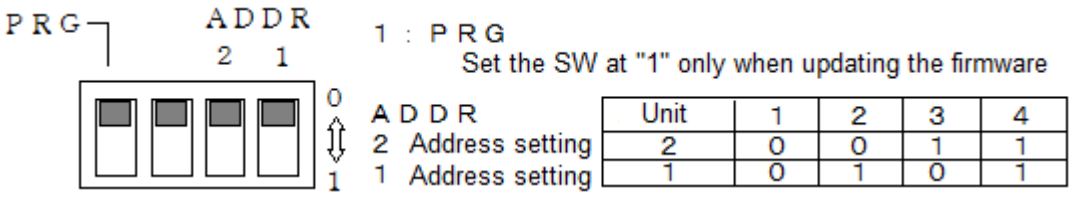
## Front panel




| No. | Name | Description |
|---|---|---|
| ① | STATUS | The status of the LED is as shown in the table below. When using it, make sure that the green LED is lit before using it.<br><br>LED: Green — Status: During normal operation<br>LED: Flashing red — Status: Alarm status<br>LED: Orange — Status: Firmware updateable state |
| ② | POWER | Power switch. |
| ③ | SENSE MAX DC100V | Input BNC connector for DC voltage and Ripple & noise voltage (Connect using the included signal cable) |
| ④ | LOAD MAX DC70V | Load terminal with a maximum applied voltage of DC70V. The current capacity, power capacity, and set resolution differ depending on the channel. Select the appropriate channel according to the specifications of the DUT to be connected. |

# Rear panel




| No. | Name | Description |
|---|---|---|
| ⑤ | OV | The overvoltage power supply (70 V / 0.5 A) inside the unit is output through an 8-channel scanner with the connector used when performing the overvoltage protection test of DUT. It can also be used as a simple pseudo voltage source. |
| ⑥ | DI / DO | It can be used when you want to control an external circuit with the input / output I / O of the photocoupler. |
| ⑦ | AUX | DVM multiplexer This is a BNC connector for connecting to the SC-830's AUX connector when the SC-830 is added.<br>The channel number of the added scanner unit starts from 17, and works with the internal scanner (1 to 16 channels). |
| ⑧ | DVM | The DC voltage is measured using the DC voltage measurement system through a 16-channel multiplexer.<br>AC voltage and Ripple & noise cannot be measured. |
| ⑨ | REMOTE BOX | This is a dedicated connector for connecting the remote box (SC-816A) used for inspection. |
| ⑩ | PRG / ADDR | Update the firmware of this unit and set the unit address.<br>Up to 4 units can be recognized by specifying the unit address. |
| |  1 : PRG<br>Set the SW at "1" only when updating the firmware<br>ADDR<br>2 Address setting<br>1 Address setting<br>Unit / 1 / 2 / 3 / 4<br>2 / 0 / 0 / 1 / 1<br>1 / 0 / 1 / 0 / 1 | |
| ⑪ | USB | This is a connector for controlling this unit with a computer using a USB interface. |

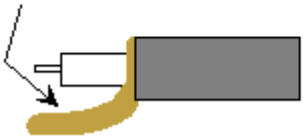
| | | |
|---|---|---|
| ⑫ | Expansion slot | An expansion slot for setting an optional scanner unit.<br>Controls the DC source controller model-519 / model-519A. |
| ⑬ | CONTROL | I / F for controlling the input source of model-519 / model-519A. |
| ⑭ | AC inlet | AC power input connector.<br>AC 100 V to AC 240 V / 50 Hz to 60 Hz |
| ⑮ | GND | Frame ground of model-800E |

# Chapter 3. Connection and operation

## Cable connection method for Ripple & Noise

Use a 50 Ω coaxial cable to measure ripple and noise, and keep the cable as short as possible. In particular, the unshielded part of the coaxial cable that connects to the DUT should be processed and wired as short as possible.

**Accurate measurement is not obtained when there is too much unshielded portion due to noise and resonation.**

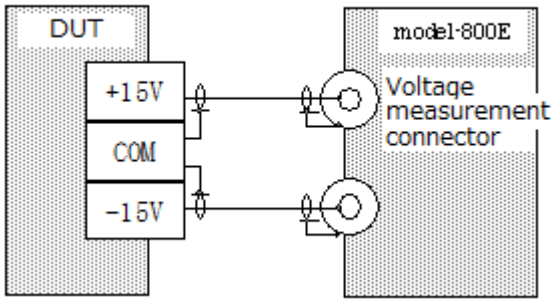


**Accurate measurement is obtained by minimum unshielded portion and shortest cable.**

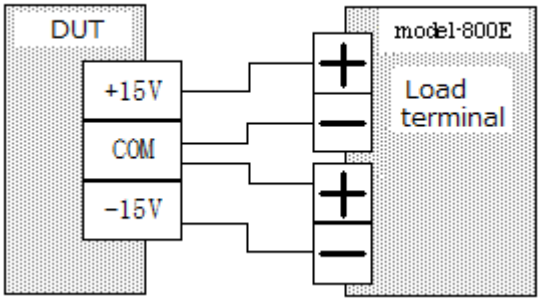
## Voltage measurement and load terminal connection

Since the voltage can be measured ±, the COM terminal can be connected to the ground as shown in the voltage measurement connection diagram below. Since the load terminal has polarity, it is necessary to pay attention to the polarity when connecting a negative power supply.
Connect by referring to the load terminal connection diagram shown below.

Voltage measurement connection

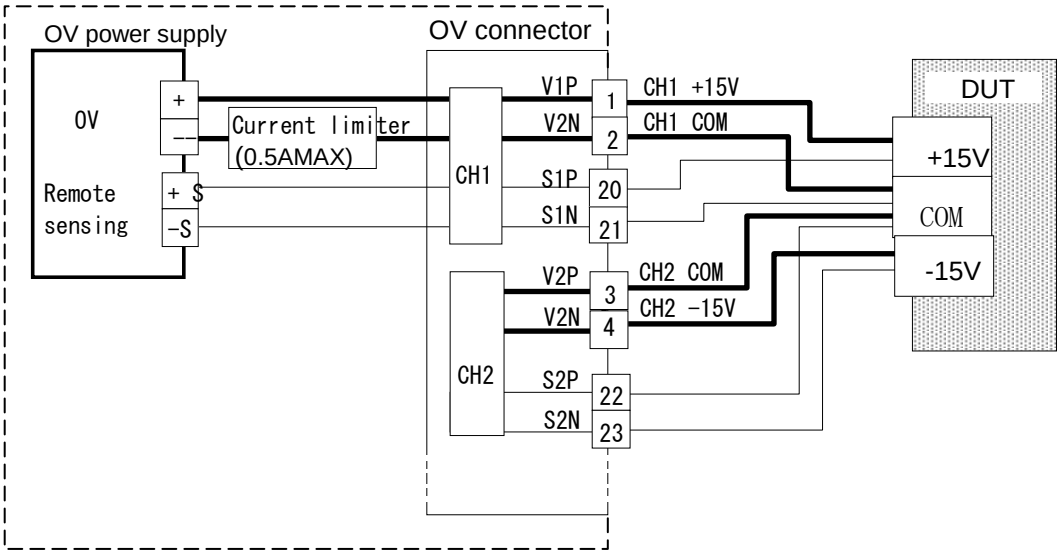



Load terminal connection



# Overvoltage protection (OVP) test connections

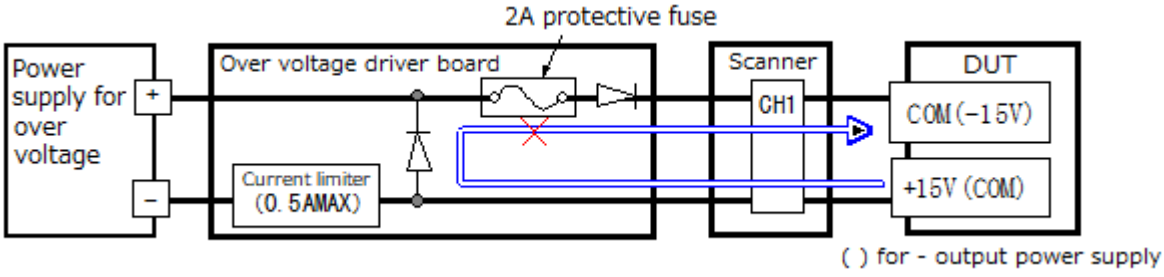
This product has a built-in OV power supply for overvoltage protection test. Since the OV power supply has polarity, it is necessary to pay attention to the polarity when connecting the negative power supply. As shown in the figure below, connect to the negative voltage of the DUT as shown in "CH2 -15V / COM".
For the connection cable to VnP and VnN (n: integer) such as V1P and V1N, use a wire that can pass a current of 0.5 A or more.
SnP and SnN (n: integer) such as S1P and S1N are remote sense, so use a wire that can use a current of about 0.1 A.




# Protection circuit of the power supply for overvoltage test

The OV power supply is equipped with 0.5A fuse intended to protect itself or parts from output shortage by any reason.
If the DUT is connected in reverse, the 2 A fuse that protects the scanner relay and wiring will blow to protect the circuit. If the fuse blows, it needs to be replaced.

Current flow when DUT is connected to Over Voltage power supply in wrong polarity




Replacement fuse: F-7142 2.0 A (Sato Parts Co., Ltd.) equivalent

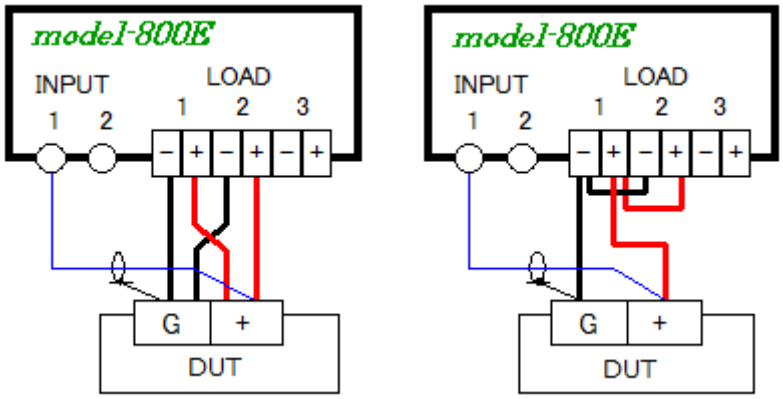
How to exchange the fuse)
Remove the cover and replace the fuse on the overvoltage driver board on the right side.

## Selecting the load channel

The model-800E has three types of load ratings, each with a different rated current and rated power.
When selecting the load, it is necessary to consider not only the rated current of the DUT but also the load current of the over current protection test. In addition, judging from the load current alone, the load power may be insufficient and an overpower alarm may occur during the inspection, making the inspection impossible.
When selecting a load channel, check the maximum current and maximum power to be set during the inspection before selecting the load channel.
In addition, if a channel with a large load capacity is selected when inspecting a DUT with a low rated current and rated power, the inspection data may vary due to the setting error current.
When selecting a load channel, check the rated power and rated current of the DUT and select the optimum load channel.

## Parallel connection of load channels

If you set the parallel connection of loads with the control software, the loads will not be automatically connected inside the model-800E, so if you specify parallel connection, connect the load terminals as shown in the figure below. Please perform parallel operation.

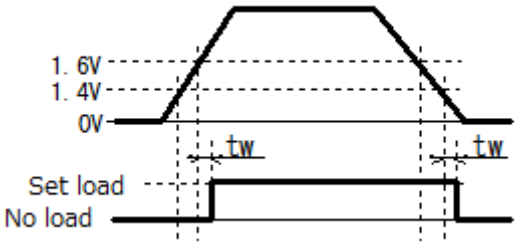


# Minimum operating voltage and load operating area of the load channel

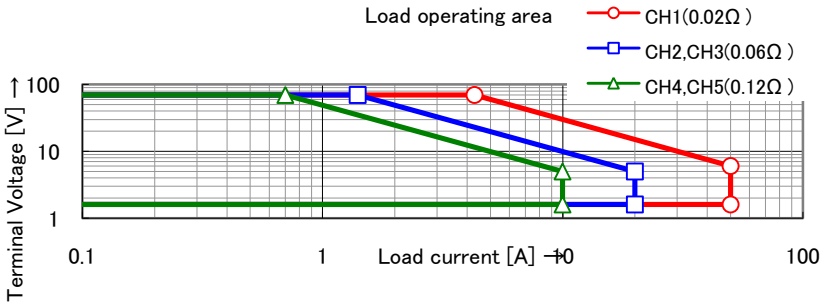
With model-800E, you can select "**minimum operating voltage**" enabled or disabled in constant current mode.

**Minimum operating voltage: Enabled (default setting)**

The minimum operating voltage can be specified only in the constant current mode, and even when the constant current is set as shown in the figure below, the DUT starts to take load current when it is about 1.6 V or more, and shut the current off about 1.4 V or less.
If you would like to change the set voltage, please contact us.

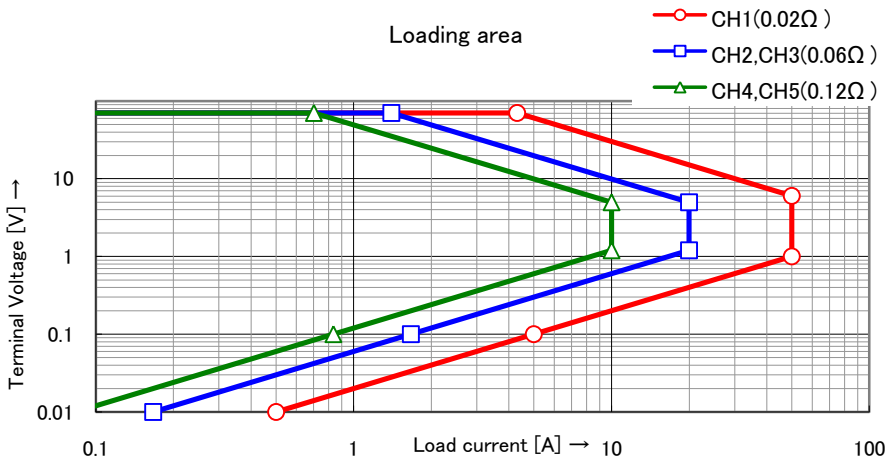



In addition, the load current operates tw (about 450 μs) after the minimum operating voltage is detected. The figure below shows the load operating area when the minimum operating voltage is enabled with the constant current mode.




**Minimum operating voltage: Disabled**

It tries to load the current being set when the power is turned on, but due to the internal resistance of model-800E, it is not possible to load the maximum current from 0 V.
The figure below shows the operating range of model-800E, and when the voltage at the terminal block of model-800E is 1 V or less, the rated load cannot flow due to the internal resistance.
Also, if the terminal voltage becomes high, the rated power will be exceeded, so an alarm will occur and no load will be set.



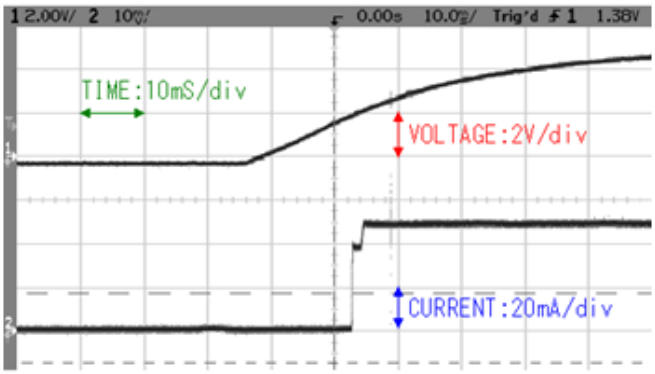
# Load operation when the DUT is turned on

This unit has two modes, constant current mode and constant resistance mode, and the response when the DUT is operated differs depending on the mode.
The following data is the result of measurement with a rated load of 10 A on CH 4 and 5 of this instrument.
The data below is the result of measurement with CH4, 5 with a rated load current of 10 A. CH1 (rated load current 50 A) has 5 times the current, and CH2 and CH3 (rated load current 20 A) have 2 times the current.
When viewing 7.8.1 to 7.8.4, convert the current according to the load rating.

