

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 for the Curve Tracer CS-8000 Series has the following structure.
 - Curve Tracer CS-8000 Series instruction manual (this manual and PDF file i in the attached CD)
 - Test Fixture CS-322 Instruction manual (PDF file in the attached CD)
 - HC Unit CS-200 Series Instruction manual (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.

 ELECTRIC 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 prohibited.
- ◇ The contents of this instruction manual are compatible with CS-8000 Series Firmware Ver1.16.
- ◇ 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

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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. And, do not remodel the switch for power supply shutoff or do not open the cover during measurement. If not, 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 generated 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 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) Make the power switch a standby.
- (2) Please 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, after making the power switch a standby, and pulling out the power plug from the power outlet, 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, after making the power switch a standby, and pulling out the power plug from the power outlet, 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 or power adaptor 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, after making the power switch a standby, and pulling out the power plug from the power outlet, 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 make the power switch a standby and disconnect 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, set the power switch to standby, remove the 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, set the power switch to standby, remove the 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 two people or more to avoid dropping.

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 made a standby.**

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 at the both sides and rear side 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 drain / collector terminal and the gate / base terminal are mis wired, 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 each SENSE terminal is connected without connecting the FORCE terminals of drain / collector, gate / base, and source / emitter, 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.
- Not limited to FORCE / SENSE of the HIGH VOLTAGE terminal of the drain / collector, MIDDLE VOLTAGE terminal, and HIGH CURRENT terminal of the HC unit when two or more terminals with different withstand voltage 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.



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 or less) and no dew condensation allowed

Upper bound value 55 %RH (at 40 °C) and no dew condensation allowed

Storage temperature : -20 °C to +60 °C

Storage humidity : 5 % to 80 %RH (no dew condensation allowed)

● **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, the cable, and the adaptor, 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.

Read this page to ensure proper safety.



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 re-start 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 maximum working current of the Test Adapter.**

For each terminal of CS-501A (TO type adapter), CS-502 (axial type adapter), and CS-503 / CS-504 / CS-505 / CS-506 / CS-510 (surface mount type adapter), Do not apply a voltage greater than 1 kV (500 V for CS-510) or a current greater than 1 A.

Do not apply a voltage exceeding 100 V or a current exceeding 0.5 A to each terminal of CS-507 / CS-509 (surface mount type adapter).

Do not apply a voltage exceeding 3 kV or a current exceeding 40 A to each terminal of the CS-508 (SMD CHIP type adapter).

Exceeding the above voltage and current values 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
- Instruction manual (this manual) : 1
- CD (Instruction Manuals, Remote Control Manual) : 1

The following options are delivered when the purchase is specified

◆Option

- HC Unit CS-200 Series (500 A to 2 kA pulse measurement) : 1
- Test Fixture CS-322 (for connecting HC Unit)..... : 1

How to use this document; Notation

It is recommended that the beginner 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 transferring to an environment with different temperature and humidity, sudden temperature change may cause dew condensation. In such a case, this instrument should be inured to the ambient temperature before using it; ambient temperature gradually changes.

◇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.iti.iwatsu.co.jp/index_e.html).

For the procedure of the version updating Firmware in the main unit, refer to the section **3.4.15** Updating Firmware in the instrument.

Contact Us

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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, sample position can be set while checking the pulse waveform.**

As for the waveform setting time of the applied pulse, the applied pulse width and data acquisition timing can be set while checking the voltage waveform and current waveform, so measurement can proceed 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 a 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 2.1 shows the front panel of the CS-8200 and describes the names and functions of each part of the CS-8000 Series.

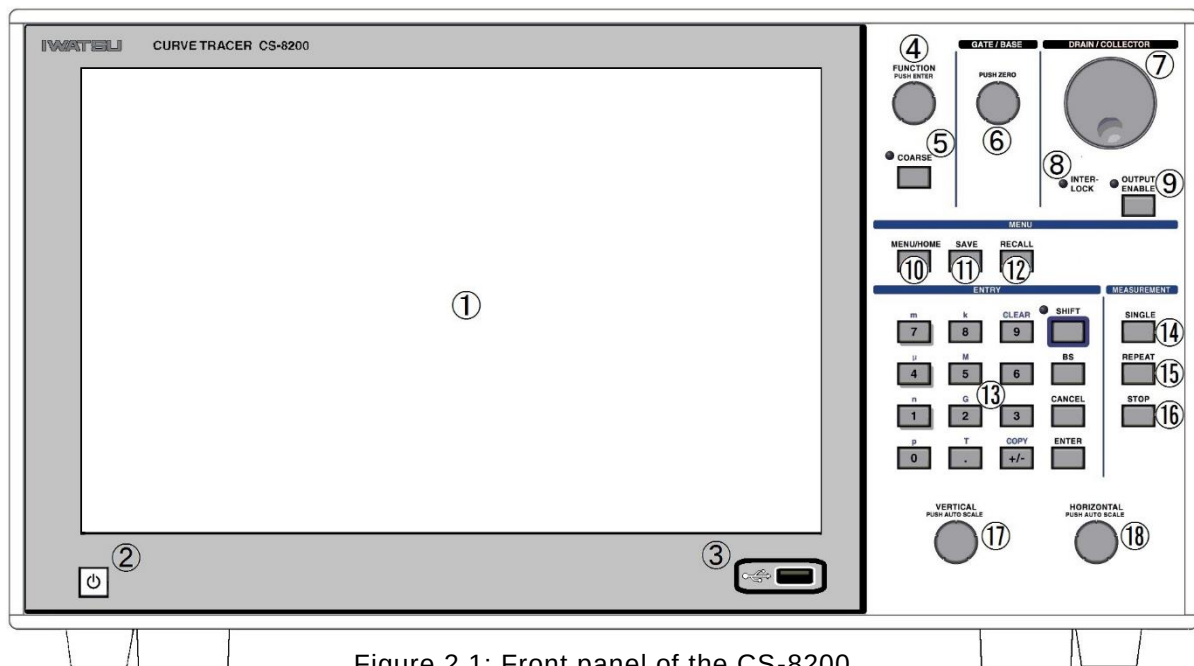


Figure 2.1: Front panel of the CS-8200

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 3.4.10, "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 2.2 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.

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 INTERLOCK 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.

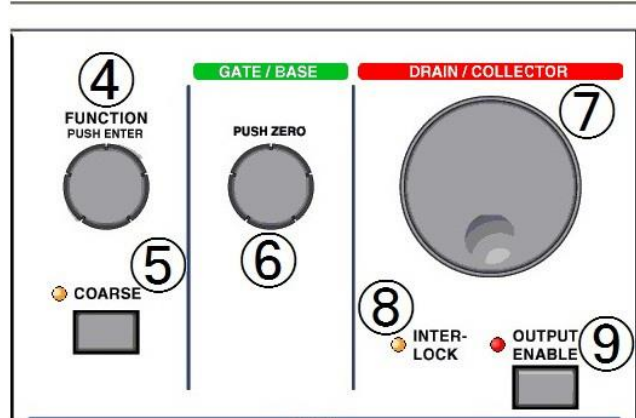


Figure 2.2: Upper right part of the front panel

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 2.3 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 3.4.13.3.

