Instruction Manual

CURVE TRACER

CS-8020
CS-8200
CS-8500

IWATSU

Preface

◇ Thank you for purchasing the Curve Tracer DS-8000 Series. Please use IWATSU instruments regularly for a long time in future.

◇ Please read this manual carefully and understand its contents before using this instrument, and then keep this manual handy for future reference.

◇ The instruction manual related to the Curve Tracer CS-8000 Series has the following structure.

- ○ Curve Tracer CS-8000 Series instruction manual (this manual and PDF file in the attached CD)
- ○ Test Fixture CS-32x Instruction manuals (PDF file in the attached CD)
- ○ HC Unit CS-200 Series Instruction manual (PDF file in the attached CD)
- ○ Optional Unit CS-40x Instruction manuals (PDF file in the attached CD)
- ○ Curve Tracer CS-8000 Series Remote control manual (PDF file in the attached CD)

Important Safety Precautions

To ensure safe operation of this instrument and to prevent injury to the user or damage to property, items to be observed are written in the ⚠ WARNING and ⚠ CAUTION in this manual. Be sure to read them for safe operation. In addition, marks indicating attention are attached on the panel.

Definitions of ⚠ WARNING and ⚠ CAUTION used in this manual

⚠ **WARNING**	Incorrect operation or failure to observe the warning may result in death or serious injury.
⚠ **CAUTION**	Incorrect operation or failure to observe the caution may result in injury or damage to the instrument.

Explanation of symbols on panel.

ELCTRIC SHOCK	Incorrect operation may cause electric shock. This symbol calls attention. To protect the user, read items in this manual before using this instrument.
WARNING	To prevent injury to the user or damage to this instrument, read items in this manual before using this instrument.

Notice

◇ Parts of the contents of this manual may be modified without notice for improvements in performance and functions.

◇ Reproduction or reprinting of the contents of this manual without prior permission from IWATSU is pro habited.

◇ The contents of this instruction manual are compatible with CS-8000 Series Firmware Version 4.05 or later.

◇ For questions about this instrument, contact IWATSU or our sales distributors.

Revision History

- Aug. 2021: 1st Edition
- Nov. 2021: 2nd Edition
- Jan. 2022: 3rd Edition
- Dec. 2022: 4th Edition
- Aug. 2024: 5th Edition

Document Number

- KMLA00525

◇ **Read this page to ensure proper safety.** (Also read the following pages.)

⚠ WARNING

●In measurement with this instrument, high voltage may be applied and high current may be supplied. Always close the cover before measurement after setting the DUT (Device Under Test) on the Test Fixture. Also, do not open the Test Fixture cover during measurement.

High voltage (max. 5 kV) may be applied and high current (max. 2 kA) may be supplied to the terminal to which the DUT is mounted. To prevent danger, if the cover of the Test Fixture is not closed, no voltage and current can be supplied to the terminal and no power can be applied to the DUT. Do not modify the power-off switch to take measurements with the cover open. Electric shock may be caused. When it is detected that the cover of the Test Fixture is opened during measurement, the supply of voltage and current to the terminals is immediately cut off, and the energization of the DUT is stopped. For your safety, do not open the cover during measurement.

●After the measurement is completed, the measurement DUT may be charged and generate heat. Never touch the measurement DUT until you can discharge it with a grounding rod, take measures against heat, and confirm the safety.

Touching a charged or heated measurement DUT may cause electric shock or burns. Take measures such as using gloves, antistatic measures, and leaving the instrument for a sufficient period of time.

●When using anything other than the test wire lead or small crocodile clip that comes with the Test Fixture, pay attention to the withstand voltage and allowable current.

If the measurement is performed without considering the measurement potential, cable outer insulation, and GND cable outer insulation rating, it may cause a fire or malfunction. Use the specified cable that comes with the Test Fixture according to the measurement content.

●Always use the interlock function.

Connect the interlock circuit to the INTERLOCK connector of this instrument. Also, check regularly that the interlock function is working properly.
Make sure that the interlock lamp (indicator LED) is lit when setting the DUT. Also, turn OUTPUT ENABLE OFF (indicator LED is off).

⚠ WARNING (Continued)

●If you notice smoke, abnormal smell or abnormal sound, immediately take measures below and unplug the power plug from the receptacle.

(1) Set the standby switch to standby.
(2) Turn off the power switch
(3) Unplug the power plug from the receptacle

Continued use under these circumstances may result in electric shock or fire. After taking measures above, contact IWATSU or our sales distributors for repair. Repairing the instrument by yourself is very dangerous. Do not attempt to repair the instrument under any circumstances.

●Do not use in an environment with explosive gases.

This may result in explosion.

●Make sure no water gets on or inside the instrument.

Failure to observe this precaution may result in electric shock or fire. If water gets on or inside the unit, turn off the power switch, unpulg the power plug from the power outlet, and then contact IWATSU or our sales distributors for repair.

●Do not touch the plug of the power cord if your hands are wet

This may result in electric shock.

●Do not place this instrument on an unstable place such as a shaky stand or inclined place.

Letting this instrument fall or topple down may result in electric shock, fire or injury. If this instrument falls or its cover is damaged, turn off the power switch, unpulg the power plug from the power outlet, and then contact IWATSU or our sales distributors for repair.

●Surely insert the power plug into the power outlet after checking that any dust is not sticking to the power plug. Additionally, disconnect the power plug from the power outlet once every six months to one year, and inspect and/or clean the power plug.

If the power plug is contaminated, this may cause an electric shock, a fire, or a malfunction.

⚠ WARNING (Continued)

●Do not put any foreign objects, such as metallic or flammable objects through the ventilation opening.

If any foreign objects of metal and the combustible one, etc. is put through the ventilation opening, this may result in electric shock, fire, and/or malfunction. If any foreign objects enter this instrument, turn off the power switch, unpulg the power plug from the power outlet, and then contact IWATSU or our sales distributors for repair.

●Always use a 3-prong power cord that suits power supply voltage for this instrument

Using a power cord that is incompatible with the power voltage may result in electric shock, fire and/or malfunction. Additionally, using a 2-prong power cord may result in electric shock.

Unless otherwise specified at purchase, a 100V (90 V to 132 V) power cord is supplied with the instrument. If operating the instrument at 200V (180 V to 250 V), always use the 3-prong power cord (optional) for 200V systems (rating: 250V) specified by IWATSU.

- If the power is supplied from the 2-prong power outlet using the 3-prong / 2-prong conversion adapter, ground the GND terminal of the adapter.
- When using the attached 3-prong power cord to supply the power from the 3-prong power outlet, grounding is made through the GND line of the power cord.

●Use this instrument at a specified supply voltage

Using this instrument at a voltage other than specified may result in electric shock, fire or malfunction. Usable power supply voltage range is written on the rear panel.

●Do not remove the case, cover and panel

Since there are parts with a high voltage in this instrument, touching the part may cause electric shock. When performing inspection, calibration, or repair, contact IWATSU or our sales distributors.

●When handling power cord, observe items below:

If not, fire or electric shock may occur. If the power cord is damaged, contact IWATSU or our sales distributors for repair.

- Do not attempt to fabricate the power cord.
- Do not pull the power cord.
- Do not forcibly bend the power cord.
- Do not heat the power cord.
- Do not twist the power cord.
- Avoid getting the power cord wet.
- Do not bind the power cord together.
- Do not place heavy objects on the top of the power cord.

⚠ WARNING (Continued)

●Do not modify or repair this instrument.

Modifications or repairs made by users may result in an electric shock, a fire, or a malfunction. This instrument cannot be repaired by users. Do not open it to attempt repairs. For repairs, contact IWATSU or our sales distributors. Note that modified Instruments will not be accepted for repairs.

●If a lightning occurs near the instrument operation place, immediately turn off the power switch, unplug the power plug from the power outlet.

A lightning may cause an electric shock, a fire, or a malfunction.

●Do not allow metal objects, etc., to touch the metal blades of the power plug.

Contact with a metal object, etc., may cause a fire or electric shock.

●Do not use multiple-connection outlets.

Power strips and other multiple-connection outlets may cause a fire or overheating.

●Do not place containers of water or chemicals, small metal objects, etc., near this instrument.

If the contents are spilled and enter the instrument, it may cause a fire or an electric shock. If water, chemicals, or metal objects enter the instrument, turn off the power switch, unplug the power plug from the outlet, and then contact IWATSU or our sales distributors for repair.

●Do not use this instrument if it is not functioning correctly.

Using a malfunctioning instrument (due to dropping, etc.) may cause an electric shock or a fire.

If the instrument is not functioning correctly, turn off the power switch, unplug the power plug from the outlet, and then contact IWATSU or our sales distributors for repair.

●Do not place this instrument in an area where frequent vibrations or impacts occur.

If this instrument is dropped or overturned, it may cause a physical injury.

●If this instrument is dropped, it may result in a physical injury or property damage.

Before transporting this instrument, remove all devices under testing, probes, and cables, and then carry it carefully by many people or more to avoid dropping.

Read this page to ensure proper safety. (Also read the following pages.)

⚠ CAUTION

●Set the power supply cord up in the place where it is pulled out easily.
When this instrument is a dicey situation, it is necessary to cut power off promptly. Do not attempt to place this instrument in the location where difficult to unplug the power supply cord from the receptacle.

●When disconnecting the power cord from the receptacle, hold the plug to pull it out.
Pulling the power cord may damage it, resulting in electric shock or fire.

●Do not use the power cord attached to this instrument for other electric apparatuses.
The power cord attached to this instrument cannot be used for other electric apparatuses in accordance with the electric apparatus safety laws.

●Connect or disconnect the power cord after the POWER switch has been turned off.
If not, fire or overheating may be caused.

●Do not short-circuit the blade of the power cord plug with metal and others.
If touched with metal, fire or electric shock may be caused.

●Do not use any damaged power cord, cable or adaptor.
If any damaged power cord, cable or adaptor is used, this may result in electric shock and/or fire.

●Do not place an object near the ventilation opening and fan of this instrument.
This may cause the inside to be filled with heat, resulting in fire or failures.

●Ensure the spaces around the ventilation holes of this instrument.
Open the space of about 100mm to the left side, the right side, and the rear of this instrument. When mounting it on the other instrument, attention should be directed to temperature increase.

●Do not place this instrument in the location with much moisture (Underground warehouse , etc.) or dirt.
If not, electric shock or fire may be caused.

●When wiring to the measurement DUT, check the said contents of the terminals and be careful of incorrect wiring.
If the wiring is incorrect, the correct measurement cannot be performed. Also, depending on the connection, the measurement DUT may be damaged or the instrument may malfunction.

- If the wiring is incorrect, the voltage exceeding the rating may be applied to the gate / base terminal of the measurement DUT and the measurement DUT may be damaged.
- If only SENSE terminal is connected without connecting the FORCE terminals, the SENSE terminals are connected by an output and a resistor inside this instrument to perform Kelvin sense. Therefore, an overcurrent may flow through the resistor and burn it out.
- Do not directly connect FORCE terminals to each other. Two or more terminals are connected to the measurement DUT at the same time, high voltage is applied to the terminal with low withstand voltage. May be applied and cause a fire or malfunction.

●Always exercise appropriate caution when using a conversion adapter with the triaxial connector.
Using an adapter with specifications designed to short-circuit each electrode may cause malfunctions.

⚠ CAUTION (Continued)

●Do not expose this instrument to the direct sunlight or with much moisture.
Direct sunlight may the inner temperature to increase, resulting in fire.

●Do not place this instrument in a place exposed to oily smoke or steam.
Doing so may cause an electric shock or fire.

●Before moving this instrument, remove the power cord and external connection cables from this instrument.
If not, the cord or the cable may be damaged, resulting in fire or electric shock.

●When connecting the power cord or measurement cable, care should be taken so that you do not pull such cable. If such cable is pulled, this may cause the instrument to be laid down.
If this instrument is laid down, this may cause an electric shock, a personal injury, a fire.

●Use this instrument within the specified operation and storage environment
Using it out of the specified operating environment or keeping it out of the specified storage environment may cause malfunction.
If not, an failure may be caused. Usable temperature range is as follows:
Only indoor use.
Operating temperature: 0 °C to +40 °C
Operating humidity: 5 % to 80 %RH (at 30 °C and no dew condensation)
Upper bound value 55 %RH (at 40 °C and no dew condensation)
Storage temperature: -20 °C to +60 °C
Storage humidity: 5 % to 80 %RH (no dew condensation)

●If not used for a long term, remove the power cord plug of this instrument from the receptacle for safety.

●When transporting this instrument, detach the power cord, and the cable, etc., and use the packing material provided at the time of purchase or packing material equivalent at least.
Excessive vibration or shock applied to this instrument during transportation may cause it to malfunction, resulting in fire. If you do not have the proper packing material or shock absorbing material, contact IWATSU or our sales distributors. When having the instrument transported by a shipping company, write "Precision instrument - Handle With Care" on each side of the packing box.

●Prior to maintenance, unplug the power plug from the outlet for safety. Use a cloth to wipe away any moisture.
Cleaning this instrument while the power plug is connected to the outlet or while the instrument is wet may cause an electric shock or a malfunction.

●Do not use the instrument without cleaning internal for a long term.
Long-term use of an instrument having a dirty or dusty interior may cause a fire or malfunction. It is recommended that you contact IWATSU or sales distributors to check and clean the interior, calibrate, etc., about once per year.

⚠ CAUTION (Continued)

- **The weight of this instrument is about 21 kg. When moving or transporting it, two persons or more should carry it.**
  If not, injury may be caused.
- **If "OVERHEAT ALERT !!!" or "Overheat alert was detected." is displayed, the temperature in the instrument is high and the instrument is overheated. The current and voltage outputs are automatically set to 0. If the overheat display appears, wait at least 5 minutes after the overheat display disappears (the time when the internal temperature drops sufficiently), return it to "ENABLE", and restart the measurement. Also, wait with the standby switch turned on (the fan is running) until the overheat display disappears.**
  If the standby switch is on, the fan will rotate, and the temperature inside the machine will easily drop. If the standby switch is turned off, it may take some time for the cabin temperature to drop.
- **When handling the open / close cover of the Test Fixture, be careful not to get your hands or fingers caught.**
  If pinched, it may cause injury to hands or fingers.
- **When measuring high voltage (HIGH VOLTAGE) with a Test Fixture, be sure to use the dedicated red high-voltage cable for connecting the drain / collector terminals.**
  Using a cable other than red may damage the DUT or the instrument if the withstand voltage is insufficient.
- **Do not use beyond the maximum working voltage and the maximum working current of the Test Adapter (CS-5xx Series).**
  This may cause damage to the equipment and the device under test.
- **Avoid measuring parts other than semiconductor devices as they may cause the instrument to malfunction or the device under test to be damaged. If you want to measure a semiconductor device that is not described in this instruction manual, please contact us.**
- **Do not use in a way that is not specified in the instruction manual for this instrument.**
  If you use this instrument in a way that does not specify it, the protection provided by this instrument may be impaired.

Items

When receiving this instrument, please check parts in the package.

◆Curve Tracer CS-8000 Series ..... : 1

＜Accessories＞

- Power cord (3-prong) ..... : 1
- Cord strap ..... : 1
- Control interface terminator ..... : 1
- Protective cover right ..... : 1
- Protective cover left ..... : 1
- Fixed belt ..... : 1
- CD (Instruction Manuals, Remote Control Manual) ..... : 1
- User's Guide ..... : 1

How to use this document; Notation

It is recommended that the biginner of this instrument should use the instrument after reading this instruction manual carefully

◆About the explanation method of this Manual

◇The Curve Tracer CS-8000 Series is designed for use in combination with optional Test Fixtures and HC Unit.

Therefore, the explanation of functions and operations is based on the assumption that the Test Fixture is connected.

In addition, the measurement range expands when the HC Unit is connected, but this manual assumes that the HC Unit is not connected.

If the HC Unit is connected, read it in combination with the instruction manual of the HC Unit.

◇WARNING, CAUTION and Memo

WARNING and CAUTION for electric shock, fire, and damage to this instrument are written at the beginning of this manual.

Explanation of each section includes cautions and memo (knowhow and details).

◆Usage example of CAUTION and Memo

◇CAUTION

CAUTION !

When you move instruments to an environment with different temperature and humidity, condensation may occur due to sudden temperature changes.

When there is a change in the environment, wait for a while until the environment inside the instruments become accustomed to the surrounding environment.

Then, turn on the main power switch of the CS-8000 series before use

◇Memo

Memo

Kelvin Sense

Since the voltage drop caused by the contact resistance of a contact point is not included in measured value, high accuracy measurement can be performed.

Updating version of Firmware

Since each Firmware program has suitability to a machine, contact IWATSU or our sales distributors for Firmware version update or visit on our Web site (URL : https://www.iwatsu.co.jp/tme/).

For the procedure of the version updating Firmware in the main unit, refer to the section 3.4.20 Updating Firmware in the instrument.

Contact Us

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Contents

Chapter 1 Overview

The development of semiconductor technology is remarkable and diverse, and the number of equipment such as heavy electric power (electric power), home appliances, air conditioning, and transportation that incorporate power devices such as inverters continues to increase, and the technological progress is remarkable. In power electronics technology, we are moving from the conventional pursuit of high efficiency of electric power to the one that tries to reduce the energy density (make it compact) or that is eco-friendly. In the transportation industry such as trains, the automobile industry, and power device manufacturers, the development of components for eco-friendly instruments is rapidly expanding.

Inverter technology used in many electronic devices such as air conditioners, refrigerators, elevators, trains, hybrid cars, solar power generation and wind power generation is a circuit technology that is indispensable for energy saving. The importance of evaluating next-generation power semiconductor devices such as SiC and GaN is increasing in order to improve the efficiency of these energy uses.

The Curve Tracer CS-8000 Series was developed by further enhancing the Curve Tracer CS-3000 Series and CS-5000 Series in order to evaluate power semiconductor devices in the power electronics market.

1.1 Features

The CS-8000 Series is a most-advanced Curve Tracer that can handle maximum peak voltage of 5 kV / maximum peak current of 2 kA by combining with various optional units.

You can select the Main Unit, high current unit (HC Unit) and Test Fixture CS-322 / CS-320 required for measurement according to the application.

The Main Unit CS-8200 / CS-8500 consists of an HV unit (2 kV / 5 kV), an MV unit (common to all Main Units) and a GATE Unit (common to all main units). The Main Unit CS-8020 consists of an MV unit (common to all main units) and a GATE unit (common to all main units).

By combining the HC Unit CS-205 / CS-210 / CS-220, it is possible to measure with a current of 500 A / 1 kA / 2 kA.

It can be used not only for measuring the characteristics of high-voltage and high-current power devices such as the latest IGBTs and power MOSFETs, but also for measuring the characteristics of various semiconductors such as transistors, diodes, and LEDs. The measurement results can be saved or sent to a PC via the standard USB port and LAN interface. The main features are shown below.

■ Maximum voltage, maximum current

The Curve Tracer CS-8000 Series has a maximum supply voltage of 5 kV and a maximum supply current of 2 A in PULSE mode.

■ HC Unit option for high current

High current can be measured by connecting to the HC Unit and Test Fixture.
The maximum supply current of the HC Unit CS-220 is **2 kA in PULSE mode**.
The maximum voltage at no load can be measured up to 50 V.

■ Wiring for each test item can be automatically changed in the Test Fixture

According to the CONFIGURATION in the CS-8000 Series, the device and various supply power supplies are selected, and the wiring is automatically switched internally. Therefore, the recall function of the setup allows smooth connection switching of various measurements

without opening and closing the Test Fixture cover.

■ In pulse measurement, sampling position can be set while checking the pulse waveform.

The applied pulse width and data acquisition timing can be set while checking the voltage and current waveforms of the applied pulse, so measurement can be proceeded with confidence.

■ Handling of the DUT (Device Under Test)

The CS-8000 Series is usually used by connecting the optional Test Fixture CS-322, but an unique Test Fixture might be required due to the size and shape of the DUT, or additional equipment for measurement.

The configuration is extensible to accommodate such test environments.

When using the Test Fixture CS-322, set the DUT by one of the following three methods.

- Set the optional Patch Panel CS-520 in the Test Fixture.

  Connect the Test Fixture connection terminals and the Patch Panel terminals with test wire leads.

  Connect the DUT into the socket of a compatible Test Adapter and then set the Test Adapter in the Patch Panel. CS-500 to CS-510 are available as Test Adapters (optional).
- Without using a Patch Panel, connect the terminal of the Test Fixture and the terminal of the DUT directly to the terminal of the Test Fixture with a test wire lead with an Crocodile clip or an HV/HC cable.
- Manufacture a dedicated measurement panel (jig) that matches the DUT, install that panel instead of the Patch Panel, and then connect wires directly between the measurement panels. Efficient measurement is possible by preparing a measurement panel that can be securely connected to the DUT and that can be easily attached and detached.

For Test Fixtures with the DUT set, close the cover before measuring.

■ Remote Control

The CS-8000 Series supports LAN interface (10/100/1000 Base-T). Connect to an external device via the ETHERNET connector on the rear panel. For details on usage, commands, etc., refer to the Remote Control Manual included in the attached CD.

CAUTION !

When using a LAN interface for remote control, be sure to use a shielded LAN cable (STP) for the Ethernet cable.

Chapter 2 Names and Functions

This chapter describes the names and functions of each part of this instrument.
Sections 2.1 and 2.2 briefly explain the names and functions of the front panel, rear panel keys and connection ports.
Section 2.3 briefly describes the controls and features of each part of the Test Fixture.

2.1 Names and Functions of the Front Panel

Figure 2.12.1 shows the front panel of the CS-8200 and describes the names and functions of each part of the CS-8000 Series.

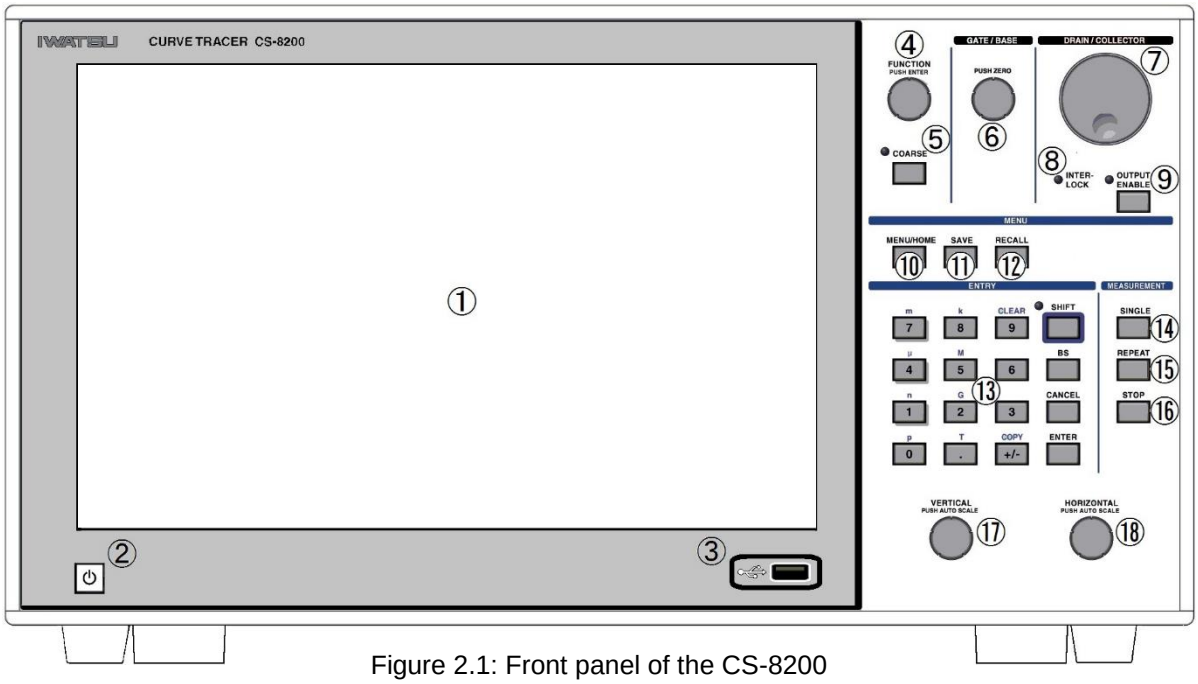


Figure 2.1: Front panel of the CS-8200

① LCD Touch Screen

12.1 in. color LCD. Various setting statuses and measurement results are displayed.
You can control settings and operations by touching the buttons and displays on the screen with your finger or touch pen.
Refer to Sections 3.3 to 3.4 for the display contents and setting.

② Standby Switch

Toggle on and standby. (To turn it off, use the main power switch on the rear panel.)
Press and hold for about 1 second to turn it on from standby.
Press and hold for about 2 seconds to switch from on to standby.
Lights red in standby mode and blue in on state.

③ USB Port

Connect a USB memory to read and write data files.
It is used to save and recall measurement settings (TEMPLATE), waveform data (WAVEFORM), and to save a screen copy file of the screen. It can also be used by connecting a USB-connected mouse or keyboard.
For the handling of USB memory, refer to Section 3.4.14, "About USB memory that can be used" in the detailed settings of the SAVE menu.

2.1.1 Top Right of the Front Panel

Figure 2.22.2 shows the FUNCTION knob, GATE / BASE knob, DRAIN / COLLECTOR knob, etc. at the top right of the front panel, and explains the names and functions of each part.

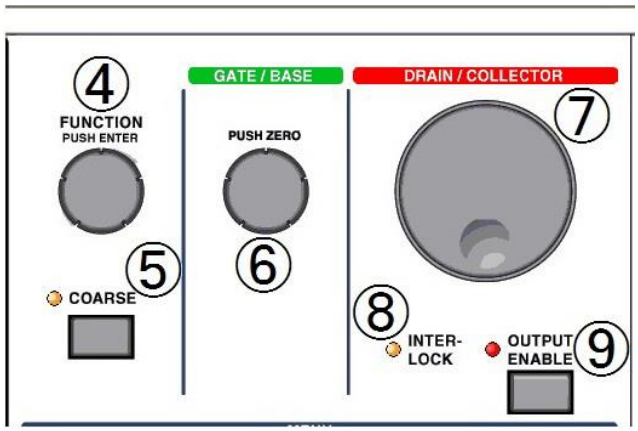


Figure 2.2: Upper right part of the front panel

④ FUNCTION Knob

Select various setting items displayed on the screen and enter/change the setting values.

By turning the knob, you can select setting fields and switches on the current menu screen.

The frame of the selected item is displayed in purple, and each item moves when you turn the knob.

When you press the knob on the item to be input / changed, it operates as follows.

1. In the case of numerical setting, the inside of the frame turns black, turning the knob to the right increases the set value, and turning it to the left decreases it.
   When you press the knob, the inside of the frame turns white and the item returns to the moving state.
2. In the case of item selection, selection candidates are displayed in a pop-up window.
   The currently selected item has a purple frame, and turning the knob to the right selects the lower candidate, and turning it to the left selects the upper candidate.
   Select the best candidate and press the knob to set.
3. For switches, each time you press the knob, it switches on and off.
4. For data lists, you can turn the knob to select a row in the table.
   Turn the knob to the right to select the row with the larger index, and to the left to select the row with the smaller index.

⑤ COARSE Key

Change the amount of increase/decrease of the numerical value by the FUNCTION knob.

The amount increases / decreases in the last digit when the LED on the upper left of the key is off.

When the LED is lit, the value one digit higher increases or decreases.

The amount of increase / decrease alternates each time the COARSE key is pressed.

⑥ GATE / BASE Knob

Adjust the output range of GATE / BASE SUPPLY. Press the knob to set the value to 0.

See Section 3.3.2 for operations related to the display screen.

⑦ DRAIN / COLLECTOR Knob

Adjust the output range of DRAIN / COLLECTOR SUPPLY.

See Section 3.3.2 for operations related to the display screen.

⑧ INTERLPOCK LED

When the panel cover of the device connected to the INTERLOCK connector on the rear panel is open, such as a Test Fixture, or if the protective cover on the rear panel is not properly attached and fixed, the interlock state will occur and the LED will light up (See Section 2.2.3).

It cannot be measured in the interlock state.

⑨ OUTPUT ENABLE Key and LED

When pressed, the outputs of GATE / BASE SUPPLY and DRAIN / COLLECTOR SUPPLY can be applied to the DUT, and the upper left LED turns on.

Measurement is not possible when the OUTPUT ENABLE LED is off.

2.1.2 Front Panel MENU

Figure 2.32.3 shows the MENU section of the front panel and describes the names and functions of each section.

Figure 2.3: Front panel MENU section

⑩ MENU / HOME Key

Press to display the MENU list or return to the HOME screen.

When you press this key while the pop-up list is displayed, the pop-up list disappears.

When you press this key while the screen other than the HOME screen is displayed, you will return to the HOME screen.

See section 3.4 for the details of the MENU list.

⑪ SAVE Key

Press to save the measurement data and measurement setups as a file in the built-in folder of this instrument or the connected USB memory. When saving the measurement data, you can select whether to save after displaying/changing the SETUP SAVE screen or without changing the settings in SAVE KEY ACTION in Section 3.4.18.3.

See Section 3.4.14 for the SAVE screen and the setting.

⑫ RECALL Key

Press to load the measurement data and measurement setups saved as a file in the built-in folder or the connected USB memory.

After loading the measurement setups, it depends on the setting at the time of SAVE whether to stop and wait for the next operation or to execute the measurement immediately. See section 3.4.14.

See Section 3.4.15 for the RECALL screen and the setting.

2.1.3 Front Panel ENTRY and MEASUREMENT

Figure 2.42.4 shows the front panel ENTRY and MEASUREMENT, and explains the names and functions of each part.

⑬ ENTRY Keys

1. Enter numbers using the keys with numbers, decimal points, and +/-.

   When the numerical value setting field is selected with the FUNCTION knob, etc., the numerical value input screen is displayed and numerical value input is possible.

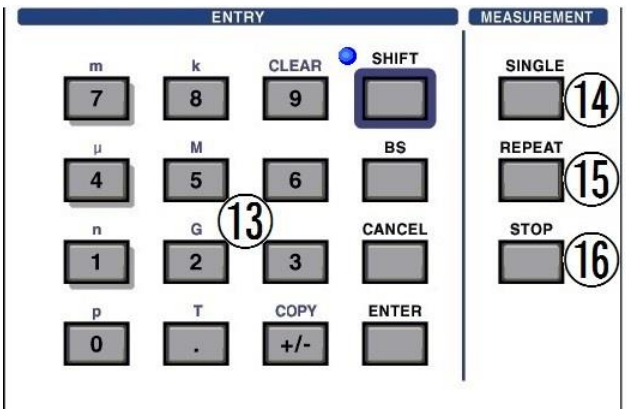


Figure 2.4: Front panel ENTRY and MEASUREMENT

2. The +/- key is a key that inverts the polarity of a number and always inverts it.
3. The BS key erases the number and decimal point immediately before the cursor.
4. The CANCEL key does not set the value you are entering and closes the pop-up screen with the previous setting.
5. The ENTER key sets the value you are entering and closes the pop-up screen.
6. Each time the SHIFT key is pressed, it switches between the SHIFT state and the normal state.
   In the SHIFT state, the SHIFT LED on the upper left lights up, and the keys with numbers and decimal points input the SI prefix letters (m, μ, n, p, k, M, G, T), and the CLEAR.
   When the SI prefix character is entered, the value being entered is determined, the pop-up screen is closed, and returns to the normal state.
7. In the SHIFT state, the CLEAR key (9 keys in the normal state) erases all the numeric character strings being input.
8. Press the COPY key (normal +/- key) in SHIFT to save a screen copy to a file.
   See Section 3.4.16 for settings to save a screen copy.
9. When you press any key in the SHIFT state, it will return to the normal state.

⑭ MEASURMENT SINGLE Key
The measurement is executed only once under the set measurement conditions and stopped.

⑮ MEASURMENT REPEAT Key
The measurement is repeated under the set measurement conditions.

⑯ MEASURMENT STOP Key
Stops the measurement under the set measurement conditions.
The acquired data is displayed as measurement data.

2.1.4 Lower Right of the Front Panel

Figure 2.52.5 shows the lower right corner of the front panel and describes the names and functions of each part.

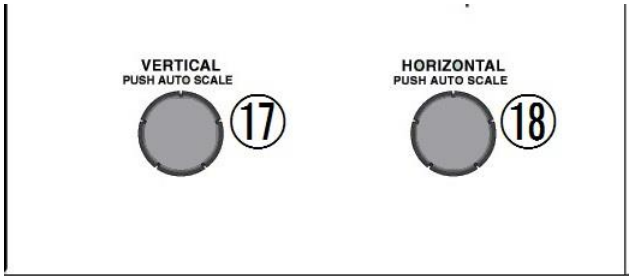


Figure 2.5: Lower right of front panel

⑰ VERTICAL Knob
Sets the vertical axis display scale of the XY graph. Turn it to the right to enlarge it, and to the left to reduce it.
When you press the knob, the optimum vertical axis display scale is automatically set based on the value of the acquired data. When the XY display is MULTI TRACE display, only TRACE set to ACTIVE is targeted.

⑱ HORIZONTAL Knob
Sets the horizontal axis display scale for the XY display. Turn it to the right to enlarge it, and to the left to reduce it.
When you press the knob, the optimum horizontal axis display scale is automatically set based on the value of the acquired data.

2.2 Names and Functions of the Rear Panel

Figure 2.62.6 shows the rear panel view of the CS-8200 and describes the names and functions of each part of the CS-8000 Series.
This figure shows the connector and terminal protective covers removed.

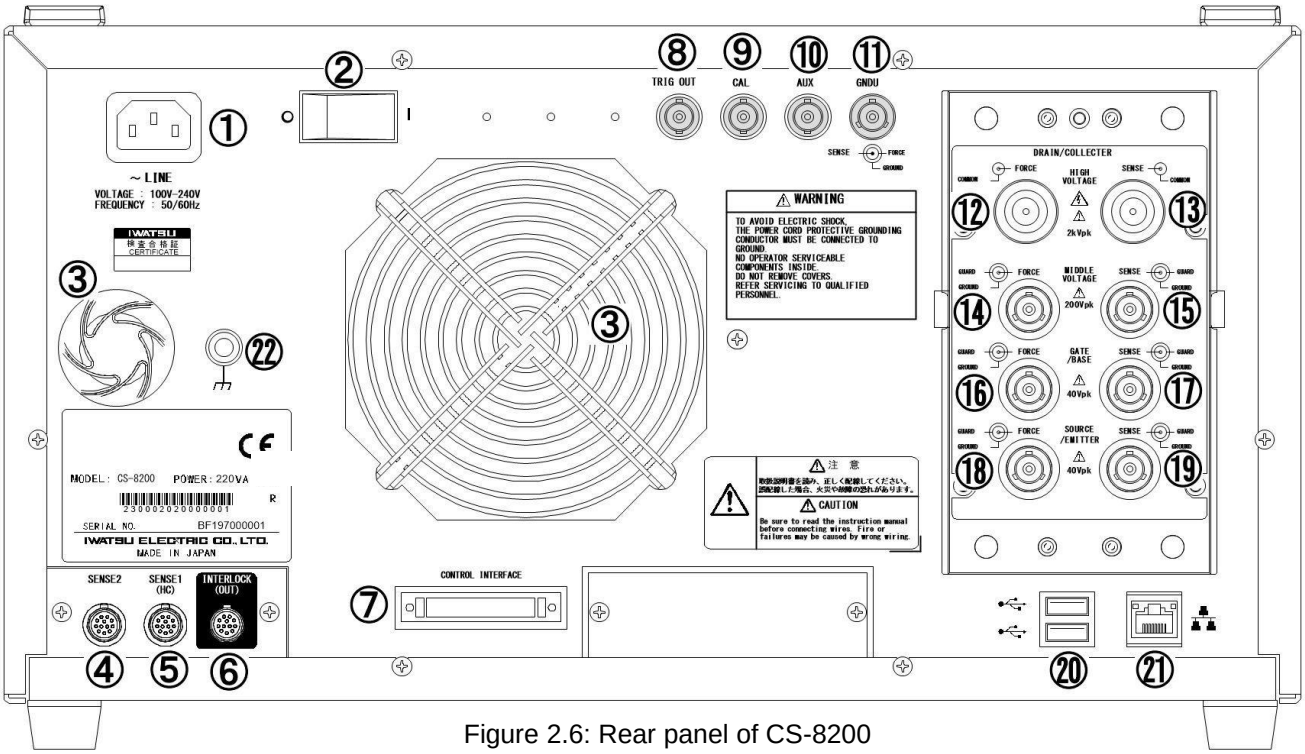


Figure 2.6: Rear panel of CS-8200

① AC LINE INPUT Connector

This is the AC power input, and connects the included 3-prong power cord.

Use an AC power supply with a frequency of 50 Hz or 60 Hz, with supply voltages from 100 V to 240 V.

This connector and the 3-prong power cord provide protective grounding.

② Main Power Switch

Turns on/off the AC power. The (○) mark side is off, and the (|) mark side is on.

When turned on, it goes into standby mode, and when the standby switch at the bottom left of the front panel is pressed, it goes into operation.

When you do not use the instrument for a long time, turn off the switch.

③ Cooling Fan

The fan exhausts the heat inside the instrument.

④ SENSE2 Connector

Connect SENSE2(OUT) connector on rear panel of Low Power Source Measure Unit CS-401, or SENSE OUT (SENSE1) connector on rear pannel of Sense Selector Unit CS-404 with a cable.

⑤ SENSE1 (HC) Connector

Connect SENSE OUT (SENSE2) connector on rear panel of Sense Emitter Measure Unit CS-402, or devices such as the HC Unit CS-200 Series with a cable.

When DRAIN / COLLECTOR SUPPLY is set to HC, the amount of current output by the HC Unit is

converted to a voltage value and input to the CS-8000 Series.