## 1) Constant current setting: When the DUT with a slow rise time is connected

The figure on the right shows the voltage waveform of the 5V DUT and the load current at 50 mA.

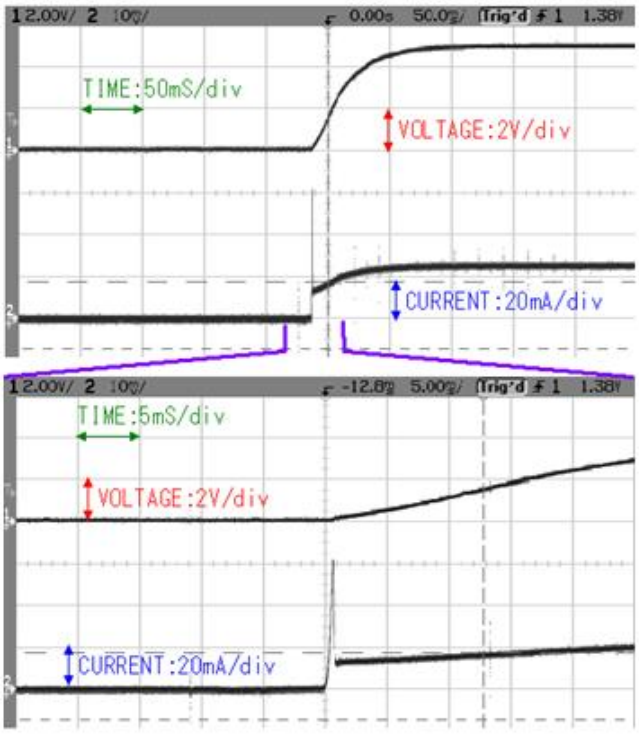
After the minimum operating voltage 1.6 V is detected, the load current flows.




## 2) Constant resistance setting: When the DUT with a slow rise time is connected

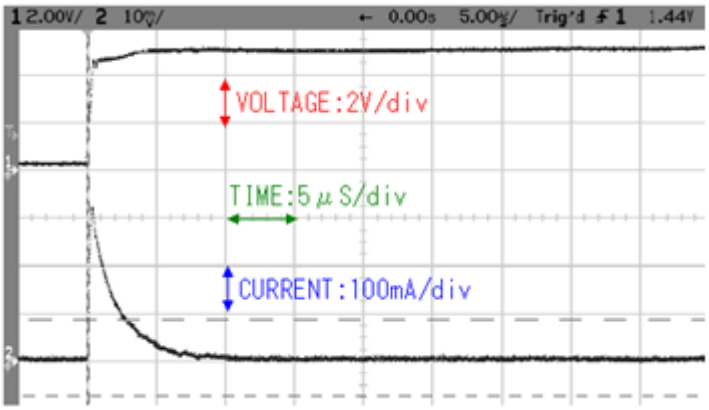
The figure on the right shows the waveforms of the voltage and load current when the 5 V DUT is operated after the constant resistance of 200 Ω is set.
The load current is determined by following the normal voltage, but as shown in the figure on the right, a spike current of 60 mA flows at 1 ms or less.
This current is the time required for the load control part of the instrument to operate stably.
This current depends on the rated current of the load channel of the instrument.

Supplement)
CH 1 : 300 mA
CH 2, 3 : 120 mA
CH 4, 5 : 60 mA



## 3) Constant current setting: When a DUT with a fast rise time is connected

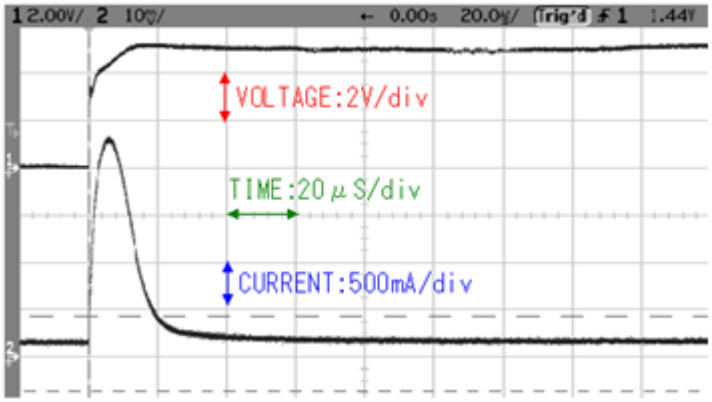
The figure on the right shows the waveforms of the voltage and load current when a 5 V DUT is operated with a constant current of 0 A. Immediately after power-on, a 300 mA pulse load current flows for 5 μs.




Supplement)
CH 1 :1500 mA
CH 2,3 : 600 mA
CH 4,5 : 300 mA

## 4) Constant resistance setting: When a DUT with a fast rise time is connected

The figure on the right is the waveform of the voltage and load current when the maximum resistance value of the constant resistance setting is set.
In the case of constant resistance setting, the circuit is always in the operating state and immediately follows the change in voltage.
Since there is no cut-off circuit like the constant current setting, a pulse current of about 2 A flows for 20 μs for a quick rise of operation.




Supplement)
CH 1 :10 A
CH 2,3 : 4 A
CH 4,5 : 2 A

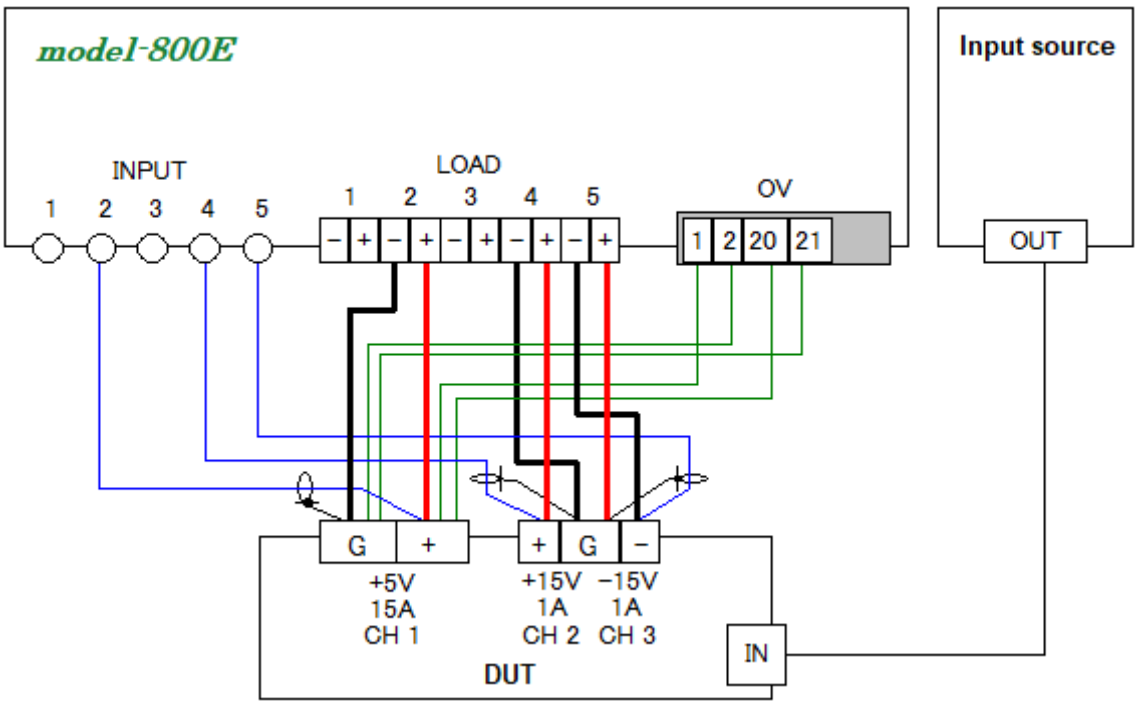
# Chapter 4. Connection with Test Power Supply (DUT)

This is a connection example when the rated specifications of the DUT are as follows.

Input : AC 100 V to 120 V, 50/60 Hz
Output CH 1 : + 5 V, 15 A, 75 W
Output CH 2 : +15 V, 1 A, 15 W
Output CH 3 : -15 V, 1 A, 15 W

Other specifications of DUT:

Over current protection: CH 1 only operates from 105% to 110%
MAX 16.5A load is required
Over voltage protection: CH 1 only operates from 120% to 140%
Requires overvoltage power supply up to 7 V
CH 2 and 3 are same common.




Connection example with DUT

The figure above is an example of connection with the DUT.
In the connection example, CH 2 of model-800E is used, but since CH 3 has the same specifications, there is no problem even if the channels used are 3, 4 and 5.

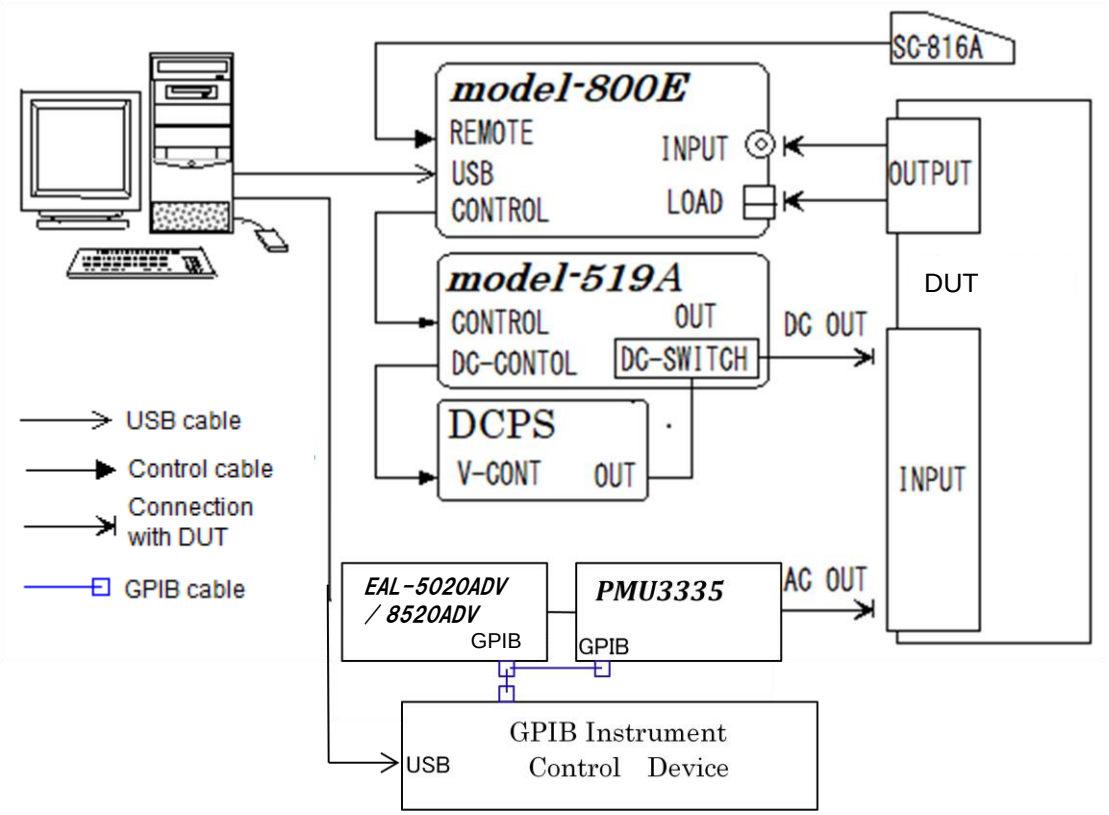
The reason for not selecting CH 1 is that the setting resolution becomes coarse.
Therefore, since the test power supply CH 1 in the above example is 5 V, 15 A, 75 W, select the load 20 A, 100 W for CH 2 of model-800E. Since CH2 and 3 of the test power supply are both 15 V, 1 A and 15 W, it is better to select the load 10 A and 50 W of CH 4 and 5 of model-800E.
For the overvoltage protection test, use OV channel 1 and connect the load and Sense of the OV power supply to CH1 of the DUT.
Since the GND of CH 2 and CH 3 of the DUT are common, connect the model-800E to the load terminal block as shown in the above figure. In particular, since CH 3 is a negative power supply, care must be taken when connecting it to the load terminal of model-800E.
Connect the CH 3 to the voltage measurement (INPUT) in the same way as any other channel.

# Chapter 5. System connection

The following connection example shows only the connection method that controls both AC / DC as an input source.

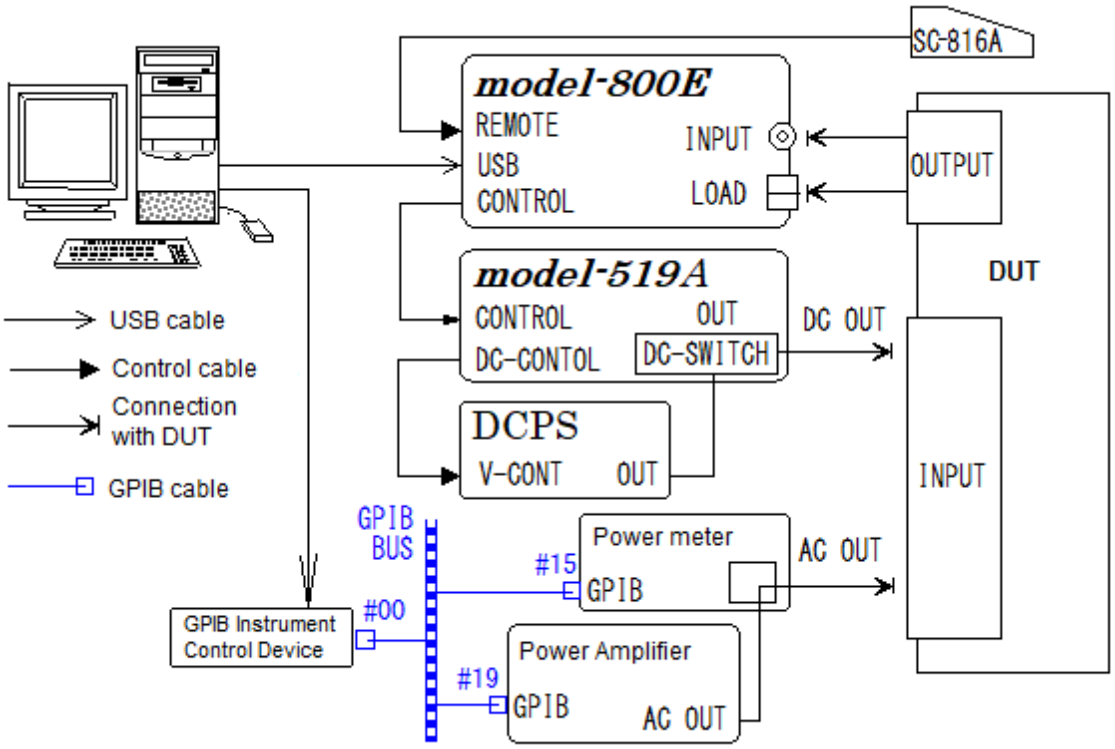
## AC (EAL-5020ADV/8520ADV+PMU3335) / DC (model-519 / model-519A) Source connection

The configuration changes depending on the input source, but the below is the standard system configuration diagram using model-800E.



# AC (GPIB control) / DC (model-519 / model-519A) source connection

This is a system configuration diagram when the input source is controlled by GPIB and the power is inspected by a power meter, and a DC power supply is also used.