See Section 3.4.10 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 3.4.10.

See Section 3.4.11 for the RECALL screen and the setting.

2.1.3 Front Panel ENTRY and MEASUREMENT

Figure 2.4 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.

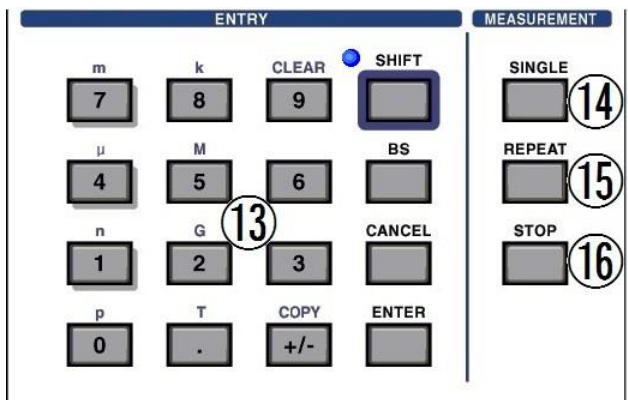


Figure 2.4: Front panel ENTRY and MEASUREMENT

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 3.4.12 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 MEASUREMENT SINGLE Key

The measurement is executed only once under the set measurement conditions and stopped.

⑮ MEASUREMENT REPEAT Key

The measurement is repeated under the set measurement conditions.

⑯ MEASUREMENT 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 2.5 shows the lower right corner of the front panel and describes the names and functions of each part.

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.

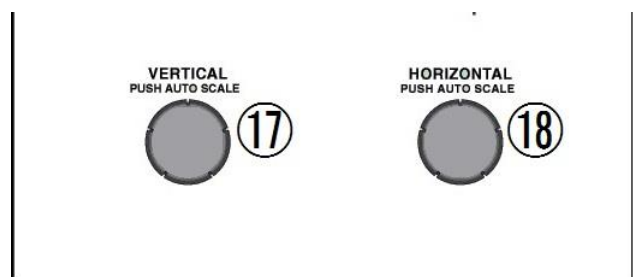


Figure 2.5: Lower right of front panel

2.2 Names and Functions of the Rear Panel

Figure 2.6 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.

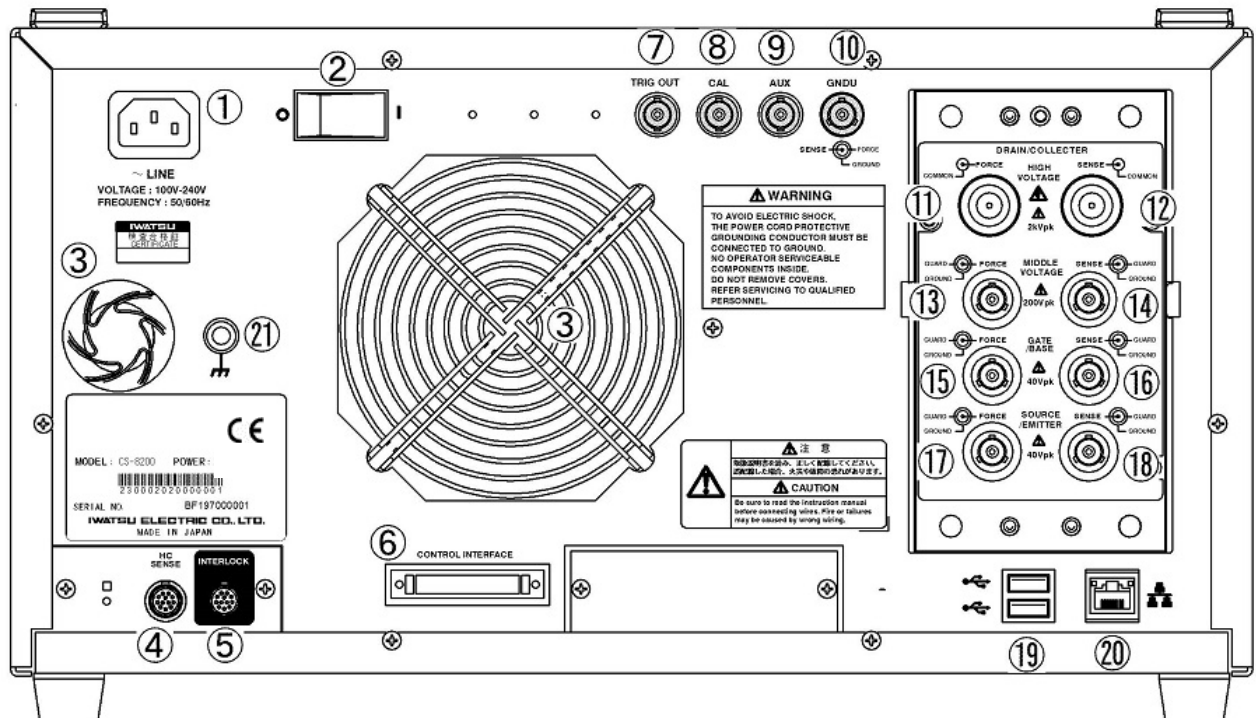


Figure 2.6: Rear panel of CS-8200

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 (O) 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 HC SENSE Connector

Connect 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.

⑤ INTERLOCK Connector

Cable devices such as optional Test Fixtures to detect interlocks and perform safety checks.

For more information, see "INTERLOCK Mechanism and Connectors" in Section 2.2.3.

⑥ CONTROL INTERFACE Connector

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

⑦ 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 SUPPLY and GATE / BASE SUPPLY of the PRIMARY SWEEP is DC or PULSE.

⑧ 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.

⑨ AUX Connector

Outputs the AUX voltage for measurement.
See "Configuring SYSTEM TOOLS" in Section 3.4.13.3 for configuration details.

⑩ GNDU Connector

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

⑪ 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 the connector.

⑫ 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 the connector.

⑬ 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.

⑭ 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.

⑮ GATE / BASE FORCE Connector

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

⑯ GATE / BASE SENSE Connector

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

⑰ SOURCE / EMITTER FORCE Connector

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

⑱ SOURCE / EMITTER SENSE Connector

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

⑲ USB Ports (Two)

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

⑳ 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.

㉑ 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 2.7 shows the triaxial electrode structure.

The center is ① the center electrode, ② the GUARD electrode surrounds the center electrode, and ③ the 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.