⑥ INTERLOCK Connector

Connect devices such as optional Test Fixtures with a cable to detect interlocks and perform safety checks. For more information, see "INTERLOCK Mechanism and Connectors" in Section 2.2.3.

⑦ CONTROL INTERFACE Connector

Various controls are performed by connecting a cable to an optional Test Fixture or HC Unit.

⑧ TRIG OUT Connector

A BNC connector that outputs a pulse at the start of each PRIMARY SWEEP cycle when a mode of the DRAIN / COLLECTOR SUPPY and GATE / BASE SUPPLY of the PRIMARY SWEEP is DC or PULSE.

⑨ CAL Connector

A BNC connector that outputs an internal reference voltage value for calibration.
It is used by connecting to an optional Unit that can be calibrated.

⑩ AUX Connector

Outputs the AUX voltage for measurement.
See "Configuring SYSTEM TOOLS" in Section 3.4.18.3 for configuration details.

⑪ GNDU Connector

This is a connector for compensating the ground potential.
It is used by connecting to an optional Unit that supports GNDU.

⑫ HIGH VOLTAGE DRAIN / COLLECTOR FORCE Connector

Connect the HIGH VOLTAGE DRAIN/COLLECTOR FORCE connector of the Test Fixture CS-322 with the optional HV cable. Note: CS-8020 is not equipped with this connector.

⑬ HIGH VOLTAGE DRAIN / COLLECTOR SENSE Connector

Connect the HIGH VOLTAGE DRAIN / COLLECTOR SENSE connector of the Test Fixture CS-322 with the optional HV cable. Note: CS-8020 is not equipped with this connector.

⑭ MIDDLE VOLTAGE DRAIN / COLLECTOR FORCE Connector

Connect the MIDDLE VOLTAGE DRAIN / COLLECTOR FORCE connector of the Test Fixture CS-322 with the optional triaxial cable.

⑮ MIDDLE VOLTAGE DRAIN / COLLECTOR SENSE Connector

Connect the MIDDLE VOLTAGE DRAIN / COLLECTOR SENSE connector of the Test Fixture CS-322 with the optional triaxial cable.

⑯ GATE / BASE FORCE Connector

Connect the GATE / BASE FORCE connector of the Test Fixture CS-322 with the optional triaxial cable.

⑰ GATE / BASE SENSE Connector

Connect the GATE / BASE SENSE connector of the Test Fixture CS-322 with the optional triaxial cable.

⑱ SOURCE / EMITTER FORCE Connector

Connect the SOURCE / EMITTER FORCE connector, of the Test Fixture CS-322, with the optional triaxial cable.

⑲ SOURCE / EMITTER SENSE Connector

Connect the SOURCE / EMITTER SENSE connector, of the Test Fixture CS-322, with the optional triaxial cable.

⑳ USB Ports (Two)

A USB-connection mouse or keyboard can be connected. You can also connect a USB memory to read and write data files.

㉑ ETHERNET Port

This is a LAN interface that connects this instrument to an external controller via Ethernet.
The specification is 10/100/1000 Base-T.

㉒ Ground Terminal

A safety ground terminal for Instrument connected to the enclosure, including the panel cover.
If necessary, connect it to a shield such as a measuring jig.

2.2.1 Triaxial Connection

This section describes the triaxial (triple coaxial) connectors and cables used in the CS-8000 Series.
Figure 2.72.7 shows the triaxial electrode structure.
The center is ① Center Electrode, ② GUARD electrode surrounds the center electrode, and ③ SHIELD electrode surrounds the outside.
By using such connectors and cables, the effects of leakage current and stray capacitance in the wiring section from the DRAIN / COLLECTOR SUPPLY and GATE / BASE SUPPLY to the DUT are reduced, and measurement errors are minimized.

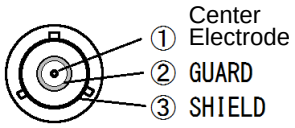


Figure 2.7: Triaxial electrode structure

CAUTION!

When using a conversion adapter or similar with the triaxial connector to convert to BNC or other format, be careful to ensure that no shorts occur in the ① center electrode, ② GUARD, or ③ SHIELD.

2.2.2 High Voltage Connectors and Cables

The connectors ⑫ and ⑬ in the rear panel of CS-8200 shown in Figure 2.62.6 have a high-voltage coaxial structure.
A high voltage of up to 5 kV is applied to the center electrode. This high voltage may appear at the open end of the cable connected here or the cable to be connected here. Be sure to connect the cable correctly before using it as it is dangerous.

2.2.3 INTERLOCK Mechanism and Connector

The CS-8000 Series and CS-8000 series optional units are equipped with an INTERLOCK mechanism, and the interlock switches in various places detect that the panel cover of the Test Fixture and protective cover on the rear of the various units are properly closed.

When all the interlock switches of the unit to be used are closed (ON), the INTERLOCK LED on the front panel goes out and measurement is possible.

If any of the interlock switches are opened (OFF) during measurement, the output from DRAIN / COLLECTOR SUPPLY and GATE / BASE SUPPLY will be cut off and the measurement will be interrupted.

In addition, by using the EXT INTERLOCK connector or the INTERLOCK OUT connector, it is possible to incorporate devices that may cause electric shock other than our products used in combination with the CS-8000 series into the INTERLOCK mechanism.

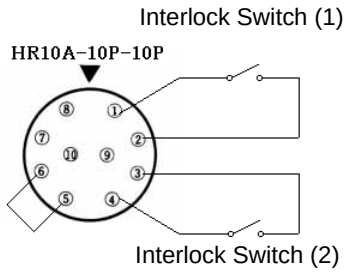


Figure 2.9: Wiring specifications for the INTERLOCK connector

When using such a device, follow the wiring specifications of the INTERLOCK connector in Figure 2.8 and construct an INTERLOCK mechanism to ensure safety before taking measurements.

CAUTION !

When the interlock terminal is short-circuited or any foreign objects are caught in the interlock switch, the INTERLOCK mechanism may not work even if the panel cover is open.

If any abnormality is found in the INTERLOCK mechanism, stop using the instrument and contact our sales or customer support.

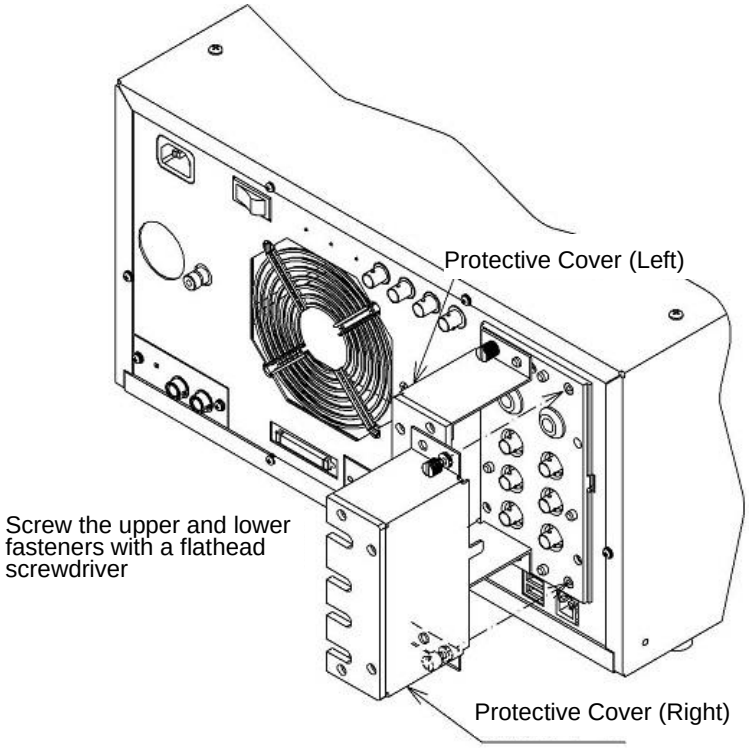


Figure 2.10: Installation of protective covers (left and right) on the rear panel

2.3 Names and Functions of the Test Fixture CS-322

CS-322 is a Test Fixture for connecting and accommodating the DUT and using it together with the CS-8000 Series and the HC Unit CS-200 Series for high current measurement.
The Test Fixture CS-322 can apply DRAIN / COLLECTOR SUPPLY with a maximum voltage of 5 kV and a maximum current of 2 kA.
By installing the optional Patch Panel CS-520 inside, you can easily measure by simply inserting it into the socket using a Test Adapter (option) suitable for the device to be measured.

2.3.1 Front Panel of the Test Fixture CS-322

Figure 2.11102.10 shows the front panel of the Test Fixture CS-322 with the cover closed, and explains the names and functions of each part.

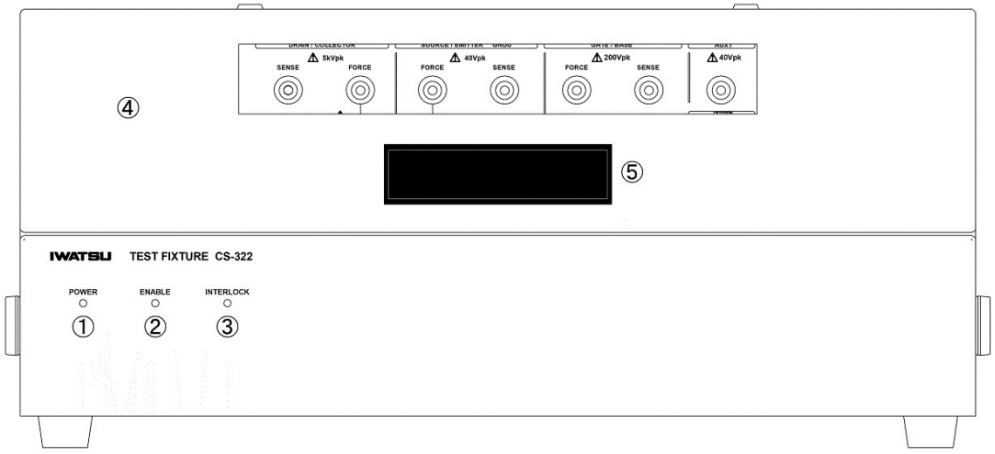


Figure 2.11: Front panel of Test Fixture CS-322

① POWER LED

When the CS-8000 Series powers up under the following conditions, the POWER LED lights up in blue.

(1) Power is supplied to the AC LINE INPUT terminal on the rear panel.

(2) The cable from the CS-8000 Series CONTROL INTERFACE connector is directly connected to the CONTROL INTERFACE IN/OUT connector. Alternatively, they are connected by a daisy chain via the CONTROL INTERFACE IN/OUT connector of another unit.

(3) The power of the CS-8000 Series is turned on.

The power cannot be turned on/off with the Test Fixture CS-322 alone.

② ENABLE LED

Lights red when measurement is available. It is linked with the OUTPUT ENABLE LED of the CS-8000 Series.

③ INTERLOCK LED

Lights when the instrument determines that measurement cannot be performed safely, such as when the panel cover described below is not closed or the protective cover on the rear panel is not attached.

④ Panel Cover

It is a cover to prevent electric shock and any foreign objects from entering during measurement. After installing and connecting the DUT to be measured inside, it can be measured by closing it properly.

⑤ Cover Handle

A handle on which you can put your finger when opening and closing the cover.

2.3.2 Rear Panel of the Test Fixture

Figure 2.12112.11 shows the Test Fixture CS-322 with the protective cover removed from the rear panel, and describes the names and functions of each part.

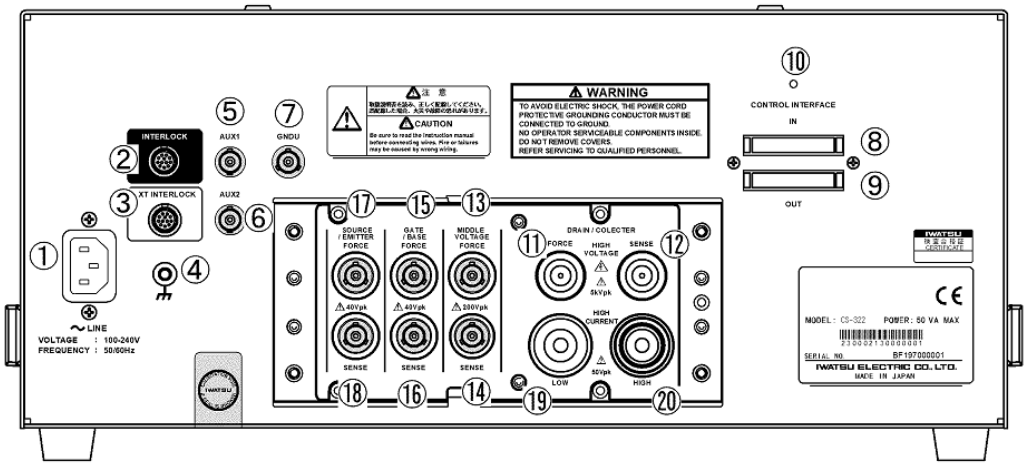


Figure 2.12: Rear panel view of Test Fixture CS-322

① AC LINE INPUT Connector

AC power input. Connect the attached 3-prong power cord. AC power with a supply voltage of 100 V to 240 V and a frequency of 50 Hz or 60 Hz is available.

② INTERLOCK Connector

Connect the INTERLOCK connector on the rear of the CS-8000 Series with a cable. The safety is confirmed by notifying the opening and closing of the panel cover of the Test Fixture and the attachment / detachment of the protective cover for the connector.

③ EXT INTERLOCK Connector

This connector is used with the INTERLOCK mechanism (see section 2.2.3) of units other than the CS-8000 Series. For connection details, contact our sales staff or customer support.

④ Ground Terminal

A ground terminal for safety connection to the housing, including the panel cover.
If necessary, connect it to a shield such as a measuring jig.

⑤ AUX1 Connector

BNC connector for inputting DC voltage for AUX measurement. Input with a BNC coaxial cable from the AUX connector on the rear of the CS-8000 Series or an external power supply.
The input voltage is output to the AUX1 terminal on the front panel, and the CS-8000 Series can control ON / OFF of the internal output of the Test Fixture. BNC coaxial cable is not included.

⑥ AUX2 Connector

A BNC connector that has the same function as the AUX1 connector. Use this when you want to output multiple signals at the same time, such as the AUX connector on the rear of the CS-8000 Series and an external power supply.

⑦ GNDU Connector

Connect to the CS-8000 Series GNDU connector with an optional triaxial cable. By connecting with this connector and enabling GNDU on the CS-8000 Series, the ground potential is compensated to be 0V.

⑧ CONTROL INTERFACE (IN) Connector

This is a connector for controlling each unit in the CS-8000 Series. It is used by connecting to the OUT side of the CONTROL INTERFACE connector of the CS-8000 Series or the CONTROL INTERFACE connector of other units.

When using multiple units, connect them with a daisy chain.

⑨ CONTROL INTERFACE (OUT) Connector

It is a connector for controlling each unit from the CS-8000 Series. Connect to the IN side of the CONTROL INTERFACE connector of another unit. When using multiple units, connect them with a daisy chain (beads connected), and connect the terminator included in the CS-8000 Series to the OUT side of the last unit in the chain.

⑩ CONTROL INTERFACE LED

It blinks during the controlled operation from the CS-8000 Series, and you can confirm that they are communicating.

⑪ HIGH VOLTAGE DRAIN / COLLECTOR FORCE Connector

Connect the HIGH VOLTAGE DRAIN / COLLECTOR FORCE connector on the rear of the CS-8200 with the optional HV cable. Note: CS-8020 is not equipped with this connector.

⑫ HIGH VOLTAGE DRAIN / COLLECTOR SENSE Connector

Connect the HIGH VOLTAGE DRAIN / COLLECTOR SENSE connector on the rear of the CS-8200 with the optional HV cable. Note: CS-8020 is not equipped with this connector.

⑬ MIDDLE VOLTAGE DRAIN / COLLECTOR FORCE Connector

Connect the MIDDLE DRAIN / COLLECTOR FORCE connector on the rear of the CS-8000 Series with the optional triaxial cable.

⑭ MIDDLE VOLTAGE DRAIN / COLLECTOR SENSE Connector

Connect the MIDDLE DRAIN / COLLECTOR SENSE connector on the rear of the CS-8000 Series with the optional triaxial cable.

⑮ GATE / BASE FORCE Connector

Connect the GATE / BASE FORCE connector on the rear of the CS-8000 Series with the optional triaxial cable.

⑯ GATE / BASE SENSE Connector

Connect the GATE / BASE SENSE connector on the rear of the CS-8000 Series with the optional triaxial cable.

⑰ SOURCE / EMITTER FORCE Connector

Connect the SOURCE / EMITTER FORCE connector on the rear of the CS-8000 Series with the optional triaxial cable.

⑱ SOURCE / EMITTER SENSE Connector

Connect the SOURCE / EMITTER SENSE connector on the rear of the CS-8000 Series with the optional triaxial cable.

⑲ HIGH CURRENT DRAIN / COLLECTOR LOW Connector

Connect to the HIGH CURRENT DRAIN / COLLECTOR LOW connector of the HC Unit CS-200 Series with the HC-FIXTURE connection unit included with the HC Unit CS-200 Series.

⑳ HIGH CURRENT DRAIN / COLLECTOR HIGH Connector

Connect to the HIGH CURRENT DRAIN / COLLECTOR HIGH connector of the HC Unit CS-200 Series with the HC-FIXTURE connection unit included with the HC Unit CS-200 Series.

2.3.3 Connection Terminals of the Test Fixture CS-322

Figure 2.13122.12 shows the connection terminals with the panel cover open, and describes the names and functions of each part.

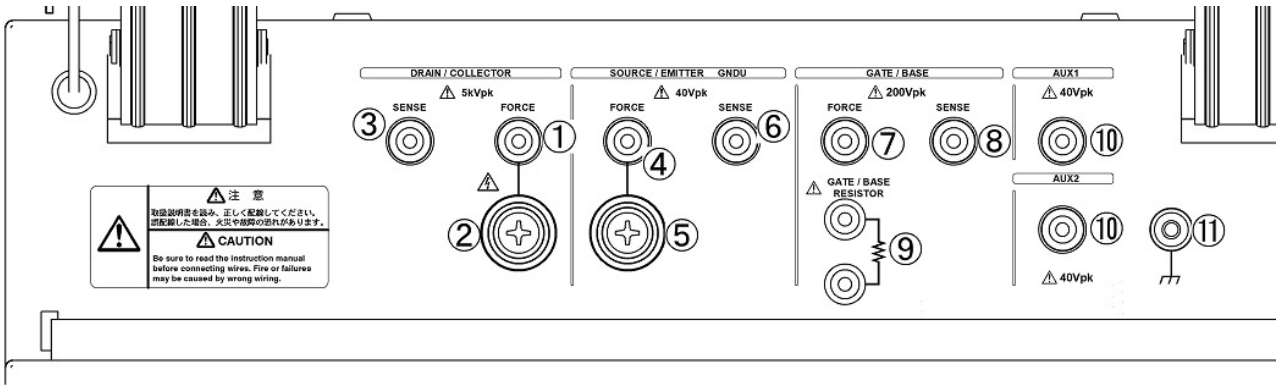


Figure 2.13: Connection terminals of Test Fixture CS-322

① DRAIN / COLLECTOR FORCE (MV / HV) Terminal

This is a terminal for the test wire lead (red) that is mainly used when the DRAIN / COLLECTOR SUPPLY of the CS-8000 Series is MV or HV. The DRAIN/COLLECTOR FORCE (HC) terminal is connected inside the instrument.

② DRAIN / COLLECTOR FORCE (HC) Terminal

This is a screw terminal for the HV / HC cable that is mainly used when the DRAIN / COLLECTOR SUPPLY of the CS-8000 Series is HC. The DRAIN / COLLECTOR FORCE (MV / HV) terminal is connected inside the instrument.

③ DRAIN / COLLECTOR SENSE Terminal

This is a lead (red) terminal for more accurately detecting (Kelvin sense) the voltage of the DRAIN / COLLECTOR FORCE terminal on the CS-8000 Series.

④ SOURCE / EMITTER FORCE (MV/HV) Terminal

This is a terminal for the test wire lead (black) that is mainly used when the DRAIN / COLLECTOR SUPPLY of the CS-8000 Series is MV or HV. It is connected to the SOURCE / EMITTER FORCE (HC) terminal inside the Instrument.

⑤ SOURCE / EMITTER FORCE (HC) Terminal

This is a screw terminal for the HV / HC cable that is mainly used when the DRAIN / COLLECTOR SUPPLY of the CS-8000 Series is HC. It is connected to the SOURCE/EMITTER FORCE (MV/HV) terminal inside the instrument.

⑥ SOURCE / EMITTER SENSE Terminal

This is a test wire lead (black) terminal for more accurately detecting (Kelvin sense) the voltage of the SOURCE / EMITTER FORCE terminal on the CS-8000 Series.

⑦ GATE / BASE FORCE Terminal

This is a terminal for the test wire lead (green) that mainly outputs the GATE / BASE SUPPLY of the CS-8000 Series.

⑧ GATE / BASE SENSE Terminal

This is a test wire lead (green) terminal for more accurately detecting (Kelvin sense) the voltage of the GATE / BASE FORCE terminal on the CS-8000 Series.

⑨ GATE / BASE RESISTOR Terminal

This is a binding post type terminal for inserting an arbitrary gate / base resistor into the gate / base of the DUT when the measurement is unstable such as when the DUT oscillates.

It can be enabled by setting GATE / BASE RESISTOR to ON on the CS-8000 Series. Be sure to insert a resistor between the terminals when setting it to ON. If it is not inserted, the gate / base connection will be open and the output of GATE / BASE SUPPLY cannot be applied to the gate / base of the DUT, making correct measurement impossible.

⑩ AUX1 / AUX2 Terminal

This is a test wire lead (yellow) terminal for using the AUX OUT voltage output from the CS-8000 Series or any voltage supplied from an external power supply inside the Test Fixture. ON/OFF can be set for each output on the CS-8000 Series.

⑪ GND Terminal

It is a ground terminal for safety.

If required, a test wire lead can be used to connect any location to ground.

CAUTION !

Voltage value display and caution mark of the connection terminal of the Test Fixture

The voltage value near each terminal indicates the maximum positive and negative voltage that can be applied to the terminal.

A caution mark near each terminal indicates that the FORCE terminal and SENSE terminal should be connected correctly.

Check the panel notation and cable label to ensure correct wiring. If you make measurements with incorrect wiring, you may not be able to make correct measurements and it may cause a malfunction.

2.3.4 Test Fixture CS-322 and the Patch Panel CS-520

The Patch Panel CS-520 (optional) with the CS-322 Test Fixture allows you to make measurements with a simple operation using the Test Adapter that matches a DUT package.
Figure 2.14132.13 shows the Patch Panel CS-520 with the panel cover open, and describe the names and functions of each part.

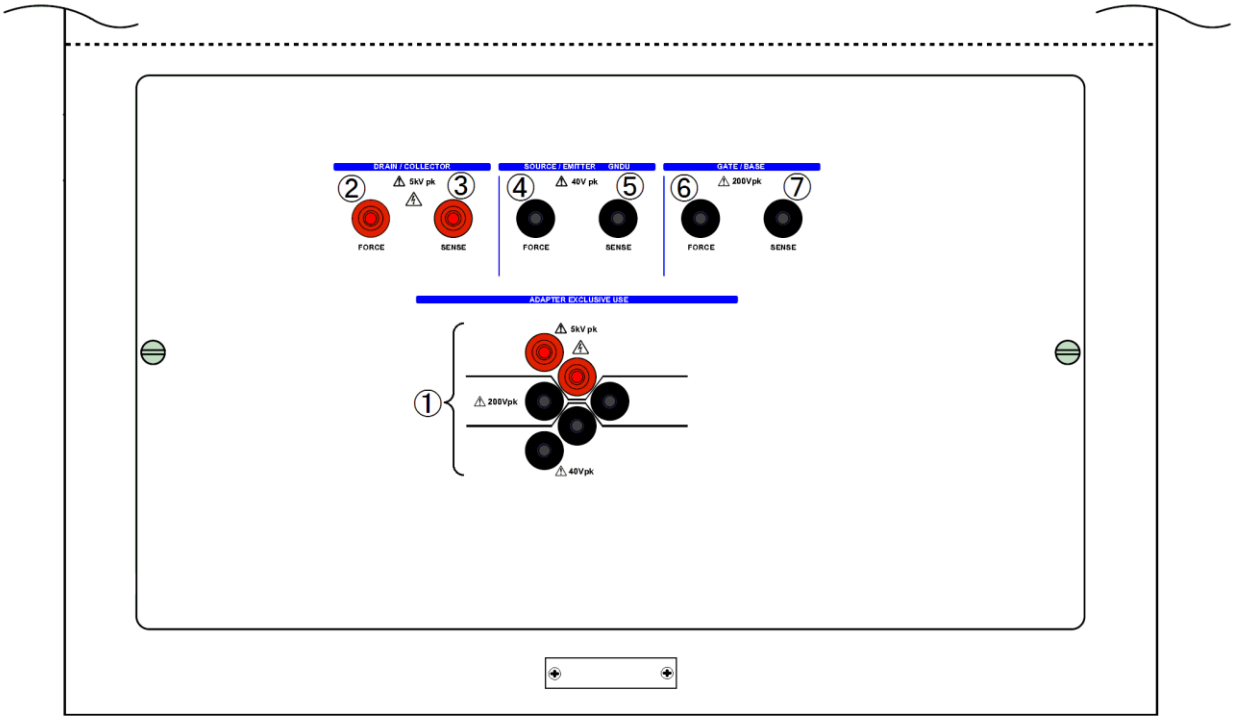


Figure 2.14: Patch Panel CS-520

① Test Adapter mounting terminals
Install a Test Adapter suitable for the DUT package.
Each of the six terminals is internally connected to terminals ② to ⑦.

② DRAIN / COLLECTOR FORCE Terminal
Connect to the DRAIN / COLLECTOR FORCE terminal of the connection terminal with a test wire lead (red), and apply it to the drain / collector of the DUT via the Test Adapter.

③ DRAIN / COLLECTOR SENSE Terminal
Connect to the DRAIN / COLLECTOR SENSE terminal of the connection terminal with the test wire lead (red), and input the voltage actually applied to the drain / collector via the Test Adapter for measurement.

④ SOURCE / EMITTER FORCE Terminal
Connect to the SOURCE / EMITTER FORCE terminal of the connection terminal with a test wire lead (black), and apply it to the source / emitter of the DUT via the Test Adapter.

⑤ SOURCE / EMITTER SENSE Terminal
Connect to the SOURCE / EMITTER SENSE terminal of the connection terminal with a test wire lead (black), and input the voltage actually applied to the source / emitter via the Test Adapter for measurement.

⑥ GATE / BASE FORCE Terminal

Connect to the GATE / BASE FORCE terminal of the connection terminal with the test wire lead (green), and apply it to the gate / base of the DUT via the Test Adapter.

⑦ GATE / BASE SENSE Terminal

Connect to the GATE / BASE SENSE terminal of the connection terminal with a test wire lead (green), and input the voltage actually applied to the gate / base via the Test Adapter for measurement.

CAUTION !

Voltage value display and caution mark on the Patch Panel of the Test Fixture

The voltage value near each terminal indicates the maximum positive and negative voltage that can be applied to the terminal.

A caution mark near each terminal indicates that the FORCE terminal and SENSE terminal should be connected correctly.

Check the panel notation and cable label to ensure correct wiring. If you make measurements with incorrect wiring, you may not be able to make correct measurements and it may cause a malfunction.

Chapter 3 Function Settings and Basic Operations

This chapter describes the precautions for installing the instrument in Section 3.1.
Section 3.2 describes the connection of the power cord, the connection of the Test Fixture and the CS-8000 Series, the connection of the Patch Panel, and the connection of a device under test (DUT) as preparations before measurement. Test Fixtures, Patch Panels, and Test Adapters are optional, but they are included for basic operation.
Section 3.3 describes the screen layout, basic operations, and screen display.
In Section 3.4, the measurement settings are explained in Sections 3.4.1 to 3.4.6 according to the menu, and the measurement result display settings are explained in Sections 3.4.7 to 3.4.13. Section 3.4.14 and subsequent sections describe useful functions for measurement.

3.1 Install the Instrument

When using this instrument, install it in a place and environmental conditions that meet the following conditions.

☆ Flat and horizontal place

Install it in a stable place, keeping it horizontal on the left, right, front and back. If not, it may fall or come down, resulting in injury to your body or damage to this instrument.

When installing in a rack, select a rack that matches the external dimensions of this instrument. The dimensions of this instrument are 424 mm in width, 555 mm in depth, and 221 mm in height (excluding accessories and protecting portions).

☆ Well-ventilated place

There are intake ports on both sides of this instrument and exhaust ports on the rear. To prevent the temperature inside the equipment from rising, leave sufficient space around it and do not block these intake and exhaust ports. Leave a space of about 100 mm on the left, right, and back of the instrument.

☆ Stacking with optional instruments

This instrument is used by connecting it to an optional Test Fixture or HC Unit. However, when the Test Fixture and HC Unit are stacked on top of the CS-8000 Series, the angle adjustment stand of the CS-8000 Series cannot be used upright. (The stand may be damaged)

☆ Operation ensured temperature and humidity

Specification ensured temperature range: +10°C to +35°C (no condensing)

Operation ensured temperature and humidity range:

0°C to +40°C,

5% to 80%RH (at 30°C and no condensing)

Upper limit:

55%RH (at 40°C and no condensing)

CAUTION !

When you move instruments to an environment with different temperature and humidity, condensation may occur due to sudden temperature changes.

When there is a change in the environment, wait for a while until the environment inside the instruments become accustomed to the surrounding environment.

Then, turn on the main power switch of the CS-8000 series before use.

3.2 Preparation for Measurement

This section describes the procedure for connecting the power supply, connecting the Test Fixture, turning on the power, connecting the DUT, and displaying the initial screen.
Here is an example of connecting the Test Fixture CS-322 and using the Patch Panel and Test Adapter CS-501A to measure FET devices in a typical TO type package.

3.2.1 Connect the Power Cord

Warnings and precautions regarding power connection and power cord are explained at the beginning of this manual. Be sure to read the warnings and cautions before connecting the power supply. The procedure for connecting the power supply is explained in ① and ② below.

Connect the power cord

① Insert the power connector of the supplied power cord into the AC LINE INPUT terminal for connecting the power cord on the rear panel (see Figure 3.13.1).
② Connect the power plug of the power cord to the power outlet (see Figure 3.13.1).

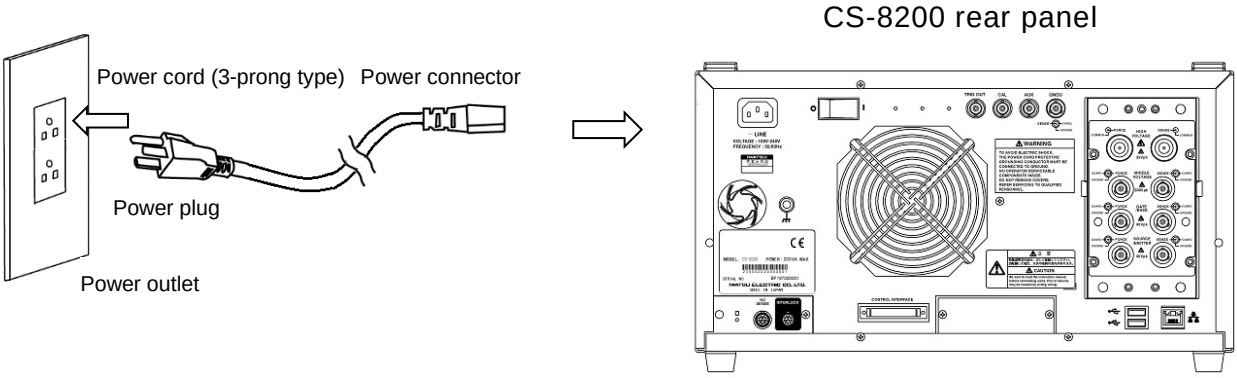


Figure 3.1: Power cord connection (CS-8000 Series)

Connect the power cord of the Test Fixture

① Insert the power connector of the supplied power cord into the AC LINE INPUT terminal for connecting the power cord on the rear panel of the Test Fixture (see Figure 3.23.2).
② Connect the power plug of the power cord to the power outlet.
Connect to a power outlet that is as close as possible to the power outlet to which the CS-8000 Series power cord is connected.

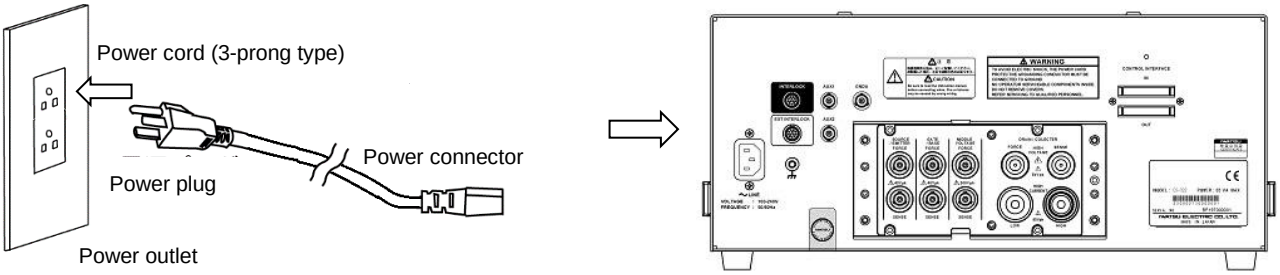


Figure 3.2: Power cord connection (Test Fixture)

3.2.2 Connect the Test Fixture CS-322 and CS-8000 Series

Connect the Test Fixture CS-322 to the CS-8000 Series with the optional HV standard cable set

Figure 3.33.3 shows the installation diagram of the CS-8200 and CS-322 with the protective cover on the rear panel removed and the numbers assigned to the connection destinations of the HV standard cable set.

Wire according to the cable connection table in Table 3.13.1. Check the cable label and wire correctly.

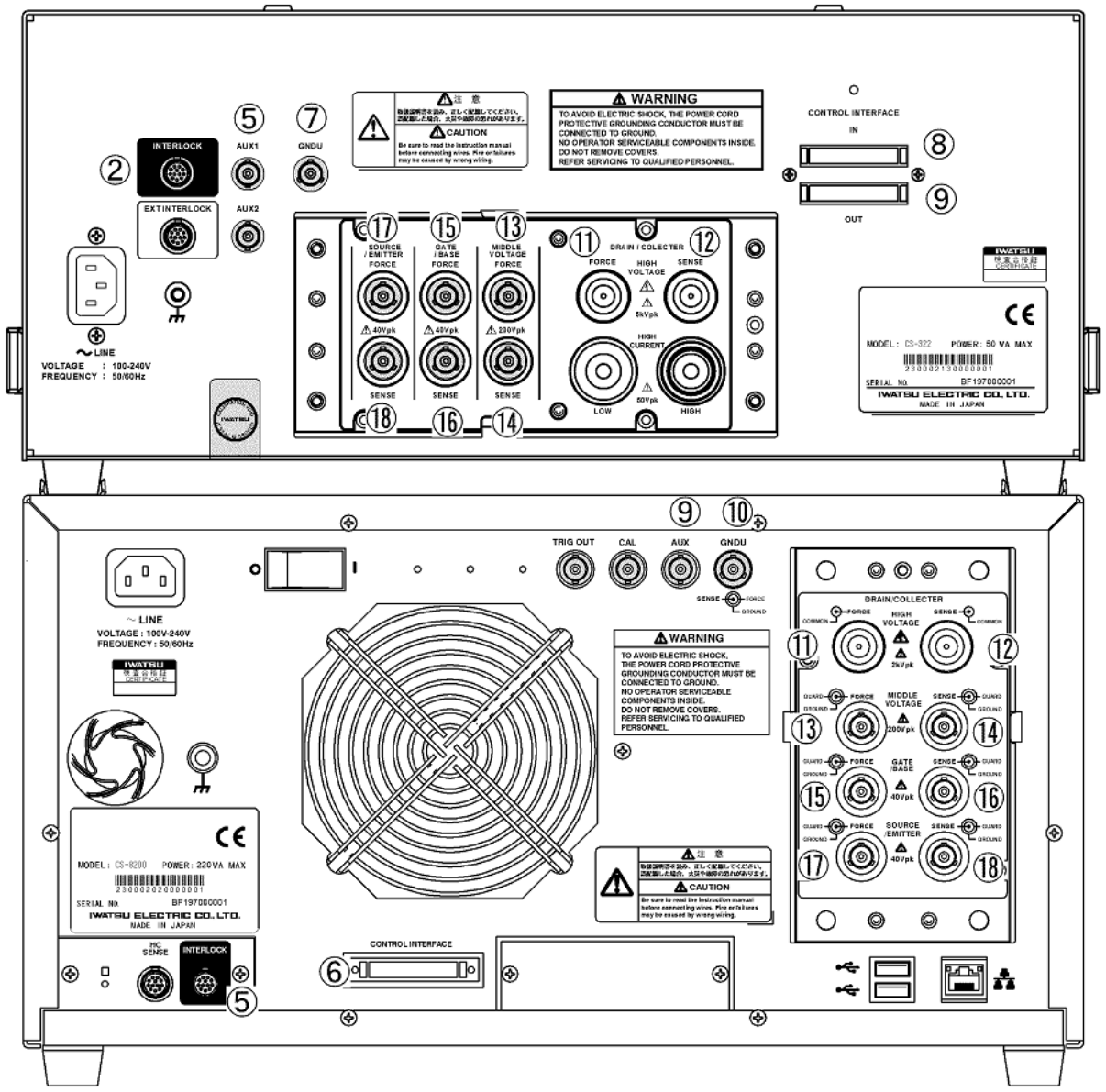


Figure 3.3: Installation of CS-8200 and CS322

Table 3.1: Connection table between CS-8000 series and Test Fixture CS-322

On the CS-8000 Series	Connector Name	Cable to be Used	On theTest Fixture CS-322	Remark
⑤	INTERLOCK	Interlock / sense cable	②	Mandatory
⑥	CONTROL INTERFACE	Control interface cable	⑧	Mandatory
⑨	AUX	Coaxial cable	⑤	
⑩	GNDU	Triaxial cable	⑦	
⑪	HIGH VOLTAGE DRAIN / COLLECTOR FORCE	HV cable	⑪	Excluding CS-8020
⑫	HIGH VOLTAGE DRAIN / COLLECTOR SENSE	HV cable	⑫	Excluding CS-8020
⑬	MIDDLE VOLTAGE DRAIN / COLLECTOR FORCE	Triaxial cable	⑬	Mandatory
⑭	MIDDLE VOLTAGE DRAIN / COLLECTOR SENSE	Triaxial cable	⑭	Mandatory
⑮	GATE / BASE FORCE	Triaxial cable	⑮	Mandatory
⑯	GATE / BASE SENSE	Triaxial cable	⑯	Mandatory
⑰	SOURCE / EMITTER FORCE	Triaxial cable	⑰	Mandatory
⑱	SOURCE / EMITTER SENSE	Triaxial cable	⑱	Mandatory
—	CONTROL INTERFACE	Control interface terminator	⑨	Mandatory

Install the protective cover for CS-8000 Series and Test Fixture CS-322

After connecting each cable, attach the protective cover on the rear panel of the CS-8000 Series and Test Fixture CS-322.