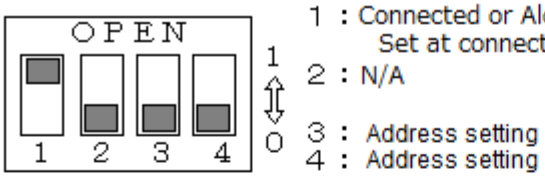
# Chapter 6. Scanner unit

## Scanner specifications

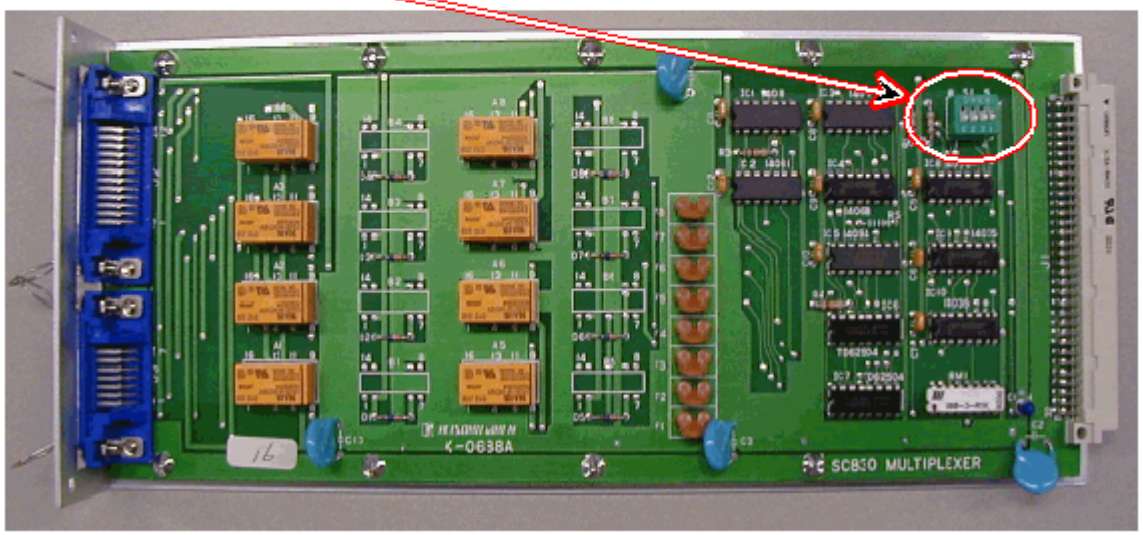
This unit can optionally expand the scanner unit.
Since some scanner unit functions are built into the main unit as standard, refer to the table below for the channel numbers to be added to the control software when expanding.

| Scanner unit | | Standard equipment | Additional options assigned channels | | | |
|---|---|---|---|---|---|---|
| Product name | Model name | Channel | A | B | C | D |
| REMOTE BOX | SC-810 | Yes | Cannot be expanded | | | |
| OV scanner | SC-820 | Yes 1-8 | Cannot be expanded | | | |
| DVM multiplexer | SC-830 | Yes 1 ~ 16 | 17-24 | 25-32 | 33-40 | 41-48 |
| User contact | SC-840 | No | 1-8 | 9-16 | 17-24 | 25-32 |
| Digital I / O | SC-850 | Yes 1-8 | 9-16 | 17-24 | 25-32 | 33-40 |
| sequence | SC-860A | No | 1-8 | 9-16 | 17-24 | 25-32 |

Yes: Standard equipment  No: No standard equipment




| Address | A | B | C | D |
|---|---|---|---|---|
| 3 | 0 | 0 | 1 | 1 |
| 4 | 0 | 1 | 0 | 1 |

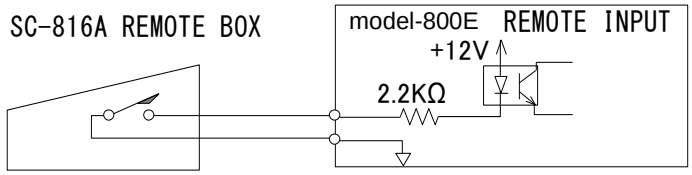


# 1. Remote box interface (standard equipment)

The remote box interface supports only the functions required to control the SC-816A remote box.

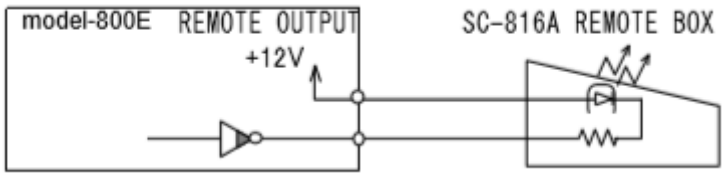
## 1) Remote box interface I / O specifications

- **Input specifications**
  It is a photocoupler input drive.




- **Output specifications**

  It is an LED drive.




## 2) Connector pin layout

| Name : REMOTE | | | |
|---|---|---|---|
| Connector: 57-30240 (DDK) | | | |
| 1 | I1 | 13 | I1i |
| 2 | I2 | 14 | I2i |
| 3 | I3 | 15 | I3i |
| 4 | | 16 | I4i |
| 5 | | 17 | |
| 6 | | 18 | |
| 7 | | 19 | I7i |
| 8 | 01 | 20 | 03 |
| 9 | 02 | 21 | 04 |
| 10 | | 22 | |
| 11 | +12V | 23 | 0V |
| 12 | +12V | 24 | 0V |

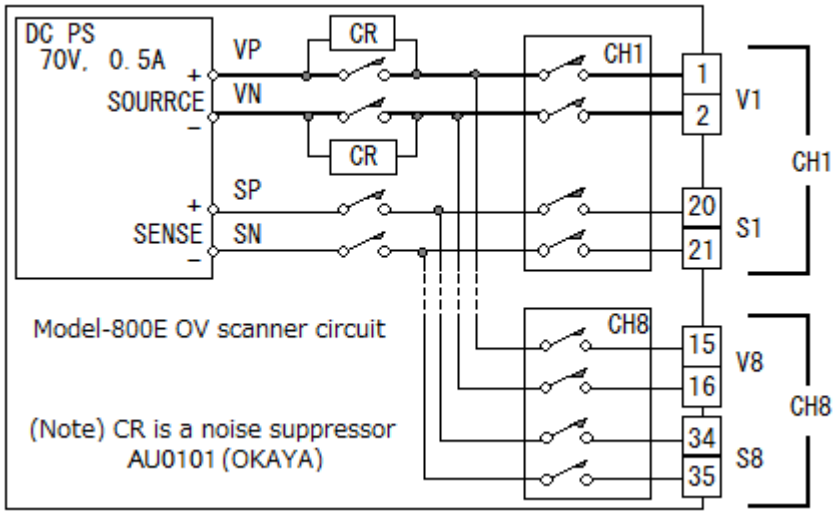
| SC-816A interface specification | | |
|---|---|---|
| Name | Description | I/F |
| S1 | ALL PRINT | I1 Input |
| S2 | NG PRINT | I2 Input |
| S3 | STOP on NG | I3 Input |
| S4 | EMERGENCY | I7i Input |
| S5 | CURSOR ↑ | I1i Input |
| S6 | CURSOR ↓ | I2i Input |
| S7 | NO | I3i Input |
| S8 | YES/START | I4i Input |
| L1 | TEST | 01 Output |
| L2 | PASS | 02 Output |
| L3 | FAIL | 03 Output |
| BZ | BUZZER | 04 Output |

In : Switch input 、 Ini : Key input 、 On : Output
n : Number 、 +12V, 0V : Power Supply

# 2. OV scanner (standard equipment)

This is an OV scanner unit used for overvoltage protection tests using the voltage application method.
Outputs the power output of the model-800E with a 70 V / 0.5 A over current limiter to any one channel.

## 1) Block diagram of OV scanner




## 2) Connector pin layout

| Name : OV OUTPUT | | | |
|---|---|---|---|
| Connector : 17JE-23370-02D8A(DDK) | | | |
| 1 | V1P | 20 | S1P |
| 2 | V1N | 21 | S1N |
| 3 | V2P | 22 | S2P |
| 4 | V2N | 23 | S2N |
| 5 | V3P | 24 | S3P |
| 6 | V3N | 25 | S3N |
| 7 | V4P | 26 | S4P |
| 8 | V4N | 27 | S4N |
| 9 | V5P | 28 | S5P |
| 10 | V5N | 29 | S5N |
| 11 | V6P | 30 | S6P |
| 12 | V6N | 31 | S6N |
| 13 | V7P | 32 | S7P |
| 14 | V7N | 33 | S7N |
| 15 | V8P | 34 | S8P |
| 16 | V8N | 35 | S8N |
| 17 | | 36 | |
| 18 | | 37 | |
| 19 | | | |

Naming of connector

VnP : + Output of OV power supply
VnN : − Output of OV power supply
SnP : + Sense of OV power supply
SnS : − Sense of OV power supply

n : Channel 1 to 8

# 3. DVM multiplexer (standard equipment / option)

The DVM multiplexer comes standard with 16 channels and can switch DC voltage. The maximum rated voltage is ± 100 V.
To add more channels, add the SC-830 DVM multiplexer unit.
When adding an SC-830 DVM multiplexer unit, set the address of the unit and insert it into the expansion slot of the unit.

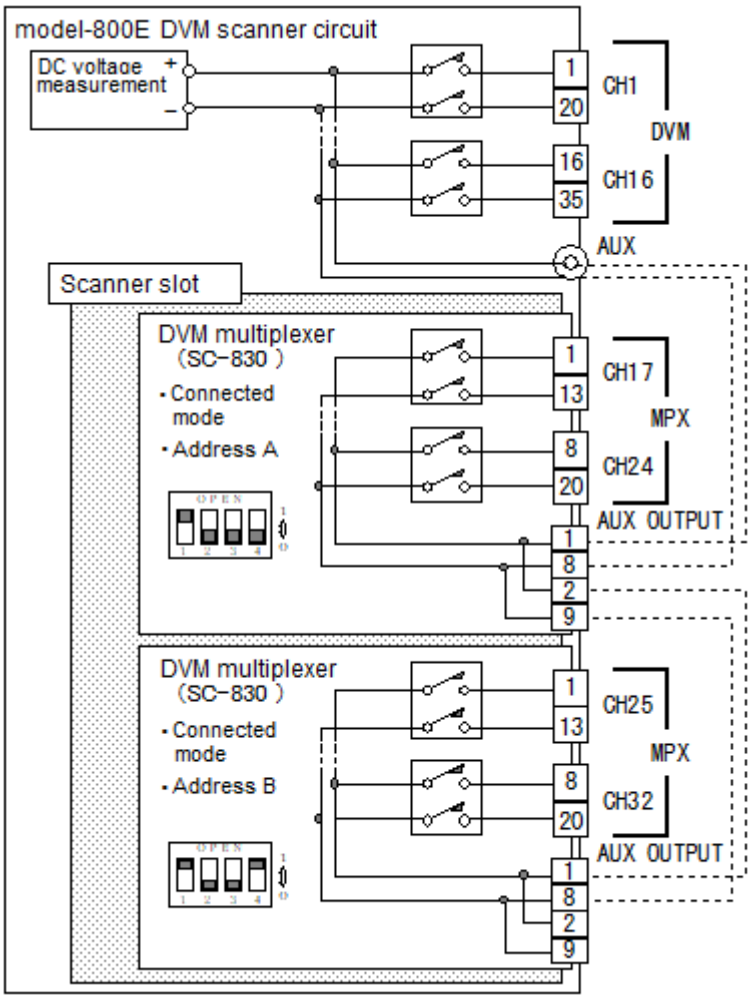
| Scanner unit | | standard equipment | Optional channel | | | |
|---|---|---|---|---|---|---|
| Product name | Model name | Channel | A | B | C | D |
| DVM multiplexer | SC-830 | 1 to 16 | 17-24 | 25-32 | 33-40 | 41-48 |

After inserting it into the slot, connect the AUX connector of this unit to the AUX connector of SC-830.

## 1) Specifications of DVM multiplexer unit (SC-830)

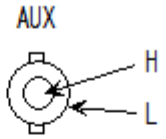
- Circuit system — Small signal magnet relay
- Number of channels — 8
- Contact rating — DC 220 V, AC 250 V 10 mA
- Number of expandable card — 4

## 2) Block diagram of DVM multiplexer section



### 3) model-800E Standard DVM connector connection pins

| Name : DVM | | | |
|---|---|---|---|
| Connector : 17JE-13370-02D8A(DDK) | | | |
| 1 | 1H | 20 | 1L |
| 2 | 2H | 21 | 2L |
| 3 | 3H | 22 | 3L |
| 4 | 4H | 23 | 4L |
| 5 | 5H | 24 | 5L |
| 6 | 6H | 25 | 6L |
| 7 | 7H | 26 | 7L |
| 8 | 8H | 27 | 8L |
| 9 | 9H | 28 | 9L |
| 10 | 10H | 29 | 10L |
| 11 | 11H | 30 | 11L |
| 12 | 12H | 31 | 12L |
| 13 | 13H | 32 | 13L |
| 14 | 14H | 33 | 14L |
| 15 | 15H | 34 | 15L |
| 16 | 16H | 35 | 16L |
| 17 | | 36 | |
| 18 | | 37 | |
| 19 | | | |




Connector : BNC connector

Naming of connector

nH : + input
nL : − input
H : AUX + input
L : AUX − input

n : channel 1 to 8
No channel setting for AUX, H and L
Input connector for scanner unit expansion

### 4) SC-830 DVM multiplexer connector pins

| Name : MPX | | | |
|---|---|---|---|
| Connector : 57-30240 (DDK) | | | |
| 1 | 1H | 13 | 1L |
| 2 | 2H | 14 | 2L |
| 3 | 3H | 15 | 3L |
| 4 | 4H | 16 | 4L |
| 5 | 5H | 17 | 5L |
| 6 | 6H | 18 | 6L |
| 7 | 7H | 19 | 7L |
| 8 | 8H | 20 | 8L |
| 9 | H | 21 | L |
| 10 | GURAD | 22 | GURAD |
| 11 | GURAD | 23 | GURAD |
| 12 | GURAD | 24 | GURAD |

| Name : AUX OUTPUT | | | |
|---|---|---|---|
| Connector : 57-30140 (DDK) | | | |
| 1 | H | 8 | L |
| 2 | H | 9 | L |
| 3 | GURAD | 10 | GURAD |
| 4 | GURAD | 11 | GURAD |
| 5 | GURAD | 12 | GURAD |
| 6 | GURAD | 13 | GURAD |
| 7 | GURAD | 14 | GURAD |

Naming of connector

nH : + input
nL : − input
H : AUX + output
L : AUX − output
GURAD : frame ground

n : channel 1 to 8
No channel setting for AUX, H and L
Input / output connector for scanner unit expansion

# 4. User contacts (optional)

The user contact is a C contact and a noise suppressor is inserted in the circuit.
Set the unit address of SC-840 as follows.