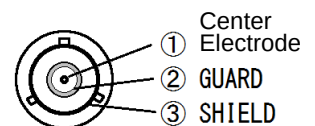


Figure 2.7: Triaxial electrode structure

2.2.2 High Voltage Connectors and Cables

The connectors ⑪ and ⑫ in the rear panel of CS-8200 shown in Fig. 2.6 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 optional Test Fixtures have an INTERLOCK mechanism, and interlock switches in various places detect that the front cover and protective cover of the rear connector of the Test Fixture are properly closed.

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

If any of the interlock switches is opened (OFF) during measurement, the output from DRAIN / COLLECTOR SUPPLY and GATE

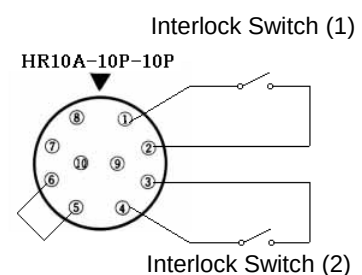


Figure 2.8: Wiring specifications for the INTERLOCK connector

/ BASE SUPPLY will be cut off and the measurement will be interrupted.

When using only the CS-8000 Series without using the Test Fixture specified by us, please contact our sales staff or customer support and be sure to install the INTERLOCK mechanism according to the wiring specifications of the INTERLOCK connector shown in Figure 2.8.

In addition to the optional Test Fixture, if you add a device that may cause electric shock, you can use the EXT INTERLOCK connector on the Test Fixture side to incorporate it into the INTERLOCK mechanism. The specifications of the EXT INTERLOCK connector are the same as those of the INTERLOCK connector, so build the INTERLOCK mechanism according to the wiring specifications shown in Figure 2-8 and use it safely.

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.

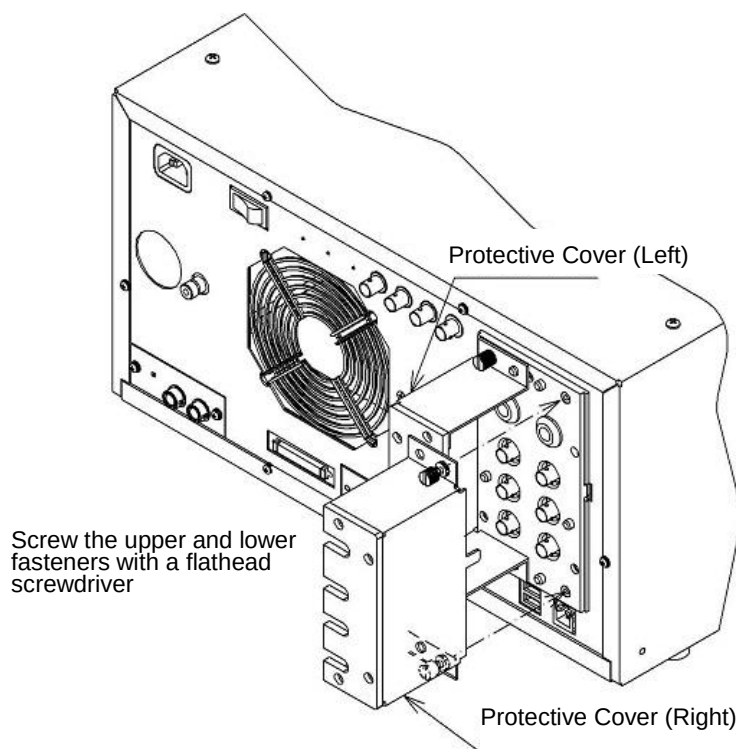


Figure 2.9: Installation of protective covers (left and right) on the rear panel

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

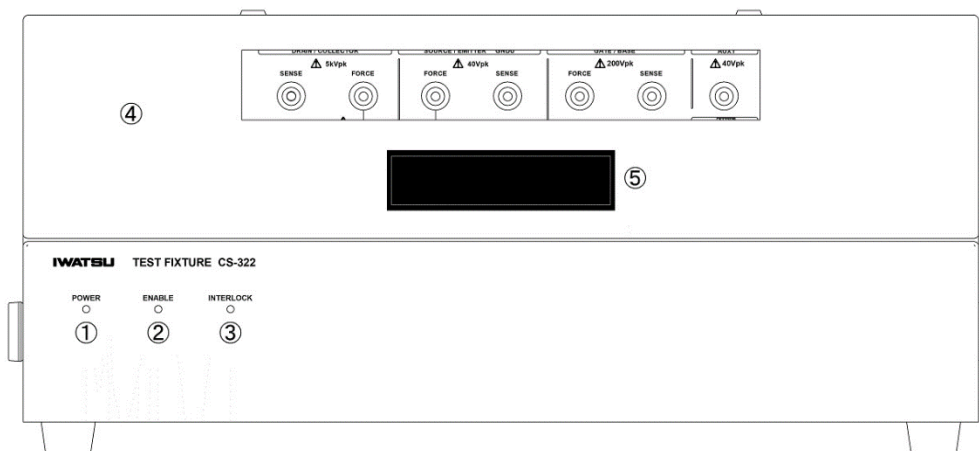


Figure 2.10: Front panel of Test Fixture CS-322

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

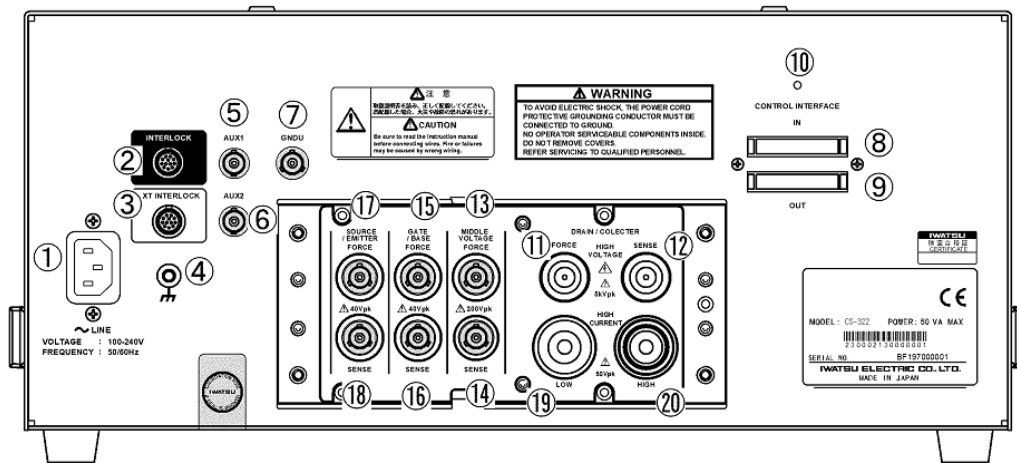


Figure 2.11: Rear panel view of Test Fixture CS-322

- ① AC LINE INPUT Connector
AC power input. Connect the included 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 Curve Tracer 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 Curve Tracer 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 Curve Tracer CS-8000 Series and an external power supply.