If it is not installed correctly, the interlock cannot be released and measurement cannot be performed. Be careful not to let the cables on the back get caught in heavy objects.

CAUTION !

The ⚠ mark inside the rear terminal indicates the following precautions.

- **Be sure to connect a Test Fixture CS-322 or a Test Fixture equivalent to CS-322 to the rear terminal.**

CAUTION !

When connecting or disconnecting the measurement cable, turn off the power of this instrument.

It may cause an electric shock or instrument failure.

3.2.3 Connect the Inside of the Test Fixture CS-322

Connect the Patch Panel using the test wire leads that come with the Test Fixture.

This section describes the connection when the HC Unit option function is not used.

Attach the Test Adapter CS-501A to the Patch Panel CS-520 as shown in Figure 3.43.4, and insert the DUT ⑧ into the socket according to the pin arrangement.

B : Gate / Base
C : Drain / Collector
E : Source / Emitter

Be sure to insert the insulation tab ⑨ into the socket on the unused side.

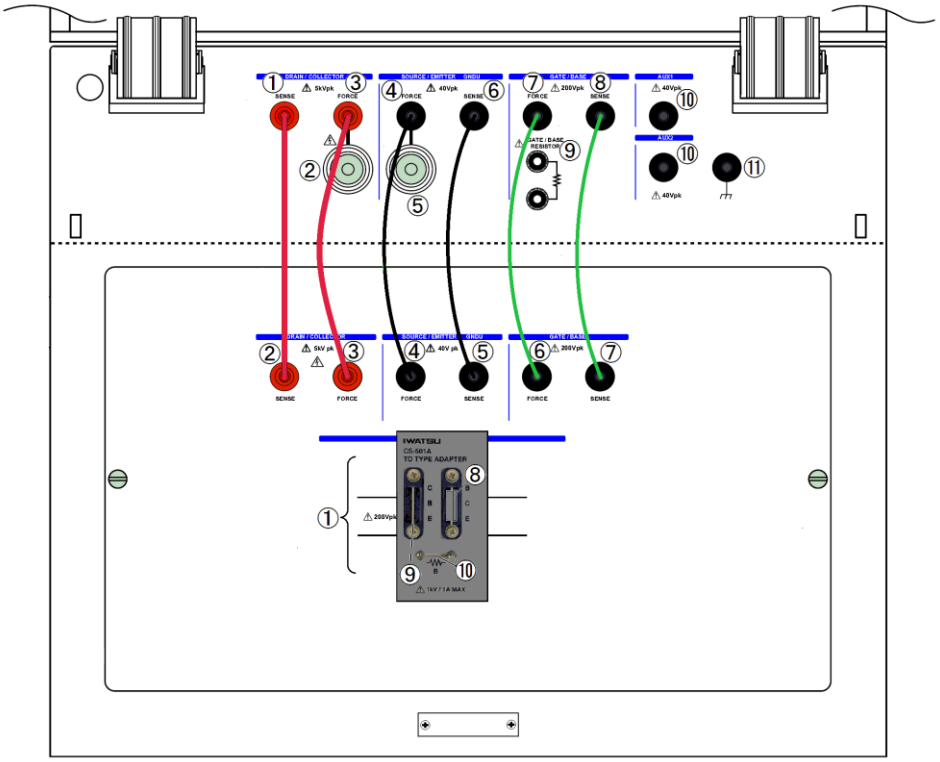


Figure 3.4: Connection diagram inside the Test Fixture

Table 3.2: Connection table between Test Fixture CS-322 and Patch Panel CS-520

On the Test Fixture	Signal Name	Cable to be Used	On the Patch Panel	Remark
①	DRAIN / COLLECTOR FORCE	Test wire lead (red)	②	
③	DRAIN / COLLECTOR SENSE	Test wire lead (red)	③	
④	SOURCE / EMITTER GNDU FORCE	Test wire lead (black)	④	
⑥	SOURCE / EMITTER GNDU SENSE	Test wire lead (black)	⑤	
⑦	GATE / BASE FORCE	Test wire lead (green)	⑥	
⑧	GATE / BASE SENSE	Test wire lead (green)	⑧	

3.2.4 Turn on the Power

Turn on the main power switch on the rear panel. (Press to the | side)
Press the standby switch on the front panel. After turning on the power, the IWATSU logo mark will be displayed on the screen and all the LEDs on the front panel will light up, so check that they are displayed and lit normally.
At this time, the power of the Test Fixture CS-322 is also turned on and the power LED lights up.
Immediately after shipping, the default setting screen is displayed.
When you want to start up with the settings that were used last time when the power is turned on, or when you want to start up with specific settings, change POWER ON RECALL in SYSTEM TOOLS in the SYSTEM MENU (see Section 3.4.18.3).

3.2.5 Register the Test Fixture as an External Unit

When you press the [MENU / HOME] button in the MENU section of the front panel, the menu list appears on the left side of the screen.

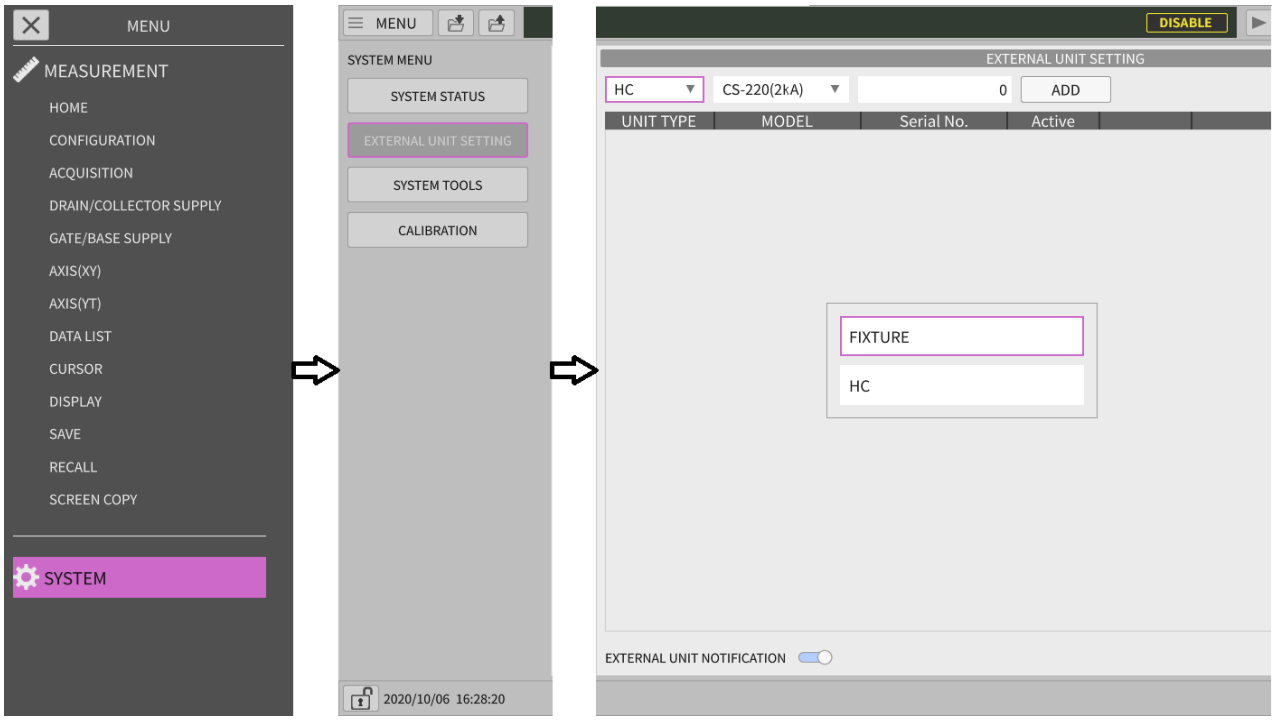


Figure 3.5: Setting menu of the external unit used for measurement

Turn the [FUNCTION] knob on the front panel to the right to move the purple selection display to [⚙ SYSTEM] at the bottom, press the [FUNCTION] knob to [ENTER], or touch [⚙SYSTEM] directly on the screen. Then, it changes to [SYSTEM MENU]. Turn the [FUNCTION] knob again, select the second [EXTERNAL UNIT SETTING], press the [FUNCTION] knob to [ENTER] or touch [EXTERNAL UNIT SETTING] on the screen. The external unit setting panel [EXTERNAL UNIT SETTING] is displayed. Use the [FUNCTION] knob to select the field at the top of [UNIT TYPE] at the top left of this panel, and then press [ENTER] or touch it. Then, [FIXTURE] and [HC] of this option are displayed on the pop-up screen. Select [FIXTURE] of the Test Fixture and press [ENTER] or touch it.

Next, select the selection field above [MODEL] and press [ENTER] or touch it. The available model will be displayed on the pop-up screen. Select [CS-322 (HV/HC)] and press [ENTER] or touch it.

Then, select the input field above [Serial No.] and press [ENTER] or touch it, the field will be reversed in black and white.

Enter only the number part of the serial number (serial number of the product) written on the label on the rear of the Test Fixture, excluding the first alphabet, with the number keys on the ENTRY part. When you enter, a pop-up screen for entering numerical values will be displayed. Check the entered values and press [ENTER] or touch the OK button on the screen.

After setting [MODEL] and [Serial No.], select the [ADD] button above [Active] and press [ENTER] or touch it to register the Test Fixture CS-322. After registering, make sure that the Active column has a check mark.

In addition to CS-322 (for 5 kV, 2 kA), Test Fixtures that can be used with the CS-8000 Series will be added in the future depending on the measurement range and purpose.

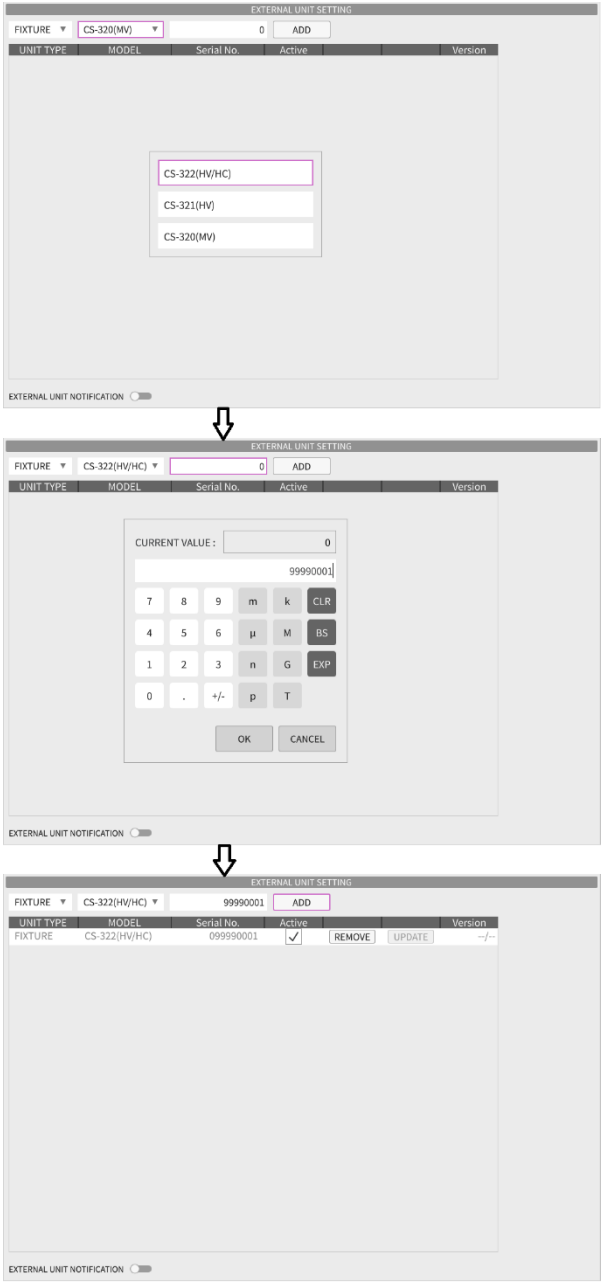


Figure 3.6: Registration of external unit used for measurement

3.3 Screen Layout and Basic Operations

3.3.1 HOME Screen Layout

Figure 3.73.7 shows the HOME screen layout displayed on the LCD screen, and explains the display contents and operations.

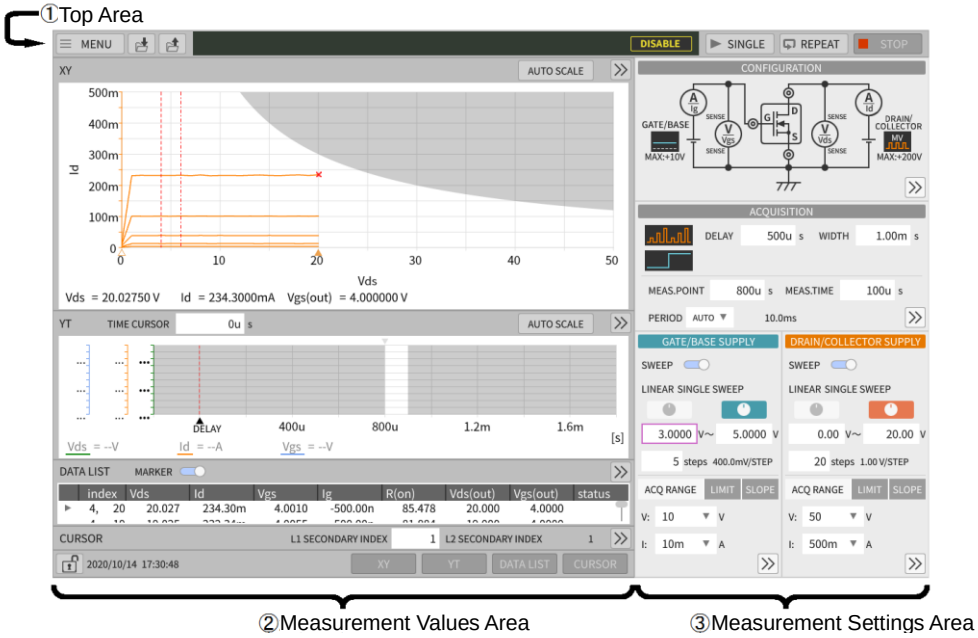


Figure 3.7: HOME Screen Layout

The ① Top Area at the top of the screen has three buttons MENU, , and on the left side, which are always displayed on the screen except when the menu list is displayed. The three buttons correspond to the MENU / HOME key, SAVE key, and RECALL key in the MENU section of the front panel, and operate in almost the same way.

The black band in the center of the top area is for displaying warnings and status. The status is notified by icon display and message display. If you cannot operate this instrument as you intended, see the display in this column and take appropriate action.

Table 3.3: Top area center icon

Icon	Status
	Remote control communication is established. No message is displayed.
	Abnormal conditions such as overheating or overload. It will be displayed until the abnormal condition is resolved.
	It is displayed when you perform an operation such as not being able to execute with a setting outside the setting range, and it is cleared after displaying for a certain period of time.
No Icon	Normal operation messages such as file save completion. Cleared after displaying for a certain period of time.

Safety-related indications are displayed as icons on the right side of this field.

Table 3.4: Icons on the right side of the top area

Icon	Status
INTERLOCK	Interlock state, such as when the Test Fixture cover is open
DISABLE	Output/measurement is not possible because the OUTPUT ENABLE button is not pressed.
ENABLE	The OUTPUT ENABLE button is pressed and output / measurement is possible.

The SINGLE button, REPEAT button, and STOP button on the right side of the top area display the measurement status. You can control the start/stop of measurement by touching the button.

Measurement Stopped
Measure SINGLE
Measure REPEAT

By tapping SINGLE button or pressing the SINGLE button on the front panel, the measurement is performed only once.
By tapping REPEAT button or pressing the REPEAT button on the front panel, the measurement is repeated.
Tap STOP button or press the STOP button on the front panel to stop the measurement.
When you tap SINGLE button or press the SINGLE button on the front panel during REPEAT measurement, the REPEAT measurement will be stopped and the SINGLE measurement will be performed. At this time, HOLD TIME is not applied.
The measurement results are mainly displayed in the ②Measurement Value Area on the left side of the screen (see Section 3.3.4).
The bottom of this area is the FOOTER display, and the lock icon on the left shows the lock/unlock status of the front panel and screen operations. The icon means unlocked and the operation is enabled, and the icon means locked and the operation is disabled.
The date/time/arbitrary comment is displayed in the center of the FOOTER display.
On the right side of the FOOTER display, there is a measurement value display selection button for XY, YT, DATA LIST,and CURSOR. Use these buttons to select the graph or data to be displayed in the measured value display area. When these buttons are selected, the text is white and the background is gray, and when not selected, the text is gray and the background is white. (Example: DATA LIST ⇔ DATA LIST)
When multiple graphs or data are selected in the measured value display area, this area is divided vertically and displayed.
In the ③Measurement Settings Area on the right side of the screen, the measurement method and measurement range setting status are mainly displayed (see Section 3.3.3).
In this area, the CONFIGURATION summary is on the top, the ACQUISITION summary is on the middle, the GATE/BASE SUPPLY summary is on the bottom left, and the DRAIN/COLLECTOR SUPPLY summary screen is on the bottom right. The main settings for each screen are displayed and there is an input field.
This input field can be changed during measurement. When the measurement is started, the HOME screen is displayed.

3.3.2 Basics of Screen Operation

The LCD screen of this instrument has the following operation methods.

① Rotating the knob on the front panel or pressing the button

② Touching the LCD screen

③ Using an external mouse or keyboard connected to the USB connector

In this manual, the operation method using the touch screen is explained. For other operation methods, read as follows.
"Tap" is the action of touching the touch screen with your fingertip or touch pen and immediately releasing it, but with mouse operation it means "pointing the mouse cursor and clicking the left button". In knob operation, it means "turn the FUNCTION knob to select and ENTER (PUSH)".
"Drag" is the action of touching the screen with your fingertip or tap and dragging it as it is, but with mouse operation, it means "pulling the mouse cursor and dragging and moving while clicking the left button". The same operation cannot be performed with the knob operation.
"Flick" is the action of touching the screen with your fingertip or tap and moving it a long distance by flipping the touched part, but with mouse operation, "Hold the mouse cursor and click the left button at a high speed. It means "release the button while moving" or "rotate the scroll wheel" and is used when rolling up/down a list with many choices. With the knob operation, you can roll 10 lines using the COURSE button.
In addition, when you frequently set numerical values or enter characters, you can connect and use a USB English keyboard layout. Please note that symbol characters cannot be entered correctly with the Japanese keyboard layout that is often used in Japan. On the keyboard, the ↑ ↓ (cursor) and TAB keys correspond to the rotation of the FUNCTION knob, the ENTER key corresponds to the pressing of the FUNCTION knob, and the ESC key cancels the setting.
When you tap a button on the screen that has characters or marks written on a gray background enclosed by a frame, the function of the characters or marks will be executed, but depending on the button, the characters will be reversed in black and white, and the function will stop. (For example, the measured value display selection button on the right side of the FOOTER display)
The field enclosed by a frame and marked with a ▼ on a white background is the item selection field, and a pop-up screen is displayed by tapping, and you can select from the settable candidate list by tapping (See Section 3.3.2.1).
The field enclosed by a frame, the numerical value is written on a white background, and the field without the ▼ mark is the numerical value setting field. Tap this to invert black and white and change the value. Use the FUNCTION knob to set a value, or tap it to display the value change input pop-up screen and enter it (See Section 3.3.2.2).
This mark  is a switch, the left position indicates the OFF state, and the right position  indicates the ON state. It changes from ON to OFF and from OFF to ON for each tap.
(Turquoise knob ) indicates that you can increase or decrease the value in the numerical field below with the BASE/GATE knob, and you can increase or decrease it at the same time that it is set in two places. (Orange knob ) indicates that you can increase or decrease the value in the numerical field below with the DRAIN/COLLECTOR knob, and you can increase or decrease it at the same time that it is set in two places. When you tap this knob mark, the display changes to (gray knob ), and the value in the numerical field below cannot be increased or decreased.

3.3.2.1 List Selection Type Pop-up Input

Figure 3.83.8 shows an example of a list selection pop-up.

This pop-up appears when a range or function can be selected, and the tapped candidate is set. When you have a large number of candidates, a scroll bar will appear on the right side of the screen.

Drag the scroll bar with your finger or flick it with touch pen to reveal invisible candidates.

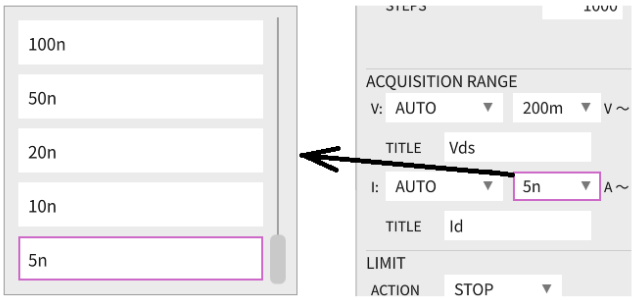


Figure 3.8: Pop-up screen for selectingcandidate list

If you cannot find a better candidate than the currently set candidate, tap anywhere other than this pop-up, press the CANCEL key, or press the Esc key on the USB keyboard to return to the original state without any changes.

3.3.2.2 Numerical Input Pop-up Input

Figure 3.93.9 shows an example of a numeric input type pop-up.

This is a pop-up that appears when setting the voltage, current value, and time. In the top field, the currently set value (CURRENT VALUE:) is displayed, the range of numbers that can be set is displayed in the field below it, and you can enter the value to change in the field below it.

Tap the number button on the screen or press the number key on the ENTRY section of the front panel to enter the number, and then press the SI prefix (m, μ, n, p, k, M, G, T, etc.) button/key, and OK to set.

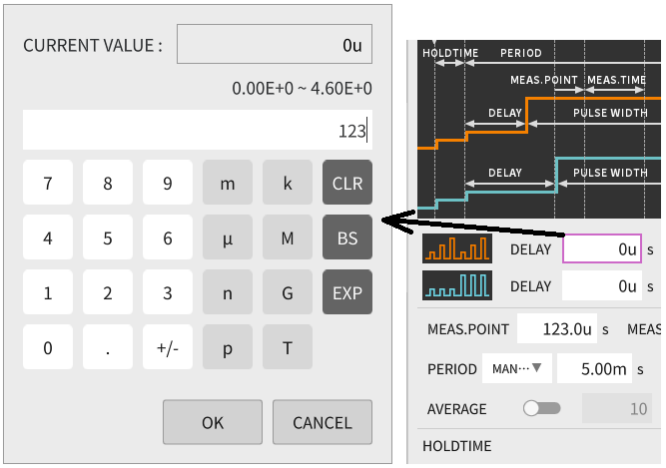


Figure 3.9: Numerical input pop-up screen

From the English keyboard, use the number keys and SI prefix key to enter, and press the ENTER key to set. Of the SI prefixes displayed here, μ (micro) is a character that is not on the keyboard, so u is entered as an alternative character and displayed, and it is written as 123us in this manual.

When inputting in exponential format by any method, enter the mantissa with numbers, decimal points, +/- buttons/keys, then tap the EXP button or press the E key, and then use the +/- button / key and the numbers for the exponential part. Finally, select OK or ENTER key to set.

If the value in the input field is outside the settable value range, the pop-up screen will not close.

If the entered value is within the configurable range, it will be rounded to the configurable resolution value and displayed.

If you make a mistake while entering a numerical value, use the BS button/key to erase the previous character, or the CLR button or CLEAR key to erase all characters on the input line, and enter the correct character.

To cancel the numerical input, press the CANCEL button/key or the Esc key on the USB keyboard to return to the original state without any changes.

3.3.2.3 Input to the String Input Pop-up

Figure 3.103.10 shows an example of a string input type pop-up.

This screen appears when you set the title or file name of the measured value. The currently set value (CURRENT VALUE:) is displayed on the top line, and there is an input/edit field below it.

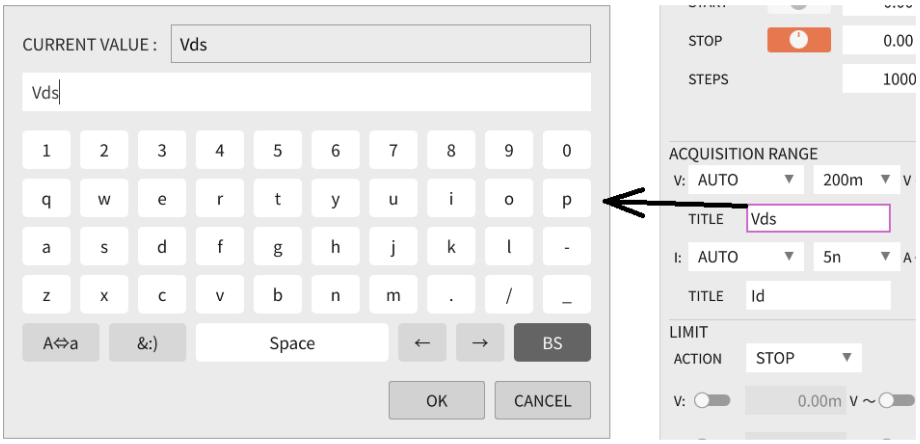


Figure 3.10: Character string input pop-up screen

In the center of the screen, there is a keyboard with white buttons that imitates an alphabetic keyboard, and it is a keyboard layout of numbers and lowercase letters. The A⇔a button at the bottom left of the screen switches between uppercase and symbol keyboard layouts. You can also switch to the keyboard layout of another symbol group with the &:) button.

Of the symbols displayed on the keyboard, the gray button indicates that the character cannot be used for the purpose of input and cannot be input. Enter with the white background button and the edit buttons (←, → and BS), confirm with the OK button or ENTER key to set. Or, tap the CANCEL button to start over.

The length of the character string that can be entered depends on the purpose of the input. If it is too long, the OK character of the button will change to a light-colored character indicating the invalid state and cannot be confirmed, so change it to a shorter expression.

These operations can also be entered from the USB keyboard. Use the Enter key instead of OK button and the Esc key instead of CANCEL button.

3.3.3 Display Contents of Measurement Settings Area

The measurement condition setting area contains the CONFIGURATION summary screen, the ACQUISITION summary screen, the DRAIN/COLLECTOR SUPPLY summary screen, the GATE/BASE SUPPLY summary screen, the SMU summary screen, and the SEMU summary screen.SThe DRAIN/COLLECTOR SUPPLY is displayed in orange, the GATE/BASE SUPPLY is displayed in turquoise, and the SMU is displayed in pink. The applied power supply and waveform display are identified by the same colors in the title bars of each summary screen and on the CONFIGURATION and ACQUISITION screens.

You can open each detailed settings screen and configure detailed settings and perform operations by tapping the » button in the title bar of each of these summary screens (see Section 3.4). At this time, the details screen is displayed in the measurement condition setting area, and the measurement condition related summary screen is displayed by sliding it toward the measurement value display area. To return to the original, tap the × button on the upper left of the details screen. You can also tap the ^ buttons on the title bars to collapse each summary screen. Tap the v buttons to expand.

3.3.3.1 CONFIGURATION Screen

Figure 3.113.11 shows an example of the CONFIGURATION screen.

See Section 3.4.1 for configuration details.

This figure is a circuit diagram showing the types of DUT, applied power supply, voltage and current measuring instruments, and connection methods.

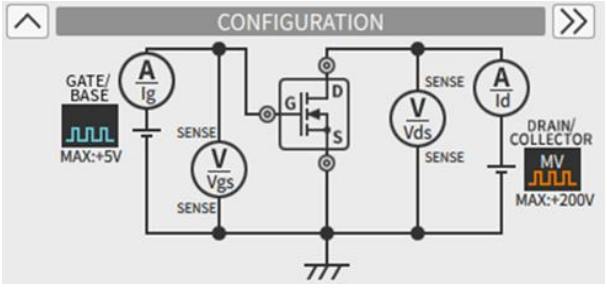


Figure 3.11: CONFIGURATION Screen

The pulse train and battery diagram labeled GATE/BASE on the left shows that GATE/BASE SUPPLY is applied as the voltage source for the pulse.

The FET in the center indicates that the DUT is a FET and will be tested at source ground. Here, the same figure is used for both P-channel FET and N-channel FET. Other devices to be measured include IGBTs, BJTs, and DIODEs, but the same figure is used for BJTs, PNPs, and NPNs.

The pulse train and battery diagram labeled DRAIN/COLLECTOR on the right shows that DRAIN/COLLECTOR SUPPLY is applied as the voltage source for the pulse.

The current flowing through the gate is measured with an ammeter for Ig, and the current flowing through the drain is measured with an ammeter for Id.

It also indicates that the voltage applied to the gate is measured from the SENSE terminal with a voltmeter for Vgs, and the voltage applied to the drain is measured from the SENSE terminal with a voltmeter for Vds.

3.3.3.2 ACQUISITION Screen

Figure 3.123.12 shows an example of the ACQUISITION screen.

See Section 3.4.2 for configuration details.

This screen shows the setting status of the timing of applying GATE / BASE SUPPLY and DRAIN / COLLECTOR SUPPLY to the DUT and the timing of measurement.

Figure 3.12: ACQUISITION Screen

The first line shows the applied power supply as

PRIMARY SWEEP (a parameter that increases
for each point during sweeping) in the color of the waveform. The second line shows the applied power supply as SECONDARY SWEEP (a parameter that does not change during the primary sweep and increases with each secondary sweep) in color. The orange waveform indicates DRAIN / COLLECTOR SUPPLY, and the turquoise waveform indicates GATE / BASE SUPPLY.
The DELAY and WIDTH values (unit: s) that follow these two lines of waveform are displayed in pulse mode. The delay time from the start of the measurement cycle (PERIOD) for each point to the rise of the pulse is displayed in DELAY, and the pulse width is displayed in WIDTH.
When using an optional external unit (SMU), the CONSTANT applied power supply will be displayed on the 3rd line after PRIMARY SWEEP and SECONDARY SWEEP. The SMU will be displayed as a pink waveform.
MEAS.POINT displays the setting for the time from the pulse rising point of whichever of the DRAIN / COLLECTOR SUPPLY or GATE / BASE SUPPLY that has the highest DELAY value until the start of current value and voltage value measurement and aggregation. MEAS.TIME displays the setting for the time to continue carrying out measurement and aggregation.
The PERIOD field is used to select how to determine the measurement cycle for each point. AUTO or MANUAL can be selected. In AUTO mode, in addition to the DELAY and WIDTH for each power supply, the shortest time calculated including the measurement processing time is set and displayed as the measurement cycle. When MANUAL is selected, the cycle setting field appears, and you can freely set the value if it is longer than the shortest time in AUTO and less than 5s.
There are mutual restrictions on the measurement timing settings, and if the settings do not meet the restrictions, an error message will be displayed and measurement cannot be executed.

3.3.3.3 GATE / BASE SUPPLY Screen

Figure 3.13:GATE/BASE SUPPLY Screen

Figure 3.133.13 shows the GATE / BASE SUPPLY screen.See Section 3.4.4 for configuration details.
This screen displays the setting status of the GATE / BASE SUPPLY applied to the gate and base of the DUT.
The SWEEP switch selects whether to measure the GATE / BASE SUPPLY with a constant value or to sweep it.
The SWEEP MODE setting status is displayed.
The figure shows the screen displayed when SWEEP MODE is set to LINEAR SINGLE. The screen displays the sweep range (START - STOP) setting display fields and setting buttons to enable or disable the operation of each knob. In SINGLE SWEEP mode, it sweeps from the START value to the STOP value, but in DOUBLE SWEEP mode, it sweeps from the START value to the STOP value and then back to the START value again.
The number of steps to sweep in this range and the amount of change per step are displayed.
The ACQ RANGE, LIMIT, and SLOPE buttons are tab buttons which select the content to be shown below the tab buttons. When ACQ RANGE is not the currently selected tab, the text on the tab is abbreviated as "ACQ…".
When ACQ RANGE is selected, the setting of the measurement range of source voltage (V:) and the measurement range of source current (I:) is displayed.
When the LIMIT tab is selected, the allowable source voltage (V:), source current (I:), and source power (P:) maximum value and minimum value limit settings are displayed. The allowable range is displayed as "Minimum value limit ~ Maximum value limit". If the minimum and maximum value limits are not set, no values will be

displayed. ACTION displays the action taken when one of the limits is exceeded.
When SLOPE is selected, a numerical setting field indicating the steepness of the rising and falling waveforms of the pulse in DC MODE and PULSE MODE is displayed.
0 is the steepest rise and 100 is the gentlest rise.
When the MODE setting of SUPPLY UNIT is AC or SIN, the LOOPING setting field is displayed.

3.3.3.4 DRAIN / COLLECTOR SUPPLY Screen

Figure 3.14:DRAIN / COLLECTORSUPPLY Screen

Figure 3.143.14 shows the DRAIN / COLLECTOR SUPPLY screen.
See Section 3.4.3 for configuration details.
This screen shows the setting status of DRAIN / COLLECTOR SUPPLY applied to the drain, collector, anode, and cathode of the DUT.
It is almost the same as the GATE / BASE SUPPLY screen.
The figure shows the screen displayed when SWEEP MODE is set to LINEAR SINGLE. As with the GATE/BASE SUPPLY screen, it displays the sweep related settings, measurement range settings, and SLOPE / LOOPING settings.

3.3.3.5 SMU Screen

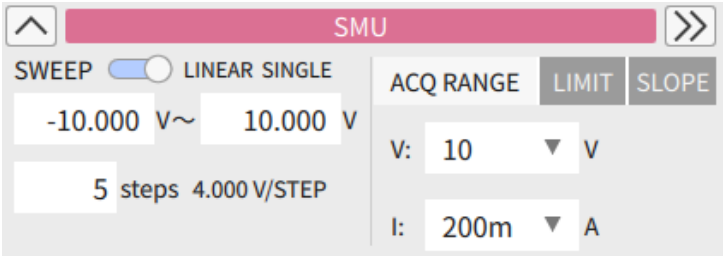


Figure 3.15 SMU Screen

Figure 3.15 shows the SMU settings screen.
See Section 3.4.5 for configuration details.
This screen is displayed when the optional external unit (SMU) is enabled. The setting items are the same as the GATE / BASE SUPPLY screen.
The figure shows the screen when the SMU is assigned to the SWEEP and the SWEEP MODE is set to LINEAR SINGLE.
See Section 3.4.1 for SMU enabled settings, and see Section3.4.2 for SWEEP assignment settings.

3.3.3.6 SEMU Screen

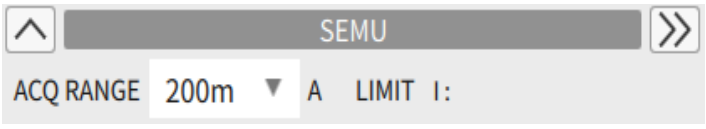


Figure 3.16 SEMU Screen

Figure 3.16 shows the SEMU settings screen.
This screen displays the SENSE EMITTER / SENSE SOURCE current measurement range setting display field. See Section 3.4.6 for configuration details. This screen is displayed when the optional external unit (SEMU) is enabled and when the SEMU is selected for measurement.
See Section 3.4.1 for SEMU enabled settings, and measurement target selection settings.

3.3.4 Measurement Display Area

In the measurement display area, in addition to the FOOTER display section on the bottom line, the XY display section, YT display section, data list display section, and cursor measurement section are displayed, and the display can be turned on/off by tapping the button on the FOOTER section. Since the display area is limited, when multiple graphs or data are selected for display, this area is divided vertically and displayed.

By dragging the border of the displays, you can secure the required area so that each can be seen easily.

By tapping the button on the right end of the title bar of these four displays, you can call up each detailed setting screen and perform detailed settings and operations (see Section 3.4). The details screen is displayed in the measurement setting area. To return to the original, tap the button on the upper left of the details screen.

3.3.4.1 XY Display

Figure 3.173.15 shows the XY display.

See Section 3.4.5 for configuration details.

This example shows the measurement results of a FET with Vds as PRIMARY SWEEP, Vgs as SECOUNDARY SWEEP, X-axis as Vds, and Y-axis as Id.

The XY display area is indicated by XY characters on the left side of the top title bar, and the title character string set arbitrarily can be displayed on the right side.

Tap the AUTO SCALE button on the right side of the top to automatically set and display the X and Y axes for the most readable display.