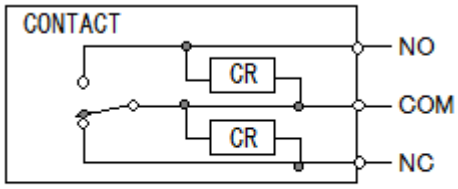
| Scanner unit | | standard equipment | Optional channel | | | |
|---|---|---|---|---|---|---|
| Product name | Model name | Channel | A | B | C | D |
| User contact | SC-840 | NO | 1-8 | 9-16 | 17-24 | 25-32 |

YES: Standard equipment, NO: No standard equipment

## 1) User contact unit (SC-840)

- Circuit type — Mechanical contact with magnet relay
- Number of channels — 8
- Contact Rating — C Contact (Transfer) DC 30 V 1 A / AC 250 V 1 A
- Number of expandable card — 4

## 2) Block diagram of the contact part




(Note) CR is a noise suppressor.
XE1201(OKAYA)

## 3) Connector pin layout

Name : CONTACT
Connector : 17JE-23250-02D8A(DDK)

| | | | |
|---|---|---|---|
| 1 | 1COM | 14 | 5COM |
| 2 | 1NO | 15 | 5NO |
| 3 | 1NC | 16 | 5NC |
| 4 | 2COM | 17 | 6COM |
| 5 | 2NO | 18 | 6NO |
| 6 | 2NC | 19 | 6NC |
| 7 | 3COM | 20 | 7COM |
| 8 | 3NO | 21 | 7NO |
| 9 | 3NC | 22 | 7NC |
| 10 | 4COM | 23 | 8COM |
| 11 | 4NO | 24 | 8NO |
| 12 | 4NC | 25 | 8NC |
| 13 | 0V | | |

Naming of connector

nCOM : Common
nNO : Normal open
nNC : Normal close

n : channel 1 to 8

# 5. Digital I / O (standard equipment / option)

It is an 8-input, 8-output unit with a photocoupler, and each circuit is separated.
Set the unit address of SC-850 as follows.

| Scanner unit | | standard equipment | Optional channel | | | |
|---|---|---|---|---|---|---|
| Product name | Model name | Channel | A | B | C | D |
| Digital I / O | SC-850 | 1-8 | 9-16 | 17-24 | 25-32 | 33-40 |

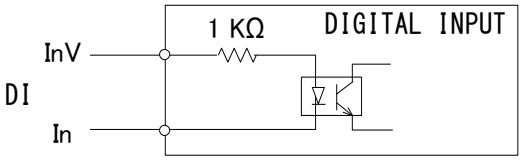
If there is no external power supply, + 12 V power can be obtained from the connector of this unit.
However, when using the + 12 V power supply of this unit, be sure to use it with a total current capacity of 200 mA or less.

## 1) Digital I / O unit (SC-850)

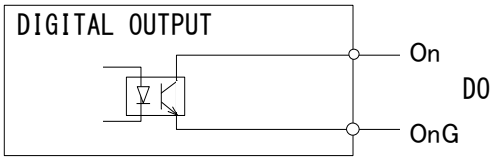
- Circuit type — Isolation input / output by photocoupler
- Number of channels — Input 8, output 8
- Circuit rated input — 12 V / 10 mA (maximum 16 mA)
  Output — 12 V / 10 mA (up to 24 V / 16 mA)
- Number of expandable card — 4

## 2) Block diagram of digital input / output section

•Digital input (DI)




•Digital output (DO)



## 3) Connector pin layout

| Name : DIGITAL I/O | | | |
|---|---|---|---|
| Connector : 57-30360 (DDK) | | | |
| 1 | I1 | 19 | I1V |
| 2 | I2 | 20 | I2V |
| 3 | I3 | 21 | I3V |
| 4 | I4 | 22 | I4V |
| 5 | I5 | 23 | I5V |
| 6 | I6 | 24 | I6V |
| 7 | I7 | 25 | I7V |
| 8 | I8 | 26 | I8V |
| 9 | O1 | 27 | O1G |
| 10 | O2 | 28 | O2G |
| 11 | O3 | 29 | O3G |
| 12 | O4 | 30 | O4G |
| 13 | O5 | 31 | O5G |
| 14 | O6 | 32 | O6G |
| 15 | O7 | 33 | O7G |
| 16 | O8 | 34 | O8G |
| 17 | +12V | 35 | 0V |
| 18 | +12V | 36 | 0V |

Naming of connector

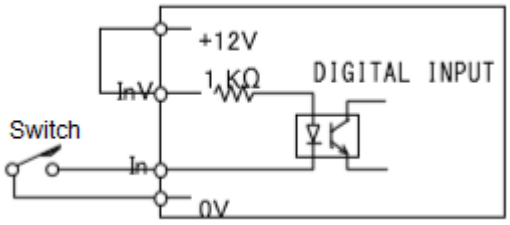
InV : Photocoupler anode input
In : Photocoupler cathode input
On : Photocoupler collector output
OnG : Photocoupler emitter output
+12V : model-800E +12V power supply
0V : model-800E +12V ground

n : channel 1 to 8

## 4) Application circuit example

- **Digital input (DI) internal power supply usage example**

When using the internal power supply of the instrument, it can be used only when the external power supply and the power supply of the instrument are not connected, such as by operating with a switch or relay contact as shown in the figure below.

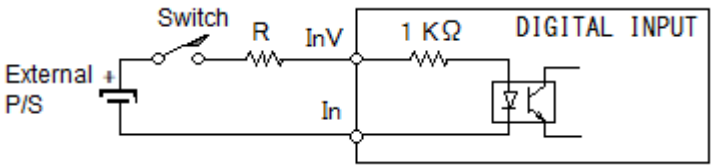



**Caution** It may damage the equipment.

- ◆ Be careful when using it as it may damage the internal circuit depending on the connection.

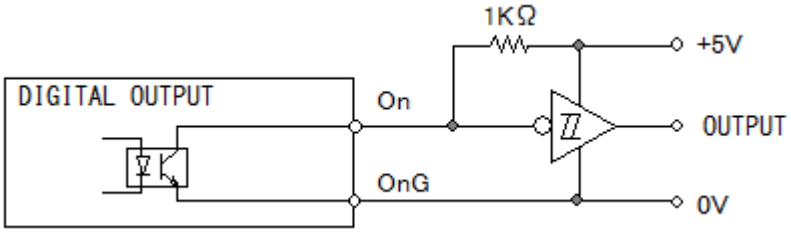
- **Digital input (DI) External power supply usage example**

When using an external power supply as shown in the figure below, pay attention to the connection, input direction, and current flowing through the photocoupler.
If the voltage of the external power supply is 5 V to 12 V, the resistor R is not required.
If it exceeds 12 V, insert a resistor R so that the current of the photocoupler is about 10 mA.




Example) When the external power supply is 24 V, the resistance R is about 1 kΩ.

- **Digital output (DO) usage example**
  In the example of driving the IC, the IC uses a Schmitt trigger input so that a pull-up resistor of about 1KΩ is connected and a load of about 5mA is applied to the output of the photocoupler.




# 6. Sequence unit (optional)

It is used when measuring the rise / fall time of the output voltage of the DUT.
The sequence unit has 3 input isolated channels in 1 unit, and the threshold voltage and rising and falling end conditions can be set individually. The measurement is started by an external trigger input, and the measurement is performed until the specified end condition is reached or the test time elapses.
Set the sequence unit address of SC-860A as follows.

| Scanner unit | | standard equipment | Optional channel | | | |
|---|---|---|---|---|---|---|
| Product name | Model name | Channel | A | B | C | D |
| sequence | SC-860A | NO | 1-8 | 9-16 | 17-24 | 25-32 |

YES: Standard equipment,  NO: No standard equipment

## 1) Sequence unit (SC-860A)

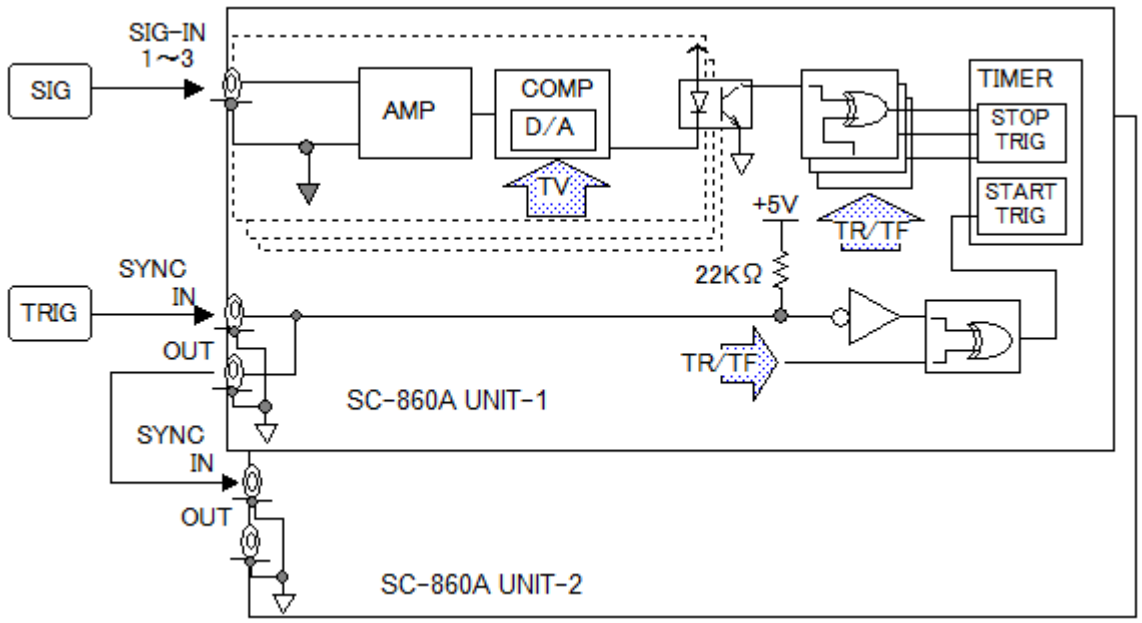
- Circuit type — Comparator
- Trigger input — Synchronous signal input is TTL level (pulled up to +5 V at 22 kΩ)

- **Channel input**
  - Number of channels — 3
  - Maximum voltage range — ± 200 V
  - Set voltage range — ± 50 V
  - Setting resolution — 100 mV
  - Setting accuracy — ± (0.3 % of stg. + 0.1 V)
  - Condition setting — Set rise and fall for each channel
  - Input impedance — Approx. 1MΩ

- **Channel measurement**
  - Measurement time clock — 0.1 ms / 0.2 ms
  - Maximum measurement time — 0.1 s to 5.0 s / 0.1 s to 10.0 s
  - Measurement accuracy — ± 0.2 ms / ± 0.4 ms

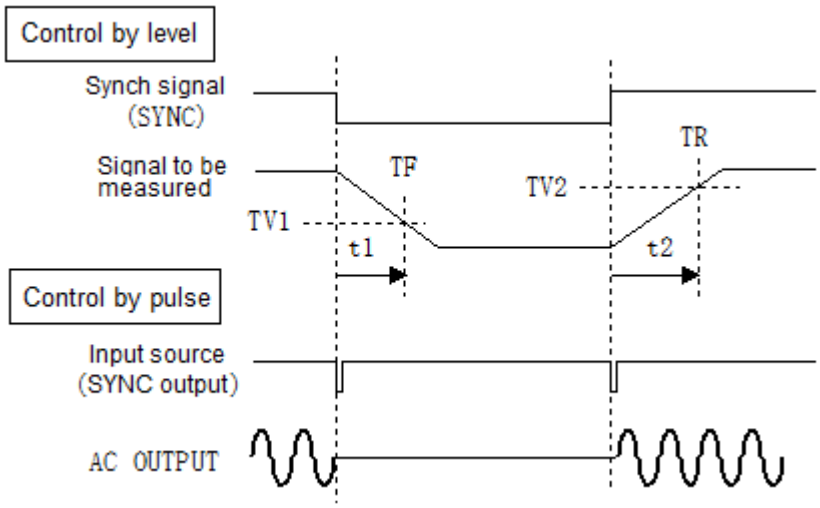
- **Number of expandable card** — **4**

## 2) Input block diagram




## 3) Sequence processing

The sequence unit (SC-860A) starts measurement by specifying the rise and fall of SYNC.
The measurement ends when the signal to be measured from "SIG" reaches the value set at the upper limit threshold for falling and the lower limit threshold value for rising.




The level control waveform in the above figure will be explained as an example.
The setting conditions for measuring the time of the waveform that the measured signal becomes LOW when the synchronization signal becomes LOW and the measured signal becomes HIGH when it becomes HIGH are as follows.

The sequence unit specifies the rise and fall of the SYNC signal and starts measurement.
Therefore, it can be operated regardless of level control or pulse control.
However, all of our input source relationships controlled by model-800E are pulse control (pulse width 0.1 ms or less). When using in combination with the trigger of our input source, make the circuit considering the SYNC waveform of the pulse control in the above figure.

**Level control**

Sync signal: HIGH → LOW

Input start trigger: TF (fall down) setting

Signal to be measured trigger: Set the set voltage TV1 at the lower limit threshold value in the TF (falling down) setting.

As for the measurement result, the time t1 from the synchronization signal LOW to the falling edge of TV1 is measured.

Sync signal: LOW → HIGH

Input start trigger: TR (rise) setting

Signal to be measured trigger: Set the set voltage TV2 at the upper limit threshold value in the TR (rise) setting.

As for the measurement result, the time t2 from the synchronization signal HIGH to the falling edge of TV2 is measured.

If the TR / TF setting of the trigger input is incorrect, the start and end conditions will not be met.

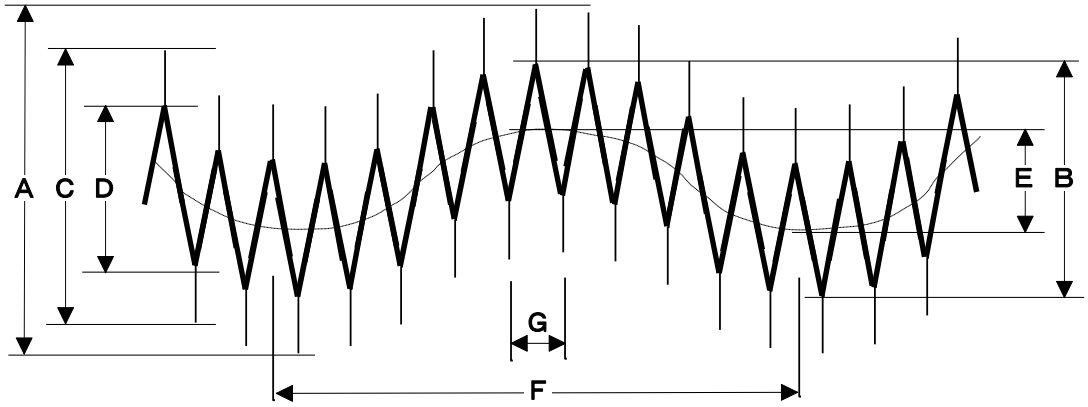
**Note** TR / TF setting when measuring negative output power supply

- Note that the TR / TF relationship is reversed when measuring a negative output power supply.

# Chapter 7. About Ripple & noise

## Explanation of terms

An example of a typical output voltage waveform of a switching power supply is shown in the figure below.



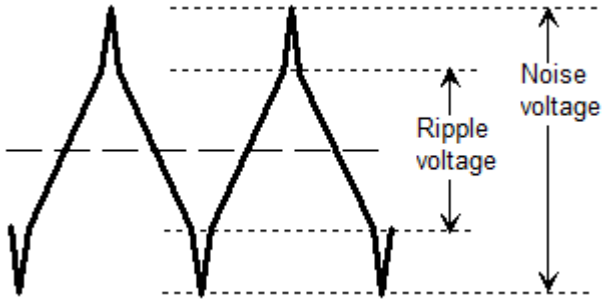

Each part of the waveform is defined as follows.

A: Ripple & noise voltage (LF + HF, NOISE)
B: Ripple voltage (LF + HF, RIPPLE)
C: Noise voltage (HF, NOISE)
D: Switching ripple voltage (HF, RIPPLE)
E: AC ripple voltage (LF, RIPPLE)
F: Input voltage cycle
G: The switching cycle

*( ) indicates the filter and mode of this unit.

# General switching ripple waveform

The output ripple and spike noise of the switching power supply generally have the waveform shown in the figure below.