⑦ GNDU Connector

Connect to the Curve Tracer CS-8000 Series GNDU connector with an optional triaxial cable. By connecting with this connector and enabling GNDU on the Curve Tracer 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 Curve Tracer CS-8000 Series. It is used by connecting to the OUT side of the CONTROL INTERFACE connector of the Curve Tracer 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 Curve Tracer 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 unit in the final stage.

⑩ CONTROL INTERFACE LED

It blinks during the control operation from the Curve Tracer CS-8000 Series, and you can confirm that you are communicating.

⑪ HIGH VOLTAGE DRAIN / COLLECTOR FORCE Connector

Connect the HIGH VOLTAGE DRAIN / COLLECTOR FORCE connector on the rear of the Curve Tracer CS-8200 with the optional HV cable. Note that the CS-8020 does not have this connector.

⑫ HIGH VOLTAGE DRAIN / COLLECTOR SENSE Connector

Connect the HIGH VOLTAGE DRAIN / COLLECTOR SENSE connector on the rear of the Curve Tracer CS-8200 with the optional HV cable. Note that the Curve Tracer CS-8020 does not have this connector.

⑬ MIDDLE VOLTAGE DRAIN / COLLECTOR FORCE Connector

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

⑮ GATE / BASE FORCE Connector

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

⑯ GATE / BASE SENSE Connector

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

⑰ SOURCE / EMITTER FORCE Connector

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

⑱ SOURCE / EMITTER SENSE Connector

Connect the SOURCE / EMITTER SENSE connector on the rear of the Curve Tracer 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 2.12 shows the connection terminals with the panel cover open, and describes the names and functions of each part.

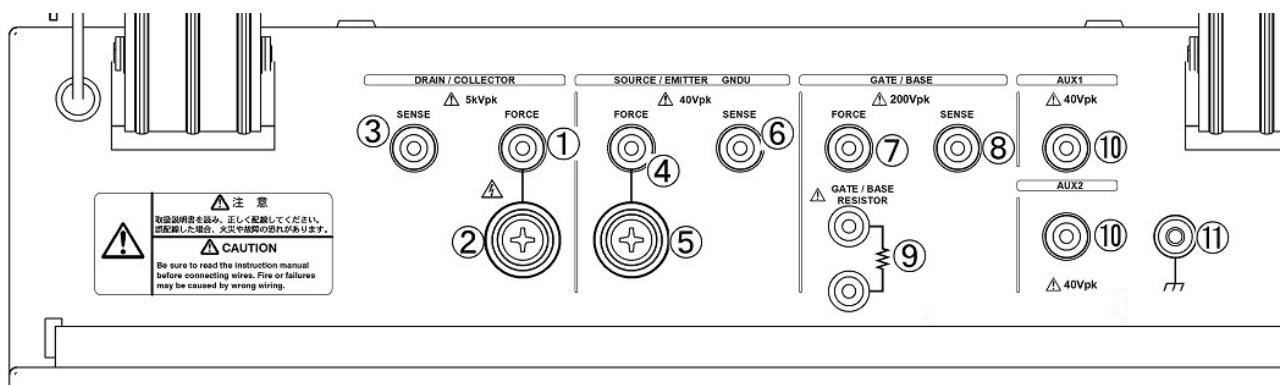


Figure 2.12: Connection terminals of Test Fixture CS-322

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 2.13 shows the Patch Panel CS-520 with the panel cover open, and describe the names and functions of each part.

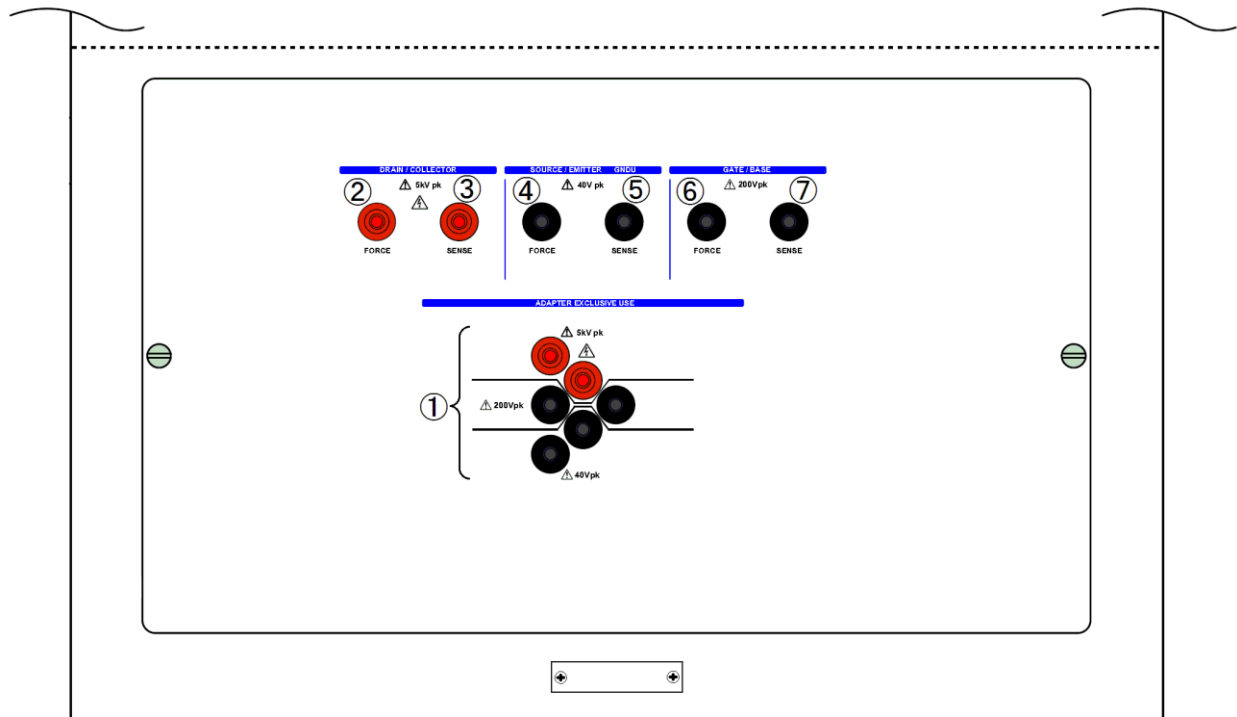


Figure 2.13: Patch Panel CS-520

- 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 3.4.4 according to the menu, and the measurement result display settings are explained in Sections 3.4.5 to 3.4.9. Section 3.4.10 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 (without dew condensation)

Operation ensured temperature and humidity range:

0°C to +40°C,

5% to 80%RH (at 30°C) and no dew condensation allowed

Upper limit:

55%RH (at 40°C) and no dew condensation allowed

CAUTION

When the instrument is moved to an environment with different temperatures and humidity, condensation may occur due to sudden temperature changes.