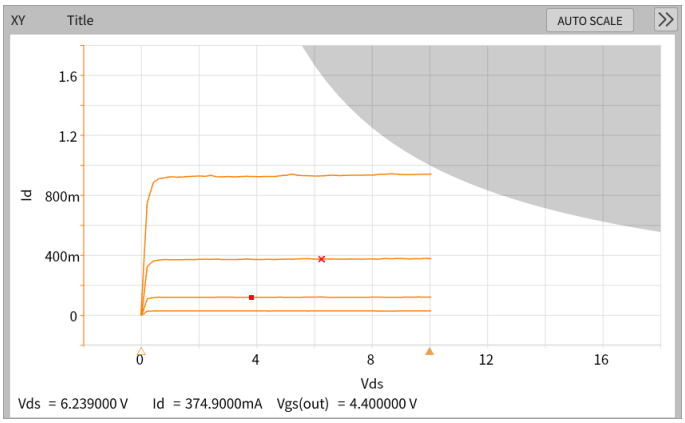


Figure 3.17: XY display

The uppermost title bar displays the status of the measured value (Hi, Lo, Lim, Err); the aggregate result of the contents of the status column in the DATA LIST display is displayed in real time. See Section 3.3.4.3 for details.

undetected	detected	Invalid *	Display Conditions
Hi	Hi	Hi	COMPARISON HIGH is set ON
Lo	Lo	Lo	COMPARISON LOW is set ON
Lim	Lim		LIMIT of either voltage/current/power of DRAIN/COLLECTOR SUPPLY and GATE/BASE SUPPLY is set ON
	Err		When Err detected

* : Invalid if there is no REFERENCE data for COMPARISON.(See Section 3.4.12)

When the MARKER (VISIBLE) switch is set to ON in the data list display section described later, the marker (✕) in the graph will be displayed on the graph in conjunction with the selected line in the data list display section. Also, when MODE is selected as DOT in the cursor measurement section, a red square cursor (■) will be displayed in conjunction with the cursor measurement section as shown in this example. When the cursor MODE is selected as FREE, two horizontal or vertical line cursors are displayed.

The gray areas on the graph indicate areas that exceed the voltage, current, and power LIMIT values. In this example, the gray area in the upper right corner indicates the area where the LIMIT value for

DRAIN/COLLECTORSUPPLY power is exceeded.
The △▲ mark on the X-axis indicates the Vds sweep range, and the value set in DRAIN/COLLECTOR SUPPLY is reflected.

The values displayed for Vds =, Id =, and Vgs (OUT) = in the lower row are the numerical data for the marker (✕).

If an abnormal condition (including LIMIT/COMPARISON ACTION) is detected and measurement is stopped, the cause will be displayed at the bottom right.

3.3.4.2 YT Display

Figure 3.183.16 shows the YT display.
See Section 3.4.8 for configuration details.
This example shows the pulse waveforms of Vds and Vgs applied to the FET
The YT display is indicated by the letters YT on the left side of the top title bar, and the TIME CURSOR display setting field is on the right side. When you tap here to set the time position, the voltage value and current value are displayed in the measured value display line at the bottom left of the screen.

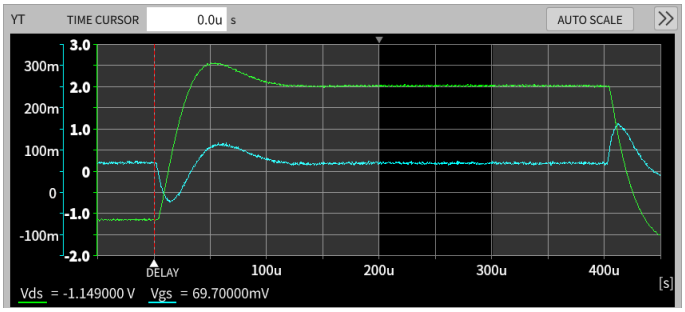


Figure 3.18: YT display

Tap the AUTO SCALE button on the right side of the top to automatically select the display range for the most visible Y-axis.
Up to 4 waveforms of Vds, Id, Vgs, Ig (when the DUT is FET) can be superimposed and displayed.
The time axis of the graph is automatically determined according to the MODE setting of SUPPLY UNIT and ACQUISITION setting, as shown in Table 3.5.

Table 3.5: MODE setting and the time axis range

MODE	Time axis range
PULSE/ PULSE(LONG) *	Display the entire pulse with the shorter source pulse width. 1st div is the rising edge of the pulse (DELAY).
DC	Display the entire MEAS.TIME. 0th div is MEAS.POINT.
AC	Display the entire 1 cycle (20msec).
RECTIFIED SINE	Display the entire 1 cycle (10msec). Intermittent is not included.

*: DRAIN/COLLECTOR SUPPLY or GATE/BASE SUPPLY is set to PULSE/PULSE(LONG)
The part where the background color of the waveform graph has changed (200us to 300us in this case) indicates the section set by MEAS.POINT and MEAS.TIME, and you can confirm that the waveform is set.

3.3.4.3 DATA LIST Display

Figure 3.193.17 shows the DATA LIST display.
See Section 3.4.9 for configuration details.
There is a DATA LIST character on the title bar and a MARKER switch to the right of it. When this is turned on, a marker (✕) is displayed on the XY display screen and linked to the selected line in the DATA LIST. When you tap the button » on the right end, the detailed setting screen of the data list display section is displayed in the measurement setting area.

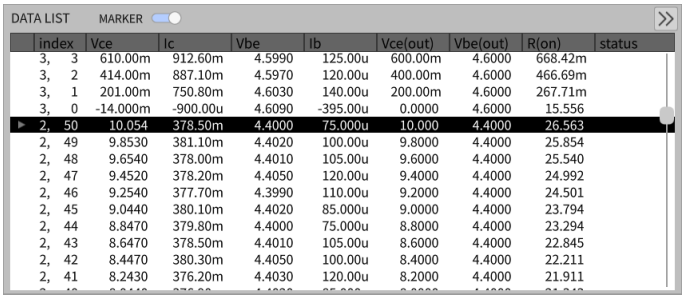


Figure 3.19: DATA LIST display

To select a line in the DATA LIST, flick anywhere in the table, or drag the scroll bar to the left of the table and tap the line.
There is an index column at the top left of each column of the DATA LIST, and the measured values are lined up between it and the status column at the right. The order in which measured values are

displayed can be swapped by dragging the title section.
In the index field, the SECONDARY SWEEP index and the PRIMARY SWEEP index are displayed in this order, separated by [,]. The data in the lower row is the data acquired first.
The status of the measured value is displayed in the status column. Table 3.6 shows the status display and measured value display according to the status of the measured value. The total result of the status of all measured values is displayed in the title bar of the XY display.

Table 3.6: Status and measured value display according to the status of the measured value

Status	Status of the measured value	Display
Err	Any of the measured values are outside the measurement range.	In red
Lim	Any of the measured values exceeds the limit specified for the supply unit.	Underline
Hi	Measured value assigned to the Y-axis are greater than the HIGH setting specified for COMPARISON.	Normal
Lo	Measured value assigned to the Y-axis are less than the LOW setting specified for COMPARISON.	Normal

3.3.4.4 CURSOR Measurement Area

Since the cursor measurement area behaves differently depending on the mode, FREE mode and DOT mode are described separately.
See Section 3.4.10 for configuration details.
Figure 3.203.18 shows the XY display (top) and the FREE mode cursor measurement (bottom).
FREE mode is effective when reading the value from the shape of the captured characteristic curve. If the cursor position and the measurement point do not match, the values are calculated by linear interpolation from the values og two measurement points that straddle the cursor position.
The title bar of the cursor measurement section has a setting display field for L1 SECONDARY INDEX and L2 SECONDARY INDEX, and set the number according to the value of SECONDARY SWEEP you want to pay attention to.

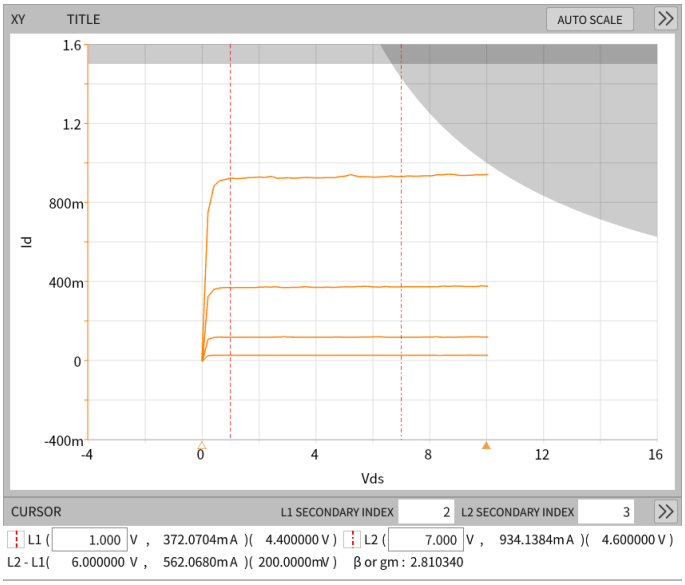


Figure 3.20: FREE mode cursor measurementand XY display

Tap the » button at the right end of the title bar to display the detailed setting screen of the cursor measurement section in the measurement setting area.
The FREE mode cursor is a straight line cursor whose position can be set freely, and there are two cursors, L1 is indicated by a broken line (⋮) and L2 is indicated by a dashed line (⋮). The cursor position is set by dragging the cursor or entering a number to the setting field either in the cursor measurement area or in the detailed setting screen of the cursor measurement section.
Each cursor can be either an X cursor or a Y cursor type. Assuming that the value indicated by SECONDARY INDEX is the Z value (Vgs value in the example in the figure), the X value, Y value, and Z

value (Vgs value) at the intersection of the characteristic curve and the cursor line in the Z value are displayed like L1 (X1, Y1) (Z1) and L2 (X2, Y2) (Z2).

If each cursor is an X cursor, X1 or X2 will be the setting field with a frame, and if it is a Y cursor, Y1 or Y2 will be the setting field with a frame.

The bottom line shows the difference between the values of L2 and L1 as L2-L1 (X2-X1, Y2-Y1) (Z2-Z1).

If the SECONDARY INDEX of L1 and L2 are different, the value of (Y2-Y1) / (X2-X1) is displayed as βor gm. If they are the same, the value of (Y2-Y1)/(X2-X1) is displayed as GRADIENT, the reciprocal of GRADIENT as 1/GRADIENT, and the value of the intersection with the X axis of a line consisting of the intersection of the characteristic curves of L1 and L2 as INTERCEPT.

Figure 3.213.19 shows the XY display and the cursor measurement section (bottom) in DOT mode.

DOT mode is effective when reading the raw data of each measured point or when finding the slope of the tangent of the characteristic curve.

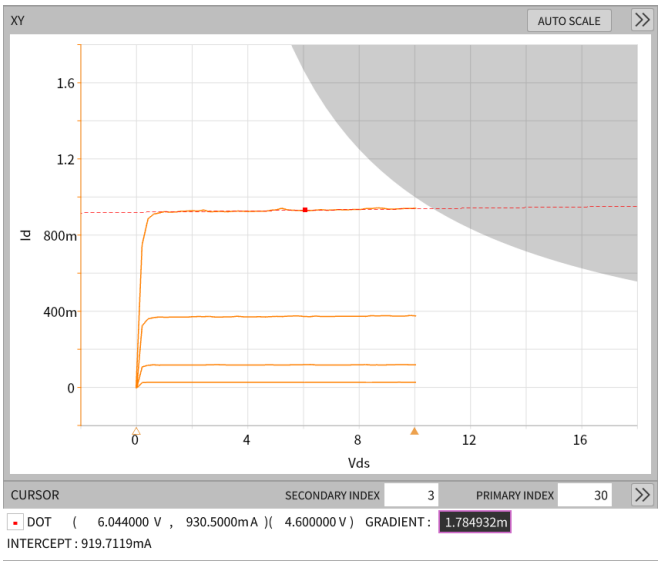


Figure 3.21: DOT mode cursor measurementand XY display

There is a setting display field for SECONDARY INDEX and PRIMARY INDEX in the title bar of the cursor measurement section. When you set the step number according to the Vds value or Vgs value you want to check, the red square cursor (■) moves on the characteristic curve at the position of the value on the XY display, and the X, Y, and Z values of the cursor points is displayed as DOT (X, Y) (Z). Z is the output value of SECONDARY SWEEP specified by SECONDARY INDEX. In the example, it is the value of Vgs. Display (Y)/(Z) values as β or gm.

As shown in the figure, when it is set to display a dashed line on the cursor, the GRADIENT setting column, the 1/GRADIENT value and the INTERCEPT value (the value of the intersection of the dashed line and the X axis) are displayed.

When this GRADIENT: value is adjusted to the slope of the characteristic curve using the FUNCTION knob or by dragging the dashed line, and when XY is displayed as X: Vds-Y: Id, or X: Vce-Y: Ic, the GRADIENT: value indicates the output conductance, the 1/GRADIENT value indicates the resistance, and the INTERCEPT: value indicates the early voltage of the bipolar transistor.

3.3.4.5 FOOTER Area

In the FOOTER section, the date and time are displayed after the lock icon, and any comment can be displayed after this (See section 3.4.18.3).

The lock icon indicates whether the screen or panel keys can be operated. The unlock icon indicates that the operation is possible, and the lock icon indicates that the operation is prohibited. To change the unlock icon to the lock icon, tap the lock icon and tap the OK button on the CONFIRMATION pop-up screen that appears. The locked screen will be the HOME screen, and any key operation other than the OUTPUT ENABLE key in the front panel will be prohibited.

You can also change it to an unlock icon by tapping the lock screen or pressing any panel key. Next, tap [I Agree.] on the displayed UNLOCK FRONT PANEL pop-up screen. Finally, you can change it to the unlock icon by checking it and tapping the OK button.

3.4 Menu Structure and Detailed Settings

When you press the MENU / HOME button in the MENU section of the front panel or tap the MENU button in the TOP area of the screen, the menu list shown in Figure 3.223.20: will be displayed on the left side of the measured value display area. Tap HOME in the menu list to display the HOME screen (measurement value display area and measurement setting area are displayed in the default positions). Tap other menus to display the respective detailed setting screens. Table 3.73.7 shows the operation of each menu item.

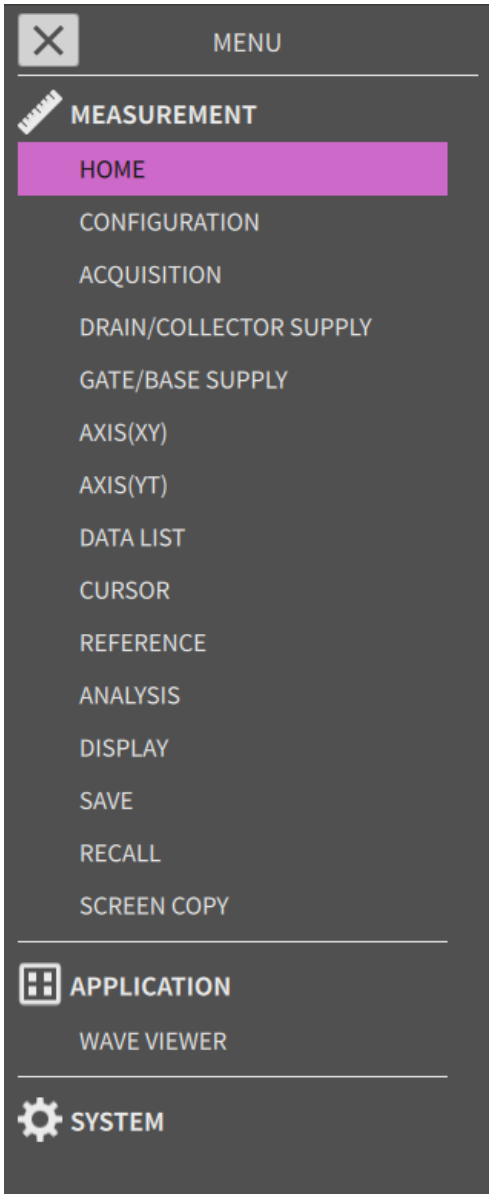


Figure 3.22: Menu list

Table 3.7: MENU list and operation details

Item		Content	Section of reference
MEASUREMENT			
	HOME	Display the HOME screen	
	CONFIGURATION	Set the measurement circuits (CONFIGURATION), output units, etc.	3.4.1
	ACQUISITION	Set the measurement order and timing.	3.4.2
	DRAIN/COLLECTOR SUPPLY	Set the source voltage and current, measurement range, and LIMIT of DRAIN/COLLECTOR SUPPLY.	3.4.3
	GATE/BASE SUPPLY	Set the source voltage and current, measurement range, and LIMIT of GATE/BASE SUPPLY.	3.4.4
	SMU	Set the source voltage and current, measurement range, and LIMIT of SMU. *1	3.4.5
	SEMU	Set the measurement range, and LIMIT of SEMU. *2	3.4.6
	AXIS (XY)	Set the XY graph display method and display sensitivity.	3.4.7
	AXIS (YT)	Set the display selection and display sensitivity of the YT graph.	3.4.8
	DATA LIST	Select the marker display and display data.	3.4.9
	CURSOR	Set the cursor display and position of the XY graph.	3.4.10
	REFERENCE	Set the REFERENCE waveform.	3.4.11
	ANALYSIS	Set the waveform comparisons and other data analysis.	3.4.12
	DISPLAY	Set the display screen selection and display color of the measurement result.	3.4.13
	SAVE	Set the save contents, save format, and save destination of TEMPLATE/WAVEFORM. Display the current settings to be saved	3.4.14
	RECALL	Selection of recall file for TEMPLATE/WAVEFORM. Display settings/waveforms to be recalled.	3.4.15
	SCREEN COPY	Set the screen save format and save destination.	3.4.16
APPLICATION			
	WAVE VIEWER	Display the browsing screen for multiple characteristic curves	3.4.17
SYSTEM		Display the SYSTEM MENU. SYSTEM STATUS EXTERNAL UNIT SETTING SYSTEM TOOLS	3.4.18

*1 :Displayed only when the optional external unit (SMU) is connected.

*2 :Displayed only when the optional external unit (SEMU) is connected.

3.4.1 Detailed Settings in the CONFIGURATION Menu

Figure 3.233.21 shows the CONFIGURATION detailed setting screen. Click the ☒ button on the left end of the title bar labeled CONFIGURATION to switch off this screen.

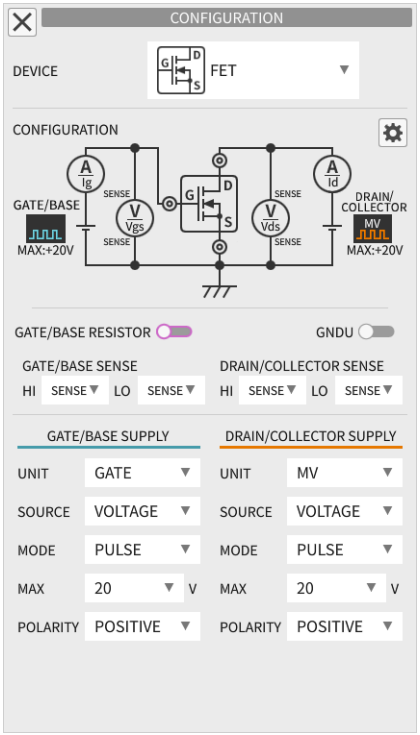


Figure 3.23: CONFIGURATION detailed setting screen

DEVICE

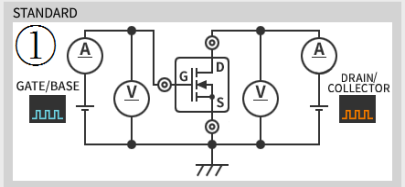
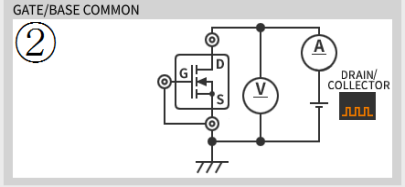
Set the type of DUT to be measured. In the figure, FET is set, but tap it to select from 5 types: FET, IGBT, BJT, DIODE (Forward), and DIODE (Reverse). For special devices, choose the device with the closest behavior from these options. When the DEVICE is changed, the V and I titles set in DRAIN/COLLECTOR SUPPLY, GATE/BASE SUPPLY and SEMU will be the default settings.

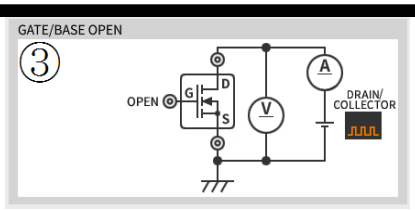
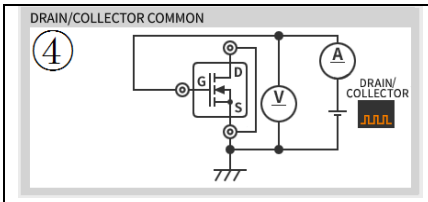
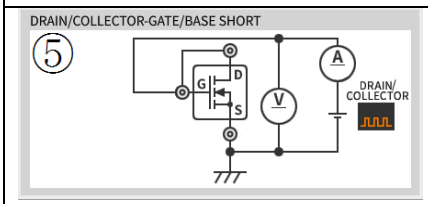
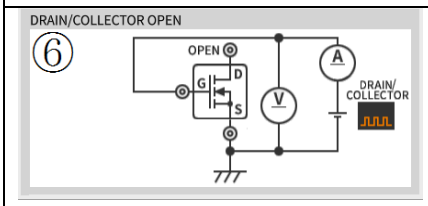
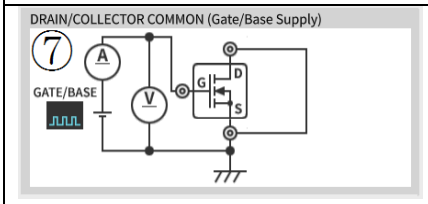
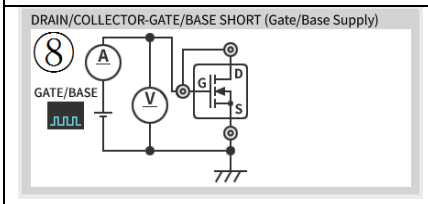
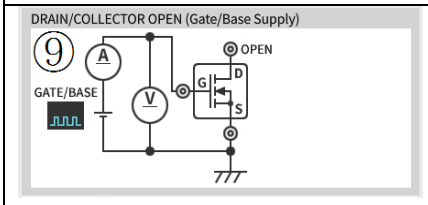
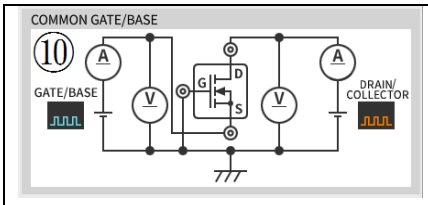
CONFIGURATION

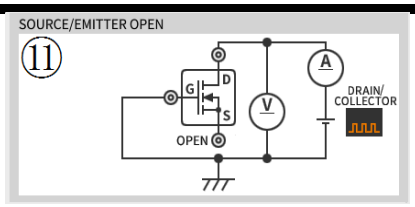
Tap the gear button ✿ on the upper right to bring up the CONFIGURATION SETTING screen and select the measurement circuit.

This setting switches the circuit of the Test Fixture registered as an external unit. It cannot be set if the Test Fixture is not registered or set to Active (see Section 3.2.5). There are 11 types of measurement circuits in 4 categories shown in Table 3.83.8.

Table 3.8: Category and circuit configuration table

CATEGORY **CONFIGURATION**	**Connection destination of each terminal of the DUT** DRAIN / COLLECTOR = D/C GATE / BASE = G/B SOURCE / EMITTER = S/E	**Measurement**
STANDARD TEST	Standard circuit	
	D/C : DRAIN / COLLECTOR SUPPLY G/B : GATE / BASE SUPPLY S/E : COMMON	Characteristic measurement in the active region and saturated region
DRAIN / COLLECTOR TEST	Circuit that connects SUPPLY UNIT only to D/C	
	D/C : DRAIN / COLLECTOR SUPPLY G/B : COMMON S/E : COMMON	Measurement of V_{DSS}, I_{DSS}, etc. under the condition of V_{GS} = 0V

		D/C : DRAIN / COLLECTOR SUPPLY G/B : OPEN S/E : COMMON	Measurement of V_{CEO} etc. under the condition of I_B = 0A
GATE / BASE TEST		Circuit that connects SUPPLY UNIT only to G/B	
		D/C : COMMON G/B : DRAIN / COLLECTOR SUPPLY S/E : COMMON	Measurement of I_{GSS}, V_{GSS}, etc. at V_{DS} = 0V
		D/C : DRAIN / COLLECTOR SUPPLY G/B : DRAIN / COLLECTOR SUPPLY S/E : COMMON	Measurement under the condition of V_{DG} = 0V
		D/C : OPEN G/B : DRAIN / COLLECTOR SUPPLY S/E : COMMON	Measurement of I_{EBO}, V_{EBO}, etc. at I_C = 0A
		D/C : COMMON G/B : GATE / BASE SUPPLY S/E : COMMON	Measurement of I_{GSS}, V_{GSS}, etc. at V_{DS} = 0V
		D/C : GATE / BASE SUPPLY G/B : GATE / BASE SUPPLY S/E : COMMON	Measurement under the condition of V_{DG} = 0V
		D/C : OPEN G/B : GATE / BASE SUPPLY S/E : COMMON	Measurement of I_{EBO}, V_{EBO}, etc. at I_C = 0A
COMMON GATE / BASE TEST		Circuit to ground G/B	
		D/C : DRAIN / COLLECTOR SUPPLY G/B : COMMON S/E : GATE / BASE SUPPLY	Measurement of I_{CBO}, V_{CBO}, etc. at I_E = 0A

		D/C : DRAIN / COLLECTOR SUPPLY G/B : COMMON S/E : OPEN	Measurement of I_{CBO}, V_{CBO}, etc. at I_E = 0A

From these 11 types of circuits, select the circuit suitable for measurement and set it with the OK button.
Depending on the CONFIGURATION setting, the applicable power supply that can be set is limited. If the source power supply cannot be selected, it is automatically set to the source power supply that can be selected when CONFIGURATION is set. If the CONFIGURATION setting is changed, the V and I titles set in DRAIN / COLLECTOR SUPPLY, GATE / BASE SUPPLY and SEMU will become the default settings.

GATE / BASE RESISTOR

This switch should be turned on when inserting the resistor of the GATE/BASE RESISTOR pin on the front panel of the Test Fixture into the circuit.
This cannot be set if no Test Fixture is registered or if there is no Test Fixture set to Active.

GNDU

A switch that controls the function of the ground unit. When turned on, the circuit (Figure 3.243.22) that compensates for the fluctuation of the ground potential due to the voltage drop caused by the test current and wiring resistance operates, and the ground potential of the DUT is set to 0V.

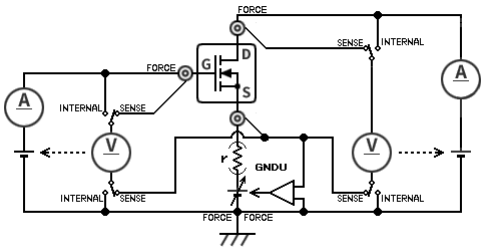


Figure 3.24: Switching the GNDU compensation circuit and measurement voltage detection point

GATE / BASE SENSE, DRAIN / COLLECTOR SENSE

When SENSE is set for each HI and LO switch, the potential of the DUT detected by the Kelvin connection in the Test Fixture is used as the measurement voltage. When set to INTERNAL, the potential of the FORCE terminal is used as the measurement voltage (Figure 3.24). For the Kelvin connection with the DUT, it is recommended to measure with SENSE as much as possible.

LEAKAGE

When DRAIN/COLLECTOR SUPPLY is set to HV and SOURCE is set to VOLTAGE, you can switch DRAIN/COLLECTOR current measurement to SOURCE/EMITTER current measurement. When the LEAKAGE switch is turned on, SOURCE/EMITTER current measurement is performed. LEAKAGE mode allows low current measurement.

ACQUISITION CH SELECT

Tap the ACQUISITION CH SELECT gear ⚙ button to display the measurement target selection screen. For details on the settings, refer to the explanation of the ACQUISITION CH SELECT screen in <SENSE SELECTOR settings> below.

GATE / BASE SUPPLY

GATE and GATE-SIN can be selected. When you select GATE, you can select DC, PULSE or PULSE (LONG) in the MODE field, and GATE-SIN is limited to AC.

When the MODE field is DC, DC is applied, and when PULSE or PULSE (LONG), a pulse is applied only during measurement. AC applies a sine wave. With PULSE (LONG), long-time pulses can be applied, but the current value is limited. With PULSE, the maximum current can be applied, although the time width is limited.

In the SOURCE field, set VOLTAGE when applying as a voltage source and CURRENT when applying as a current source. On the circuit diagram, the VOLTAGE power supply is represented by the battery symbol (⏚), AC is represented by the AC voltage source symbol (⏚), and the CURRENT power supply is represented by the current source symbol (⏚).

The result of the setting is displayed as  (DC),  (PULSE),  (AC) waveform next to each power supply.

The MAX field sets the maximum voltage or current that can be applied. When MODE is set to AC and MAX is set to 1V, a sine wave with a peak voltage of ± 1V can be applied.

The output polarity is set in the POLARITY field. There are POSITIVE, NEGATIVE, and BIPOLAR options when the GATE is selected. For GATE-SIN, it is limited to BIPOLAR only.

DRAIN / COLLECTOR SUPPLY

MV, MV-SIN, HV can be selected. When you connect an optional device to this instrument, you will have more choices. When you select MV, you can select DC, PULSE or PULSE (LONG) in the MODE field. When you select HV, you can select DC or PULSE in the MODE field. RECTIFIED SINE, AC can be selected for MV-SIN. In MV, PULSE (LONG) can apply a pulse with a long time width, but the current value is limited. PULSE allows the maximum current to be applied, although the time width is limited.

In the SOURCE field, set VOLTAGE when applying as a voltage source or CURRENT when applying as a current source. The VOLTAGE power supply is represented by the battery symbol (⏚) for DC, PULSE, PULSE (LONG) on the schematic, the AC voltage source symbol (⏚) for AC, and the current source symbol (⏚) for CURRENT power supply.

The result of the setting is displayed as  (DC), (PULSE),  (AC),  (RECTIFIED SINE) waveforms next to each power supply.

The MAX field sets the maximum voltage or current that can be applied.

The output polarity is set in the POLARITY field. There are POSITIVE, NEGATIVE, and BIPOLAR options, however the options may be restricted based on other settings.

When HC (external optional unit) is selected for the UNIT, and CURRENT is selected for the SOURCE, the CHARGE field will be displayed and the maximum charge voltage can be set. In addition, if VOLTAGE is selected for the SOURCE, the CONST-V SEARCH switch will be displayed and the voltage search mode can be set. In voltage search mode measurement, PRIMARY SWEEP is locked to DRAIN / COLLECTOR SUPPLY, and DRAIN / COLLECTOR SUPPLY SWEEP MODE is locked to CONST-V SEARCH. The voltage output is SWEEPed and measured so that the DRAIN / COLLECTOR SUPPLY voltage measurement value matches the TARGET value.

OPTION UNIT Settings

If an optional external unit (SEMU/SMU, etc.) is connected, the OPTION UNIT settings will be displayed.

<SMU Settings>

The SMU is enabled and disabled using the corresponding switch. If enabled, the SMU will be displayed in the CONFIGURATION diagram as shown in Figure 3.25.

The SMU cannot be used during CV measurement.

See Section 3.4.2 for SMU SWEEP assignment settings.

See Section 3.4.5 for SMU voltage / current measurement detailed settings.

Tap the gear ✿ button to display the SMU settings screen.

The SMU voltage measurement detection points can be set to either SENSE or INTERNAL in the HI SENSE field and LO SENSE field.

The output voltage reference potential is set in the LO FORCE field. The INTERNAL GND is based on the system GND potential, and EXTERNAL GND is based on the LO FORCE terminal potential.

The VOLTAGE (voltage source) and CURRENT (current source) are set in the SOURCE field.

The maximu voltage or current that can be applied is set in the MAX field.

The output polarity is set in the POLARITY field. There are POSITIVE, NEGATIVE, and BIPOLAR options, however the options may be restricted based on other settings.

<SEMU Settings>

The SEMU is enabled and disabled using the corresponding switch. If enabled, the configuration diagram device will display 4 terminals and the SENSE EMITTER / SENSE SOURCE terminal connections will be displayed as shown in Figure 3.272877.

The SEMU cannot be used during CV measurement.

See Section 3.4.6 for SEMU current measurement detailed settings.

Tap the gear ✿ button to display the SEMU settings screen.

(Figure 3.282788)

This screen is used to set the SENSE and FORCE for the EMITTER / SOURCE terminal and SENSE EMITTER / SENSE SOURCE terminal to SHORT or OPEN. It is set to SHORT if the switch is ON, and OPEN if the switch is OFF.

When the SENSE EMITTER / SENSE SOURCE current measurement is enabled, the SHORT / OPEN settings will be restricted as follows.

・The SENSE EMITTER / SENSE SOURCE terminal FORCE will be locked to the SHORT setting

・The EMITTER / SOURCE terminal SENSE and SENSE EMITTER / SENSE SOURCE terminal SENSE will both be unable to be set to SHORT

Current measurement can be enabled and disabled on the ACQUISITION CH SELECT screen.

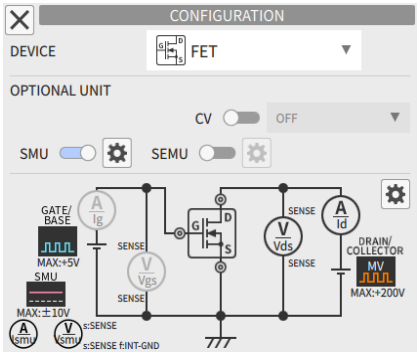


Figure 3.25: CONFIGURATION detailed settings screen (OPTIONAL UNIT:SMU)

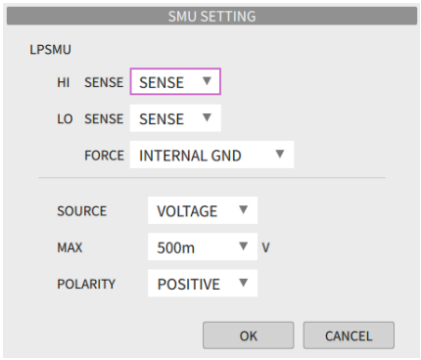


Figure 3.26 SMU setting screen

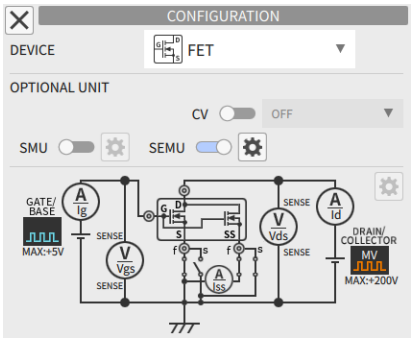


Figure 3.27: CONFIGURATION detailed setting screen (OPTIONAL UNIT:SEMU)

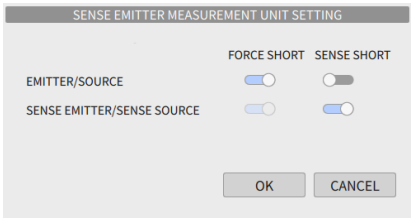


Figure 3.28 SEMU setting screen

<SENSE SELECTOR settings>

If a SENSE SELECTOR unit is used, 5 measurement targets can be selected for voltage measurement / current measurement for internal units (DRAIN / COLLECTOR SUPPLY, GATE / BASE SUPPLY) and external units (HC, SMU, SEMU, etc.).

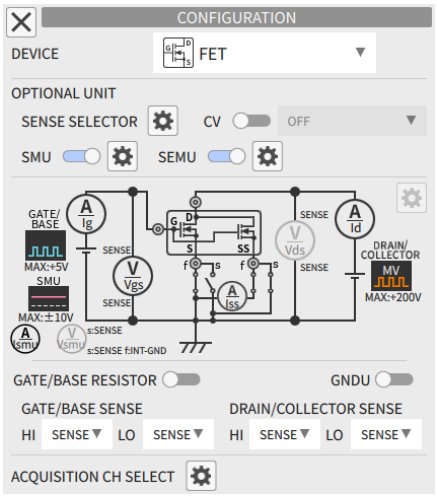


Figure 3.29 CONFIGURATION detailed setting screen
(OPTIONAL UNIT:SENSE SELECTOR)

Tap the gear ✿ button to display the SENSE SELECTOR unit settings screen. (Figure 3.30)

The units connected to each SENSE SELECTOR unit INPUT terminal are set in INPUT1 through INPUT4.

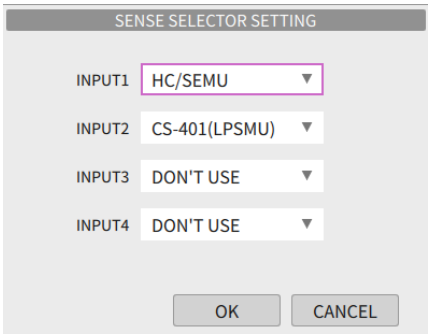


Figure 3.30 SENSE SELECTOR setting screen

Tap the ACQUISITION CH SELECT gear ✿ button to display the measurement target selection screen. (Figure 3.31)

The items which can be selected from those below will be displayed with the same name set in the ACQUISITION RANGE TITLE. A maximum of 5 items can be selected.