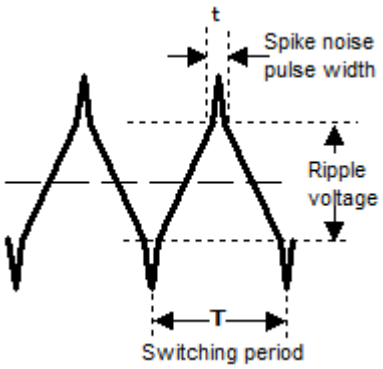

The semiconductor switch element repeats ON and OFF for each switching cycle, and a triangular wave-shaped ripple voltage integrated by a smoothing capacitor or filter is generated.
In addition, the transitional period of switching is accompanied by large spike-like noise, which is superimposed near the peak of the ripple voltage.

Various methods can be considered to separate and measure the ripple voltage from this comprehensive waveform. A simple method is to remove the high-frequency component of spike noise with a low-frequency filter and measure it as a ripple voltage.
However, with this method, it is not possible to ideally remove only the spike component, and the ripple voltage waveform is also changed, making accurate measurement impossible.
Also, if the switching frequency changes significantly (such as 20 kHz or 500 kHz) or if the spike pulse width is wide, it will be difficult to separate with a filter.

# Ripple converter (RC-01A) method

## Separation method based on pulse width duty ratio

The RC-01A method uses the pulse width duty ratio method described below as the ripple voltage separation method.



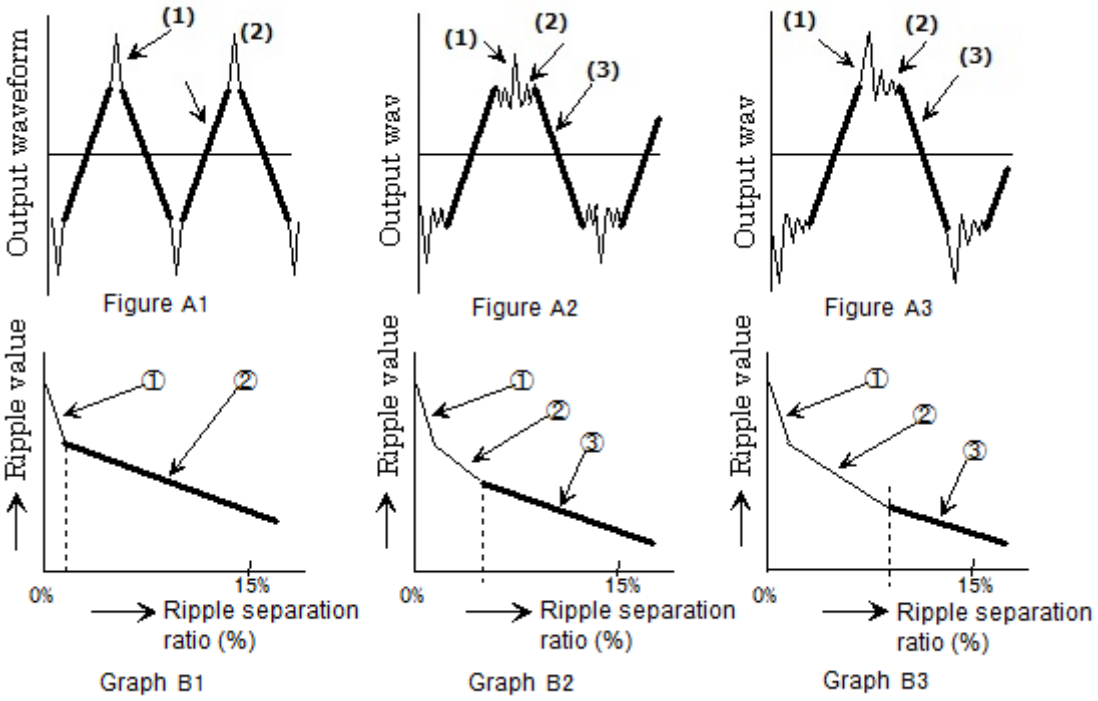

In the case of the waveform on the left, if the pulse width of the spike noise to be removed is t with respect to the period T of the switching frequency, t / T × 100 (%) is called the ripple separation ratio and ranges from 0 to 15 % can be specified.

That is, for one switching cycle, the level at which the pulse width duty ratio of spike noise becomes equal to the specified ripple separation ratio is calculated and used as the ripple voltage.

In this way, the full bandwidth can be separated without affecting the original waveform. Therefore, the measurement result is in good agreement with the observation result by the oscilloscope.

# How to set the ripple separation ratio (RIPPLE RATIO %)

The measurement result varies depending on the ripple separation ratio setting value.
It means how much the ripple voltage is after separating the spike noise. In other words, the ripple voltage value is a function of the ripple separation ratio.
In other words, in order to quantitatively express ripple and spike noise by focusing on the amplitude component, it is ideal to measure the ripple voltage value for each ripple separation ratio (0 to 15 %, etc.).
However, in general, the existence of multiple ripple measurements is confusing and difficult to measure.
Therefore, the method of setting the ripple separation ratio that matches the result of visual measurement with an oscilloscope that has been performed conventionally is described below.
First, the Ripple & noise voltage waveform A is shown for each ripple separation ratio setting, as shown in the figure below.



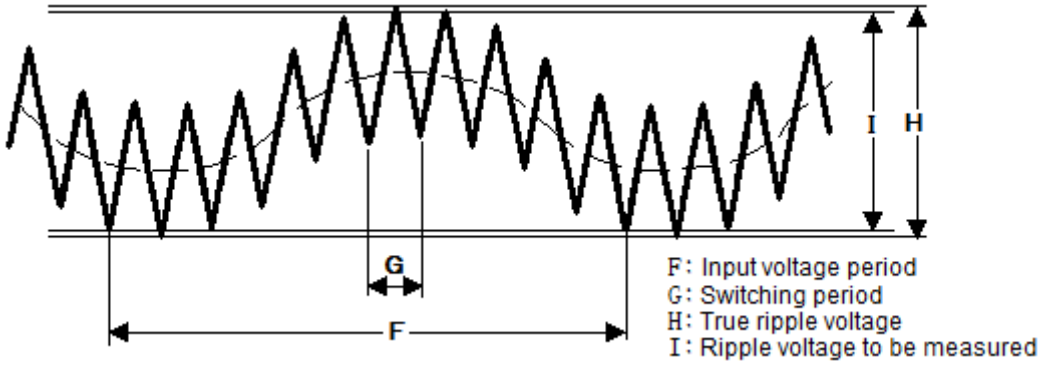

Looking at the ripple measurement value for the change in the ripple separation ratio, at 0 %, the tip of the spike noise is caught and the largest value is shown, and there is a part ① that drops with a steep slope as the separation ratio increases.

Also, if you increase the separation ratio steadily, you will end up with part ③, which shows the gentlest slope.
When the spike noise is accompanied by vibration, such as the waveforms of A2 and A3, there is a part (2) that shows an intermediate slope between (1) and (3) above.
In the visual measurement with an oscilloscope, of the waveforms shown in A1 to A3, the part shown by the thick line of the switching fundamental wave component looks brightest as the bright line, and the spike noise part looks dark because it changes sharply.
Therefore, the amplitude of the thick line is read as the ripple voltage component.
In conclusion, in the graphs B1 to B3, it is better to set the ripple separation ratio corresponding to the left end of the straight line ③ which shows the gentlest slope.

Once the separation ratio is determined, there is almost no need to change it for the same type of DUT.

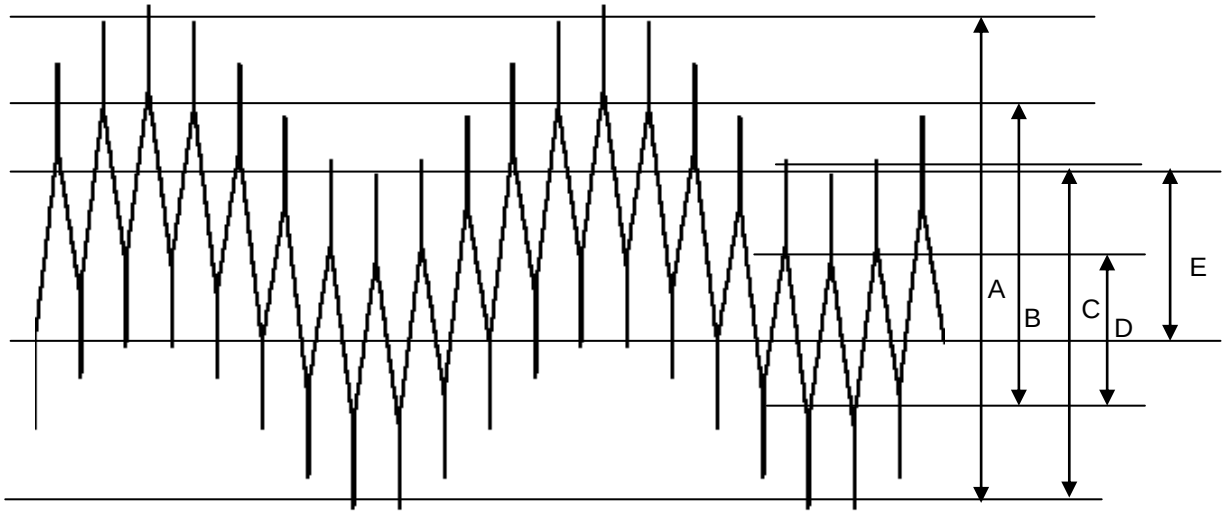
# Effect of overlapping AC ripple and switching ripple

In the ripple voltage separation method by RC-01A, when the ripple conversion is performed directly (in the state of the filter THRU) on the signal having the fundamental wave of 2 frequencies, the measured value is low.
That is, instead of setting the switching fundamental wave as one cycle, the longest cycle (AC component, etc.) is set as one cycle, and the level at which the total average duty ratio of the spike voltage during that one cycle becomes the ripple separation ratio set value is measured. However, in the valley part of the AC component, the level drops so that it cuts into the switching fundamental wave component in the mountain area to compensate for the interrupted spike component.
Thus, for measurements with two frequency fundamentals, setting the filter to LF + HF mode will give correct results.



# Ripple & noise separation method

The output waveform of the switching power supply contains multiple components as shown in the figure below, and it is necessary to separate the ripple (noise) component from this waveform in order to measure the ripple (noise) voltage.




The power supply tester (model-800E) implements RC-01A as a module for measuring Ripple & noise

| Type | Measurement method | Remarks |
|---|---|---|
| RC-01A | Pulse width duty ratio Setting method | It is possible to set the separation conditions in detail by combining our original Ripple & noise method (patented) and filter. |

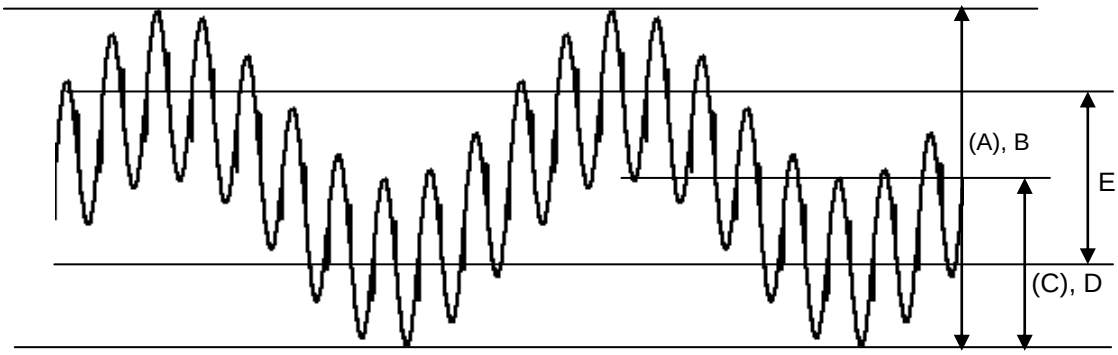
With the software (PowerTestSite), you do not need to aware the difference between these types, and you can measure the waveforms of A to E with the following settings.

| Each part | Measurement item (name) | Software settings | RC-01A |
|---|---|---|---|
| A | Ripple & noise | NOISE, LF + HF | LPF = 3 kHz<br>HPF = 1 kHz |
| B | Ripple | RIPPLE, LF + HF | LPF = 3 kHz<br>HPF = 1 kHz |
| C | Noise | NOISE, HF | HPF = 1 kHz |
| D | Switching ripple | RIPPLE, HF | HPF = 1 kHz |
| E | AC ripple | RIPPLE, LF | LPF = 3 kHz |

* When the filter setting is LF + HF, it is the total value of the individual results measured by each filter.
* The measurement frequency band of RC-01A is 50 MHz.

Ripple & noise measurement is a high frequency measurement and has the unique property of measuring the noise component. Therefore, there are various know-how and points to be noted in the measurement. In addition, although the two types of measurement methods were explained in the previous section, please note that these measurement methods may have different measurement results due to different measurement principles.

The transitional period of switching is accompanied by large spike-like noise. If the spike noise is not superimposed near the peak of the ripple voltage (the output waveform of the switching power supply in the figure below), the ripple and noise components cannot be separated by the two types of measurement methods explained in the previous section.




The transitional period of switching is accompanied by a large spike-like noise, and the ripple voltage cannot be measured separately from this total waveform that is not superimposed near the peak of the ripple voltage. In that case, Ripple & noise (A) and Ripple (B), and Noise (C) and Switching Ripple (D) are the same.

| Each part | Measurement item (name) | Software settings | RC-01A |
|---|---|---|---|
| A | Ripple & noise (Ripple) | NOISE, LF + HF | LPF = 3 kHz<br>HPF = 1 kHz |
| B | Ripple | RIPPLE, LF + HF | LPF = 3 kHz<br>HPF = 1 kHz |
| C | Noise (Switching ripple) | NOISE, HF | HPF = 1 kHz |
| D | Switching ripple | RIPPLE, HF | HPF = 1 kHz |
| E | AC ripple | RIPPLE, LF | LPF = 3 kHz |

Visually measure the output waveform of the switching power supply with an oscilloscope, and set the ripple separation ratio and filter that match the visual measurement results. There is almost no need to change the separation ratio, etc. once determined for the same type of DUT.

# Chapter 8. Ripple & noise measurement and error factors

Here is a Ripple & noise measurement and error factors.
The same can be said for Ripple & noise measurement of the RC-01A ripple converter.

## Noise generation mechanism peculiar to switching power supplies

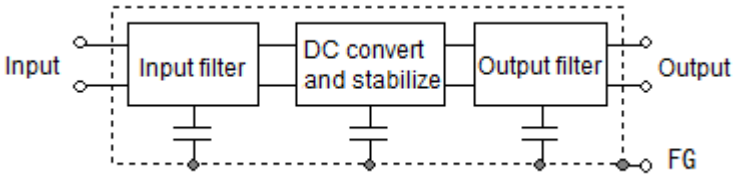
In principle, general switching power supplies tend to be a noise source. This is because the primary input of AC or DC is once switched at a high frequency and then converted to DC voltage.
In the internal circuit, a pulse waveform with a power larger than the DC output is driven by a transistor or a power transformer, and it is impossible not to generate noise. Therefore, measures are taken to prevent the generated noise from being output.
The power switching waveform inside the power supply is radiated to the outside as noise through the following path.

① DC output terminal
② AC (direct current) input terminal
③ Magnetic field
④ Electric field
⑤ Electromagnetic radiation

When the switching power supply is incorporated in the product, the noise of the various paths mentioned above acts in a complex manner, which may adversely affect the inside of the product or affect other surrounding equipment. We are taking measures to reduce the occurrence as much as possible.
Ripple & noise meter aims to measure the peak to peak value of the waveform of the DC output terminal component of these noise sources.
This is the most commonly used method for evaluating a single switching power supply and has the same purpose as the method for observing the DC output terminal voltage with an oscilloscope.