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

And then, turn on the main power switch.

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 Fig. 3.1).
- ② Connect the power plug of the power cord to the power outlet (see Figure 3.1).

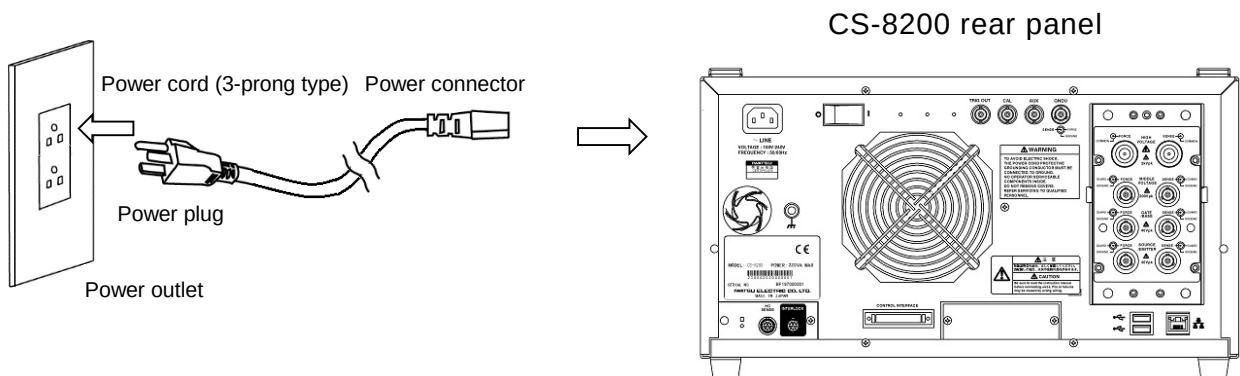


Figure 3.1: Power cord connection (CS-8000 Series)

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 Fig. 3.2).
- 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.

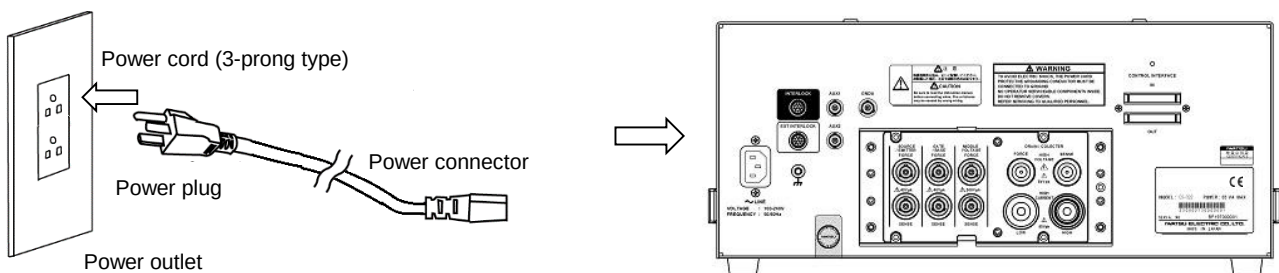


Figure 3.2: Power cord connection (Test Fixture)

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 3.3 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 3.1. Check the cable label and wire correctly.

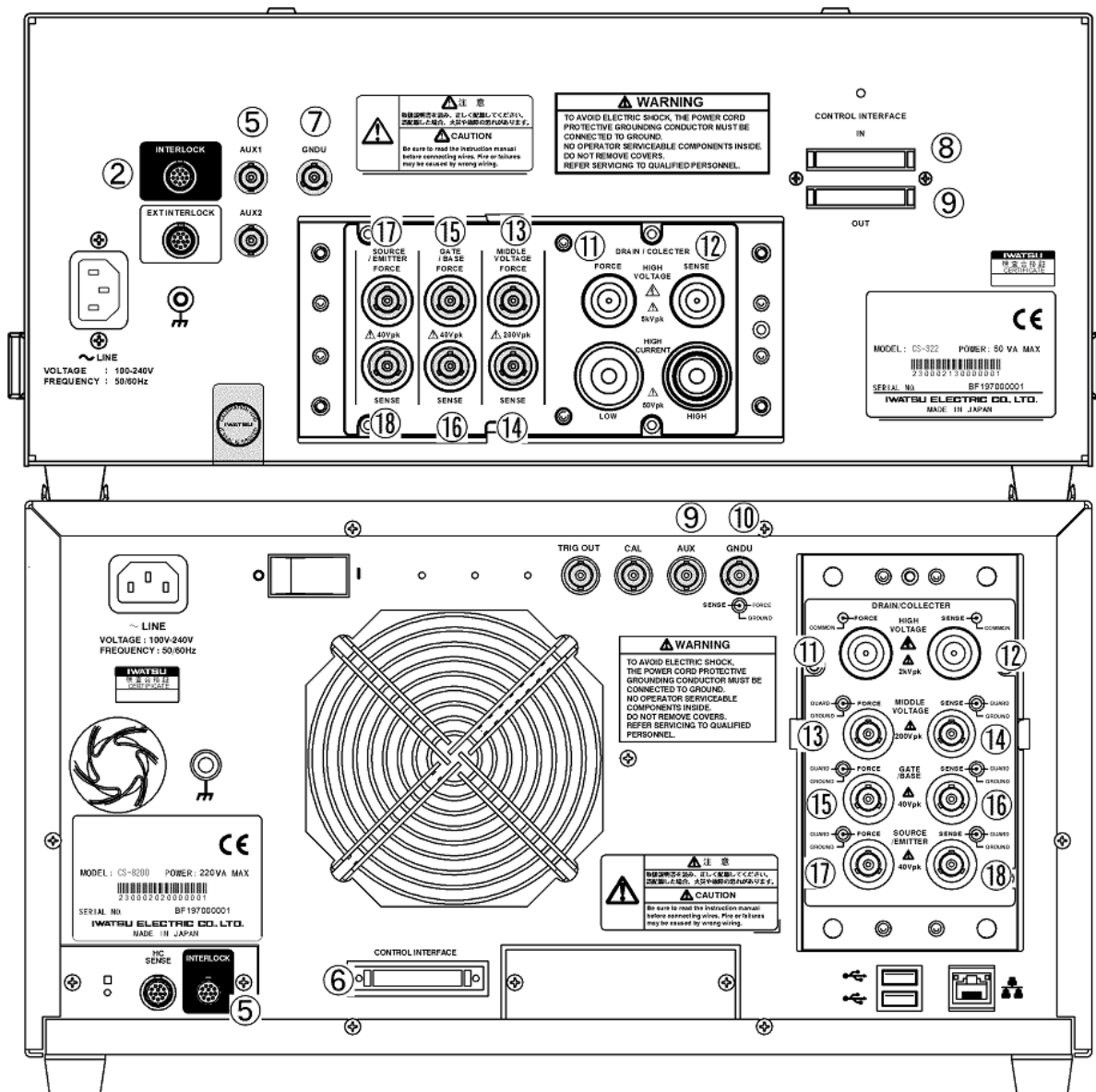


Figure 3.3: Installation of CS-8200 and CS322

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 the Test 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 3.4, 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.