DRAIN / COLLECTOR SUPPLY voltage measurement / current measurement

GATE / BASE SUPPLY voltage measurement / current measurement

SMU voltage measurement / current measurement

SEMU current measurement

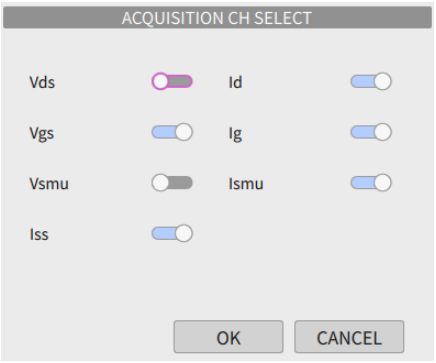


Figure 3.31 measurement target selection screen

When using a SENSE SELECTOR, the items which can be selected will vary depending on the SENSE SELECTOR unit INPUT 1 to 4 settings.

If a SENSE SELECTOR is not used, only GATE / BASE SUPPLY or SMU will be selectable for both voltage measurement and current measurement.

The value of the current measurement has been corrected for the impact of the measurement system using the voltage measurement value. The product specifications are the value when the voltage measurement value can be obtained normally.

3.4.2 Detailed Settings in the ACQUISITION Menu

Figure 3.323.23 shows the detailed setting screen.
Click the ☒ button on the left end of the title bar labeled ACQUISITION to switch off this screen.

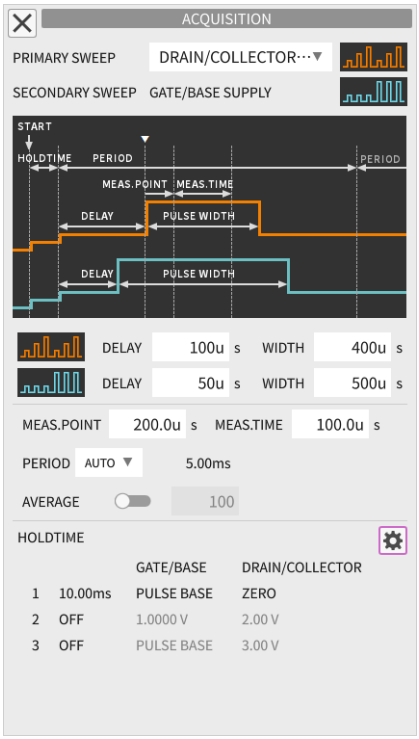


Figure 3.32: ACQUISITION detailed setting screen

PRIMARY SWEEP

Set the measurement order when a circuit configuration that uses multiple from DRAIN / COLLECTOR SUPPLY, GATE / BASE SUPPLY and SMU power supplies is selected in the CONFIGURATION settings. Select the power supply to sweep the SUPPLY power supply value first.
For the Vds-Id characteristics of FETs and the Vce-Ic characteristics of BJTs, it is common to select DRAIN / COLLECTOR SUPPLY.
The figure shows a circuit configuration using 2 power supplies; DRAIN / COLLECTOR SUPPLY and GATE / BASE SUPPLY, and DRAIN / COLLECTOR SUPPLY is selected for PRIMARY SWEEP. The GATE / BASE SUPPLY not selected for PRIMARY SWEEP will be used for SECONDARY SWEEP..When GATE / BASE SUPPLY is selected for PRIMARY SWEEP, DRAIN / COLLECTOR SUPPLY is automatically used for SECONDARY SWEEP.

SECONDARY SWEEP

When using an optional external unit (SMU), PRIMARY SWEEP and SECONDARY SWEEP can be selected from a total of 3 power supply systems consisting of the SMU in addition to DRAIN / COLLECTOR SUPPLY and GATE / BASE SUPPLY. The unselected power supply will be used for CONSTANT.

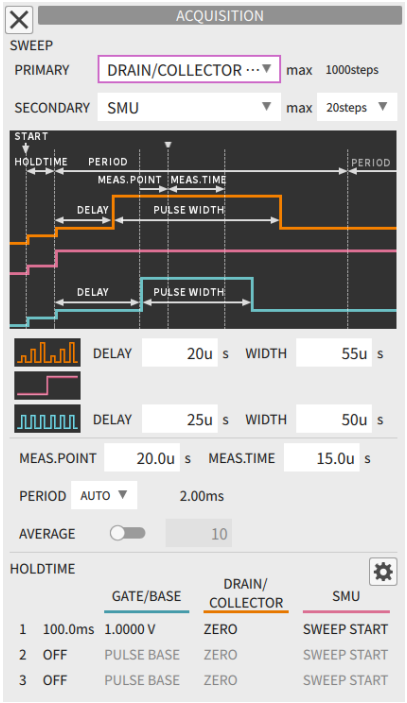


Figure 3.33 ACQUISITION detailed settings screen (OPTIONAL UNIT:SMU)

SECONDARY SWEEP maximum number of steps setting

The maximum number of steps which can be set for the number of SWEEP steps is set in the Max field. The maximum number of steps for PRIMARY SWEEP will be set as shown in Table 3.9 according to the maximum number of steps for SECONDARY SWEEP.

Table 3.9 SECONDARY SWEEP and PRIMARY SWEEP maximum number of steps

SECONDARY SWEEP maximum number of steps	PRIMARY SWEEP maximum number of steps
5	4000
10	2000
20	1000

In CONST-V SEARCH mode, SECONDARY SWEEP can be set to a maximum of 1,000 steps.
Regardless of the value set here, if the SECONDARY SWEEP SWEEP MODE is set to NONE (1-POINT), the PRIMARY SWEEP can be set to a maximum of 20,000 steps.

Synchronization setting of PRIMARY SWEEP and SECONDARY SWEEP

When the SYNC WITH PRIMARY switch is turned ON, the SWEEP settings (SWEEP MODE, SWEEP range (START to STOP), and number of steps) of the SECONDARY SWEEP are synchronized with the settings of the PRIMARY SWEEP. However, the output is limited according to the MAX and POLARITY settings in the SUPPLY settings in the CONFIGURATION menu.

SYNC WITH PRIMARY cannot be set under the following conditions:

- The SOURCE settings of the power supply units set for PRIMARY SWEEP and SECONDARY SWEEP do not match.
- CONST-V SEARCH mode

Timing Chart

The figure shows the waveform timing of DRAIN / COLLECTOR SUPPLY, GATE / BASE SUPPLY and SMU from the start of measurement to the end of the first cycle (PERIOD) when DRAIN/COLLECTOR SUPPLY and GATE/BASE SUPPLY power supplies are in pulse mode. From the top, PRIMARY SWEEP. SECONDARY SWEEP, and CONSTANT (constant output) are displayed in that order.
START on the chart is the start of measurement, and then the measurement of the first cycle starts after the HOLD TIME elapses. During the HOLD TIME period, both SUPPLY power supplies apply voltage and current for the HOLD TIME 1 to 3 hours set at the bottom of the screen.

DELAY (pulse delay time) and WIDTH (pulse width)

Waveform icons are displayed in the order of PRIMARY SWEEP, SECONDARY SWEEP, and CONSTANT from the top. When the SUPPLY power supply is in pulse mode, you can set the DELAY and WIDTH settings. You can set the pulse output delay time and pulse width from the start of one cycle (PERIOD) for each SUPPLY power supply. However, there is a restriction between the two pulses that "the pulse that rises first must maintain the pulse until the fall point of the pulse that rises later". If this constraint is not met, the message "Pulses not nested" will be displayed.

MEAS.POINT (measurement point) and MEAS.TIME (measurement time)

MEAS.POINT sets the starting point for measurement value collection. In PULSE mode, it is set by the elapsed time from the rising point of the pulse that rises later. In DC mode, set the elapsed time from the start of one cycle (PERIOD).
MEAS.TIME sets the time from the start point of measurement value collection to the end of collection. The pulse must be maintained until the end of measurement collection. If this constraint is not met, the [Meas.Point, Time] message will be displayed.
The measured value for one cycle is the average value between MEAS.POINT and MEAS.TIME.

PERIOD

When PERIOD is AUTO, the shortest one cycle time that can be measured with the current setting is automatically set. For MANUAL, you can set any time (up to 5s) that is larger than the AUTO cycle.

AVERAGE

When the AVERAGE switch is turned ON, the average number of times (2 to 100) can be set in the field on the right, and the measurement for one cycle (PERIOD) is repeated a specified number of times, and the result of the average processing is used as the value of this measurement point.

HOLD TIME

By setting HOLD TIME, voltage and current can be applied to the DUT in three stages before the sweep operation starts. HOLD TIME only applies at the start of measurement.

Tap the gear button (⚙) on the far right to display the HOLD TIME SETTING screen. Set the HOLD TIME 1 to 3 switches and time, GATE/BASE SUPPLY, DRAIN/COLLECTOR SUPPLY and SMU at any timing and with the source voltage and current values. The source type is limited by the waveform mode as shown in the table below.

Table 3.10: HOLD TIME Settings

SUPPLY UNIT	HOLD TIME Source Type	Description	Waveform Mode
DRAIN / COLLECTOR	ZERO	0A or 0V	PULSE
	SWEEP START	SWEEP START value	DC
	MANUAL	Arbitrary setting output	PULSE / DC
GATE / BASE	PULSE BASE	PULSE BASE value set in GATE / BASE SUPPLY	PULSE
	SWEEP START	SWEEP START value	DC
	MANUAL	Arbitrary setting output	PULSE / DC
SMU *	SWEEP START	SWEEP START value	--
	MANUAL	Arbitrary setting output	--

* : Valid only when using the optional external unit (SMU)

Tap OK on the HOLD TIME SETTING screen to reflect the previous settings on the ACQUISITION advanced detailed settings screen.

Figure 3.343.24 shows an example of the ACQUISITION detailed setting screen in the rectified waveform mode.

The timing chart (waveform diagram) shows one-sided sine wave waveforms, but you can insert a sine wave sequence by setting the INTERMITTENT field at the bottom.

When the value of the INTERMITTENT field is 0, it becomes a full-wave rectified waveform without gaps, and when it is 1, it becomes a half-wave rectified waveform, and the number of gaps can be set up to 49.

Since the time length of one side waveform of a sine wave is 10 ms, the time of (INTERMITTENT value + 1) x 10 ms is PERIOD (measurement cycle).

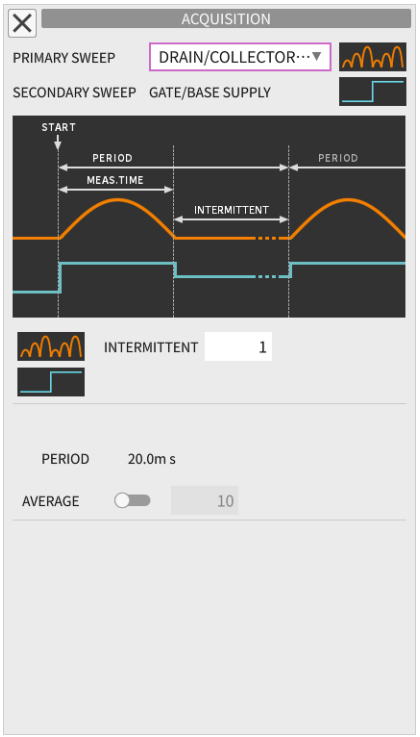


Figure 3.34: ACQUISITION detailed setting screen (rectified waveform mode)

Measurement timing constraints

There are some restrictions on the measurement timing settings (DELAY, WIDTH, MEAS.POINT, MEAS.TIME, PERIOD), and if the settings do not meet the restrictions, an error message will be displayed and measurement will not be possible. The table below describes the error messages and the contents of the restrictions.

Table 3.11: Error Messages

Error Message	DRAIN / COLLECTOR Waveform Mode	GATE / BASE Waveform Mode	Restrictions
Pulses not nested	PULSE	PULSE	The pulse that rises first must maintain the pulse until the fall point of the pulse that rises later.
Meas.Point, Time	DC/NON	DC/NON	MEAS.POINT+MEAS.TIME < 5.0 s
	Either is PULSE		(MEAS.POINT+MEAS.TIME) < (Pulse width of the pulse that rises later)
Delay, Pulse Width	Either is PULSE		(DELAY + WIDTH) of the pulse that falls later < =4.6 s
Shorter Width > 1.6 s	Either is PULSE		(WIDTH of the pulse that rises later) < =1.6 s
Pulse Width / Period	Either is PULSE		Pulse duty ratio is within the specified range
Period < xx s	-	-	PERIOD >= (Minimum period calculated from the current setting (xx s))

3.4.3 Detailed Settings in the DRAIN / COLLECTOR SUPPLY Menu

Figure 3.353.25 shows the DRAIN / COLLECTOR SUPPLY detailed setting screen.
Click the ☒ button on the left end of the title bar labeled DRAIN/COLLECTOR SUPPLY to switch off this screen.

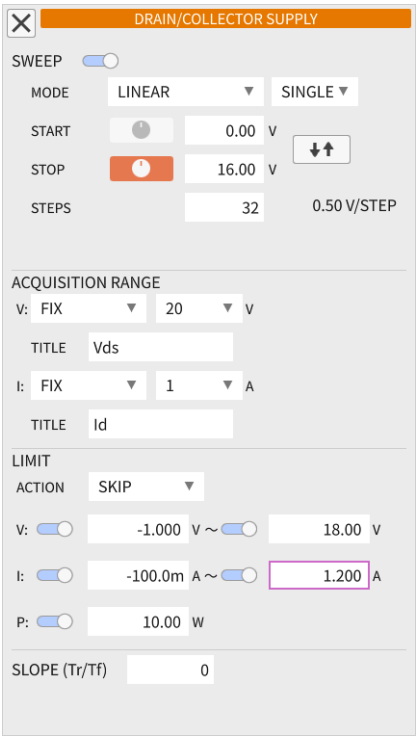


Figure 3.35: DRAIN/COLLECTOR SUPPLY detailed setting screen

SWEEP

The SWEEP switch selects whether to measure DRAIN / COLLECTOR SUPPLY with a constant value or to sweep it.
In this figure, the SWEEP switch is ON, and the sweep step interval is selected as LINEAR (equal interval), LOG (geometric interval) or LIST(value list) in the left field, SINGLE (one-way sweep) or DOUBLE (reciprocal sweep) in the right field of the MODE.
Set the sweep range in the START and STOP fields. The START and STOP knob icons switch between white and orange each time you tap them, and if they are orange, you can also increase or decrease the value with the DRAIN / COLLECTOR knob on the front panel.
By tapping the [↓ ↑] button on the right side of the START and STOP fields, you can switch the START and STOP values with each other.
In the STEPS field, set the number of steps from the START value to the STOP value. For LINEAR sweeps, the amount of change per step is displayed after this field.
When the SWEEP switch is OFF, NON (1-POINT) is displayed in the MODE field, and the value to be applied is set in the STOP field below it.

When SWEEP MODE is set to LIST, the output of the supply unit is changed according to the desired output value list. At this time, the sweep setting screen changes to the output value list editing screen shown at right. Tap [PREPEND]/[APPEND] at the top/bottom of the list to add a line to the top/end of the list.
If a value is set outside the output range determined by the MAX and POLARITY settings, it is displayed in red on the list. No input restrictions are applied. Values outside the output range are rounded to within the range when measuring.
If the list length exceeds the maximum length, the excess is not used in the measurement. The maximum length of the list is 1000 in PRIMARY SWEEP and 20 in SECONDARY SWEEP.
The actions of each button to edit the list are shown in the table below.

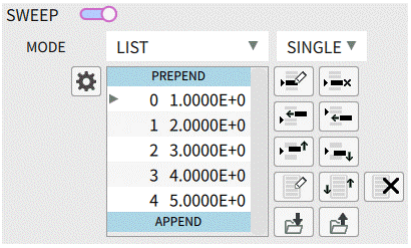


Figure 3.36: Output value list editing screen

Table 3.12 Buttons for editing the value list

BUTTON	ACTION	BUTTON	ACTION
	Change the selected value.		Delete the selected value.
	Insert new value above selected row.		Insert new value below selected row.
	Move the selected value forward one row.		Move the selected value back one row.
	Open the value list in a text editor. *		Reverses the order of values in the list up or down.
	Delete all values and empty the list.		Export the value list to a file.
	Import from text file to value list. *		Shows the edit dialog for the value list.

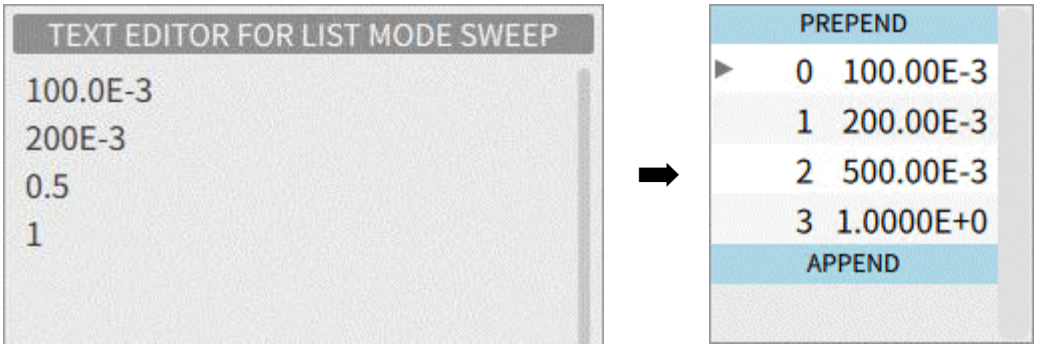
*: About the text format of the output value list:

A) Describe output values in one line per value.

B) Each output value should be described in exponential format (ex. “1.23E-3”).
The exponent part can be omitted if unnecessary (ex. “0.00123”).
Descriptions with added units are not supported (ex. “1.23mV”).

C) When importing a file created with a text editor on a PC, the file extension should be ".LST".

Example of Value List Description: Case of outputting in order of 100mV, 200mV, 500mV, 1.0V.



When HC is selected for the DRAIN / COLLECTOR SUPPLY UNIT in the CONFIGURATION settings, and CONST-V SEARCH is set to ON, the SWEEP MODE will be CONST-V SEARCH.
In CONST-V SEARCH, the voltage output is SWEEPed and measured so that the DRAIN / COLLECTOR SUPPLY voltage measurement value matches the set TARGET value. If the TARGET TYPE is set to MANUAL, the value set in VALUE will be the TARGET value, and when SECONDARY OUTPUT is set, the SECONDARY SWEEP output setting value will be the TARGET value.
The SECONDARY OUTPUT options will be displayed as the "voltage measurement value title (out)" for the power supply set for SECONDARY SWEEP.

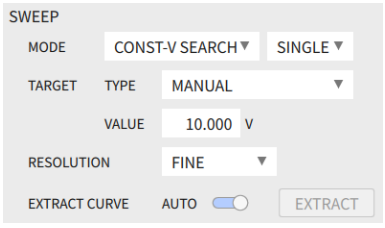


Figure 3.37: CONST-V SEARCH setting

The search resolution can be set to FINE or COARSE under RESOLUTION. The COARSE setting provides coarser resolution but shorter search times.
EXTRACT CURVE configures waveform extraction settings. Waveform extraction extracts TARGET value data from the DRAIN / COLLECTOR SUPPLY waveform data for each SECONDARY output and creates and displays a waveform consisting of the extracted data.
The extracted data is calculated from two points that cross the TARGET value according to the SEARCH MODE setting.

SEARCH MODE	The extracted data
INTERPOLATE	Calculated value of linear interpolation between two points.
NEAREST	Data closer to the TARGET value.
UPPER	Data larger than TARGET value.
LOWER	Data smaller than ARGET value.

When the AUTO switch is ON, the waveform will be extracted after measurement is complete, when the switch is OFF extraction will not be carried out and the data will remain as a TARGET value search SWEEP waveform. Clicking the EXTRACT button will extract the waveform. Exercise caution as the data cannot be restored to its original format once extraction is run.
The GATE / BASE SUPPLY SWEEP number of steps can be set to a maximum of 1,000 steps in CONST-V SEARCH. A longer amount of time may be required to start measurement depending on the number of GATE / BASE SUPPLY SWEEP steps.

ACQUISITION RANGE

Set the measurement range and the name of the measured value of the voltage(V) and current(I) actually applied from DRAIN / COLLECTOR SUPPLY. The measurement range settings will be displayed when the voltage and current are each set in the measurement target.
The name of the measurement voltage / current is set in the TITLE field using a text string of 32 characters or less. The name set here is used in the CONFIGURATION diagram and measurement value display area tables and graphs.
The measurement range setting method can be selected from AUTO (automatic setting), FIX (fixed range), and SYSTEM (linked with output values). However some options may not be available depending on the CONFIGURATION settings.
In the AUTO setting, the measurement range is increased or decreased in 1-2-5 steps to search for the optimum measurement range. At this time, two fields for setting and displaying the range to be searched for the measurement range are provided on the right side of the field, and the optimum measurement range is searched between the two fields.
In the FIX setting, a field for setting and displaying the measurement range is provided to the right of the field, and measurement is always performed in the same measurement range.
In the SYSTEM setting, the measurement is performed in the measurement range linked to the MAX setting of DRAIN / COLLECTOR SUPPLY. In the LOG SWEEP setting, measurement is performed within the measurement range according to the output value.

LIMIT

Set the operation to protect the device when the voltage, current, or power applied to the DUT exceeds the maximum rated value. The voltage / current LIMIT settings will be displayed when the voltage and current are each set in the measurement target. The power LIMIT setting will be displayed when the voltage and current are both set in the measurement target.

In the ACTION field, select SKIP and STOP. In SKIP, when the LIMIT condition is exceeded, the continuation of PRIMARY SWEEP is not measured and SECONDARY SWEEP is advanced by one step to continue measurement from the beginning of PRIMARY SWEEP. STOP stops both PRIMARY SWEEP and SECONDARY SWEEP.

The V: row and I: row have a lower limit switch and an upper limit switch in the LIMIT condition to control each limit operation.

When both are OFF, the limit operation will not work.

When only the lower limit switch on the left is ON, the limit operation will be performed with a value lower than the value in the column immediately after the lower limit switch.

When only the upper limit switch on the right is ON, the limit operation will be performed with a value higher than the value in the column immediately after the upper limit switch.

When both are ON, the limit operation will be performed regardless of whether the value is lower than the value in the left column or higher than the value in the right column.

Below that is the P: switch, which controls the power limit operation. When ON, the power consumption is calculated from the voltage value and current value, and the limit operation is performed with the power consumption higher than the field immediately after this switch.

SLOPE (Tr/Tf)

In DC mode or PULSE mode, set the slope of the rising and falling edges of the DRAIN / COLLECTOR SUPPLY output. Set to prevent unnecessary overshoot due to changes in rising and falling. The setting range is 0 to 100, and 0 does not control the rising and falling edges. Increasing the value causes a gradual change. Set while checking the waveform on the YT screen.

LOOPING

In AC mode and RECTIFID SINE mode, set a pseudo loop correction in the software thinning process. No correction is performed when 0 is set.

3.4.4 Detailed Settings in the GATE / BASE SUPPLY Menu

Figure 3.383.27 shows the GATE / BASE SUPPLY detailed setting screen. Click the ☒ button on the left end of the title bar labeled GATE/BASE SUPPLY to switch off this screen.

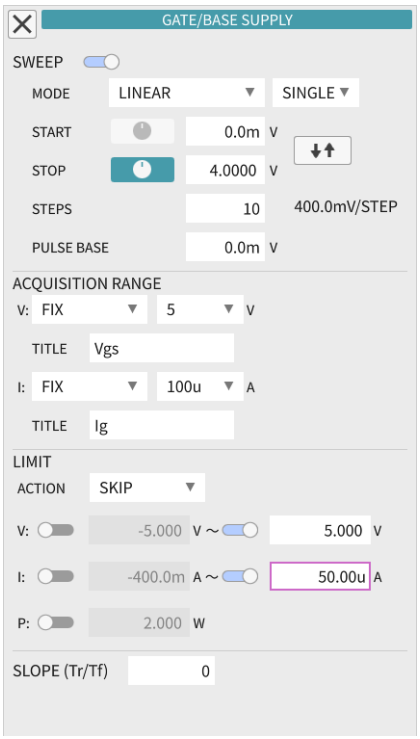


Figure 3.38: Detailed setting screen of GATE/BASE SUPPLY

SWEEP

The SWEEP switch selects whether to measure GATE / BASE SUPPLY with a constant value or to sweep.

The figure shows the screen when the SWEEP switch is ON. Select LINEAR (equal interval), LOG (geometric interval) or LIST (value list) for the sweep step interval in the field to the left of MODE. In the field on the right, select SINGLE (one-way sweep) or DOUBLE (reciprocal sweep).

The START and STOP fields set the sweep range. The START and STOP knob icons switch between white and turquoise with each tap, and when turquoise, you can also increase or decrease the value with the GATE / BASE knob on the front panel.

The [↓ ↑] button on the right side of the START and STOP fields can be tapped to switch the START and STOP values.

In the STEPS field, set the number of steps from START to STOP. For LINEAR sweeps, this field is followed by the amount of change per step.

In the BASE or PULSE BASE field, set the gate voltage at which the DUT is turned off. This is a setting to specify the value applied during the period when no pulse is applied or during the transient period when the applied voltage is changed by sweeping to prevent unexpected current from flowing to the DUT.

When the SWEEP switch is OFF, NON (1-POINT) is displayed in the MODE field, and the value to be applied is set in the STOP field below it.

When SWEEP MODE is set to LIST, the output of the supply unit is changed according to the desired output value list. At this time, the sweep setting screen changes to the output value list editing screen. Editing the output value list is the same as for DRAIN/COLLECTOR SUPPLY. (See Section 3.4.3)

ACQUISITION RANGE

Set the measurement range of the voltage and current actually applied from GATE / BASE SUPPLY, and the name of the measured value. The measurement range settings will be displayed when the voltage and current are each set in the measurement target.

The name of the measurement voltage / current is set in the TITLE field using a text string of 32 characters or less. The name set here is used in the CONFIGURATION diagram and measurement value display area tables and graphs.

The measurement range setting method can be selected from AUTO (automatic setting), FIX (fixed range), and SYSTEM (linked with output values). However some options may not be available depending on the CONFIGURATION settings.

In AUTO, the measurement range is increased or decreased in 1-2-5 steps, and measurement is performed while searching for the optimum measurement range. At this time, two fields for setting the range to search for the measurement range are displayed on the right side of the field, and the optimum measurement range is searched between both.

In FIX, a field for setting the measurement range is displayed to the right of the field, and the meas-

urement is always performed in the same measurement range.
In SYSTEM, measurement is performed in the measurement range linked with the MAX setting of GATE / BASE SUPPLY.

LIMIT

Set the action to protect the device when the voltage, current, and power applied to the DUT exceed the values such as the maximum rating.
In the ACTION field, select SKIP and STOP. SKIP does not measure the continuation of PRIMARY SWEEP when the LIMIT condition is met, but advances SECONDARY SWEEP by one step and continues measurement from the beginning of PRIMARY SWEEP. STOP stops both PRIMARY SWEEP and SECONDARY SWEEP.
V: and I: have lower and upper switches for the LIMIT condition, which control the action at each limit.
If both are OFF, the limit action will not work.
When only the lower limit switch on the left is ON, the limit action will be performed with a value lower than the value in the column immediately after the lower limit switch.
When only the upper limit switch on the right is ON, the limit action will be performed with a value higher than the value in the column immediately after the upper limit switch.
When both are ON, a value lower than the value in the left column or a value higher than the value in the right column will be a limit action.
Below that is P: switch which controls the power consumption limit operation. When ON, the power consumption is calculated from the voltage value and current value, and the limit action is performed with the power higher than the field after this switch.

SLOPE (Tr/Tf)

In EC mode or PULSE mode, set the slope of rising and falling edges of the GATE / BASE SUPPLY output. Set to prevent unnecessary overshoot due to changes in rising and falling. The setting range is 0 to 100, and 0 does not control the rising and falling edges. Increasing the value causes a gradual change. Set while checking the waveform on the YT screen.

LOOPING

In AC mode, set a pseudo loop correction in the software thinning process. No correction is performed when 0 is set.

3.4.5 Detailed Settings in the SMU Menu

Open the SMU detailed settings screen.

The ☒ button on the left end of the title bar is used to close this screen.

This screen is only displayed when an optional external unit (SMU) is connected.

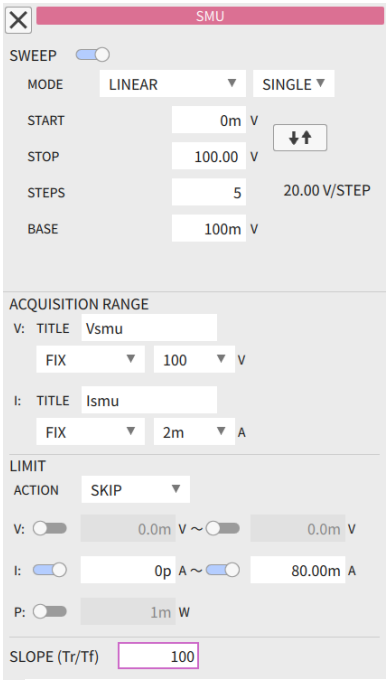


Figure 3.39: SMU detailed settings screen

SWEEP settings

The SWEEP switch selects whether to measure the SMU with a constant value or to sweep it.

The figure shows the screen with the SWEEP switch ON. Select either LINEAR (equal intervals) or LIST (numerical value list) for the sweep step interval in the left MODE field, and select either SINGLE (one-way sweep) or DOUBLE (two-way sweep) in the right MODE field.

The sweep range is set in the START and STOP fields.

Tapping the [↓ ↑] button on the right side of the START and STOP fields will interchange the values in the START and STOP fields.

The number of steps from the START value to the STOP value are set in the STEPS field. For LINEAR sweep, the amount of change per 1 step is displayed immediately after this field.

The BASE field at the bottom of the SWEEP section sets a specified value to be applied during the transient period when the applied voltage is changed by sweeping to prevent unexpected current from flowing to the DUT.

When the SWEEP switch is OFF, NON (1-POINT) will be displayed in the MODE field, and the value to be applied is set in the STOP field below the MODE field.

When SWEEP MODE is set to LIST, the output is changed according to the output value list. At this time, the sweep setting screen will change to the output value list editing screen. Editing the output value list is the same as for DRAIN / COLLECTOR SUPPLY so refer to Section 3.4.3.

ACQUISITION RANGE Settings

The measurement range of the voltage (V) and current (I) actually applied from the SMU and the name of the measurement value are set here. The measurement range settings will be displayed when the voltage and current are each set in the measurement target.

The name of the measurement voltage / current is set in the TITLE field using a text string of 32 characters or less. The name set here is used in the CONFIGURATION diagram and measurement value display area tables and graphs.

The measurement range setting method can be selected from AUTO (automatic setting), FIX (fixed range), and SYSTEM (linked with output values). However some options may not be available depending on the CONFIGURATION settings.

When using the AUTO method setting, measurement is carried out while increasing and decreasing the measurement range by 1-2-5 steps to find the optimal measurement range. During this, two fields for setting the range to search for the measurement range will be displayed to the right of the measurement range setting method field.

When using the FIX method setting, a field for setting the measurement range will be displayed to the right of the measurement range setting method field and measurement will always be carried out in the same measurement range.

When using the SYSTEM method setting, measurement will be carried out in a measurement range linked to the SMU MAX system.

LIMIT Settings

This sets the action used to protect the device in the event the voltage, current, or power applied to the DUT exceeds the maximum rating or other values. The voltage / current LIMIT settings will be displayed when the voltage and current are each set in the measurement target. The power LIMIT setting will be displayed when the voltage and current are both set in the measurement target.

The ACTION field can be set to SKIP or STOP options. When the SKIP setting is selected, if the LIMIT condition is met, the SECONDARY SWEEP will advance 1 step without measuring the remainder of the PRIMARY SWEEP, and then measurement will continue from the beginning of the PRIMARY SWEEP. When the STOP setting is select, both PRIMARY SWEEP and SECONDARY SWEEP will stop if the LIMIT condition is met.eBoth V: and I: have a lower limit switch and upper limit switch in the LIMIT conditions which control the actions at each limit.

If both are OFF, the limit action will not execute.

When only the left lower limit switch is ON, the limit action will execute at a value lower than the value in the field next to the lower limit switch.

When only the right upper limit switch is ON, the limit action will execute at a value higher than the value in the field next to the upper limit switch.

When both switches are ON, the limit action will execute at a value lower than the value in the left field or at a value higher than the value in the right field.

Below these is the P: switch which controls the power consumption limit action. When this switch is ON, the power consumptions is calculated from the voltage value and current value, and the limit action will execute at a power higher than the value in the field next to the switch.

SLOPE(Tr/Tf) Setting

This sets the steepness of the rising and falling edges of SMU output. This is set to prevent unnecessary overshoot due to changes in rising and falling. The setting range is 0 to 100 with 0 meaning no relaxing control of the rising and falling edges, with gradual changes applied as the value is increased. Set while verifying the waveform on the YT screen.

3.4.6 Detailed Settings in the SEMU Menu

Open the SEMU detailed settings screen.

The ☒ button on the left end of the title bar is used to close this screen.

This screen is only displayed when an optional external unit (SEMU) is connected.

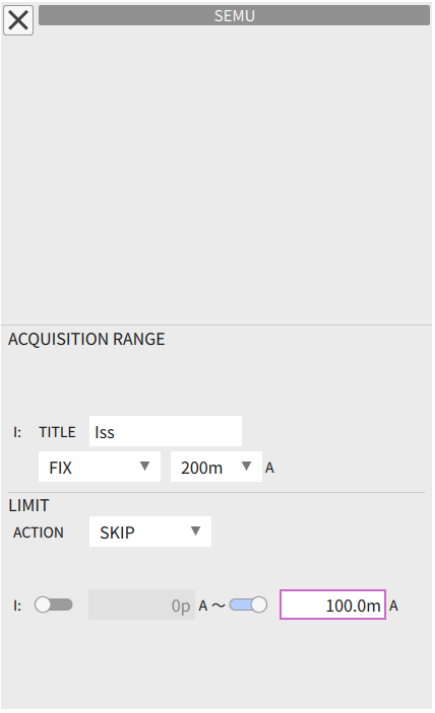


Figure 3.40: SEMU detailed settings screen

ACQUISITION RANGE Settings

The measurement range of the SENSE EMITTER / SENSE SOURCE current (I) and the name of the measurement value are set here.

The measurement range settings will be displayed when the EMITTER/SENSE SOURCE current is set in the measurement target.

The name of the measurement current is set in the TITLE field using a text string of 32 characters or less. The name set here is used in the CONFIGURATION diagram and measurement value display area tables and graphs.

The measurement range setting method is FIX (fixed range), and the measurement range can be set to 1-2-5 steps.

LIMIT Settings

This sets the action used to protect the device in the event the current flowing to the DUT exceeds the maximumg rating or other values. The current LIMIT setting will be displayed when the current is set in the measurement target.

The ACTION field can be set to SKIP or STOP options. When the SKIP setting is selected, if the LIMIT condition is met, the SECONDARY SWEEP will advance 1 step without measuring the remainder of the PRIMARY SWEEP, and then measurement will continue from the beginning of the PRIMARY SWEEP. When the STOP setting is select, both PRIMARY SWEEP and SECONDARY SWEEP will stop if the LIMIT condition is met.AThere is a lower limit switch and upper limit switch in the LIMIT conditions which control the actions at each limit.

If both are OFF, the limit action will not execute.

When only the left lower limit switch is ON, the limit action will execute at a value lower than the value in the field next to the lower limit switch.

When only the right upper limit switch is ON, the limit action will execute at a value higher than the value in the field next to the upper limit switch.

When both switches are ON, the limit action will execute at a value lower than the value in the left field or at a value higher than the value in the right field.

3.4.7 Detailed Settings in the AXIS (XY) Menu

Figure 3.413.28 shows the AXIS (XY) detailed setting screen.
Click the ☒ button on the left end of the title bar labeled AXIS (XY) to switch off this screen.
On this screen, set the display method of the XY display section of the measured value display area.
In the TITLE field, set the title of the graph displayed on the title bar of the XY display section to 32 characters or less.
The MULTI TRACE switch sets the display trace on the XY display as a single trace(OFF) or up to 5 multiple traces(ON). Figure 3.413.28 shows single trace settings, Figure 3.423.29 shows multi trace settings.
The AUTO RANGE switch automatically sets the RANGE and POSITION of X-AXIS and Y-AXIS so that all the acquired data is displayed optimally after the measurement operation is completed. The RANGE and POSITION of X-AXIS and Y-AXIS will be described later.
The DISP ZERO switch is automatically set to display the graph including the origin when the measurement operation is completed or when the AUTO SCALE button on the XY title bar is tapped.

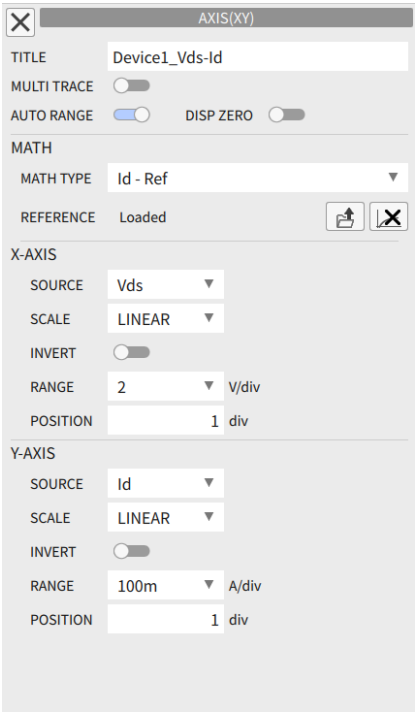


Figure 3.41: AXIS (XY)detailed setting screen (MULTI TRACE=OFF)

MATH

Set the calculation type of the measured value in the MATH TYPE field.