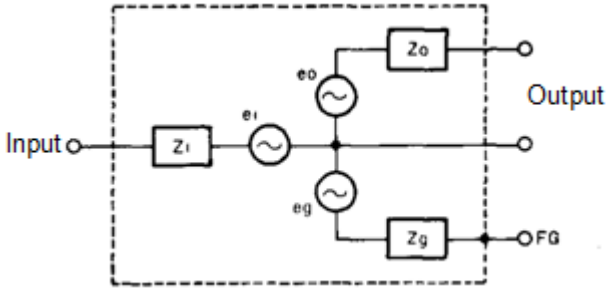
# Noise source model

The schematic configuration of a switching power supply can be represented as shown in the figure below.




Of these, the power switching is performed in the DC converter, which normally uses a high-power pulse wave of 100 to 200 V.
To prevent this noise source from being output, a noise filter is provided on the input / output side to suppress the noise (eo) between output terminals to the order of 10 to 100 mV.
However, noise voltage (ei, eg) of the same level or higher exists between other terminals, and high-frequency noise current due to large electric cable flows out to each part through various stray capacitances.

An example of actual measurement using several types of samples is shown below.



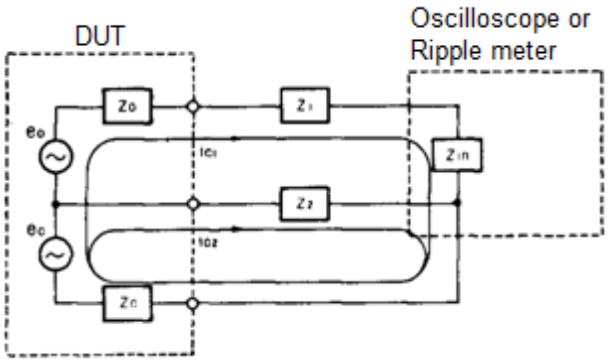

Model of the noise source seen from the power supply terminal

| | |
|---|---|
| eo: Output terminal noise voltage | 5 to 50 mVpp |
| Zo: Output terminal impedance | 0.1 to 2 Ω (100 kHz to 10 MHz) |
| ei: Input terminal noise voltage | 1 to 15 Vpp |
| Zi: Input terminal impedance | 100 to 2 kΩ |
| eg: FG terminal noise voltage | 50-500 mVpp |
| Zi: FG terminal impedance | 10 to 200 Ω |

In this way, the voltage between other terminals cannot be ignored with respect to the voltage between the output terminals, and a wraparound current is generated in the measurement system due to these, resulting in common mode noise, which may cause a large error in the measured value.
For the above reasons, it is one of the reasons why it is difficult to accurately measure switching power supply noise compared to measuring the voltage of a single voltage source.

# Effect of common mode current

The figure below shows the equivalent circuit for wraparound noise when measuring ripple noise.



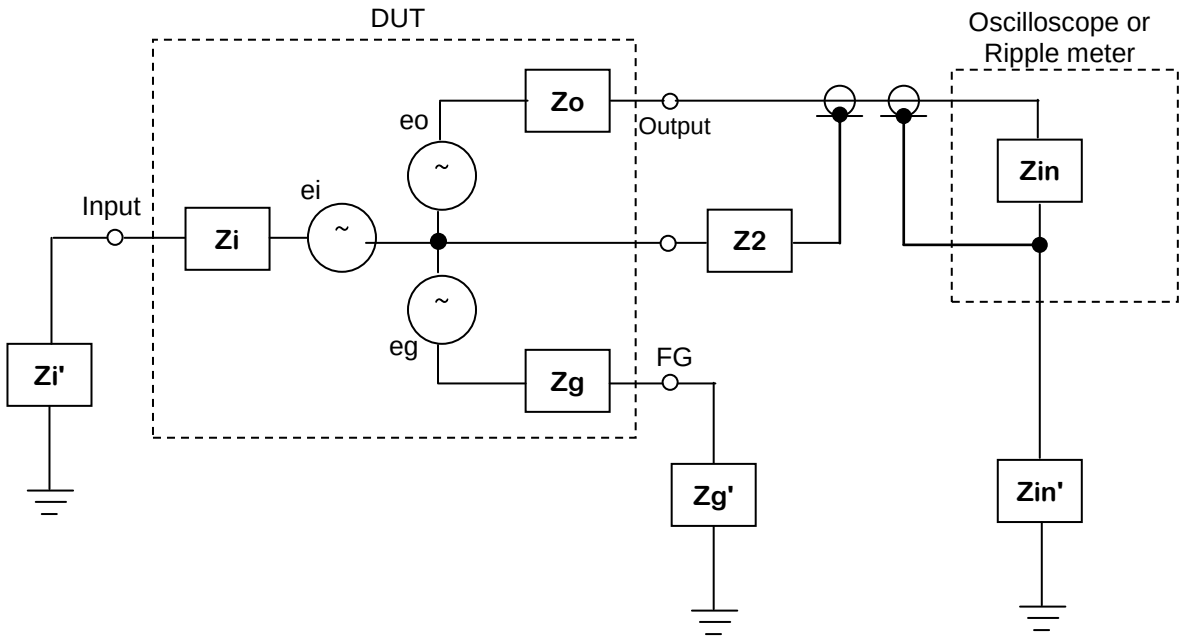

Equivalent circuit for common mode noise

eo: Output terminal noise voltage
ec: Common mode voltage
Zo: Output terminal impedance
Zc: Common mode impedance
Z1: Probe cable core impedance
Z2: Probe cable tip ground wire impedance
Zin: Input impedance of measuring instrument

Assuming that the common mode voltage ec is representative of the noise voltage existing in the input terminal and FG terminal, current loops ic1 and ic2 are generated by this.
The input impedance Zin of the measuring instrument is generally high, and ic1 is sufficiently smaller than ic2.
Therefore, the voltage observed by the measuring instrument is approximately eo + ic2 × Z2, so ic2 and Z2 must be fully considered.

# How to reduce common mode current

The figure below shows the equivalent circuit including the noise source and measurement system as seen from each terminal of the DUT.

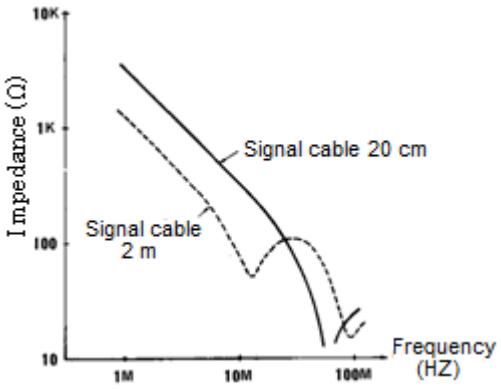



Equivalent circuit of each terminal noise source and measurement system

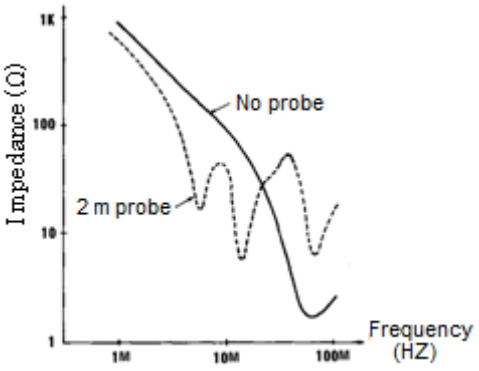
Zi' : DUT input to ground impedance (including power cable)
Zg' : Impedance to ground of DUT housing
Zin' : Instrument input to ground impedance (including power cable)
Z2 : Probe cable tip ground wire impedance

(a) How to increase the impedance to ground of the measuring instrument input terminal
Theoretically, the common mode current can be reduced by making Zin's high enough, but it is not possible to obtain high values up to high frequencies due to the ground impedance of the power cable, housing, and signal cable of the measuring instrument.

An example of this instrument and oscilloscope is shown below.




Example of ripple meter ground impedance




Example of ground impedance of 100 MHz oscilloscope

As you can see, the ground capacitance of the measuring instrument itself is 50 to 200 pF, and when a signal cable or probe is connected, the ground capacitance varies depending on the spatial position of the cable, and it is complicated by the cable length and these ground capacitances. Resonance phenomenon is exhibited, and it drops from several Ω to several 100 Ω depending on the frequency.
This indicates that it is not a common mode current through an AC power cable, and even if it is a battery-powered measuring instrument, the same effect can be considered.

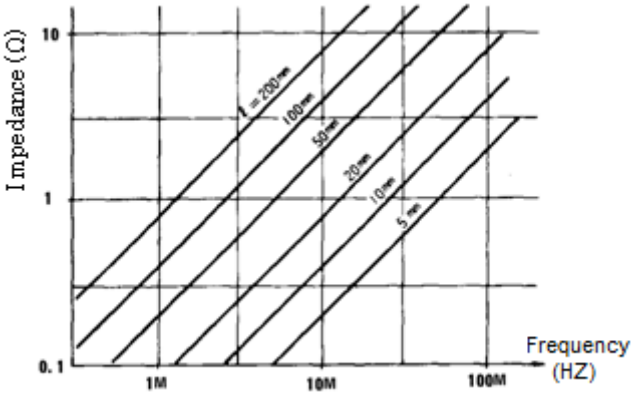
(b) How to ground the frame ground (FG) of the DUT
When the noise voltage source on the FG terminal is sufficiently small and its impedance Zg is small in the equivalent circuit shown in "Diagram of the equivalent circuit of the noise sources on each terminal and the measurement system", the common mode current caused by the noise voltage source on the input terminal ei can be reduced by grounding the FG terminal.
However, if the eg is large, the loop current due to this will increase, and this will have a negative effect.

(c) How to insert a common mode choke coil into the DUT input terminal
In "Figure of equivalent circuit of each terminal noise source and measurement system", it is a method to raise the impedance Zi' of the input terminal by the common mode choke in order to reduce the current due to the noise voltage source ei of the input terminal.
At this time, it is necessary to connect the choke coil to the terminal at the shortest distance.

(d) How to connect the common terminal of the DUT and the common side of the measuring instrument
What can be easily understood on the equivalent circuit in "Figure of equivalent circuit of each terminal noise source and measurement system" is that an error occurs when the common mode current passes through the ground wire impedance Z2 at the tip of the probe cable. , It is conceivable to short-circuit the power supply common terminal and the common terminal of the measuring instrument so that it does not flow to Z2.
However, in reality, Z2 has a low impedance of a few centimeters of wire, and it is difficult to obtain a sufficiently low short circuit wire to bypass it, which is not a very effective method.

# Common mode impedance

Among the error voltages generated by the common mode current described in the previous section, the ground wire impedance at the tip of the probe cable is the largest factor.
Also, the sheath impedance of the probe cable itself can be considered, but as long as the cable has a coaxial structure, crosstalk can be almost ignored.
Therefore, it is important to pay attention to the above-mentioned ground line impedance and keep it as low as possible.




Relationship between ground wire length and impedance

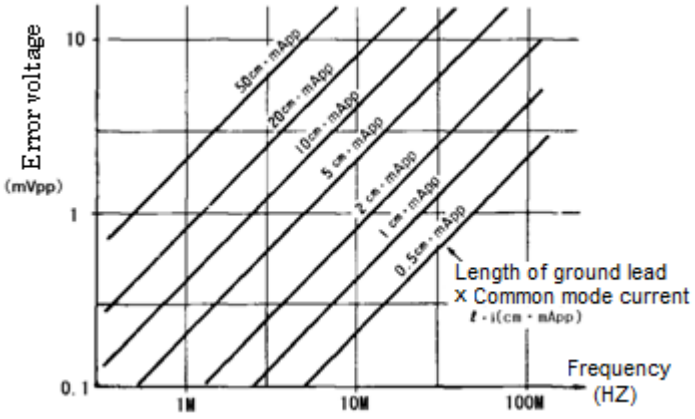
Generally, a ground wire of several cm is used, and most of this impedance can be considered as inductance, and the higher the frequency, the higher the impedance.

# Quick reference table of common mode error

The diagram below shows the relationship between the length of the ground wire and the error voltage due to the common mode current.
There are two ways to read the quick reference table in the figure below.

(a) The error voltage e (eg.2 mVpp) generated in the ground line length l (eg. 5 cm) due to the flow of the common mode current I (eg. 1 m App) of the frequency f (eg. 10 M Hz) can be obtained.

(b) The value of the product of the ground line length l and the common mode current I (eg 0.5 cm, App) for measuring within the common mode error e (eg 2 mVpp) up to the frequency band f (eg 100 MHz) is obtained.




Quick reference table of common mode error.

Shorten the ground wire length of the measurement system so that it is less than or equal to the value of this product, or reduce the common mode current.

# Detection method using differential probe and differential amplifier

One way to actively prevent the effects of common mode noise is to use a differential probe or differential amplifier.
This method is said to be ideal for accuracy, such as evaluation tests for DUT.
It is necessary to use one with a sufficient common mode rejection ratio (CMRR) up to the high frequency band. (100 MHz band, etc.) Even with these measurement methods, good results cannot be obtained if the signal line connection method to the 2-input terminal and the ground line processing are inappropriate.
The input signal line should be as short as possible with a shielded wire or coaxial wire, and keep the two wires of equal length, and connect the shielded sheaths on the terminal side to be measured.
Also, when the input signal cable is 20 cm or more, it must be terminated at the characteristic impedance so that the cable does not become a distributed constant resonator.
(Refer to "9.9 Probe cable" in the following section.)
These methods are not used in this instrument because they are expensive.

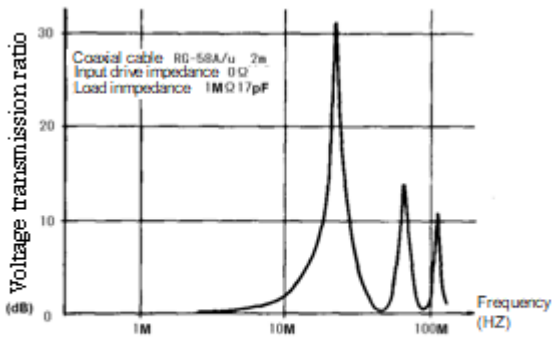
# An easy way to investigate the effects of common mode noise

As mentioned above, the effects of common mode noise must always be considered when using any instrument.
Then, in order to check how much common mode noise is picked up by the measurement system, short-circuit the signal line and ground line at the tip of the probe with the actual length, and connect to one side of the DUT output.
The voltage observed at this time is the value in the no-input signal and is the error voltage due to common mode noise or the like.
For accurate measurement, the error voltage due to common mode noise must be sufficiently small compared to the ripple noise voltage measured by connecting between the two terminals of the DUT output.
Measurement accuracy higher than the ratio (S / N) of these two cannot be expected.
(For example, when S = 20 mV N = 2 mV, accuracy of about 10% or more cannot be expected.)

# Probe cable

(a) Characteristics of coaxial cable

A coaxial cable may be used instead of a dedicated probe for high impedance input (1 MΩ 20 pF, etc.) like an oscilloscope.
In this case, reflection occurs at the receiving end due to impedance mismatch, and a complete resonance phenomenon occurs at a specific frequency with a cable length of 1/4 wavelength and its higher order wave.
The voltage transmission characteristics of an example are shown in the figure below.

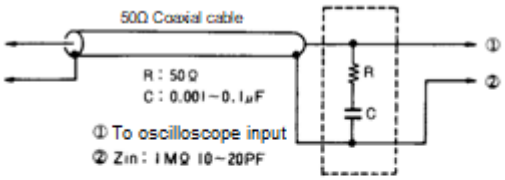



Coaxial cable voltage transmission ratio when the load is open

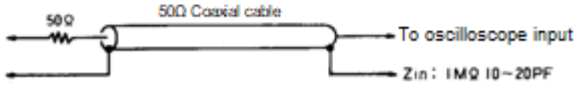
When a coaxial cable at the open end of the load is connected to a signal source with a very low impedance such as the power supply output, the situation is close to the input drive impedance (0Ω) shown on the left, and at the resonance frequency, several to several tens of times higher voltage will be generated.
To eliminate the mismatch, it is common to terminate the load end with the cable characteristic impedance.