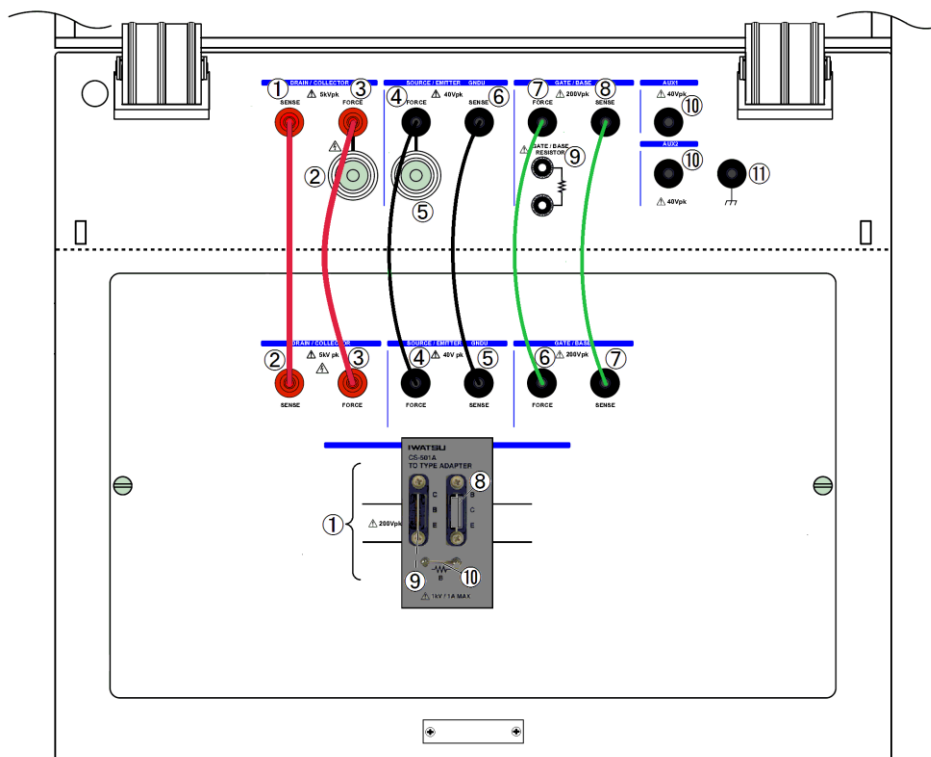


Figure 3.4: Connection diagram inside the Test Fixture

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)	⑦	

3.2.4 Turn 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 3.4.13.3).

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.

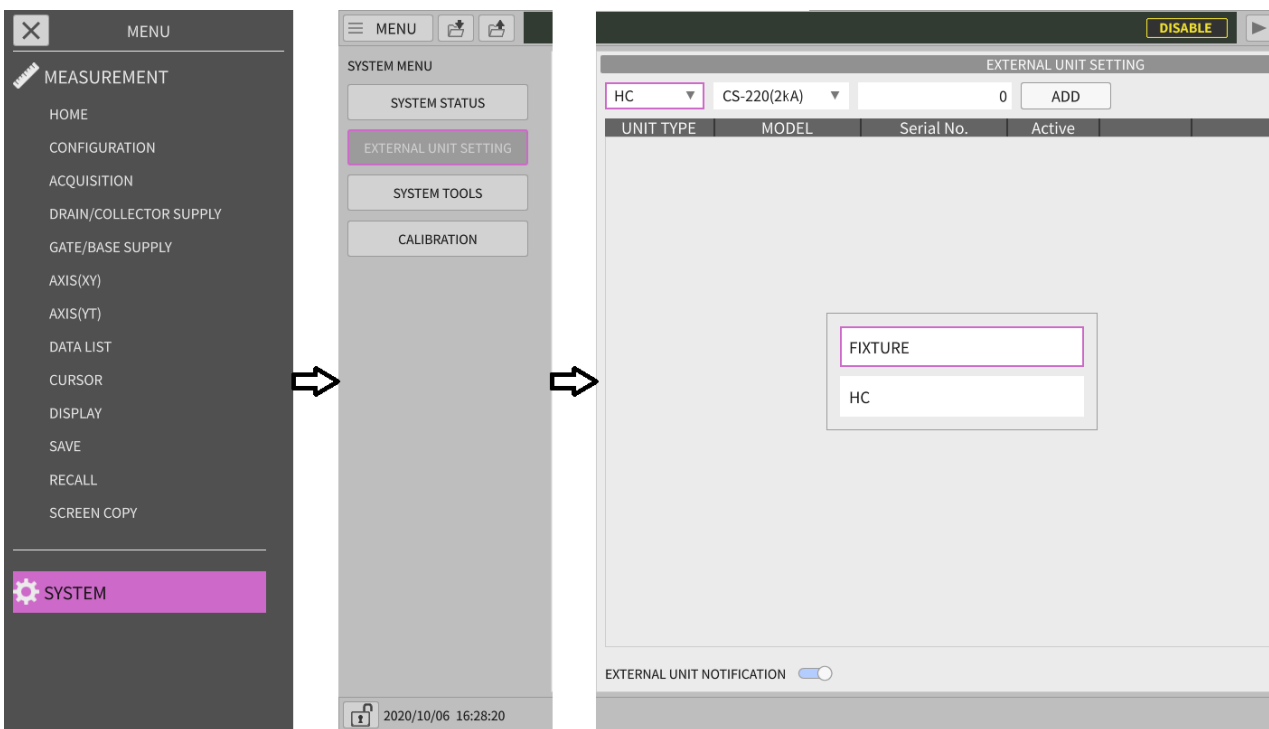


Figure 3.5: Setting menu of the external unit used for measurement

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, [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, [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) 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 3.7 shows the HOME screen layout displayed on the LCD screen, and explains the display contents and operations.