Table 3.13: MATH TYPE

MATH TYPE *1	Content
OFF	Not calculate
R(on)	ON resistance value(DRAIN/COLLECTOR SUPPLY voltage value divided by current value)
Vds – Ref	DRAIN/COLLECTOR SUPPLY voltage value minus Reference value
Id - Ref	DRAIN/COLLECTOR SUPPLY current value minus Reference value
Vgs – Ref	GATE/BASE SUPPLY voltage value minus Reference value
Ig – Ref	GATE/BASE SUPPLY current value minus Reference value
Vsmu – Ref	SMU voltage value minus Reference value *2
Ismu - Ref	SMU current value minus Reference value *2
Iss - Ref	SEMU current value minus Reference value *2

*1: This name is the setting for the ACQUISITION RANGE TITLE field in the DRAIN / COLLECTOR SUPPLY, GATE / BASE SUPPLY, SMU and SEMU advanced settings.

*2: Displayed only when using the optional external unit (SMU)

Linear interpolation is performed the MATH target data of REFERENCE waveform data to calculate the Reference value corresponding to the X-axis value of the measurement value.
Tap the button to read and set from any waveform data file (CSV format).

Tap the  button to clear the REFERENCE waveform data.

Table 3.14: Status of REFERENCE waveform data for MATH

Message	Status of REFERENCE waveform data	MATH operation
Empty	Waveform data not set.	N/A
Invalid target data	Waveform data has no data for X-axis and MATH calculation.	N/A
Loaded	Waveform data has data for X-axis and MATH calculation.	Available

REFERENCE waveform data for MATH can also be set in the REFERENCE menu. See Section 3.4.11 for setting operations and the format of the waveform data file (CSV format) used for the REFERENCE waveform.
MATH operations are performed regardless of the SOURCE setting of Y-AXIS and the display ON/OFF setting of the REFERENCE waveform.

X-AXIS
Set the name of the X-axis (horizontal axis) in the SOURCE field.
This name was set in the ACQUISITION RANGE TITLE field in the advanced settings for DRAIN / COLLECTOR SUPPLY and GATE / BASE SUPPLY. Some options have this name followed by (out), but this will use the value you are trying to source.
In the SCALE field, select whether the X-axis scale is LINEAR (linear scale) or LOG (logarithmic scale).
When the INVERT switch is turned on, the X-axis display is flipped horizontally. It is used, for example, to compare a P-channel device with an N-channel device.
When the SCALE field is LINEAR, the RANGE field sets the display value per division on the X-axis. Set in 1-2-5 steps from the choices that pop up by tapping or using the HOLIZONTAL knob on the front panel. The POSITION field sets the display position of the origin. When you want to set the left edge to the origin, set it to 0 div, and when you want to set the right edge to the origin, set it to 10 div. If you set a negative value, the origin will be off the leftmost screen.
When the SCALE field is LOG, set the X-axis display range with minimum and maximum values. Set from the 1-10-100 step choices that pop up when you tap. Set the value in the right field to be greater than the value in the left field. You can use the HORIZONTAL knob on the front panel to set the maximum value.

Y-AXIS
Similar to the X-AXIS setting, the SOURCE field sets the name of the Y axis (vertical axis).
If SOURCE is set to MATH, displays the MATH calculation value. If SOURCE is set to MATH when MATH TYPE is set to REFERENCE calculation, the REF.VISIBLE switch will appear, allowing you to set the visibility of the REFERENCE waveform used in MATH.
In the SCALE field, select LINEAR (linear scale) or LOG (logarithmic scale) for the Y-axis scale.
When the INVERT switch is turned on, the Y-axis display is flipped upside down.
When the SCALE field is LINEAR, the RANGE field sets the display value per division on the Y axis.
The POSITION field sets the display position of the origin.
When the SCALE field is LOG, set the Y-axis display range with minimum and maximum values. Set from the 1-10-100 step choices that pop up when you tap. Set the value in the right field to be greater than the value in the left field. You can set the maximum value using the VERTICAL knob on the front

panel.

Figure 3.423.29 shows the AXIS (XY) detailed setting screen when the MULTI TRACE switch is set to ON.
In the case of multi-trace display, there is only one type of X-axis data, but up to five types of Y-axis data can be set from TRACE1 to TRACE4 and MATH.

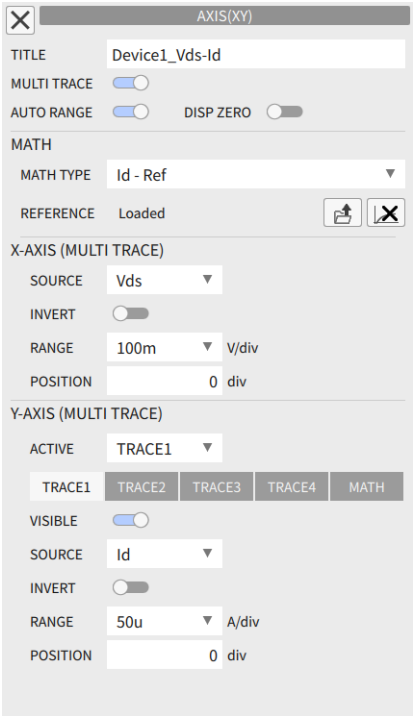


Figure 3.42: Detailed setting screen for AXIS (XY) (MULTI TRACE=ON)

X-AXIS (MULTI TRACE)

This setting is the same as for a single trace, but you cannot set the LOG scale.

Y-AXIS (MULTI TRACE)

In the ACTIVE field, select the trace for the cursor or marker from multiple traces. The selected trace will show the source name and scale value in bold.
The TRACE1 to TRACE4 and MATH buttons below the ACTIVE field are selections to set the Y-axis for each trace. For the selected trace, the select button will be a white background, and the switches and fields below it will be the settings for the selected trace.
When the VISIBLE switch is ON, the trace is displayed as a graph.
The settings for SOURCE, INVERT, RANGE, and POSITION are the same as for a single trace, but the LOG scale cannot be set.
For MATH traces only, MATH can be selected in the SOURCE field. If SOURCE is set to MATH when MATH TYPE is set to REFERENCE calculation, the REF.VISIBLE switch will appear, allowing you to set the visibility of the REFERENCE waveform used in MATH.

3.4.8 Detailed Settings in the AXIS (YT) Menu

Figure 3.433.30 shows the AXIS (YT) detailed setting screen.
Click the ☒ button on the left end of the title bar labeled AXIS (YT) to switch off this screen.
Set the display method of the YT part of the measured value display area.
When the AUTO RANGE switch is ON, the RANGE and POSITION of each data are automatically set so that the optimum display is obtained after the measurement operation is completed. In the display during measurement operation, the current settings are displayed.
DISP ZERO switch automatically sets the graph to include the origin when the measurement operation is complete or when the AUTO SCALE button on the YT title bar is tapped.

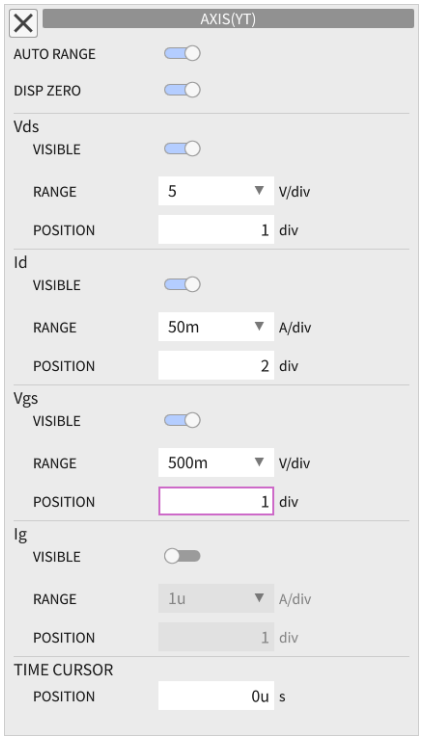


Figure 3.43: AXIS (YT)detailed setting screen

Setting of each voltage / current waveform display

Set the display of the voltage / current waveform applied from DRAIN / COLLECTOR SUPPLY, GATE / BASE SUPPLY, SMU and the current waveform applied from SEMU. This name is the setting for the ACQUISITION RANGE TITLE field in the DRAIN / COLLECTOR SUPPLY, GATE / BASE SUPPLY ,SMU and SEMU advanced settings.
The VISIBLE switch is set to display when it is ON, and is set to be hidden when it is OFF.
The RANGE field sets the voltage value of the vertical axis scale 1div of the display waveform.
The POSITION field sets the 0V or 0A position of the display waveform as an integer as the div value from the bottom.
In the figure, the measurement targets are the DRAIN/COLLECTOR SUPPLY voltage waveform (Vde), the DRAIN/COLLECTOR SUPPLY current waveform (Id), the GATE/BASE SUPPLY voltage waveform (Vge), and the GATE/BASE SUPPLY current waveform (Ig). , only the Ig VISIBLE is set OFF.

TIME CURSOR

The cursors used on the YT screen move on the time axis. The POSITION field sets the position of these cursors.
This value is 0s (DELAY position) in the first div from the left when the MODE of either SUPPLY power supply is PULSE in CONFIGURATION, but it is 0s at the left end except in the case of PULSE.
This value is linked to the TIME CURSOR field on the left side of the title bar on the YT screen.

3.4.9 Detailed Settings in the DATA LIST Menu

Figure 3.443.31 shows the DATA LIST detailed setting screen.
Click the ☒ button on the left end of the title bar labeled DATA LIST to switch off this screen.
Set the DATA LIST display in the measured value display area.

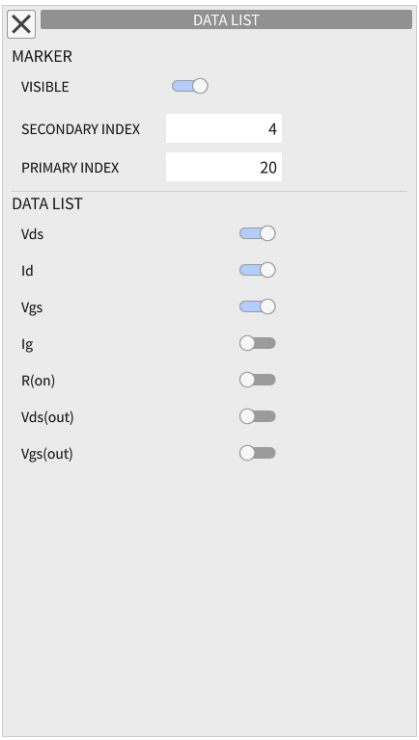


Figure 3.44: DATA LIST detailed setting screen

MARKER

The position of the MARKER is specified in the SECONDARY INDEX and PRIMARY INDEX fields. In the data list, a triangle marker (▶) is displayed at the left end of the corresponding line.
When the VISIBLE switch is turned on, a red marker (✕) is displayed on the plot of the XY graph. This VISIBLE switch works with the MARKER switch on the title bar of the data list display.

DATA LIST

Select the items to display in the DATA LIST.
The switches for the values set for the measurement target are displayed from below.
Display/hide on DATA LIST can be set using the switch.

DRAIN/COLLECTOR SUPPLY Voltage/Current measurement value
GATE/BASE SUPPLY Voltage/Current measurement value.
SMU Voltage/Current measurement value.
SEMU Current measurement value
MATH calculated value
PRIMARY SWEEP/SECONDARY SWEEP/CONSTANT output setting value

Each item is displayed with the name set in ACQUISITION RANGE TITLE.

3.4.10 Detailed Settings in the CURSOR Menu

Figure 3.453.32 shows the CURSOR detailed setting screen.
Click the ☒ button on the left end of the title bar labeled CURSOR to switch off this screen.
Set the cursor in the XY display of the measured value display area.

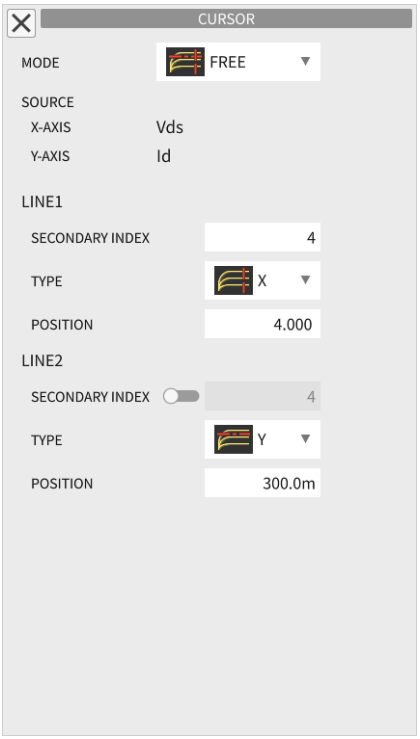


Figure 3.45: CURSOR FREE mode detailed setting screen

MODE

In the MODE setting field, select from OFF, FREE, and DOT. When you select OFF, the cursor will not be displayed.
When you select FREE, the screen shown in Figure 3.453.32 is displayed.
FREE allows you to use two cursors that allow you to move freely within the graph, regardless of the position of the plot data.

SOURCE

SOURCE's X-AXIS has the data name set on the X-axis in XY display (Vds in this figure), Y-AXIS has the data name set on the Y-axis, and MULTI TRACE has an ACTIVE trace. The set data name (Id in this figure) is displayed.

LINE1 settings in FREE MODE

In LINE1, set the L1 cursor.
In the SECONDARY INDEX field, specify the sweep index number you want to focus on with the L1 cursor. This value is linked to the value in the L1 SECONDARY INDEX column on the left of the title bar of the cursor measurement section in the measured value display area.
In the TYPE field, set X for a vertical cursor that moves on the X axis and Y for a horizontal cursor that moves on the Y axis.
In the POSITION field, specify the cursor position by the voltage or current value of that axis. This value is linked to the value of the setting field in L1 () of the cursor measurement part of the measured value display area.

LINE2 settings in FREE MODE

In LINE2, set the L2 cursor.
When the SECONDARY INDEX switch is OFF, the sweep index number that the L2 cursor focuses on is considered to be the same as that of the L1 cursor. When this switch is ON, you can specify your own sweep index number. This value is linked to the value in the L2 SECONDARY INDEX field on the left of the title bar of the cursor measurement section in the measured value display area.
The field settings for TYPE and POSITION are the same as for LINE1.

When DOT is selected in MODE of the cursor, the screen shown in Figure 3.463.33 is displayed.
The DOT cursor moves by indexing the plot data, and on the XY display screen, the red square cursor (■) moves on the characteristic curve and reads the data value at that point.
The display of SOURCE is the same as for the FREE cursor.

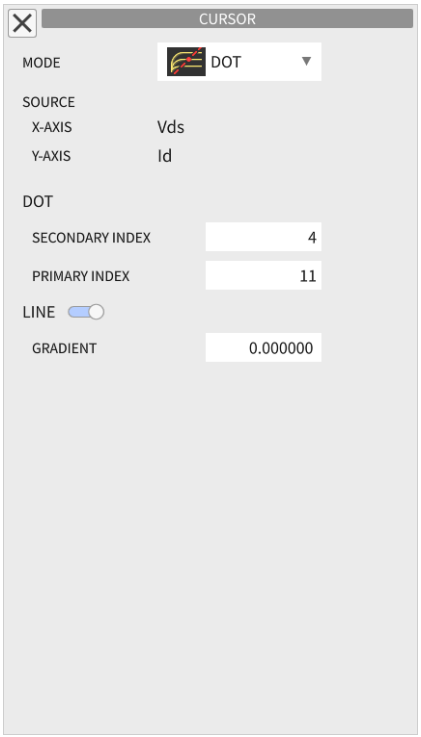


Figure 3.46: CURSOR DOT mode detailed setting screen

DOT

In the SECONDARY INDEX field, set the index number corresponding to the value you want to pay attention to in the sweep of the SUPPLY power supply that has become SECONDARY SWEEP.
In the PRIMARY INDEX field, set the index number corresponding to the value you want to focus on in the SUPPLY power supply sweep set to PRIMARY SWEEP.

LINE

Turn on the LINE switch to display a straight line connecting the cursor points.
You can set the slope of the displayed straight line in the GRADIENT field in the lower row.
For numerical input, set the unit by dividing the amount of electricity of Y-AXIS by the amount of electricity of X-AXIS. When Y-AXIS is voltage and X-AXIS is current, the unit is Ω [ohm]. Conversely, When Y-AXIS is current and X-AXIS is voltage, the unit is set to S [Siemens].
When set with the FUNCTION knob, the value does not increase or decrease at equal intervals, but the rotation angle of the straight line increases or decreases at intervals of approximately 0.1 degrees. If it becomes a vertical line, “inf.” is displayed.
The GRADIENT setting is linked to the value in the GRADIENT field of the cursor measurement section in the measured value display area.

3.4.11 Detailed Settings in the REFERENCE Menu

Figure 3.473.34 shows the REFERENCE detailed setting screen.

Click the ☒ button on the left end of the title bar labeled REFERENCE to switch off this screen.

Displays the specified data on the XY display section of the measured value display area, which cannot be displayed if the MULTI TRACE setting of XY-AXIS is ON.

Use the VISIBLE switch to display/hide the REFERENCE waveform.

When setting the display, the setting status of the REFERENCE waveform data is displayed in REFERENCE DATA.

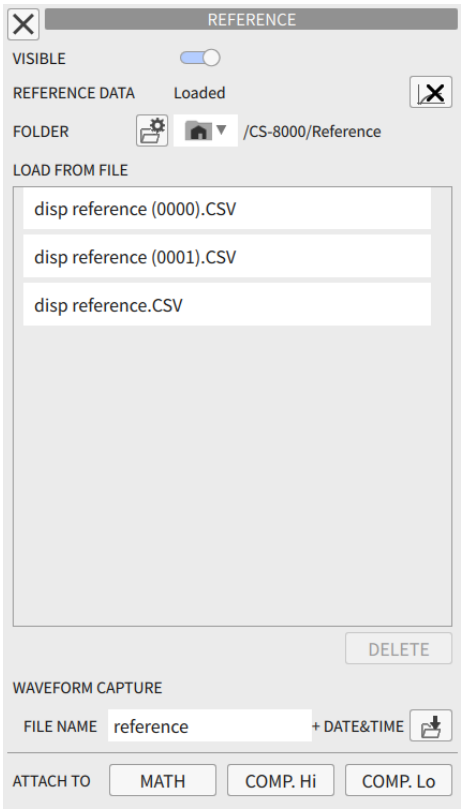


Figure 3.47: REFERENCE deteiled setting screen

Table 3.15: Status of REFERENCE waveform data

Message	Status of REFERENCE waveform data
Empty	Waveform data not set.
Invalid target data	Waveform data has no the target data for X-axis and Y-axis.
Loaded	Waveform data has the target data for X-axis and Y-axis.

If the Y axis SOURCE is set to PRIMARY OUTPUT, SECONDARY OUTPUT, or CONSTANT OUTPUT, the REFERENCE waveform data will not be displayed and an invalid target data message will be displayed.

Tap the button to clear the REFERENCE waveform data.

REFERENCE DATA

Set the REFERENCE waveform data using one of the following methods.

-LOAD FROM FILE

Read and set from any waveform data file (CSV format).

CSV format files in the folder set in FOLDER are listed in LOAD FROM FILE.

When a file is selected, the file is read and set as REFERENCE waveform data.

-WAVEFORM CAPTURE

Saves the currently displayed measurement data to a CSV format file and sets it.

Tap the button saves the data selected in the SECONDARY INDEX of MARKER of the measurement data currently displayed in the file set in FOLDER and FILE NAME in CSV format and sets it to REFERENCE waveform data.

See section 3.4.14.1 for the FILE NAME/FOLDER setting operation.

As REFERENCE waveforms, in addition to the waveforms for viewing in this section, MATH calculation waveforms and COMPARISON HIGH/LOW waveforms can be displayed. Tap the MATH button/COMP.Hi but-

ton/COMP Lo button in ATTACH TO to set the REFERENCE waveform data set in this menu as the data of each REFERENCE waveform of MATH/COMPARISON HIGH/LOW.

Format of waveform data file (CSV format) used for REFERENCE waveform

The data format for DISPLAY REFERENCE/MATH REFERENCE/COMPARISON REFERENCE(HIGH/LOW) is the same. You can use CSV format files saved with WAVEFORM (XY-TEXT) in the SAVE menu. If you wish to create your own file, please create a file with the CSV extension in the following format.

Ch info line	ChInfo,	,	DRAIN_V,	DRAIN_I,	GATE_V,	GATE_I,	MATH,	PRIMARY,	SECOND-ARY
header line	“Secondary”,	“Primary”,	“Drain V”,	“Drain I”,	“Gate V”,	“Gate I”,	“Math”,	“P(out)”,	“S(out)”
data line	Secondary Index,	Primary Index,	Drain/ Collector Voltage value,	Drain/ Collector Current value,	Gate/Base Voltage value,	Gate/Base Current value,	Math value,	Output value of Primary Sweep	Output value of Secondary Sweep
	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.

Create Ch information lines using the following structure.

Column 1: "ChInfo" Fixed character string set

Column 2: Arbitrary character string set (can also contain blank spaces)

Column 3 and later: Data type character string sets (Table 3.16)

Data line data will be read as data in the order specified by the Ch information line.

Table 3.16 Ch information line character string sets by data type

Ch information line character string set	Data type	Remarks
DRAIN_V	DRAIN / COLLECTOR voltage meas-urement value	
DRAIN_I	DRAIN / COLLECTOR current meas-urement value	
GATE_V	GATE / BASE voltage measurement value	
GATE_I	GATE / BASE current measurement value	
SMU_V	SMU (LPSMU) voltage measurement value	Ver.3.00 or later
SMU_I	SMU (LPSMU) current measurement value	Ver.3.00 or later
SE_I	SENSE EMITTER current measurement value	Ver.3.00 or later
MATH	MATH calculated value	
PRIMARY	PrimarySweep output setting value	Y axis cannot be set
SECONDARY	SecondarySweep output setting value	
CONSTANT	Constant output setting value	Y axis cannot be set Ver.3.00 or later

If there is no Ch information line, it will be read in the order DRAIN_V, DRAIN_I, GATE_V, GATE_I, MATH, PRIMARY, and SECONDARY.

The header line is required. The "Secondary" and "Primary" in the header line are fixed strings, and the following 7 columns are arbitrary data title strings. The data lines following the header line are numeric data. Non-numeric data will be invalid. Up to the 4 columns (Secondary Index, Primary Index and 2 arbitrary data column) is required, and subsequent columns can be omitted, but the number of columns in the header line and data lines must match. If the file contains multiple Secondary Index data, the first Secondary Index data is read as the REPERENCE waveform data.

3.4.12 Detailed Settings in the ANALYSIS Menu

Figure 3.483.35 shows the ANALYSIS detailed setting screen.
Click the ☒ button on the left end of the title bar labeled ANALYSIS to switch off this screen.

This screen is used to set up the analysis settings for comparison of measurement data, etc.

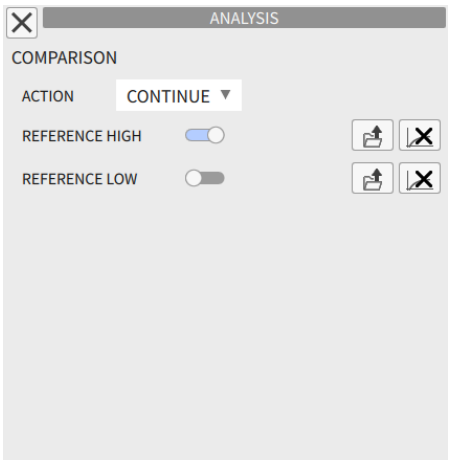


Figure 3.48: ANALYSIS deteiled setting screen

COMPARISON

The COMPARISON function cannot be used when the XY-AXIS MULTI TRACE setting is ON.

Arbitrary waveform data is set to REFERENCE HIGH and REFERENCE LOW, and each is compared with the measured value at the time of measurement as the upper/lower limit value, and the comparison result is displayed in the status column of DATA LIST.

Hi : Measured value > REFERENCE HIGH

Lo : Measured value < REFERENCE LOW

When Hi or Lo is detected, the action set in ACTION is performed.

The value that corresponds to the X-axis value of the measured value is interpolated from the REFERENCE waveform and compared with the Y-axis value.

When the AVERAGE setting is ON, the comparison is performed using the averaged value.

ACTION

In the ACTION field, set the action to be taken when the measured value exceeds the REFERENCE waveform.

CONTINUE	Continue measurement.
SKIP	The continuation of PRIMARY SWEEP is not measured, and SECONDARY SWEEP is advanced by one step to continue measurement from the beginning of PRIMARY SWEEP.
STOP	Stop measurement.

The REPERENCE HIGH switch turns the upper limit waveform display ON/OFF.

The REPERENCE LOW switch turns the lower limit waveform display ON/OFF.

The displayed waveform is the target for comparison.

Tap the button to read and set from any waveform data file (CSV format).

Tap the button to clear the REFERENCE waveform data.

The setting data that corresponds to the X-axis source and Y-axis source will become the REFERENCE waveform. The status of the REFERENCE waveform data will be displayed.

Table 3.17: Status of REFERENCE waveform data for COMPARISON

Message	Status of REFERENCE waveform data
Empty	Waveform data not set.
Invalid target data	Waveform data has no the target data for X-axis and Y-axis.
Loaded	Waveform data has the target data for X-axis and Y-axis.

REFERENCE waveform data for COMPARISON can also be set in the REFERENCE menu. See Section 3.4.11 for setting operations and the format of the waveform data file (CSV format) used for the REFERENCE waveform.

EXTRACT CURVE Settings

The EXTRACT CURVE function extracts values set as TARGETs from each PRIMARY SWEEP measurement waveform data and creates waveforms consisting of the extracted data.

The TARGET value specification method is set in TARGET TYPE.

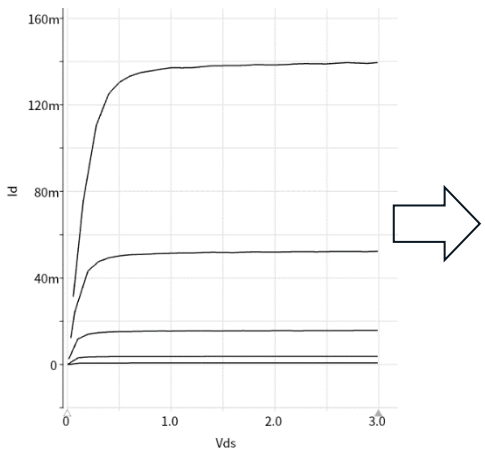
TARGET TYPE	Specification method	Setting items
INDEX	Specify as the PRIMARY INDEX	INDEX
VALUE	Specify as the voltage value or current value*	SEARCH MODE、SOURCE、VALUE
SECONDARY OUTPUT	The SECONDARY SWEEP output setting value will be the TARGET value*	SEARCH MODE

*: The extracted data is calculated from two points that cross the TARGET value according to the SEARCH MODE setting.

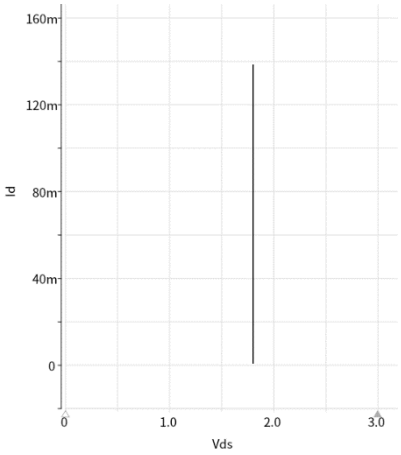
SEARCH MODE	The extracted data
INTERPOLATE	Calculated value of linear interpolation between two points.
NEAREST	Data closer to the TARGET value.
UPPER	Data larger than TARGET value.
LOWER	Data smaller than ARGET value.

Tap the EXTRACT button to run extraction. The data cannot be restored to its original format once extraction is run.

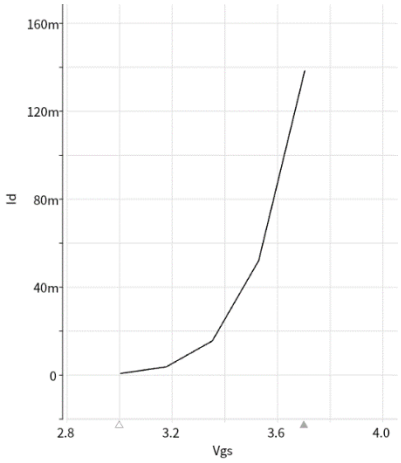
An example of extraction with TARGET TYPE=VALUE, SEARCH MODE=INTERPOLATE, SOURCE=VOLTAGE, and VALUE=1.8V is shown below.



Vds-Id waveform
SECONDARY SWEEP Vgs=3.0~3.7V



EXTRACT result Vds-Id waveform
TARGET Vds=1.8V



EXTRACT result Vgs-Id waveform
TARGET Vds=1.8V

3.4.13 Detailed Settings in the DISPLAY Menu

Figure 3.49 shows the DISPLAY detailed setting screen.
Click the ☒ button on the left end of the title bar labeled DISPLAY to switch off this screen.
Set the display settings of the measured value display area and the line type and color of the plot.

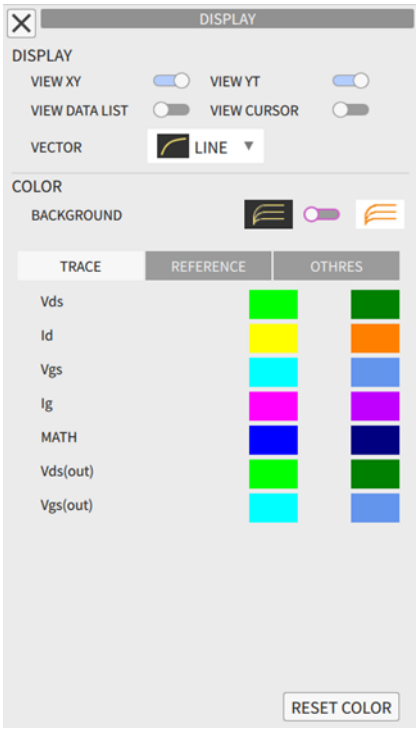


Figure 3.49: DISPLAY detailed setting screen

DISPLAY

The VIEW XY switch shows XY when it is ON and hides it when it is OFF.
The VIEW YT switch shows YT when it is ON and hides it when it is OFF.
The VIEW DATA LIST switch shows the DATA LIST when it is ON and hides it when it is OFF.
The VIEW CURSOR switch shows CURSOR when it is ON and hides it when it is OFF.
These four switches are linked to the measured value display selection buttons XY, YT, DATA LIST, and CURSOR on the bottom right side of the measured value display area.
The VECTOR field selects how the graph is displayed. LINE displays the position of the measured value with a polygonal line connecting the positions of the measured values in the order of PRIMARY INDEX, and DOT is a display that simply places a point at the position of the measured value.

COLOR

When the BACKGROUND switch is OFF, the background color of graphs and tables is black, and the lines and points to be plotted are displayed in the color combination of the left column. When ON, the background color is white and the lines and points to be plotted are displayed as a combination of colors in the right column.
By tapping the color, you can change it from the 24 candidate colors in the pop-up list.
Color setting items are displayed for each category on the [TRACE], [REFERENCE], and [OTHERS] tabs.

RESET COLOR

Tap the RESET COLOR button on the bottom row to restore all color settings except the background color.

3.4.14 Detailed Settings in the SAVE Menu

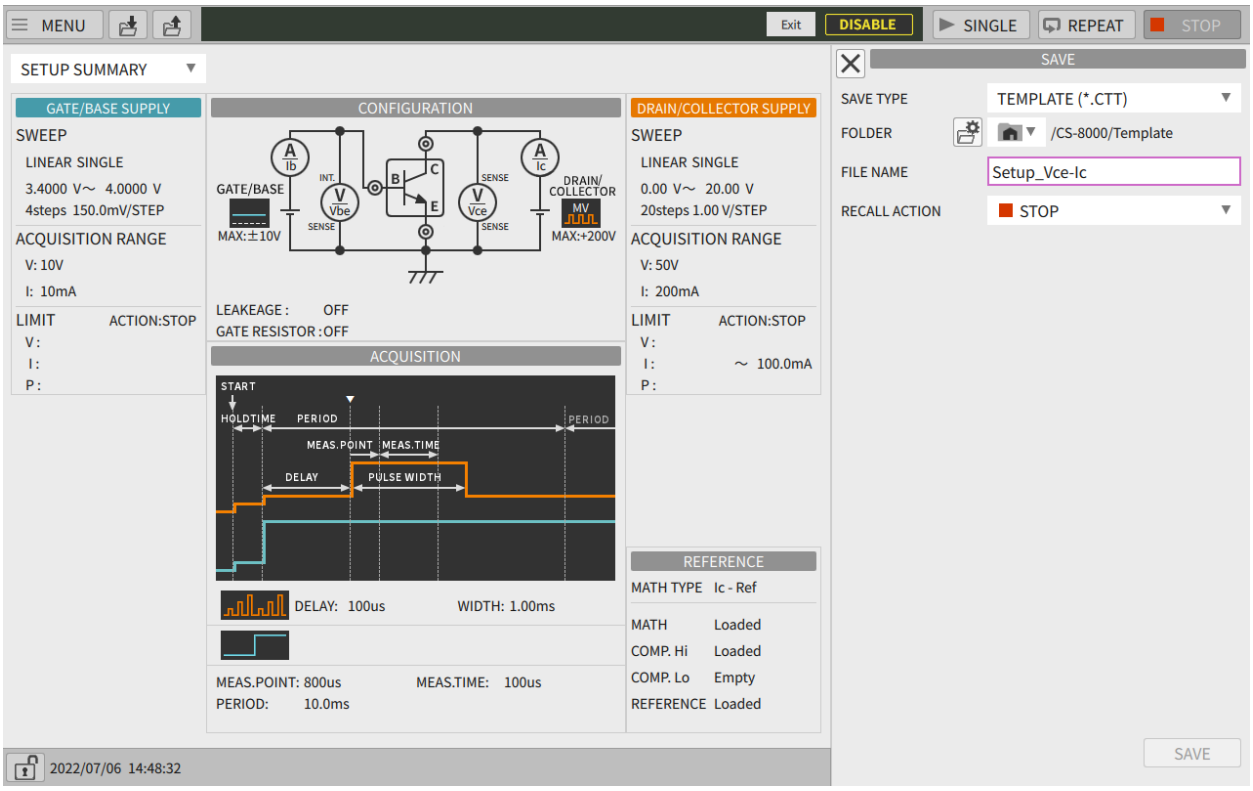


Figure 3.50: Screen when SAVE Menu is selected

Figure 3.51503.370 shows an example of the screen when the SAVE Menu is selected.
The SAVE detailed setting screen is displayed in the measurement condition setting area on the right side of this screen. The measured value display area on the left summarizes the settings saved by the save operation under the currently set measurement conditions.
This screen disappears when you press the ☒ button on the left end of the title bar of the SAVE detailed setting screen on the right side of the screen.
In the SAVE TYPE field, select the save format. TEMPLATE (*.CTT) and WAVEFORM (*.CTW) can be selected. Select TEMPLATE (*.CTT) to save only the measurement conditions (file extension .CTT). Select WAVEFORM (*.CTW) to save both the current measurement conditions and the measured data (file extension .CTW).
When you select WAVEFORM (*.CTW), you can check the saved measurement data by selecting another XY CHART in the SETUP SUMMARY selection field on the upper left.

Save operation of TEMPLATE (*.CTT)

Figure 3.51503.370 shows TEMPLATE(*.CTT) settings.
In the folder specified in the FOLDER field, save the file with the .CTT extension with the file name specified in the FILE NAME field. See section 3.4.14.1 for the FILE NAME/FOLDER setting operation.
The RECALL ACTION field sets whether the measurement can be started after this measurement condition file is recalled.
When STOP is selected, only the measurement conditions will be set. When REPEAT is selected, repeated measurement will start after setting. When SINGLE is selected, the measurement operation will be executed only once. However, the settings made by the OUTPUT ENABLE button on the front panel are not saved in the TEMPLATE (*.CTT) file, so the measurement operation will not start if the OUTPUT ENABLE lamp is off.
To execute save, tap the SAVE button at the bottom.

If a file with the specified name already exists in the folder, the CONFIRMATION screen confirms overwriting, so click the OK button to save. Click the CANCEL button to cancel saving.

Save operation of WAVEFORM (*.CTW)

Figure 3.505213.381 shows an example when WAVEFORM (*.CTW) is selected in the SAVE TYPE field of the SAVE menu.
The file with the file name specified in the FILE NAME field and the extension .CTW or .CSV is saved in the folder specified in the FOLDER field. See section 3.4.14.1 for the FILE NAME/FOLDER setting operation.
There are three types of files created by WAVEFORM (*.CTW), and these are created with a single save operation.
The first is a file with a .CTW extension, which stores the same measurement condition data as the template file and binary measurement data in internal format. This is a format that allows the same data evaluation as during measurement even after recall.
Turn on the BINARY DATA (*.CTW) switch to save this type of file.
The second is a file that saves the data used for XY display in text format and has a .CSV extension. To save this file, turn on the XY-TEXT (*.CSV) switch.
The third is a file that saves the data used for YT display in text format, and has a .CSV extension. To save this file, turn on the YT-TEXT (*.CSV) switch.
The XY-TEXT and YT-TEXT files have good consistency with PC applications, but cannot be restored to this instrument. XY-TEXT files can be used for REFERENCE waveform data and display in WAVE VIEWER.