The resonance frequency due to mismatch changes depending on the length of the cable, and when the cable is short, it resonates at a higher frequency.
Ripple meters have a 2 m cable with a resonant frequency of 22 MHz, whereas only frequencies above 1 MHz are terminated by 50 Ω.

When using a coaxial cable for the oscilloscope, it is recommended to connect a matching box as shown




Matching box




Series matching method

on the right with a capacitor in series for DC cut and high frequency termination to the terminating resistor.

There is also a series matching method shown on the right, which uses the fact that the impedance at the output end of the power supply is sufficiently low to match only at the input end of the cable.
One of the major features of the coaxial cable is that the impedance seen from the input is almost constant (50 Ω) with almost pure resistance, no matter how long the cable is, and another feature is that it is compared to the oscilloscope cable. , Is very low loss. An example of the characteristics is shown in the following table.

| Frequency (MHz) | 1 | 10 | 30 | 100 |
|---|---|---|---|---|
| Attenuation (dB / m) | 0.014 | 0.048 | 0.081 | 0.16 |
| Capacitance (pF / m) | 94 | | | |
| Characteristic impedance | 50 | | | |

RG58A / U coaxial cable characteristic example

(b) Compared to coaxial cables, the 1/10 probe used in oscilloscopes uses an extra-fine resistance wire as the core wire to cause a loss in the resonance phenomenon, and is devised so that it does not resonate even when the load is open.
However, the cable alone has a very large loss in the high frequency range compared to the coaxial cable, therefore frequency compensation is performed in the 1/10 attenuation.
In the case of a probe that can switch the attenuation ratio between 1/1 and 1/10, the frequency response in the 1/1 / state cannot compensate for the loss of the cable, so the bandwidth is usually very narrow.
To give an example of a 2m cable, a 1/10 probe for 100 MHz, has 6.7 MHz bandwidth in the 1/1 state and an input capacity of 105 pF.

In this way, when measuring low levels of ripple and noise, even if the oscilloscope itself is not sensitive enough, using a 1/1 probe will drastically reduce the frequency band. The high frequency impedance is also extremely low (such as 15Ω at 100 MHz), which is not desirable.

# Input impedance

The input impedance of the measuring instrument should be sufficiently higher than the object to be measured, and it is necessary that the conditions of the object to be measured are not disturbed by connecting.
Like an oscilloscope, observing various measurement points in an electronic circuit requires a sufficiently high input impedance, and it is common to use a 1/10 probe with 10 MΩ and 10 to 20 pF.
But even with this, the impedance of 10 MΩ is from DC to 1 kHz, and at 100 MHz it drops to 80 to 160 Ω.
Here, if we limit ourselves to dedicated measuring instruments for DC power output, bypass capacitors for removing ripples and noise are connected in the terminals under test, therefore the impedance is generally extremely low.
Electrolytic capacitors with good high-frequency characteristics and small-capacity high-frequency capacitors are used in parallel for this bypass capacitor, and it seems that most of them are 2 Ω or less at DC to 30 MHz. At 100 MHz (apart from those using power output lead wires), the output impedance may increase due to the distance to the output terminal with the bypass capacitor added, as it becomes about 3 Ω with only the 10 m lead wire.

Even if a DUT with such a low impedance is measured with an input impedance of 50 Ω, the error will not be so large.
If the output terminal or output lead wire is long from the bypass capacitor inside the power supply, the lead wire inductance raises the impedance over a wide area.
At this time, the observed voltage should decrease due to the load effect due to the input impedance of the measuring instrument.
However, in the actual DUT, the above-mentioned "effect of common mode current" works greatly, and on the contrary, the noise voltage is usually observed to be large.
Therefore, in order to ensure accuracy, in order to reduce this common mode noise, probing is performed at the shortest distance, or a separate vibrator capacitor is attached to the tip of the output lead wire (conditions close to the mounted state of the power supply) are the best way to measure with.

# Chapter 9. model-800E specifications

## Specification

| Model name | | model-800E | | | | |
|---|---|---|---|---|---|---|
| **DC voltage measurement** | | | | | | |
| Range [V] | | 6 | 30 | 100 | | |
| Number of channels | | 5 ch switching | | | | |
| Resolution | | 0.001 % of fs | | | | |
| Measurement accuracy (* 1) | | Fast ± (0.1 % of rdg. + 0.25 % of fs)/<br>Slow ± (0.05 % of rdg. + 0.05 % of fs) | | | | |
| Standard measurement time | | Fast 10 ms/<br>Slow 25 ms (+10 ms when switching channels and ranges) | | | | |
| Input impedance | | 1 MΩ | | | | |
| **DVM measurement** | | | | | | |
| Range [V] | | 6 | 30 | 100 | | |
| Number of channels | | 16 ch switching | | | | |
| Resolution | | 0.001 % of fs | | | | |
| Measurement accuracy (* 1) | | Fast ± (0.1 % of rdg. + 0.25 % of fs)/<br>Slow ± (0.05 % of rdg. + 0.05 % of fs) | | | | |
| Standard measurement time | | Fast 10 ms/<br>Slow 25 ms (+10 ms when switching channels and ranges) | | | | |
| Measurement function | | DC voltage measurement | | | | |
| Input impedance | | 1 MΩ | | | | |
| **DC current measurement** | | | | | | |
| | | CH1 | CH2 | CH3 | CH4 | CH5 |
| Range [A] | | 50 | 20 | 20 | 10 | 10 |
| resolution | | 0.001% of fs | | | | |
| Measurement accuracy (* 1) | | Fast ± (0.2% of rdg. + 0.25% of fs)/<br>Slow ± (0.1% of rdg. + 0.1% of fs) | | | | |
| Standard measurement time | | Fast 10 ms/<br>Slow 25 ms (+10 ms when switching channels) | | | | |
| **Load setting** | | | | | | |
| | | CH1 | CH2 | CH3 | CH4 | CH5 |
| Maximum rating | Rated power [W] (* 2) | 300 | 100 | 100 | 50 | 50 |
| | Rated voltage [V] | 70 | | | | |
| | Rated current [A] | 50 | 20 | 20 | Ten | Ten |
| Constant current setting | HIGH range [A] | 50 | 20 | 20 | Ten | Ten |
| | LOW range [A] | Five | 2 | 2 | 1 | 1 |
| | Nominal resolution (* 3) | 0.04 % of range | | | | |
| | Setting accuracy (* 1) | ± (0.5 % of stg. + 0.1 % of Curr.High fs) | | | | |
| Constant resistance setting | HIGH range [Ω] | 0.1-0.2 k | 0.25-0.5 k | 0.25-0.5 k | 0.5-1 k | 0.5-1 k |
| | LOW range [Ω] | 1-2 k | 2.5-5 k | 2.5-5 k | 5-10 k | 5-10 k |
| | Auto range Switching [Ω] | 2.5 | 5 | 5 | 10 | 10 |
| | Nominal resolution (* 3) | 0.04 % of 1 / range | | | | |
| | Setting accuracy (* 14) | ± (0.5 % of Conv.Curr. + 0.3 % of Curr.High fs) | | | | |
| function | Internal resistance | 0.02 | 0.06 | | 0.12 | |

| | | | | |
|---|---|---|---|---|
| | [Ω] | | | |
| | Minimum operating voltage setting | Invalid: Operates if there is a potential difference<br>Effective: Only constant current setting operates at about 1.6 V | | |
| | Protective function | Overcurrent protection, overpower protection, temperature protection | | |
| | Warning function | Overvoltage warning, reverse connection warning | | |
| **Power supply for overvoltage test** | | | | |
| Set voltage | | 1 V ~ 70 V | | |
| Output current | | 0.0 A to 0.5 A (with over current limiter) | | |
| Nominal resolution (* 3) | | 0.04 % of range | | |
| Setting accuracy (* 1) | | ± (0.1 % of stg. + 0.2 % of fs) | | |
| **Remote box I / F** | | | | |
| Specification | | SC-816A control only | | |
| **OV scanner** | | | | |
| Output channel | | 8 | | |
| Contact rating | | 70 V, 0.5 A | | |
| **DVM multiplexer** | | | | |
| Number of input circuits | | 16 | | |
| Contact rating | | DC 100 V, 10 mA | | |
| **Digital I / O** | | | | |
| Input circuit format | | Optocoupler insulation input<br>[Input resistance 1 kΩ, 12 V / 10 mA (maximum 16 mA)] | | |
| Number of input circuits | | 8 | | |
| Output circuit format | | Optocoupler insulated open collector<br>[12 V / 10 mA (Max 24 V / 16 mA)] | | |
| Number of output circuits | | 8 | | |
| **CONTROL I / F** | | | | |
| Input device control I / F | | model-519 / model-519A (DC PS controller) | | |
| Range [V] (* 5) | | 3 | | |
| resolution | | 0.001 % of fs | | |
| Measurement accuracy (* 1) | | ± (0.05 % of rdg. + 0.05 % of fs) | | |
| Standard measurement time | | Depends on the connected device | | |
| **Control I / F** | | | | |
| PCAT connection I / F | | Compliant with USB 2.0 (Full Speed) | | |
| **Ripple & noise measurement** | | | | |
| Range [mVpp] | | 200 | 2000 | |
| Resolution [mV] | | 0.1 | 1 | |
| Measurement accuracy (* 1) | | ± (2 % of rdg. + 2 % of fs) | | |
| Measurement time [ms] (* 6) | | 300-2000 | | |
| Nominal bandwidth | | 50 MHz | | |
| Ripple measurement method | | Separation ratio setting method | | |
| Ripple & noise separation ratio | | 1 % to 15 % | | |
| THRU | | 50 Hz to 50 MHz | | |
| LPF | | 50 Hz to 3 kHz | | |
| HPF | | 1 kHz to 50 MHz | | |
| Input impedance | | 50 Ω (high frequency 1 MHz or higher) | | |
| cable | | 50 Ω coaxial cable 1.5 M | | |
| **General specifications** | | | | |
| Input power supply voltage range | | AC 85 to 264 V, 50/60 Hz (47 to 63) | | |
| power consumption | | 200 VA | | |
| Withstanding voltage | | AC 1500 V 1 minute<br>(input-FG) | | |
| Insulation resistance | | DC 500 V 30 MΩ or more (input-FG, input-measurement terminal / input-FG, input-load terminal) | | |
| Altitude | | 2000 m or less | | |
| cooling method | | Forced air cooling by fan | | |

| | | |
|---|---|---|
| Environmental condition | Installation environment | Indoor use<br>Install in a place away from high temperature, humidity, freezing, condensation, dust, direct sunlight, flammable or corrosive gas, and machinery that generates vibration. |
| | Installation posture | Be sure to use it with the bottom side down and level. |
| | Operating temperature / humidity range | 0 °C ~ 40 °C, 20 % ~ 85 % RH or less (no condensation) |
| | Storage temperature / humidity range | -20 °C ~ 60 °C, 20 % ~ 85 % RH or less (no condensation) |
| External dimensions | | 430 (W) x 198.2 (H) x 500 (D) mm (excluding protrusions) |
| mass | | 17 kg |
| Estimated relay replacement | | Electrical life: Approximately 5 million times (± 100 V 60 times / minute Ambient temperature 23 °C) |
| | | Mechanical life: Approximately 100 million times |
| | | * The relay will be replaced by the user. |

* 1 Guaranteed for 6 months at an ambient temperature of 23 ± 5 °C and a humidity of 70% or less.
* 2 At the maximum rated power (load), the operating time is 1 minute or less.
* 3 Nominal resolution indicates an estimate of the resolution assumed in each setting mode.
* 4 Conv.Curr indicates the ideal current value of "input voltage / set resistance value".
* 5 Measures the maximum voltage of DC ± 3 V of the connected device, converts it according to the conditions, and returns the result.
* 6 Measurement time for the same measurement mode and range.

**Accessories**

| Product name | Model name | Quantity |
|---|---|---|
| CD-ROM | model-800E Operating manual | 1 |
| power cable | 3P 2 m power cable | 1 |
| USB cable | 1.8 m USB cable | 1 |
| Signal cable | BM-58U-150KO | 5 |
| Remote box | SC-816A | 1 |
| OV connector | 17JE-23370-02D8A (DDK) | 1 |
| Connector for DVM | 17JE-13370-02D8A (DDK) | 1 |
| DI / DO connector | 57-30360 (DDK) | 1 |

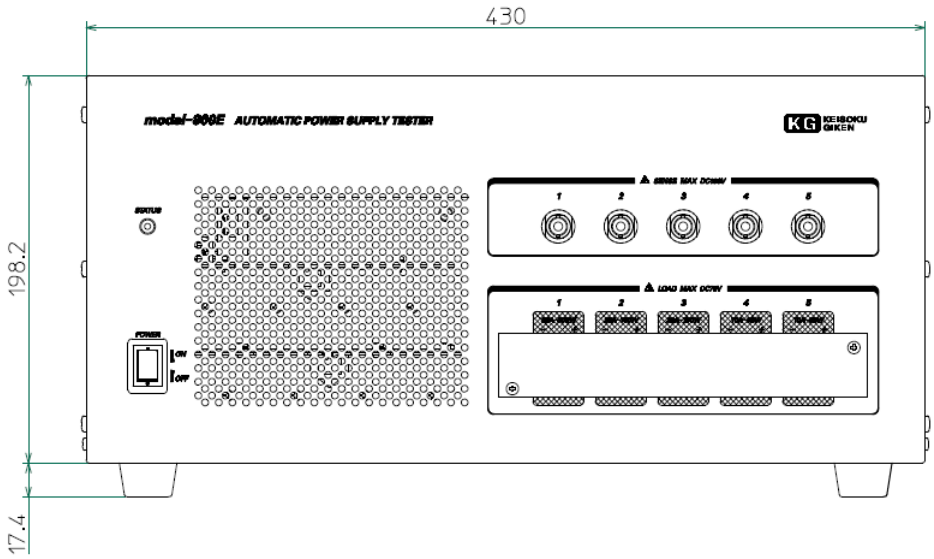
# model-800E External dimensions

## External dimensions

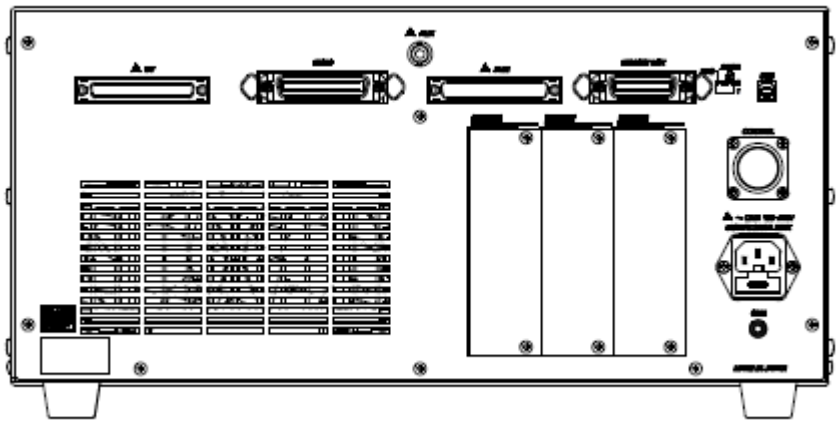
430 (W) x 198.2 (H) x 500 (D) mm (excluding protrusions)