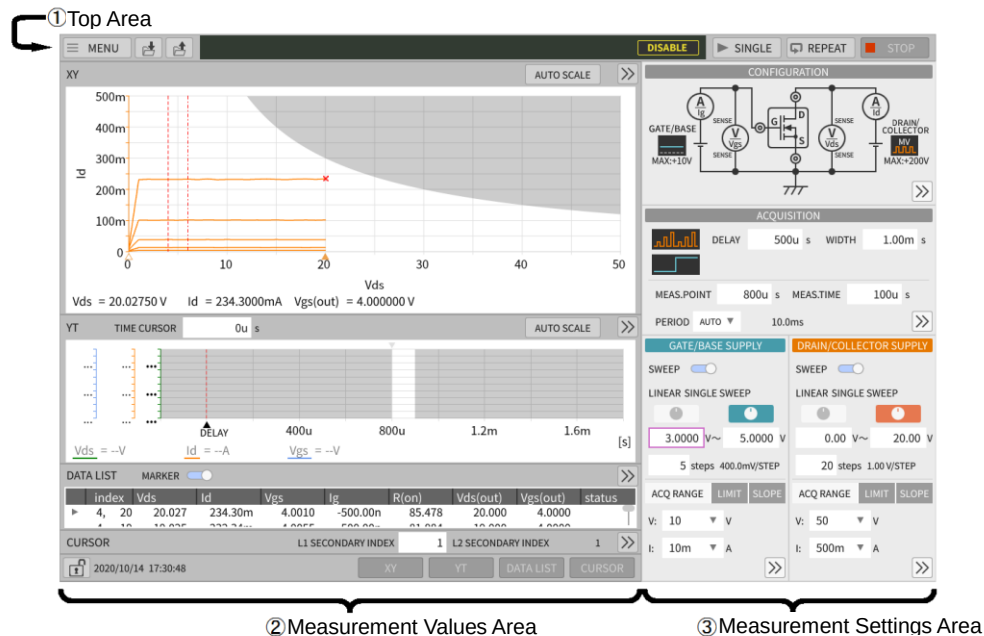


Figure 3.7: HOME Screen Layout

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 state, such as when the Test Fixture cover is open
	Output/measurement is not possible because the OUTPUT ENABLE button is not pressed.
	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  button or pressing the SINGLE button on the front panel, the measurement is performed only once.

By tapping  button or pressing the REPEAT button on the front panel, the measurement is repeated.

Tap  button or press the STOP button on the front panel to stop the measurement.

When you tap  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 (2) measurement value display 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 , , , and . 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:  ⇌ )

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 $\uparrow$ $\downarrow$ (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 3.8 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.

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.

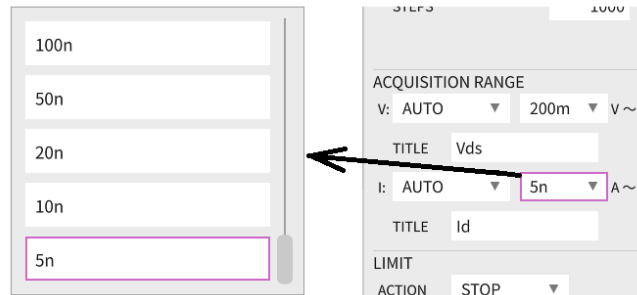


Figure 3.8: Pop-up screen for selecting candidate list

3.3.2.2 Numerical Input Pop-up Input

Figure 3.9 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.

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.

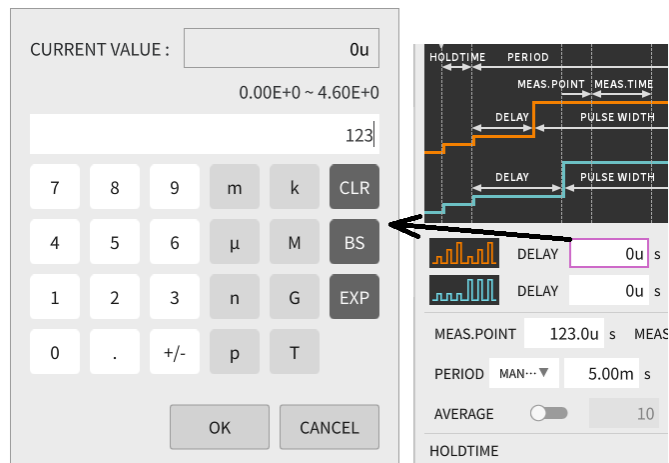


Figure 3.9: Numerical input pop-up screen

3.3.2.3 Input to the String Input Pop-up

Figure 3.10 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.

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.

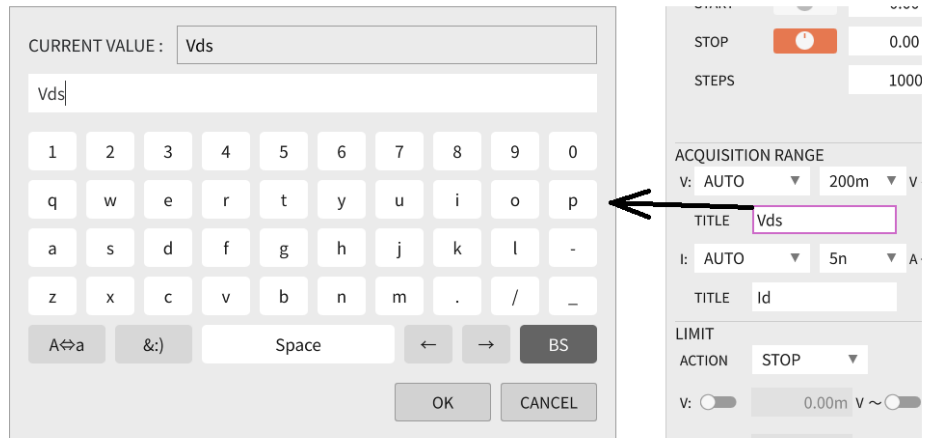


Figure 3.10: Character string input pop-up screen

3.3.3 Display Contents of Measurement Settings Area

The measurement condition setting area has the CONFIGURATION summary screen at the top, the ACQUISITION summary screen at the center, the GATE/BASE SUPPLY summary screen at the bottom left, and the DRAIN/COLLECTOR SUPPLY summary screen at the bottom left.

The title bar of the GATE/BASE SUPPLY summary screen is shown in turquoise, and the title bar of the DRAIN/COLLECTOR SUPPLY summary screen is shown in orange. Even on the CONFIGURATION and ACQUISITION screens, the applied power supply and waveform display are identified by the same color. By tapping the  button at the bottom right of these four summary screens, 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 condition setting area, but the summary screen related to the measurement conditions is displayed by sliding it toward the measurement value display area so that it can be seen as it is. To return to the original, tap the  button on the upper left of the details screen.

3.3.3.1 CONFIGURATION Screen

Figure 3.11 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.

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 I_g , and the current flowing through the drain is measured with an ammeter for I_d .

It also indicates that the voltage applied to the gate is measured from the SENSE terminal with a voltmeter for V_{gs} , and the voltage applied to the drain is measured from the SENSE terminal with a voltmeter for V_{ds} .