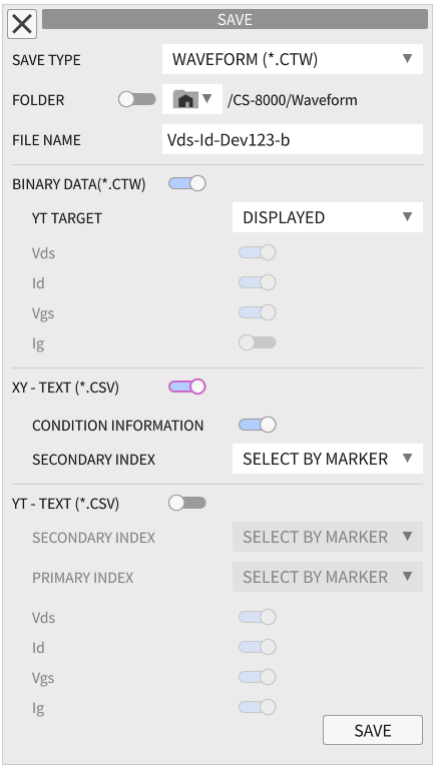


Figure 3.50: SAVE menu WAVEFORM (*.CTW) type detailed setting screen

BINARY DATA (*.CTW) switch related settings

In addition to the XY display and DATA LIST characteristic measurement data, the YT TARGET field sets whether to include and save the time axis waveform data at the time of measurement. Not included in NON. DISPLAYED includes only the time axis waveform data being displayed in YT. ALL saves the time axis waveform data at all measurement points.
The switches below (Vds, Id, Vgs, Ig in the figure) set the data to be saved for the time axis waveform data.
From the top down, turn ON the data which you want to save from DRAIN / COLLECTOR SUPPLY voltage waveform data/current waveform data, GATE / BASE SUPPLY voltage waveform data/current waveform data, SMU voltage waveform data/current waveform data, and SEMU current waveform data. Each switch uses the name set in each SUPPLY setting ACQUISITION RANGE TITLE.
This *.CTW file stores measurement condition data and measurement result data. Both are data at the time the save operation was performed, so when you change the measurement conditions and save after acquiring the measurement results, a contradiction may occur after the file is recalled. To prevent this, be sure to save the CONFIGURATION, ACQUISITION, and both SUPPLY settings after measurement without changing the settings.

XY-TEXT (*.CSV) switch related settings

The CONDITION INFORMATION switch is turned on to include the recording of the main measurement conditions of CONFIGURATION, ACQUISITION, and both SUPPLY when measuring the XY characteristics in the file. SELECT BY MARKER saves only the secondary sweep data specified under SECONDARY INDEX in the MARKER settings section of the DATA LIST menu screen.
The target data to be saved is set under TARGET. Tap the gear ✿ to open the settings screen. Turn ON the data which you want to save from DRAIN / COLLECTOR SUPPLY voltage waveform data/current waveform data, GATE / BASE SUPPLY voltage waveform data/current waveform data, SMU voltage waveform data/current waveform data, SEMU voltage waveform data, MATH waveform data, primary output waveform data, Secondary output waveform data, and Constant output waveform data.
Each switch uses the name set in each SUPPLY setting of the ACQUISITION RANGE TITLE.

YT-TEXT (*.CSV) switch related settings

The data to be saved is set in the SECONDARY INDEX field and PRIMARY INDEX field. SELECT BY MARKER saves only the data specified under SECONDARY INDEX and PRIMARY INDEX in the MARKER settings section of the DATA LIST menu screen. RANGE will save the data in the range from the index specified in the "from" field to the index specified in the "to" field.
The TIME INDEX field sets the time information for each data to be saved; if NUMBER is selected, a number from 0 to 999 is saved; if TIME STAMP is selected, the time corresponding to the data is saved. Table 3.183.16 shows the relationship between waveform mode and YT display time.

Table 3.18: Relationship between waveform mode and YT display time

MODE of DRAIN/COLLECTOR SUPPLY	**MODE of GATE/BASE SUPPLY**	**Position of 0.0sec**
DC	DC	MEAS.POINT
PULSE	DC	PULSE DELAY of DRAIN/COLLECTOR
DC	PULSE	PULSE DELAY of GATE/BASE
PULSE	PULSE	PULSE DELAY of pulse that rises later
AC	DC	Start of AC output
DC	AC	
RECTIFIED SIN	DC	Start of RECTIFIED SIN (Intermittent is not included)

There are four switches (Vds, Id, Vgs, Ig in this figure). Turn ON the data which you want to save from DRAIN / COLLECTOR SUPPLY voltage waveform data/current waveform data, GATE / BASE SUPPLY voltage waveform data/current waveform data, SMU voltage waveform data/current waveform data, SEMU voltage waveform data. Each switch uses the name set in each SUPPLY setting of the ACQUISITION RANGE TITLE.
This file is larger than the BINARY DATA (*.CTW) format file and the XY-TEXT (*.CSV) format file, so you need to be careful about the remaining capacity of the recording medium.
To execute save, tap the SAVE button at the bottom.

3.4.14.1 FILE NAME/FOLDER setting operation

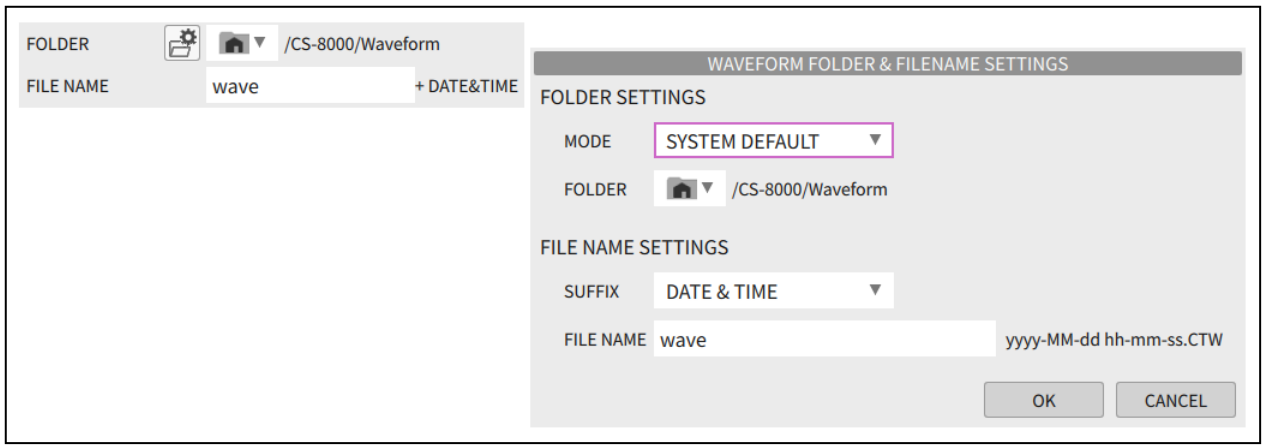


Figure 3.52: FOLDER/FILE NAME setting fields and the pop-up screen

Figure 3.53523.392 shows the FOLDER/FILE NAME setting fields and the pop-up screen.
Tap the button (Left side of figure) to open the FOLDER & FILENAME SETTINGS pop-up screen.
Tap the OK button to apply the folder/file name settings and close the pop-up window.
Tap the CANCEL button to close the pop-up window without applying the folder/file name settings.

FOLDER SETTINGS

In the MODE field, select the folder setting method from SYSTEM DEFAULT and USER DEFINE.
If you select SYSTEM DEFAULT, the default folders shown in Table 3.193.17 are set. In the FOLDER field, you can select internal memory or USB memory. If USB memory is selected and the default folder does not exist in USB memory, it will be created.

Table 3.19: SAVE/RECALL target and derault folder/file extension

SAVE/RECALL target	Default folder *	File Extension
TEMPLATE	CS-8000/Template	.CTT
WAVEFORM(BINARY)	CS-8000/Waveform	.CTW
WAVEFORM(XY-TEXT,YT-TEXT)		.CSV
SCREEN COPY	CS-8000/ScreenCopy	.png/.jpg/.bmp
REFERENCE waveform data	CS-8000/Reference	.CSV

* : Relative path from root of internal memory/USB memory

If you select USER DEFINE, you can set any folder. Click the FOLDER field to open the SELECT FOLDER pop-up screen. (Figure 3.515433.403)

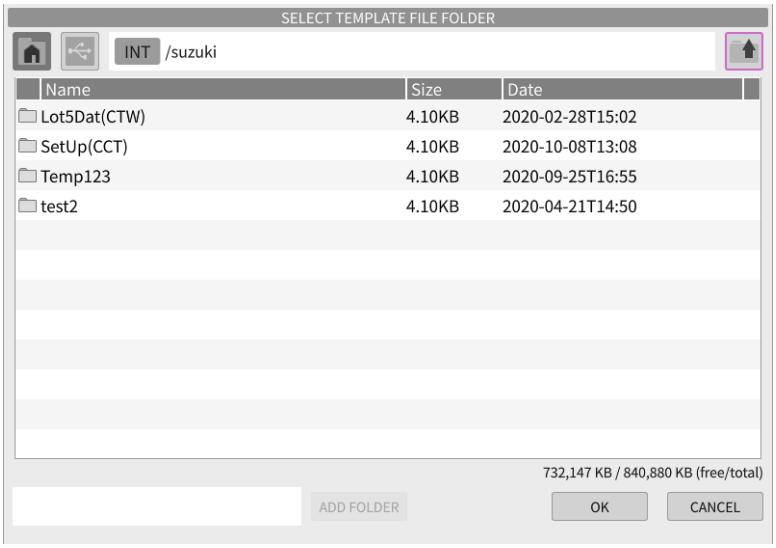


Figure 3.51: SELECT FOLDER pop-up screen

The field below the title bar shows the name of the current save folder, and the field below it shows a list of its subfolders. You can go to a lower folder by tapping the desired folder line. By tapping the button at the right end of the top field, you can move up to a folder one level higher than the current one. Since it is a screen that displays folders, individual files are not displayed side by side with folders like on a PC. To create a new folder under the current folder, set the folder name in the input field at the bottom left and click the ADD FOLDER button.
Tap the OK button to apply the selected folder to the FOLDER settings and close the pop-up screen; click the CANCEL button to close the pop-up screen without changing the FOLDER settings.

FILE NAME SETTINGS

The SUFFIX field is used to set the information to be appended to the end of the file name.
Table 3.203.18 shows the SUFFIX settings and additional information.

Table 3.20: SUFFIX settings and additional information

SUFFIX settings	**Format of additional information**	**Details**
NONE		No addition
DATE & TIME	yyyy-MM-dd hh-mm-ss	Date and time of save execution
SEQUENCE NUMBER	(0000)	4-digit numbers from 0 to 9999 Numbers where files do not exist in ascending order

Set the name of the file to be saved in the FILE NAME field.

About USB memory that can be used

The USB memory that can be used with this instrument must meet the USB 2.0 standard and be formatted in one of the FAT, FAT32, and exFAT formats. Those formatted in NTFS format cannot be used. It does not support USB memory with security function.
When removing the USB memory, follow the procedure shown in the USB FLASH DRIVE section of the SYSTEM TOOLS screen in Section 3.4.18.3. Never remove the USB memory while it is being accessed.

3.4.15 Detailed Settings in the RECALL Menu

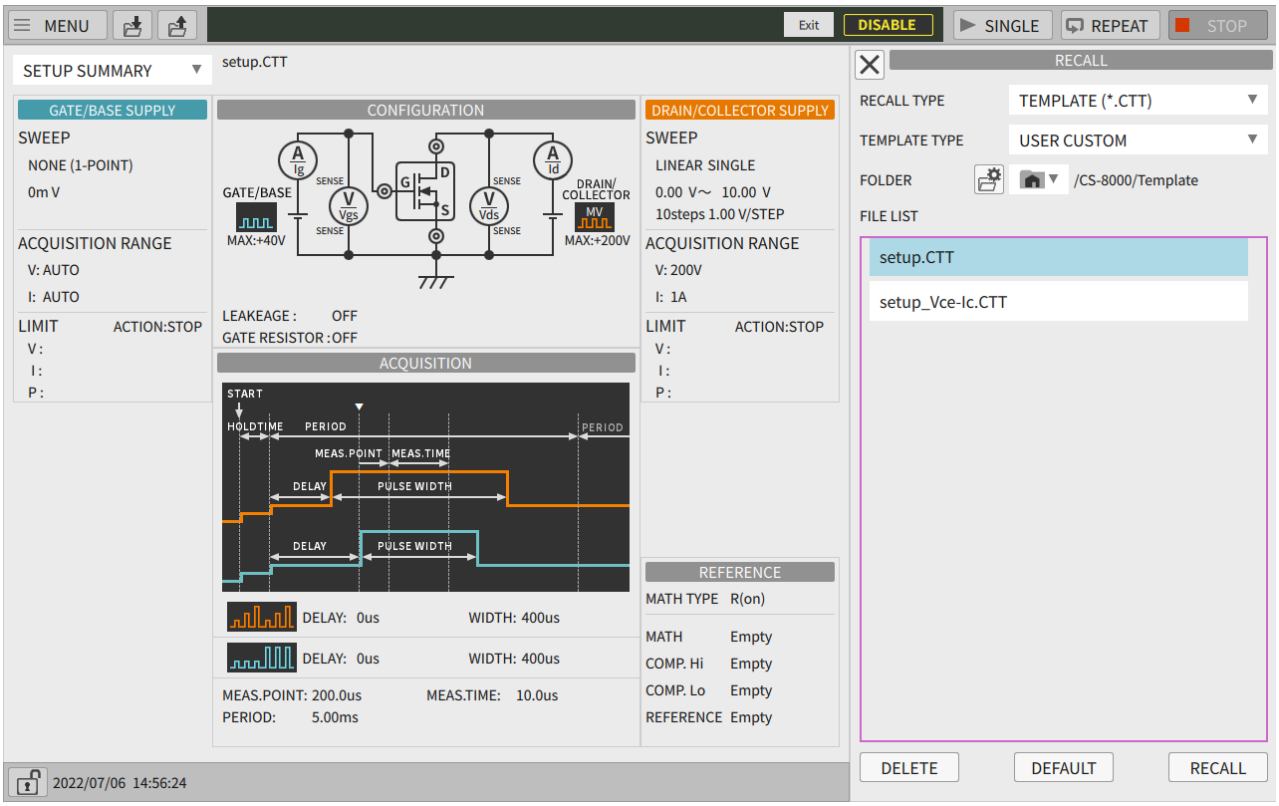


Figure 3.52: Screen when RECALL Menu is selected

Figure 3.525543.414 shows an example of the screen when the RECALL Menu is selected.
The RECALL detailed setting screen is displayed in the measurement condition setting area on the right side. The measurement display area on the left side shows a summary of the contents of the selected file.
Click the ☒ button on the left end of the title bar of the RECALL detailed setting screen on the right side of the screen to hide this screen.
You can select TEMPLATE (*.CTT) or WAVEFORM (*.CTW) in the RECALL TYPE field. TEMPLATE (*.CTT) recalls the measurement conditions from the file (extension .CTT) that stores only the measurement conditions.
WAVEFORM (*.CTW) recalls from the file (extension .CTW) that stores both the measurement conditions and the data measured under those conditions, and sets and displays the data.
If you select WAVEFORM(*.CTW), you can check the measurement data of the selected file by selecting XY CHART in the upper left selection field.

TEMPLATE file restore operation

The TEMPLATE TYPE field has two choices: BUILT-IN and USER CUSTOM. When BUILT-IN is selected, typical measurement examples built in the instrument at the time of shipment are displayed in the FILE LIST field. Select the best example from these.
The DEFAULT.CTT file in the BUILT-IN FILE LIST is a file that restores the instrument to its default settings. Select this and tap the RECALL button, or tap the DEFAULT button at the bottom of this screen to return to the default state.
When you select USER CUSTOM, you can set the file saved in the detailed settings of the SAVE menu in the previous section.
All saved TEMPLATE (*.CTT) files in the selected folder will be displayed in the FILE LIST field. See

section 3.4.14.1 for the FOLDER setting operation.
When you select a file in the FILE LIST field, the setting conditions are summarized and displayed in the left measurement value display area, so you can check the new settings. If no file is selected, the currently set measurement conditions are displayed.
If there is a file you want to recall, tap the file name and tap the RECALL button to execute the recall.
See Table 3.243.21 in Section 3.4.19 for the items recalled by the TEMPLATE restore operation and the settings recalled by DEFAULT.CTT.

WAVEFORM file restore operation

All saved WAVEFORM (*.CTW) files in the selected folder will be displayed in the FILE LIST field. See section 3.4.14.1 for the FOLDER setting operation.
The content of the measurement value display area on the left changes to recalled settings/current settings depending on whether a file is selected/deselected in the FILE LIST field, just like in the case of TEMPLATE. However, if you tap SETUP SUMMARY in the upper left field and change it to XY CHART, the content of the measurement value display area on the left will display the XY waveform of the measurement results. When you select a file in the FILE LIST field, the measurement results are summarized and displayed, making it easy to check and compare restore operations.
If the file you want to recall is in this folder, tap the file name and tap the RECALL button to execute the recall.

Restored file delete operation

To delete unnecessary saved files, tap the unnecessary files in the FILE LIST field, then tap the DELETE button. At this time, you will be asked to confirm the deletion on the CONFIRMATION screen, so click the OK button to execute the deletion or the CANCEL button to cancel the deletion.

3.4.16 Detailed Settings in the SCREEN COPY Menu

Figure 3.535653.425 shows an example of the screen when the SCREEN COPY Menu is selected.

Click the ☒ button on the left end of the title bar of the SCREEN COPY to hide this screen.

Set the method for creating a screen copy file for the LCD screen, which is created by pressing the SHIFT button on the front panel ENTRY section and then pressing the COPY key. In the FORMAT field, set the save format of the screen copy file from three choices.

PORTABLE NETWORK GRAPHICS (*.png) is a format often used in illustrations. JPEG (*.jpg) is the format used for photography. BITMAP (*.bmp) has a long history and is an image format that can be used in most PC applications.

When you select FULL COLOR in the COLOR MODE field, the color screen will be saved as it is on the LCD screen, and when you select GRAY SCALE, it will be saved on a black and white screen with light and dark.

The BACK COLOR field sets the background color of the graph or table in the measurement display area when saving the screen copy file. When saving, use the color set in the DISPLAY menu for the line color of the drawing plot as well as the background color.

Saves the screen copy to the file specified in the FILE NAME field in the folder specified in the FOLDER field. (Extension of the format specified in the FORMAT field)

See section 3.4.14.1 for the FILE NAME/FOLDER setting operation.

All storage formats are consistent with PC applications, but for FULL COLOR, the JPEG (*.jpg) format is the smallest for the file size, followed by the PORTABLE NETWORK GRAPHICS (*.png) format, and the BITMAP (*.bmp) format is the largest size. In GRAY SCALE without color information, the PORTABLE NETWORK GRAPHICS (*.png) format is the smallest, followed by the JPEG (*.jpg) format and the BITMAP (*.bmp) format.

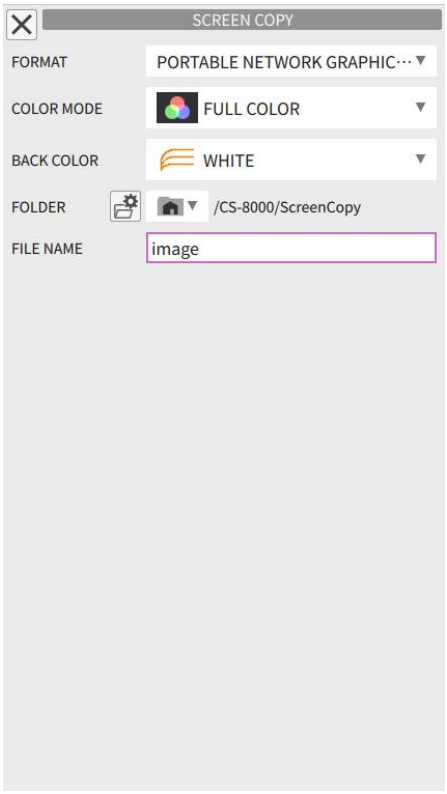


Figure 3.53: Detailed setting screen of SCREEN COPY Menu

3.4.17 Detailed Settings in the WAVEVIEWER Menu

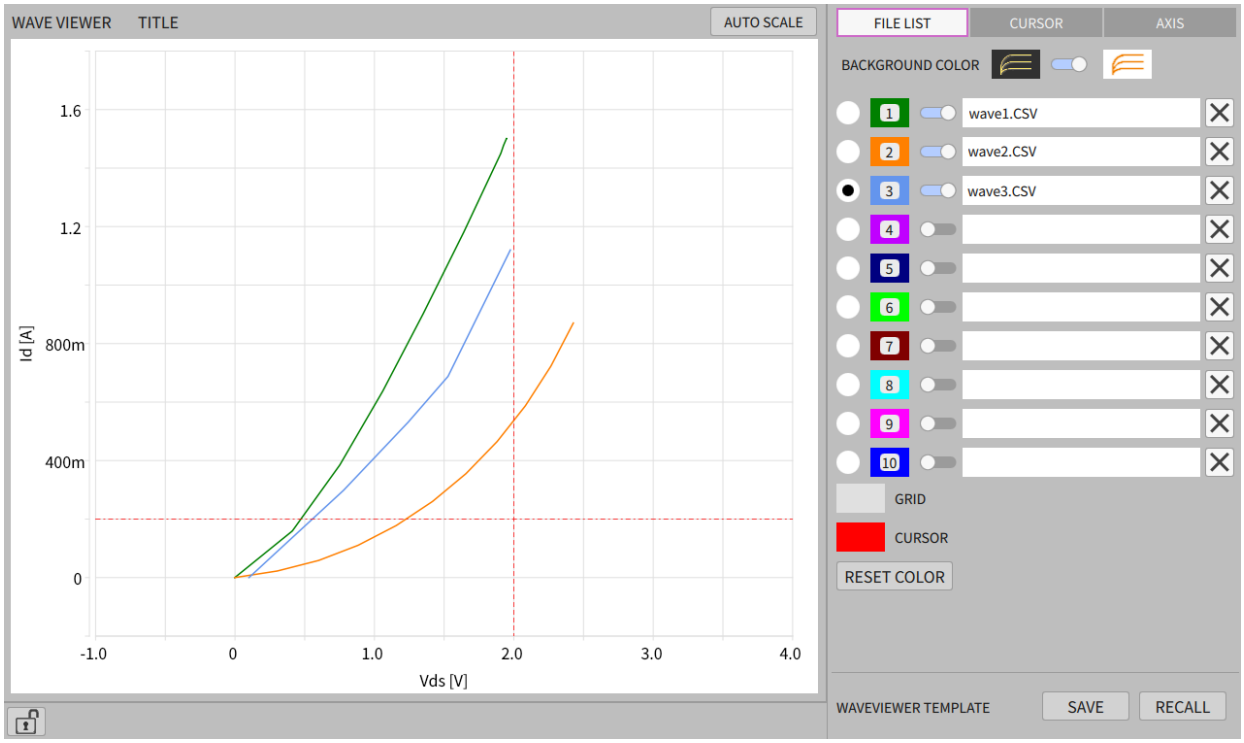


Figure 3.54: WAVEVIEWER screen

Figure 3.545763.436 shows the screen when the WAVEVIEWER menu is selected.

The waveform data of the files set on the [FILE LIST] tab on the right of this screen is displayed on the WAVE VIEWER graph on the left. It is not linked with the XY graph setting on the HOME screen.

Tapping the [AUTO SCALE] button on the WAVE VIEWER title bar automatically sets the X-AXIS and Y-AXIS RANGE and POSITION settings described below so that all waveforms set for display are displayed in the graph.

Tapping the [FILE LIST] tab, [CURSOR] tab, or [AXIS] tab will display the respective setting screens.

3.4.17.1 FILE LIST

Figure 3.545763.436 shows the screen when the [FILE LIST]tab is selected. Set the waveform data file to be displayed and the color of the drawing.

The BACKGROUND switch sets the background color of the graph. When the switch is OFF, the background color of the graph is black; when the switch is ON, the background color is white. The color of the waveforms and other graphics has a setting for each background color, which is switched by the BACKGROUND switch. You can change the drawing color individually by tapping on the color display and choosing from 24 colors in the pop-up list. Tapping the [RESET COLOR] button sets all drawing color settings to the default settings.

Figure 3.555873.447 shows the FILE LIST entry.

① Select the waveform to display in the foreground.

② Displays the waveform index and drawing color.

Tap to set the drawing color.

③ Show/Hide the waveforms.

Figure 3.55: FILE LIST entry

④ Displays the file name. Tap to open the waveform data file selection screen.

Set the CSV format file saved as XY-TXT (*.CSV) of WAVEFORM.

If there is no data in the specified format, the file name will be grayed-out and no waveform will be displayed.

In addition, if the file does not contain the target data for the X axis or Y axis, an icon will be displayed instead of a waveform.

⑤ Tap to delete the waveform data file settings.

3.4.17.2 CURSOR

Figure 3.565893.458 shows the screen when the [CURSOR]tab is selected. Cursor settings for LINE1 and LINE2 and display of cursor measurement values.

In the SECONDARY INDEX field, specify the SECONDRY SWEEP index number you want to focus on with the cursor.

In the TYPE field, set X for a vertical cursor that moves on the X axis and Y for a horizontal cursor that moves on the Y axis.

In the POSITION field, specify the cursor position by the voltage or current value of the axis specified by TYPE. You can also move the cursor in the graph display section by dragging.

Values of the points at which waveform of the specified SECONDARY INDEX of each waveform data set at FILE LIST intersects the cursor values are displayed by interpolating the data.

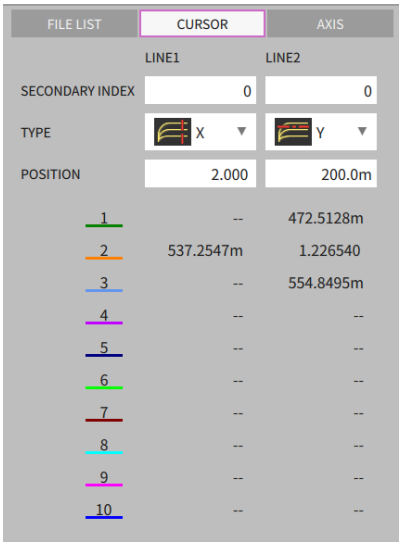


Figure 3.56: WAVE VIEWER screen (CURSOR)

3.4.17.3 AXIS

Figure 3.596051593.46 shows the screen when the [AXIS]tab is selected.

Set the axis of the WAVE VIEWER graph.

In the TITLE field, set the title of the graph displayed on the title bar of the WAVE VIEWER graph to 32 characters or less.

The AUTO RANGE switch automatically sets the X-AXIS and Y-AXIS RANGE and POSITION so that all displayed waveforms are optimally displayed on the graph when a waveform data file is set in FILE LIST.

The DISP ZERO switch is automatically set to display the graph including the origin when a waveform data file is set in FILE LIST or when the [AUTO SCALE] button is tapped.

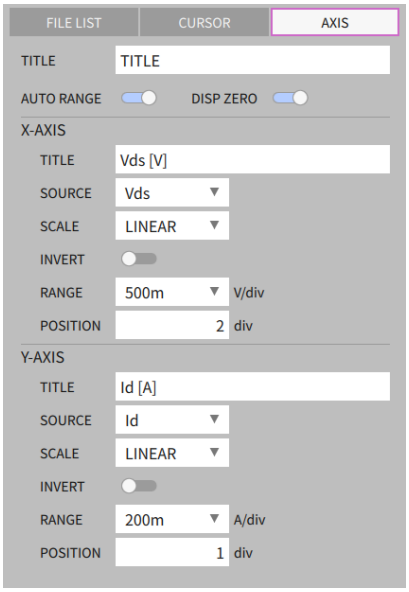


Figure 3.59: WAVE VIEWER screen (AXIS)

X-AXIS

Set the title of the X-axis of the WAVE VIEWER graph in the TITLE field.

The SOURCE field sets the X-axis data source . The choices are displayed with the names of typical FET devices. MATH also can be the choice.

In the SCALE field, select whether the X-axis scale is LINEAR (linear scale) or LOG (logarithmic scale). When the INVERT switch is turned ON, the X-axis display is flipped horizontally.

When the SCALE field is LINEAR, the RANGE field sets the display value per division on the X-axis. Set in 1-2-5 steps from the choices that pop up by tapping or using the HOLIZONTAL knob on the front panel. The POSITION field sets the display position of the origin. When you want to set the left edge to the origin, set it to 0 div, and when you want to set the right edge to the origin, set it to 10 div. If you set a negative value, the origin will be off the leftmost screen.

When the SCALE field is LOG, set the X-axis display range with minimum and maximum values. Set from the 1-10-100 step choices that pop up when you tap. Set the value in the right field to be greater than the value in the left field. You can use the HORIZONTAL knob on the front panel to set the maximum value.

Y-AXIS

Similar to the X-AXIS setting.

Set the title of the Y-axis of the WAVE VIEWER graph in the TITLE field.

The SOURCE field sets the Y-axis data source . The choices are displayed with the names of typical FET devices. MATH also can be the choice.

In the SCALE field, select whether the Y-axis scale is LINEAR (linear scale) or LOG (logarithmic scale). When the INVERT switch is turned ON, the Y-axis display is flipped vertically.

When the SCALE field is LINEAR, the RANGE field sets the display value per division on the Y-axis; The POSITION field sets the display position of the origin.

When the SCALE field is LOG, set the Y-axis display range with minimum and maximum values.

You can use the VERTICAL knob on the front panel to set RANGE.

3.4.17.4 SAVE/RECALL of WAVE VIEWER TEMPLATE

WAVE VIEWER settings can be saved to/read from a file with the extension CVT.

Tap the [SAVE] button to open the file setting screen. Set an arbitrary file name and tap the [OK] button to save the current WAVE VIEWER settings.

Tap the [RECALL] button to open the file selection screen. Select any file and tap the [OK] button to read the WAVE VIEWER settings saved in the selected file.

The file paths of FILE LIST are saved in the CVT file, and waveforms are displayed by reading from the saved paths when executing RECALL.

3.4.18 Detailed Settings in the SYSTEM Menu

Figure 3.576103.470 shows an example of the screen when the SYSTEM menu is selected.
The SYSTEM menu also has three menus on the left side of the screen.
SYSTEM STATUS
EXTERNAL UNIT SETTING
SYSTEM TOOLES

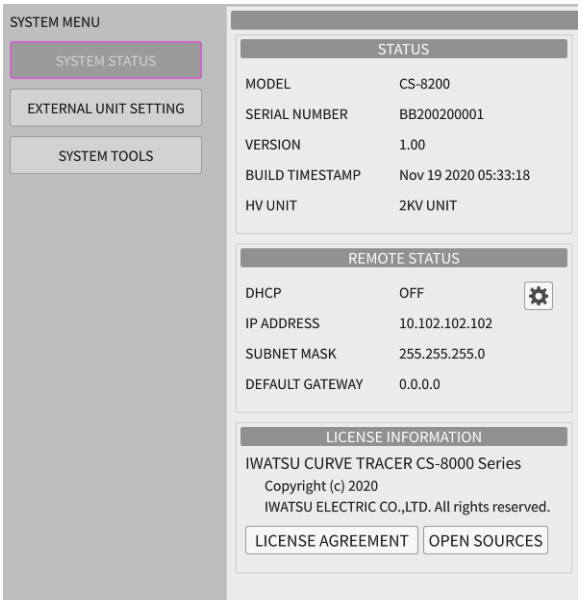


Figure 3.57: SYSTEM submenu (left side) and SYSTEM STATUS screen (partial)

3.4.18.1 SYSTEM STATUS

The right side of Figure 3.576103.470 is part of the SYSTEM STATUS screen.
The STATUS section shows the details of manufacturing and modification of this instrument.
The MODEL field displays the model name of this instrument.
The SERIAL NUMBER field displays the serial number of this instrument.
The VERSION field displays the version of the software in this instrument.
The BUILD TIMESTAMP field displays the date and time the software was updated.
The HV UNIT field displays the name of the built-in high voltage unit.

REMOTE STATUS displays information for remote control of this instrument by connecting it to a LAN via Ethernet.
When the DHCP column is ON, if the DHCP (Dynamic Host Configuration Protocol) server is functioning in the connected LAN environment, the IP ADDRESS, SUBNET MASK, and DEFAULT GATEWAY values assigned by the DHCP server are displayed in each column. If the DHCP field is OFF, the value set arbitrarily will be displayed.
With this IP ADDRESS, you can send measurement instructions and receive measured values from a controller such as a PC via LAN. Once LAN communication is established, the  button in the upper right will appear and  icon will appear in the top area of the screen. Tap the  button to disconnect.
Tap the gear button  on the upper right to display the NETWORK SETTING pop-up screen shown in Figure 3.586213.481, where you can change the settings. When the DHCP switch is turned off, the IP ADDRESS, SUBNET MASK, and DEFAULT GATEWAY values can be set arbitrarily.

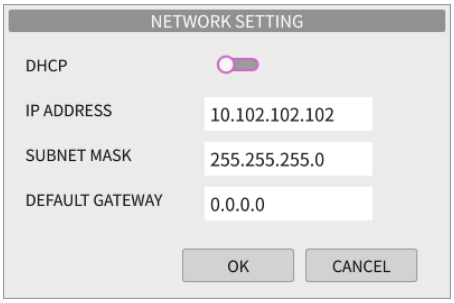


Figure 3.58: NETWORK SETTING pop-up screen

LICENSE INFORMATION displays our copyright regarding this instrument in English.
Tap the LICENSE AGREEMENT button to check the open source license agreement, and tap the OPEN SOURCES button to check the module that uses open source.

3.4.18.2 EXTERNAL UNIT SETTING

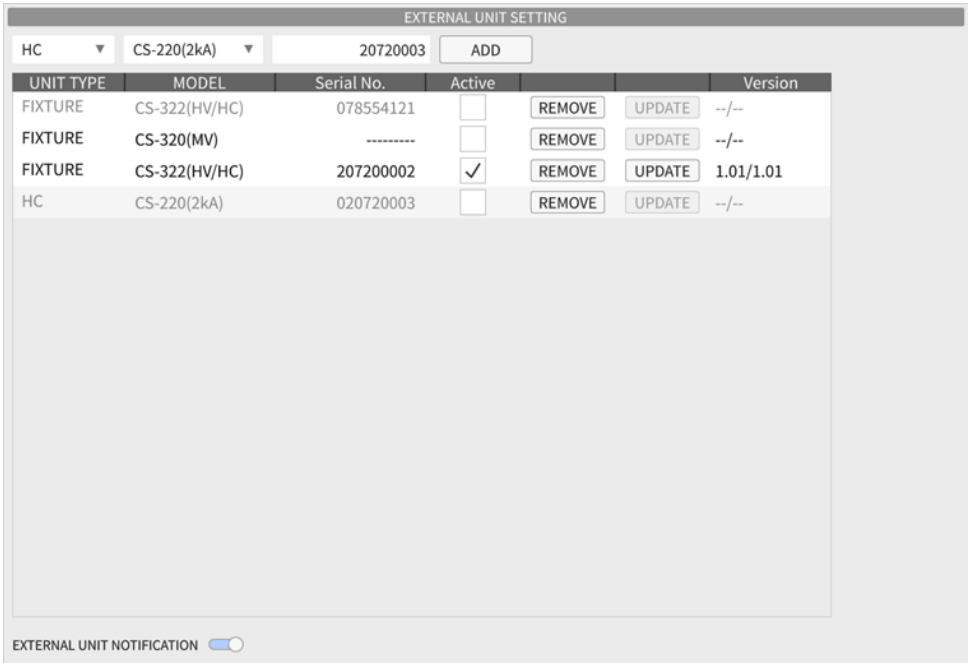


Figure 3.59: EXTERNAL UNIT SETTING screen

Figure 3.596323.492 shows the EXTERNAL UNIT SETTING screen.
Registers and cancels external units (connecting devices) such as Test Fixtures and HC units that connect to this instrument.
Below the title bar is a settings field for new registrations, below which a list of already registered external units and their contents are listed.
To register a new one, tap the leftmost field and select the unit type (UNIT TYPE) to connect from the pop-up list. If the external unit is a Test Fixture, select FIXTURE, and when it is an HC unit, select HC.
Then tap the second field from the left and select the model name (MODEL) of the external unit you want to use from the pop-up list.See Table 3.21 for UNIT TYPE and MODEL.
Next, tap the third field from the left and set the serial number (Serial No.) of the external unit serial number excluding the alphabet (9 digits). After confirming the model name and serial number, tap the ADD button on the far right to complete the registration and add it to the registered device list.

Table 3.21 UNIT TYPE and MODEL of external unit

UNIT TYPE	MODEL
FIXTURE	CS-322(HV/HC)、CS-323(HV/HV/CV)
HC	CS-210(1kA)、CS-220(2kA)
SMU	CS-401(LPSMU)
SEMU	CS-402(SEMU)
CMU	CS-403(CV)
OTHERS	CS-404(SELECTOR)、CS-405(POWER)

The information at the time of registration is displayed as it is in the UNIT TYPE, MODEL, and Serial No. fields in the registered external unit list. External units that cannot establish communication with the main unit will be grayed out and cannot be used.

It will be automatically set to Active during registration. For units that cannot be set to Active at the same time (FIXTURE, HC, SMU of the same model, etc.), the unit that is set to Active later takes precedence. Also, in a special case, if you do not use the Test Fixtures we provide and connect to a device equivalent to your own Test Fixtures for measurement, uncheck all Test Fixtures.
Tap the REMOVE button to unregister the relevant external unit and remove it from this list.
Tap the UPDATE button to update the firmware of the external unit. Update data is sent from the CS-8000 Series to the external unit for updating. This button is disabled if you do not need to update it.
When the EXTERNAL UNIT NOTIFICATION switch under the list of registered external units is set to the ON state, a pop-up screen will notify you when the power is turned on under the following conditions.