## External dimensions

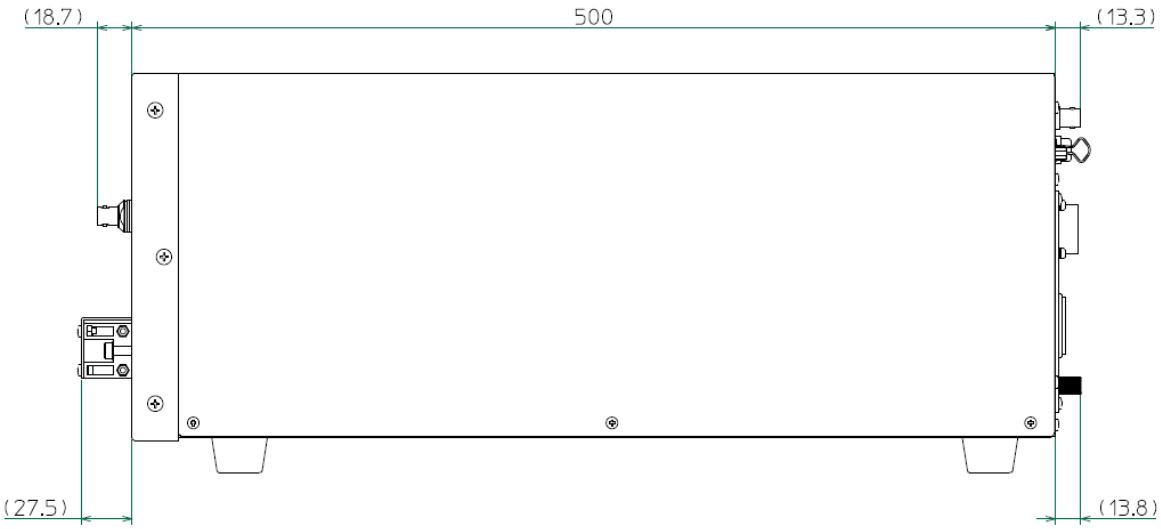
### Front

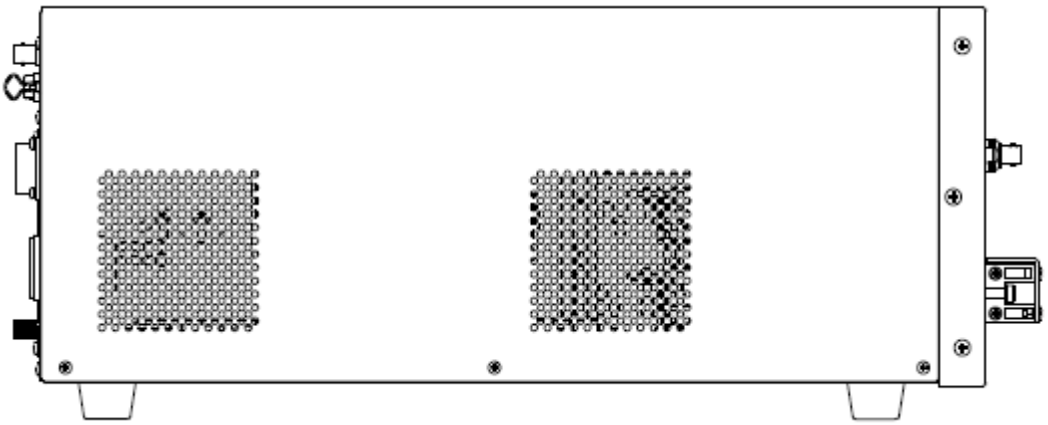



### Back



## Side



# Chapter 10. Maintenance and inspection

## Replacement of relays and photo-couplers

When in maintenance, the relays can be replaced.

For DC voltage measurement switching, DC voltage measurement (INPUT), Current measurement
Relay model: DIP-2M-05SN (Okita)

For DVM measurement switching, OV switching
Relay model: X2-DC5V (Panasonic)

For OV switching
Relay model: NC2EBD-DC5V (AW821960) (Panasonic)

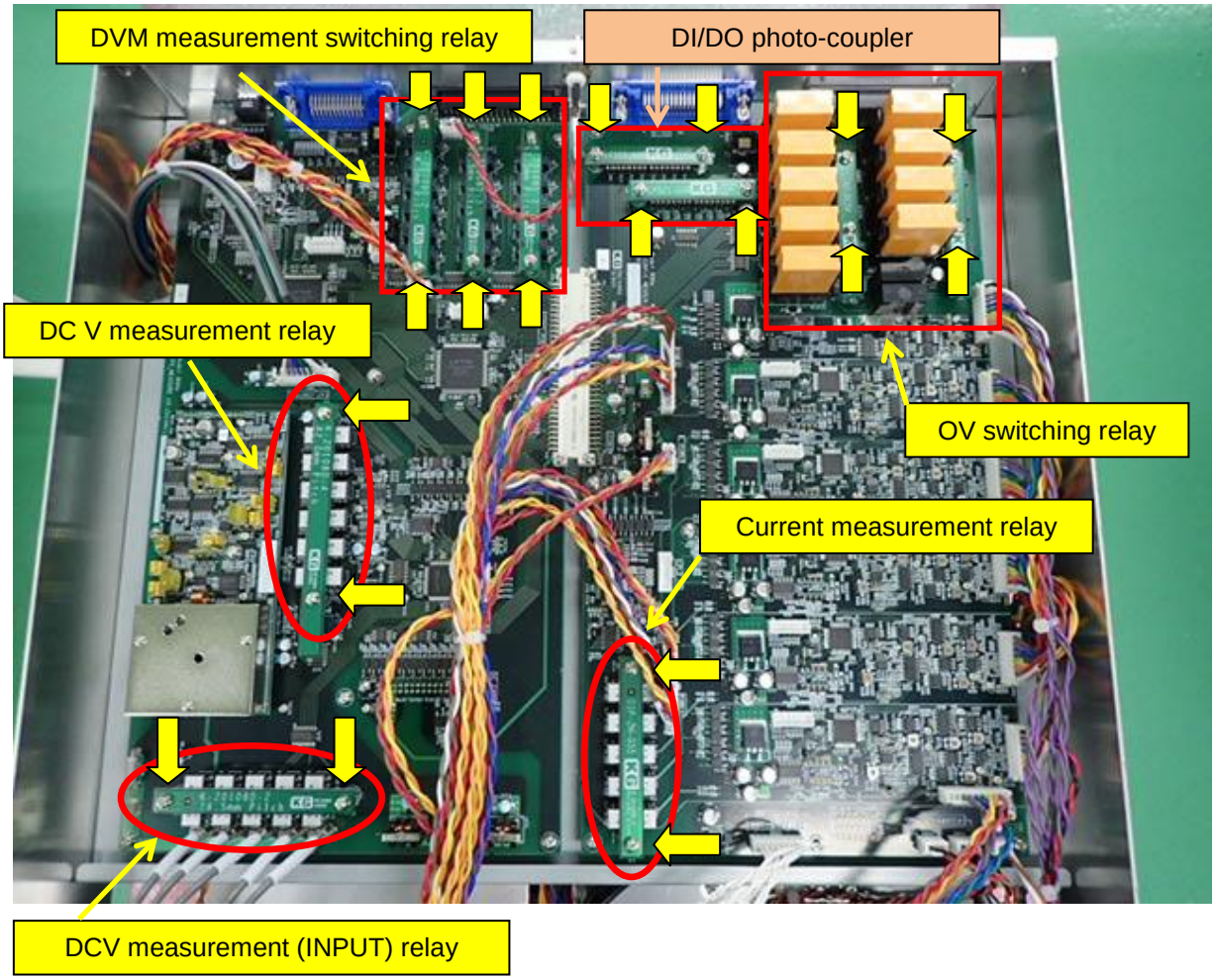
When to change them is depending on the condition of use and environment. Refer to Chapter 9 model-800E specifications, Relay replacement.

The photo-coupler can also be changed in maintenance.
Model name: TLP785F(GR, F (Toshiba)

**warning** **There is a risk of electric shock.**

- **Prior to open the cover, turn OFF the power switch and disconnect all cables from the connectors.**

## Replaceable relays and photo-couplers




## Procedure to replace relays and photo-couplers

1) Prior to remove the cover, **turn OFF the power SW and remove all cables**.
2) Remove screws on the side of cover (6 screws ) and top place (1 screw)
3) Unscrew 2 screws on the relay holding board.
4) Remove the relay holding board
5) Replace the relays and photo-couplers

**Caution** There is a risk of damaging the instrument.

- When replacing relays or photo-couplers, make sure that the direction of pin numbers are correct.

6) Install the relay holding board.

**Caution** It may damage the instrument.

- Tighten the screws on the relay holding board with a torque of 0.5 ± 20 % [N▪m].

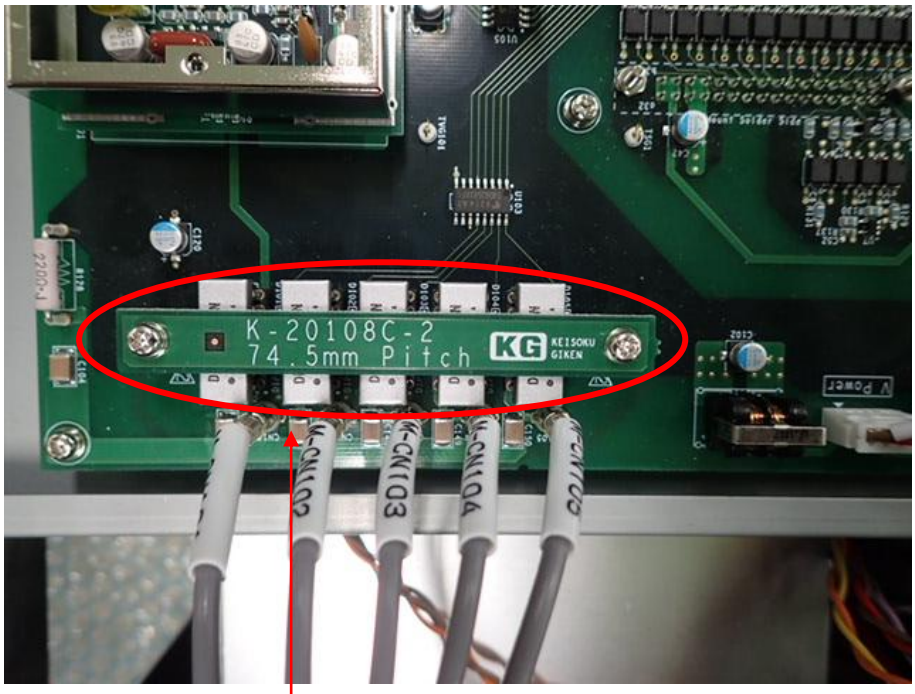
7) Place the cover, tighten the screw for the side (6 screws) and top (1 screw).

**Caution** It may damage the instrument.

- Tighten the screws with a torque of 0.5 ± 20 % [N▪m].

## Regarding replacement of DC voltage measurement (INPUT) relay

The life of the channel switching relay for DC voltage measurement (INPUT) may be extremely shortened depending on the test power supply to be inspected.
It is recommended to replace the relay regularly by referring to the guideline for relay replacement. Refer to Chapter 9 model-800E specifications, Relay replacement.




Relay holding board

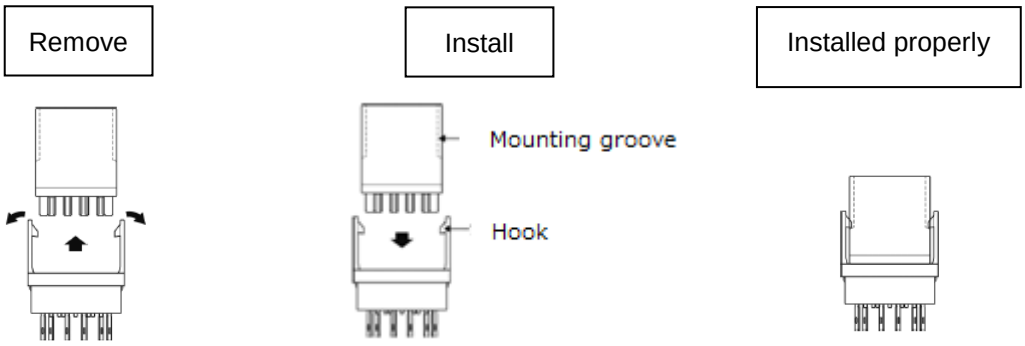
# About OV switching relay replacement

The 0V switching relay is mounted on the dedicated socket. [Relay model: NC2EBD-DC5V (AW821960) (Panasonic)]
When removing it, widen the hook of the socket and pull it out.
When installing it, match the direction of the both relay and socket then push it into the socket firmly till it comes to the slit.

When mounting, align the relay and socket, and make sure that both ends of the relay are fully inserted until both hooks fit into the mounting grooves.

**Caution** It may damage the instrument.

- When installing or removing the relay, if you push the hook part more than necessary, it may be deformed and the relay may not be hooked or damaged.



# Regarding replacement of reverse connection protection fuse for overvoltage test

For details on the failure of the reverse connection protection fuse for overvoltage test, refer to the item refer to the item "Protection circuit for power supply for overvoltage test".

Protection circuit of the power supply for overvoltage test

To replace the fuse, **be sure to disconnect all connected cables and turn off the power before removing the cover**. Then remove the cover and replace the fuse attached to the fuse holder on the board behind the right side.

Replacement parts

| | |
|---|---|
| Product name | : Fuse |
| Model name | : FG-10-2A |
| Manufacturing company | : Sato Parts Co., Ltd. |


# For long-term use

Perform regular maintenance and inspections for long-term use.

## Cleaning

Wipe off any dirt on the instrument with a soft cloth or a damp cloth.

**⚠ Caution** It may damage the equipment.

- Be sure to turn off the power switch and unplug the AC power cord before proceeding.
- Do not use organic solvents (benzene, acetone, etc.) that may change the quality of plastics. Also, be careful not to allow liquids such as

solvents to seep into the equipment.

## Fuse replacement

This unit has a power fuse, and when replacing it, follow the procedure below.

**Caution** It may damage the equipment.

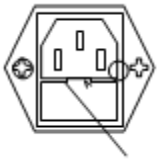
- Be sure to turn off the power switch and unplug the AC power cord before proceeding.

**Warning** **There is a risk of electric shock.**

- To prevent fire and electric shock, use the built-in spare fuse or a product that conforms to the safety standards of the country of use. It is very dangerous to use an unspecified fuse or short-circuit the fuse holder. Please absolutely stop.
- If you experience any symptoms such as a strange odor or noise before replacing the fuse, stop using it immediately and request repair.

As shown in the figure below, remove the power fuse and replace the fuse.

1. Removing the power fuse



Use such as flat head screw to pull out.

2. Replacing the power fuse


- Replace with the fuse on the front.
- If you do not have a spare fuse, use a standard-compliant product with similar specifications.

## Input power cord

Check and inspect for tearing of the coating, rattling of the plug, cracks, etc.

**Warning** **There is a risk of electric shock.**

- There is a risk of electric shock if the coating is torn. Please stop using it immediately.

To purchase accessories, please contact the distributor from which you purchased the product or us.

## Calibration

For calibration of this instrument, contact your dealer you purchased it or us.

## Storage

If you do not use the device for a long period of time, cover it with a vinyl cover or put it in a cardboard box to prevent dust, and store it in a dry place out of direct sunlight.
The storage temperature and humidity range is -20 ° C to 60 ° C and 20% to 85% RH or less (no condensation).

## Options

Following options are available

| Product name | Model name | Description |
|---|---|---|
| Rack adapter JIS | PX-4J-JIS | JIS standard 4J |
| Rack mount kit EIA | PX-5U-KIT-EIA | EIA standard 5U |

# Power supply tester
# model-800E
# Operating manual

**M-2560-02**

**Rev. 1.5**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Power supply tester
model-800E Operating manual
M-2560-02 Rev. 1.5

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