1. When the external connection device has never been set after delivery of this instrument (see Section 3.2.5)
2. When communication with the device set to Active is not possible
3. When there is a device for which the firmware should be updated

3.4.18.3 SYSTEM TOOLS

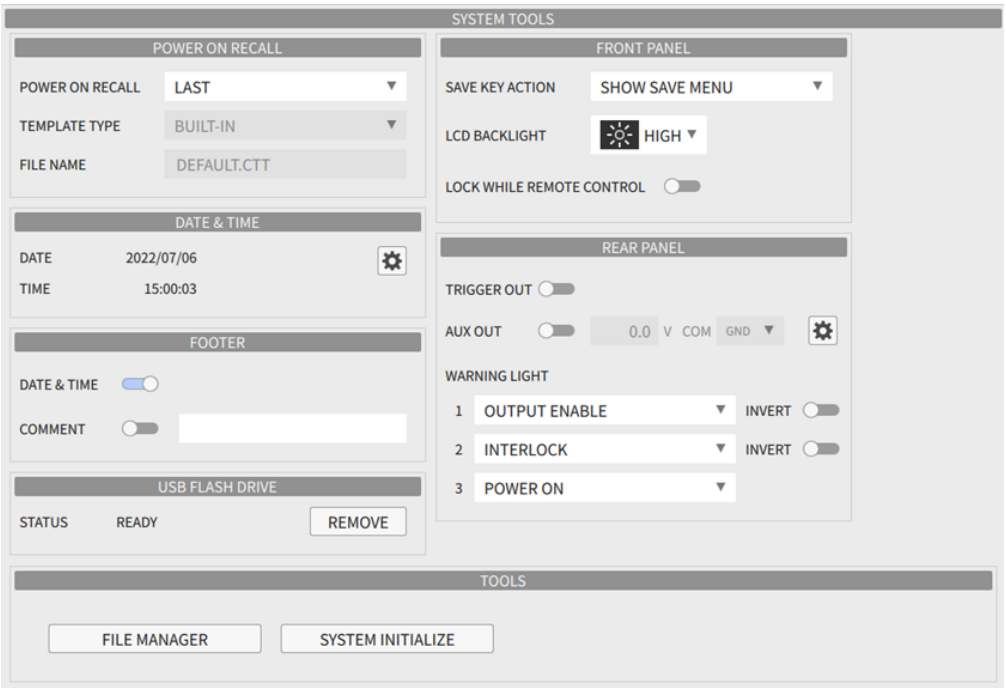


Figure 3.60: SYSTEM TOOLS screen

Figure 3.606433.503 shows the SYSTEM TOOLS screen.
This menu provides various setting tools required to use this instrument.

In the POWER ON RECALL section, select the setting status when the power is turned on.
There are three choices in the POWER ON RECALL field.
DEFAULT is the basic setting of this instrument.
In LAST, the setting returns to the setting when the standby switch was turned off after the previous use.
In TEMPLATE (*.CTT), it can be set in any setting condition file. Select BUILT-IN or USER CUSTOM in the TEMPLATE TYPE field below.
BUILT-IN is a setting condition file built in at the time of shipment. The name of the current configuration file is displayed in the FILE NAME field below. When you tap this field, the SELECT BUILT-IN TEMPLATE FILE pop-up screen will be displayed, and a list of BUILT-IN setting conditions will be

displayed. Select the one that is close to the desired measurement.
USER CUSTOM is a setting condition file saved by the user in this instrument. It is necessary to save any measurement conditions in the TEMPLATE (*.CTT) file in advance using the SAVE menu, etc. The file name of the selected configuration condition is displayed in the FILE NAME field below. Tap this field to display the SELECT TEMPLATE FILE pop-up screen. A list of setting conditions saved by the user will be displayed on this instrument. Select a file from this list.

DATE & TIME sets the date and time of the instrument's internal clock.
To correct the time, tap the gear icon on the right. The DATE & TIME SETTING screen shown in Figure 3.616543.514 is displayed. Set the year, month, and day in the DATE field, set the hour, minute, and second in the TIME field, and tap the OK button to set.
The time of this internal clock is used as the time stamp when creating various files.

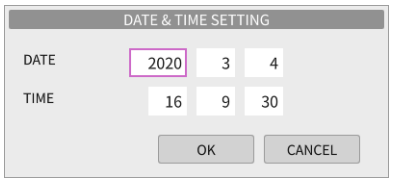


Figure 3.61: DATE and TIME SETTINGS screen

In the FOOTER section, set the FOOTER display section at the bottom of the measured value display area.
When the DATE & TIME switch is turned on, the current date and time is displayed.
When the COMMENT switch is turned on, the character string is displayed in the field on the right. Tap the field to edit the string. The character string input pop-up screen will be displayed. Edit it and set it with the OK button.
The maximum length of the character string is 128 characters, but the part that cannot be displayed due to the limitation of the display area is displayed as "...".

USB FLASH DRIVE confirms the removal of the USB memory.
When the USB memory is not connected, EMPTY is displayed to the right of STATUS.
When the USB memory is connected, the file system is read, and if available, STATUS is displayed as READY, and the USB memory can be used by operations such as SAVE, RECALL, and SCREEN COPY.
To remove the USB memory, tap the REMOVE button on the right and the STATUS will change to SAFE TO REMOVE. Check this before removing the USB memory. After removing it, STATUS will be displayed as EMPTY again.

In the FRONT PANEL section, make settings related to the front panel.
In the SAVE KEY ACTION field, select the action for pressing the SAVE key in the MENU section of the front panel and the  button at the top of the screen.

Table 3.22: SAVE KEY ACTION

SAVE KEY ACTION	Button	Operation
SHOW SAVE MENU		Displays the SAVE menu This is the same operation as tapping SAVE in the MENU
EXEC SAVE (WAVEFORM)		Execute file saving of the measured data. The save target and save folder/file name depend on the WAVE-FORM(*.CTW) type setting in the SAVE menu.
SCREEN COPY		Execute file saveing of screen copy. The save target and save folder/file name depend on the SCREEN COPY menu setting.

The LCD BACKLIGHT field adjusts the brightness of the LCD screen backlight.
Set in 3 levels: HIGH, MID, and LOW.
When the LOCK WHILE REMOTE CONTROL switch is turned on, the operation of the front panel and LCD screen is disabled while the instrument is remotely controlled from a controller such as a PC via LAN except for the standby switch and OUTPUT ENABLE key.

REAR PANEL controls the TRIGGER OUT output and AUX OUT output on the rear panel.
When the TRIGGER OUT switch is turned on, a trigger signal is output from the TRIGGER OUT connector on the rear panel.
When the AUX OUT switch is turned on, the specified voltage is output to the AUX connector on the rear panel. The field to the right of the AUX OUT switch sets the output voltage of the AUX connector. In the COM field to the right of the output voltage, select the reference potential of the output voltage of the AUX connector with the GND potential or the ground side SENSE potential of the DUT. The AUX output is output only during the period from the start of measurement to the end of measurement.
Tap the gear button (⚙) on the right to display the FIXTURE UNIT AUX SETTING screen. Set AUX1 and AUX2 of the Test Fixture. With the AUX1 and AUX2 switches, set the terminal to be used to ON and tap the OK button to enable/disable AUX1 and AUX2 of the Test Fixture. The voltage applied to the corresponding AUX connector on the rear of the Test Fixture is output from the AUX terminal set to ON on the Test Fixture connection terminal. Below the AUX OUT switch, the name of the terminal set to ON is displayed.
In addition to the AUX output of this instrument, the voltage applied to the Test Fixture can also be the output from an external DC power supply as an auxiliary voltage for the DUT. Connect to the AUX1 and AUX2 connectors on the rear of the Test Fixture that are set to ON on the FIXTURE UNIT AUX SETTING screen. This voltage will be output to the AUX terminal of the connection terminal of the Test Fixture of the same name.
The output of the AUX terminal of the Test Fixture connection terminal is not controlled by the measurement timing. The voltage applied to the AUX connector on the rear of the Test Fixture is output as it is. However, when the OUTPUT ENABLE lamp on the front panel of this instrument is off and the INTERLOCK lamp on the front panel of the Test Fixture is on, the output from the AUX terminal on the connection terminal is stopped.
WARNING LIGHT is the setting of the conditions for turning on/off the warning light that is installed as an option. This setting is displayed only when the option is installed. A maximum of three warning lights can be installed, and the settings for the installed lights will be displayed.

Table 3.23: WARNING LIGHT ON/OFF condition

Setting	Condition
OFF	Always OFF
POWER ON	The System is powered on.
OUTPUT ENABLE	OUTPUT ENABLE=ON *
INTERLOCK	INTERLOCK is occurring *
INTERLOCK or OUTPUT DISABLE	INTERLOCK is occurring or OUTPUT ENABLE=OFF *
MEASURING	SINGLE/REPEAT measuring is progress *
OVERHEAT	OVERHEAT is occurring *

* : When INVERT is set to OFF, it is a condition for the light to be on; when INVERT is set to ON, it is a condition for the light to be off.

The TOOLS section has a FILE MANAGER button and a SYSTEM INITIALIZE button.
Tap the FILE MANAGER button to display the FILE MANAGER pop-up screen shown in Figure 3.626653.525.
You can specify a folder in this instrument or a USB memory to display and manage files and lower folders in it.
Below the FILE MANAGER title bar is the location of the current folder. Tap the icon in the instrument, or tap the icon in the USB memory.
In both file systems, the first folder specified / displayed is the top folder, and its contents are displayed in the table below.
From the left, the displayed contents are in the order of check box, file ( ) or folder ( ) identification icon, file name or folder name, file size, and file creation date and time.
When a folder is displayed, tap the part other than this check box to display the contents of the folder. You can also go up one folder by tapping his icon ( ) at the right end of the display field for the current folder location. You can browse all the folders by repeating this.

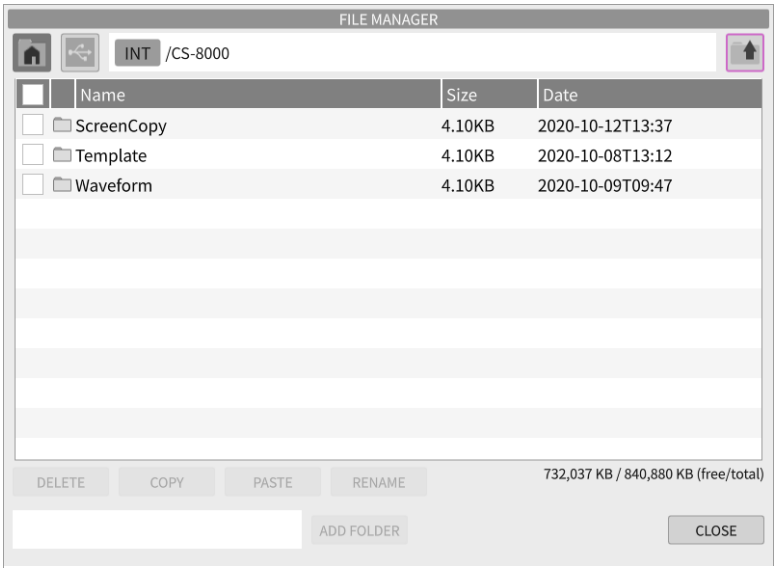


Figure 3.62: FILE MANAGER screen

You can handle files in four ways: DELETE (delete), COPY & PASTE (duplicate), RENAME (renaming), and ADD FOLDER (add folder).
To delete, check the check box of the file you want to delete. You can also check multiple files. Also, when you tap the check box in the item row of the table, all files will be checked.
Tap the DELETE button. You will be asked to confirm the deletion on the CONFIRMATION screen. Click the OK button to delete, or the CANCEL button to cancel the deletion.
For duplication, check the check box of the original file of duplication and tap the COPY button. Then move to the destination folder and tap the PASTE button. You cannot make duplicates with the same

name in the same folder.

To change the file name, check the check box of the file and tap the RENAME button. A pop-up screen for entering a character string will be displayed. Edit it and set it with the OK button.

To add a folder, tap the field to the left of the ADD FOLDER button and set the folder name on the string input pop-up screen. The ADD FOLDER button will be enabled, and tapping it will add a folder.

The above is the operation of FILE MANAGER. To finish this, tap the CLOSE button.

The SYSTEM INITIALIZE button returns the various settings of this instrument to the factory defaults. Initializes the part that is not included in the initialization settings using the DEFAULT key in the RECALL menu.

The items and contents initialized by SYSTEM INITIALIZE are the items set by Table 3.243.214 RECALL operation, the default settings, and the items and initial values that are not subject to SYSTEM INITIALIZE and are not subject to Table 3.253.22 RECALL operation.

The measurement data files and various setting condition files acquired up to that point will not be lost.

3.4.19 DEFAULT and the INTIALIZE Settings

In this section, Table 3.243.214 shows the items set by the RECALL operation and their default settings. Table 3.253.225 shows the items that are not subject to the RECALL operation and are subject to the SYSTEM INITIALIZE operation and their settings.
Items not covered by the RECALL and SYSTEM INITIALIZE operations are listed in Table 3.263.236.

Table 3.24: Items set by the RECALL operation and default settings

(1/4)

Category	Item	Default Setting
CONFIGURATION	DEVICE	FET
CONFIGURATION	CONFIGURATION	STANDARD
	GATE / BASE RESISTOR switch	OFF
	LEAKAGE switch	OFF
	GNDU switch	OFF
	HI/LO selection of DRAIN / COLLECTOR SENSE and GATE / BASE SENSE	SENSE
DRAIN / COLLECTOR SUPPLY	UNIT	MV
	SOURCE	VOLTAGE
	MODE	PULSE
	MAX	20
	POLARITY	POSITIVE
GATE / BASE SUPPLY	UNIT	GATE
	SOURCE	VOLTAGE
	MODE	PULSE
	MAX	1
	POLARITY	POSITIVE
AUX OUT	AUX OUT switch	OFF
	AUX voltage	0
	COM	GND
	AUX1 switch	OFF
	AUX2 switch	OFF
ACQUISITION	PRIMARY SWEEP	DRAIN / COLLECTOR SUPPLY
DRAI N/ COLLECTOR SUPPLY	DELAY	0 u
	PULSE WIDTH	400 u
GATE / BASE SUPPLY	DELAY	0
	PULSE WIDTH	400 u

(2/4)

Category	Item			Default Setting
ACQUISITION (Continued)				
TIMING	Pulse MEAS.POINT			200.0 u
	Pulse MEAS.TIME			10 u
	DC MEAS.POINT			200 u
	DC MEAS.TIME			10 u
	PERIOD			MANUAL
	PERIOD in MANUAL			5.00 m
AVERAGE	AVERAGE switch			OFF
	AVERAGE times			10
HOLDTIME1 to HOLDTIME3	Switch			OFF
	Retain Time			0.00 m
	GATE / BASE SUPPLY			PULSE BASE
	DRAIN / COLLECTOR SUPPLY			ZERO
DRAIN / COLLECTOR SUPPLY	SWEEP switch			ON
	MODE			LINEAR
	MODE-2			SINGLE
	START			0.00
	STOP			0.00
	STEPS			1000
ACQUISITION RANGE	V:	Setting		FIX
		Measurement Range Setting		20
		TITLE		Vds
	I:	Setting		FIX
		Measurement Range Setting		2
		TITLE		Id
LIMIT	ACTION			STOP
	V:	Upper	Switch	OFF
			Value	0.00 m
		Lower	Switch	OFF
			Value	0.00 m
	I:	Upper	Switch	OFF
			Value	0 p
		Lower	Switch	OFF
			Value	0 p
	P:	Upper	Switch	OFF
			Value	1 m
SLOPE (Tr/Tf)	Value			0

(3/4)

Category	Item			Default Setting
GATE / BASE SUPPLY	SWEEP switch			OFF
	MODE			NONE (1-POINT)
	STOP			0 m
	PULSE BASE			0 m
ACQUISITION RANGE	V:	Setting		FIX
		Measurement Range Setting		1
		TITLE		Vgs
	I:	Setting		FIX
		Measurement Range Setting		1
		TITLE		Ig
LIMIT	ACTION			STOP
	V:	Upper	Switch	OFF
			Value	0.00 m
		Lower	Switch	OFF
			Value	0.00 m
	I:	Upper	Switch	OFF
			Value	0 p
		Lower	Switch	OFF
			Value	0 p
	P:	Upper	Switch	OFF
			Value	0 m
SLOPE (Tr/Tf)	Value			0
AXIS-XY	TITLE			Blank
	MULTI TRACE			OFF
	AUTO RANGE			ON
	DISP ZERO			ON
X-AXIS	SOURCE			Vds
	SCALE mode			LINEAR
	INVERT function			OFF
	RANGE (V/div)			1 k
	POSITION (div)			0
Y-AXIS	SOURCE			Id
	SCALE mode			LINEAR
	INVERT function			OFF
	RANGE (A/div)			1 k
	POSITION (div)			0
MATH	MATH TYPE			R(on)
	REFERENCE			(none)

(4/4)

Category	Item		Default Setting
AXIS-YT	AUTO RANGE		ON
	DISP ZERO		ON
Vds	VISIBLE switch		ON
	RANGE (V/div)		20
	POSITION (div)		0
Id	VISIBLE switch		ON
	RANGE (A/div)		200 m
	POSITION (div)		0
Vgs	VISIBLE switch		ON
	RANGE (V/div)		20
	POSITION (div)		0
Ig	VISIBLE switch		ON
	RANGE (A/div)		200 m
	POSITION (div)		0
TIME CURSOR	POSITION (s)		200 u
DATA LIST			
MARKER	VISIBLE switch		ON
	SECONDARY INDEX		0
	PRIMARY INDEX		0
DATA LIST	Vds switch		ON
	Id switch		ON
	Vgs switch		ON
	Ig switch		ON
	R(on) switch		ON
	Vds(out) switch		ON
	Vgs(out) switch		ON
	Display Order		Vds, Id, Vgs, Ig, R(on), Vds(out), Vgs(out)
CURSOR	MODE		OFF
REFERENCE	VISIBLE switch		OFF
	REFERENCE		(none)
ANALYSIS			
COMPARISON	ACTION		NONE
	HIGH	Switch	OFF
		REFERENCE	(none)
	LOW	Switch	OFF
		REFERENCE	(none)
DISPLAY	VIEW XY switch		ON
	VIEW YT switch		ON
	VIEW DATA LIST switch		OFF
	VIEW CURSOR switch		OFF
	VECTOR		LINE

Table 3.25: Items that are not subject to RECALL operations and

(1/3)

Category	Item	Default Setting
REFERENCE	FOLDER MODE	SYSTEM DEFAULT
	FOLDER	INT/CS-8000/Reference
	SUFFIX	NONE
	FILENAME	reference
DISPLAY		
COLOR	BACKGROUND	Black
	Color of Vds to GRID	Color of RESET COLOR
RECALL	RECALL TYPE	TEMPLATE (*.CTT)
	TEMPLATE TYPE	BUILT-IN
	FOLDER (TEMPLATE)	INT/
	FOLDER (WAVEFORM)	INT/
SAVE	SAVE TYPE	TEMPLATE (*.CTT)
TEMPLATE	FOLDER MODE	SYSTEM DEFAULT
	FOLDER	INT/CS-8000/Template
	SUFFIX	NONE
	FILENAME	setup
	RECALL ACTION	STOP
WAVEFORM	FOLDER MODE	SYSTEM DEFAULT
	FOLDER	INT/CS-8000/Waveform
	SUFFIX	DATE & TIME
	FILENAME	wave
	BINARY DATA (*.CTW) switch	ON
	YT TARGET	DISPLAYED
	Vds switch	ON
	Id switch	ON
	Vgs switch	ON
	Ig switch	ON
	XY-TEXT (*.CSV) switch	OFF
	CONDITION INFORMATION switch	ON
	SECONDARY INDEX	SELECT BY MARKER
	YT-TEXT (*.CSV) switch	OFF
	SECONDARY INDEX	SELECT BY MARKER
	PRIMARY INDEX	SELECT BY MARKER
	Vds switch	ON
	Id switch	ON
	Vgs switch	ON
	Ig switch	ON

(2/3)

Category	Item		Default Setting
SCREEN COPY	FORMAT		PNG
	COLOR MODE		FULL COLOR
	BACK COLOR		BLACK
	FOLDER MODE		SYSTEM DEFAULT
	FOLDER		INT/CS-8000/ScreenCopy
	SUFFIX		DATE & TIME
	FILENAME		image
WAVE VIEWER			
FILE LIST	BACKGROUND		black
	WAVE1 to 10, CURSOR, color of GRID		Color of RESET COLOR
	ACTIVE		WAVE 1
	WAVE1 to 10	VISIBLE switch	OFF
		File	(none)
CURSOR	LINE1	SECONDARY INDEX	0
		TYPE	X
		POSITION	0.0
	LINE2	SECONDARY INDEX	0
		TYPE	Y
		POSITION	0.0
AXIS	TITLE		(none)
	AUTO RANGE		ON
	DSIP ZERO		ON
	X-AXIS	TITLE	(none)
		SOURCE	Vds
		SCALE	LINEAR
		INVERT	OFF
		RANGE(V/div)	1k
		POSITION(div)	0
	Y-AXIS	TITLE	(none)
		SOURCE	Id
		SCALE	LINEAR
		INVERT	OFF
		RANGE(V/div)	1k
		POSITION(div)	0

(3/3)

Category			Item	Default Setting
SYSTEM MENU				
	SYSTEM STATUS. REMOTE STATUS		DHCP switch	ON
			IP ADDRESS (DHCP OFF)	10.102.102.102
			SUBNET MASK (DHCP OFF)	255.255.255.0
			DEFALT GATEWAY (DHCP OFF)	0.0.0.0
	EXTERNAL UNIT SETTING		EXTERNAL UNIT NOTIFICATION switch	ON
	SYSTEM TOOLS			
		POWER ON RECALL	POWER ON RECALL	DEFAULT
			TEMPLATE TYPE (TEMPLATE)	BUILT-IN
			FILENAME (TEMPLATE)	FIX
		FRONT PANEL	SAVE KEY ACTION	SHOW SAVE MENU
			LCD BACKLIGHT	HIGH
			LOCK WHILE REMOTE CONTROL switch	N/A
		REAR PANEL	TRIGGER OUT switch	OFF
		FOOTER	DATE & TIME switch	ON
			COMMENT switch	OFF
			COMMENT	Blank

These settings can be returned to the default settings by SYSTEM INITIALIZE. See Section 3.4.18.3.

Table 3.26: Items not covered by SYSTEM INITIALIZE and factory settings

Category		Item	Default Setting
SYSTEM MENU			
	EXTERNAL UNIT ETTING	All items except the switch of EXTERNAL UNIT NOTIFICATION	N/A

3.4.20 Firmware Update

The Curve Tracer CS-8000 Series can be updated with the firmware update program provided by IWATSU.
The update can be performed by the user.

1) Preparation
   Prepare a USB memory with a copy of the firmware zip file and a USB keyboard.
   For information on how to obtain the latest version of the firmware, please refer to our sales staff or our website URL: https://www.iwatsu.com/tme/

2) Start Curve Tracer CS-8000 Series
   Connect the USB keyboard and USB memory to the USB connector of the CS-8000 Series, and turn on the standby switch. To be on the safe side, make a note of the current VERSION and BUILD TIMESTAMP as shown in SYSTEM STATUS in Section 3.4.18.1

3) Launching the firmware update tool
   After the CS-8000 Series is started, the displayed IWATSU logo disappears once. During about two seconds when both IWATSU logo and the mouse cursor arrow is displayed again, press [F1] key.

4) Firmware selection
   Tap the [Browse ...] button of the Select boot image file (*.zip), select the zip file of the latest version of the firmware of the USB memory in the file selection dialog, and tap the [OK] button.

5) Firmware writing
   Tap the [Write] button to start writing the CS-8000 Series firmware.
   It takes about 1 to 2 minutes, and when the writing is completed, the message "Writing boot image completed." And the [Exit] button are displayed. Remove the USB memory and tap the [Exit] button. The message "The system reboots" and the OK button are displayed. Tap [OK] to restart the CS-8000 Series.

6) FPGA configuration
   If an FPGA (circuit configuration) update is included, the FPGA configuration (about 8 to 10 minutes) will start automatically. In this case, follow the on-screen message to restart the standby switch on/standby.

7) Check version
   After booting on the normal screen, follow the SYSTEM STATUS display in Section 3.4.18.1 to confirm that the application was successful with the VERSION and BUILD TIMESTAMP displays.

Memo

Chapter 4 Daily Maintenance and Calibration

It explains inspection, maintenance, and calibration when using Curve Tracer CS-8000.

4.1 Daily maintenance

To clean the exterior, use a soft cloth including a small amount of water and gently wipe it.

Use of solvent or detergent prohibited for cleaning may cause discoloration or unexpected failures.

Do not use the following solvent and the detergent.

- Alcohol, gasoline, acetone, lacquer, ether, thinner, detergent including ketone.

CAUTION !

Since electric shock may be generated, be sure to remove the power cord before cleaning.

Inside this instrument, there is a battery that maintains the clock function.

It has a life of 8 years in a room temperature environment. When the battery life is exhausted, the time display of this product shows an abnormal time.

If you continue to use it as it is, the date of the file saved by this product may become abnormal and it may not be processed correctly by the application of the personal computer that processes the data.

Customers cannot replace the battery, please contact IWATSU or our sales distributors.

4.2 Calibration

It is recommended that CS-8000 be calibrated regularly for accurate measurement.

For regular calibration of the entire product, contact IWATSU or our sales distributors. **Regular calibration once per year** is recommended.

4.3 Repair and sending of repaired Instrument

If a failure occurs, contact IWATSU or our sales distributors. If an unexpected failure by our fault occurs during the warranty period, it can be repaired without charge.

When sending the product, please write the product name, production number, failure, name, place, and telephone number of the person in charge clearly.

To avoid an accident during transportation when sending it, use the corrugated carton box used for delivery or equivalent: i.e., having shock absorbing materials. If a proper packing box is not found, contact IWATSU or our sales distributors.

4.4 Storage and transportation

Do not store in the locations below:

- Direct sunlight is received.
- With much dirt
- Corrosive gas is generated.

Conditions to store CS-8020 / CS-8200 / CS-8500 are as follows:

- Storage temperature: −20°C to +60°C
- Storage humidity: 5% to 80% RH (40°C, and no condensing)

When transporting the instrument, use the packing materials attached when purchasing it or equivalent.

Chapter 5 Specifications

5.1 Specifications

Table 5.1 CS-8000 Series Specifications

(1/5)

Item			Specifications
DRAIN/COLLECTOR SUPPLY			
MV UNIT			
	Output Part	Max. peak Power	200 W (200 V, 1 A / 100V, 2A)
		Voltage Range	200 V (Note1), 100 V, 50 V, 20 V
		Current Range	2 A (Note2), 1 A (Note2), 500 mA (Note 2), 200 mA to 5 nA (1-2-5 steps)
		Setting resolution	1/±20000
		Mode	DC, PULSE, PULSE (LONG)
		Polarity	POSITIVE, NEGATIVE, BIPOLAR
		Setting Accuracy	± (Set value x 1.2% + Set range x 0.4%)
		Note1: Polarity is POSITIVE, NEGATIVE only Note2: PULSE Mode only	
	Measure-ment Part	Voltage Range (Note1)	200 V to 200 mV (1-2-5 steps)
		Current Range (Note1)	2 A to 5 nA (1-2-5 steps)
		Measurement reso-lution	1/±20000
		Measurement accu-racy (Note2,3,4)	± (measured value x 1.2% + measurement range x 0.4%)
		Note1: Measure up to 125% of the measurement range Note2: Specify within the measurement range. Note3: For current measurement, add (measurement range x 0.002% x Vo) (Vo is output Voltage [V]) Note4: 200mV range adds ± 10mV and ± 50pA addition for 5nA to 20nA rang	
	SIN Output	Mode	AC, RECTIFIED SIN (Full wave (1/1), Half wave (1/2), 1/3 to 1/50)
		Frequency	50 Hz (AC)
		Setting accuracy	± (Set value x 1.2% + Set range x 0.4%)
		Setting resolution	1/±1000

(2/5)

Item			Specifications
DRAIN/COLLECTOR SUPPLY (Continued)			
HV UNIT (CS-8200/CS-8500)			
	Output Part	Max. peak power	40 W (2 kV, 20 mA at CS-8200 / 5 kV, 8 mA at CS-8500)
		Voltage Range	5 kV (Note1), 2 kV, 1 kV, 500 V, 200 V
		Current Range (Note2)	20 mA to 50 μA (1-2-5 steps)
		Setting resolution	1/±20000
		Mode	DC, PULSE
		Polarity	POSITIVE, NEGATIVE
		Setting Accuracy	± (Set value x 1.5% + Set range x 0.5%)
		Note 1: 5 kV CS-8500 only Note 2: CS-8200 only	
	Measure-ment Part	Voltage Range (Note1)	5 kV to 50 V (1-2-5 steps)
		Current Range (Note1)	20 mA (Note2) to 50 uA (1-2-5 steps) However, 2 mA to 5 nA (1-2-5 steps) when LEAKAGE is set
		Measurement Resolution	1/±20000
		Measurement Accuracy (Note3,4,5)	± (Set value x 1.2% + Set range x 0.4%)
		Note 1: Measure up to 125% of the measurement range Note 2: 20 mA is CS-8200 only. CS-8500 up to 10 mA. Note 3: Specified within the measurement range Note 4: In current measurement, add (measurement range x 0.002% x Vo) (Vo is the output voltage [V]) Note 5: 20 nA to 5 nA range is ± (measurement range x 5.0% + 200 pA) addition	

(3/5)

Item			Specifications
GATE/BASE SUPPLY			
	GATE UNIT		
		Output Part	Max. peak power	40 W (40 V, 1 A)
			Voltage Range	40 V, 20 V, 10 V, 5 V, 2 V, 1 V
			Current Range	1 A (Note 1), 500 mA (Note 1), 200 mA (Note 1), 100 mA to 5 nA (1-2-5 steps)
			Setting Resolution	1/±20000
			Mode	DC, PULSE, PULSE (LONG)
			Polarity	POSITIVE, NEGATIVE, BIPOLAR
			Setting Accuracy	± (Set value x 1.2% + Set range x 0.4%)
			Note 1: PULSE Mode only	
		Measure-ment Part	Voltage Range (Note 1)	50 V, 20 V, 10 V, 5 V, 2 V, 1 V
			Current Range (Note 1)	1 A to 5 nA (1-2-5 steps)
			Measurement Resolution	1/±20000
			Measurement Accuracy (Note 2,3,4)	± (measured value x 1.2% + measurement range x 0.4%)
			Note 1: Measure up to 125% of the measurement range Note 2: Specified within the measurement range Note 3: For current measurement, add (measurement range x 0.002% x Vo) (Vo is the output voltage [V]) Note 4: ± 50 pA is added for the 20 nA to 5 nA range.	
		SIN output	Mode	AC
			Frequency	50 Hz (AC)
			Setting Accuracy	± (Set value x 2% + Set range x 0.5%)
			Setting Resolution	1/±1000
GNDU				
	GND UNIT		Output voltage	0 V±100 μV
			Maximum sink current	±2.5 A
			Connecting terminal	FORCE, SENSE (Triaxial)
AUX			Output voltage (Note 1)	±40 V
			Output current	±50 mA (Typical value)
			Note 1: Output only during measurement	
TRIG OUT			Output voltage	3.3 V CMOS output Output at the start of the measurement cycle

(4/5)

Item			Specifications
Data acquisition			
Measurement cycle			2 ms to 5 s
Measuring point			Can be set
Measurement time			Can be set
MV, GATE UNIT			
	PULSE	Pulse width (Note 1)	50 μs to 10 ms
		Duty ratio	≦10 %
	PULSE (LONG)	Pulse width (Note 1)	50 μs to 1.6 s
		Duty ratio	≦50 % to 80 %
	Note 1: When the pulse width is narrow, it may not be possible to output up to the maximum voltage / current.		
HV UNIT			
	PULSE	Pulse width (Note 1)	20 ms to 1.6 s
		Duty ratio	≦50 % to 80 %
	Note 1: When the pulse width is narrow, it may not be possible to output up to the maximum voltage / current.		
MEASUREMENT		Measurement mode	SINGLE, REPEAT, STOP
		Sweep method	NONE (1-POINT), SINGLE, DOUBLE
		Number of steps	1 to 1000
		Hold time	3 stages of HOLDTIME1, HOLDTIME2, HOLDTIME3 Each stage 0-5 s, each voltage can be set
DISPLAY		Display	12.1 inch TFT-LCD with touch panel
		Dimensions (H × V)	261.12 mm × 163.2 mm
		Number of pixels	1280 × 800 (WXGA)
		Screen display	XY, YT, DATA LIST, CURSOR
SYSTEM		user interface	Operation panel, touch panel, mouse, keyboard (alphabetic)
		interface	LAN (10 /100/1000 Base-T)
		External memory	USB memory (file system: FAT, FAT32, exFAT) Measurement data, setup, screen copy
		Internal storage	Measurement data, setup, screen copy
		Control signal	Control interface, Interlock (HR10A connector: 10 pins), Calibration CAL output
		Indicator (LED)	INTERLOCK, OUTPUT ENABLE
		Built-in clock	Year / month / day hour: minute: second

(5/5)

Item		Specifications
Power Source	Power Voltage Range/ Frequency	AC 100 V to 240 V ±10%, 50/60Hz
	Power line consumption	220 VA max (CS-8200 / 8500) 200 VA max (CS-8020)
Physical	Dimensions (W × H × D)	424 mm × 221 mm × 556 mm (Excluding accessories and projection)
	Weight	CS-8200 / 8500: About 21 kg (Excluding accessories and options) CS-8020: About 19 kg (Excluding accessories and options)
Environmental Conditions	Performance ensured Temperature	+10 °C to +35 °C
	Operating Temperature	0 °C to +40 °C, 5% to 80% RH (30 °C, and no condensing)
	Operating Humidity	upper limit 55% RH (40 °C, and no condensing)
	Warm-up time	30 minutes from power on Note: The performance is the ensured value after the warm-up time.
	Storage Temperature / Humidity	−20 °C to +60 °C, 5% to 80% RH (No condensing)
	Altitude	Operating: Up to 2000 m
Accessory		Control interface terminator : 1 Protective cover right : 1 Protective cover left : 1 Fixed belt : 1 User's Guide : 1 CD (Instruction Manual / Remote Control Manual) : 1 Power Cord : 1 Cord Strap : 1

5.2 Compliance information

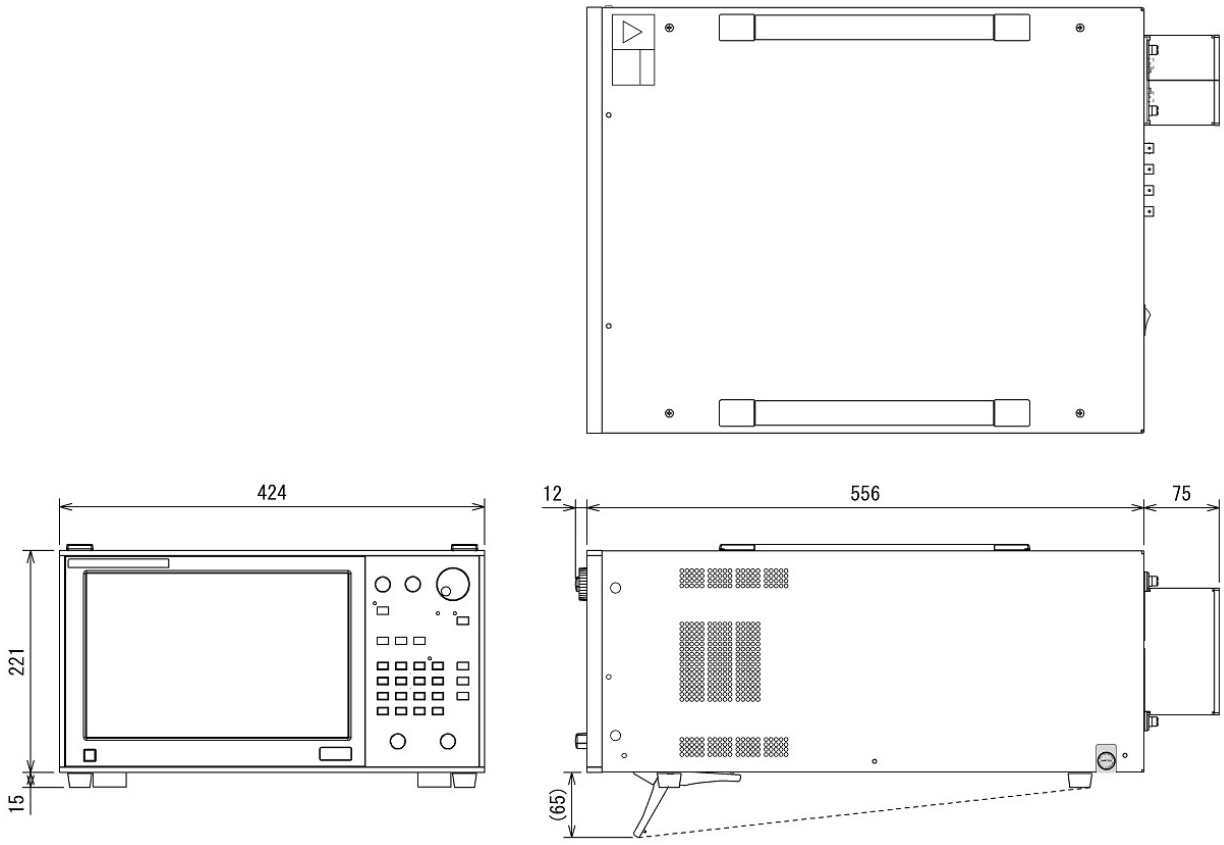
Table 5.2 CS-8000 Series Compliance information

Directive	Descriptions
Low Voltage Directive (Safety)	EN61010-1: 2010/A1: 2019 Pollution degree 2 Overvoltage category (installation category) II
EMC Directive	EN61326-1: 2021 (Group1,ClassA)Note
RoHS Directive	EN IEC 63000: 2018

Note: Cable condition

Use an Ethernet cable that is a shielded LAN cable (STP).

5.3 External dimensions



Unit: mm Tolerance ± 3

Figure 5.1: Curve Tracer CS-8500

CS-8020/ CS-8200/ CS-8500

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