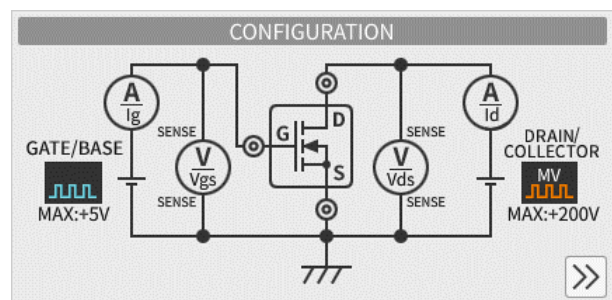


Figure 3.11: CONFIGURATION Screen

3.3.3.2 ACQUISITION Screen

Figure 3.12 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.

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

Figure 3.12: ACQUISITION Screen

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.

MEAS.POINT on the 3rd line shows the time setting from the rising point of the pulse with the larger DELAY value of DRAIN / COLLECTOR SUPPLY or GATE / BASE SUPPLY to the start of current and voltage measurement and aggregation. MEAS.TIME displays the time setting for measurement and aggregation.

The PERIOD field on the third line selects how to determine the measurement cycle for each point. AUTO or MANUAL can be selected. In AUTO, in addition to DELAY and WIDTH on the 1st and 2nd lines, 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 shows the GATE / BASE SUPPLY screen.

See Section 3.4.4 for configuration details.

This screen shows the setting status of GATE / BASE SUPPLY applied to the gate and base of the DUT.

The SWEEP switch on the top line selects whether to measure GATE / BASE SUPPLY with a constant value or to sweep it. When the SWEEP switch is OFF, NON (1-POINT) is displayed on the 2nd line, the knob icon is displayed on the 3rd line, and the display setting field is displayed on the 4th line.

This example shows the screen when the SWEEP switch is turned on. The sweep mode setting status is displayed on the second line, and the knob icon and sweep range setting are displayed on the third and fourth lines.

In SINGLE SWEEP mode, it sweeps from the value in the left column to the value in the right column, but in DOUBLE SWEEP mode, it sweeps again to the value in the left column.

The fifth line shows the number of steps to sweep this range and the amount of change per step.

The three buttons below this are tab-operated buttons (ACQ RANGE, LIMIT, SLOPE from the left) that select the content to be displayed below, and ACQ RANGE is displayed as ACQ... when not selected.

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 LIMIT is selected, the allowable range of source voltage, source current, and source power is displayed as shown in the middle row. [ACTION:] displays the action when one of the tolerances is exceeded. Displays the lower limit to the upper limit of the source voltage [V:], the upper limit of the source current [I:] to the upper limit, and the upper limit of the source power [W:].

If the upper and lower limits are not set, the values will not be displayed.

When SLOPE is selected, a numerical setting field indicating the steepness of

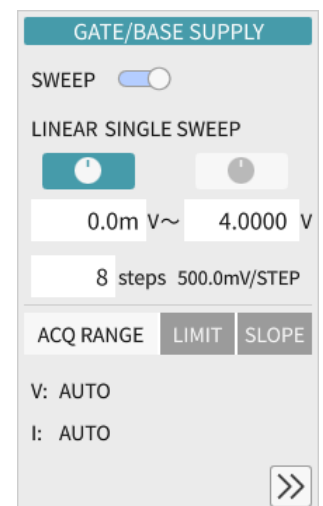
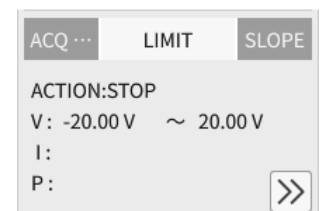


Figure 3.13:
GATE/BASE
SUPPLY Screen

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 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.

This figure shows the screen when the SWEEP switch is turned on, and the sweep-related settings are displayed in the upper half.

In the lower half, the measurement range, source voltage/source current/source power upper / lower limit settings, and pulse rising / falling waveform settings are displayed.

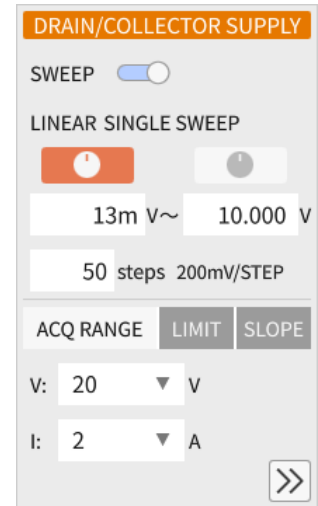


Figure 3.14:
DRAIN / COLLECTOR
SUPPLY Screen

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.

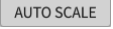
3.3.4.1 XY Display

Figure 3.15 shows the XY display.

See Section 3.4.5 for configuration details.

This example shows the measurement results of a FET with V_{ds} as PRIMARY SWEEP, V_{gs} as SECONDARY SWEEP, X-axis as V_{ds} , and Y-axis as I_d .

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

Also, 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 upper part of the graph, the right part, and the gray part on the upper right of the hyperbola show the area where the voltage, current, and power LIMIT values of DRAIN / COLLECTOR SUPPLY applied to the DUT are exceeded.

The   mark on the X-axis indicates the V_{ds} sweep range, and the value set in DRAIN/COLLECTOR SUPPLY is reflected.

The values displayed for V_{ds} =, I_d =, and V_{gs} (OUT) = in the lower row are the numerical data for the marker (✕).

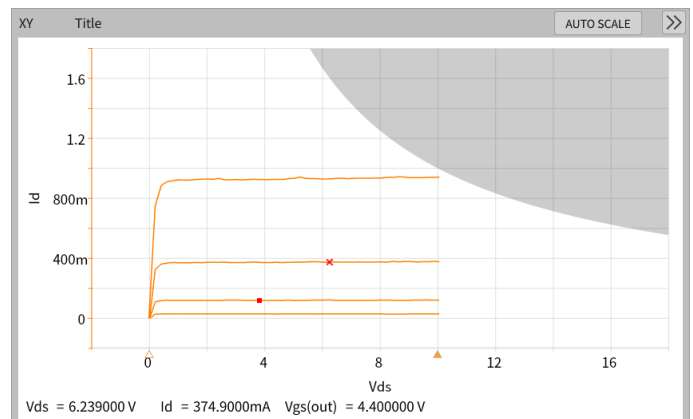


Figure 3.15: XY display

3.3.4.2 YT Display

Figure 3.16 shows the YT display.

See Section 3.4.6 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.

Tap the **AUTO SCALE** button on the right side of the top to automatically select the display range for the most visible Y-axis.

The time-base of the waveform graph is automatically determined that can display the entire pulse with the shorter source pulse width when the MODE is set to PULSE (including LONG), and a value that can display the entire cycle when set to SIN or AC. In addition, in the case of DC, the value that can be displayed for the entire MEAS.TIME. Up to 4 waveforms of Vds, Id, Vgs, Ig (when the DUT is FET) can be superimposed and displayed.

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.

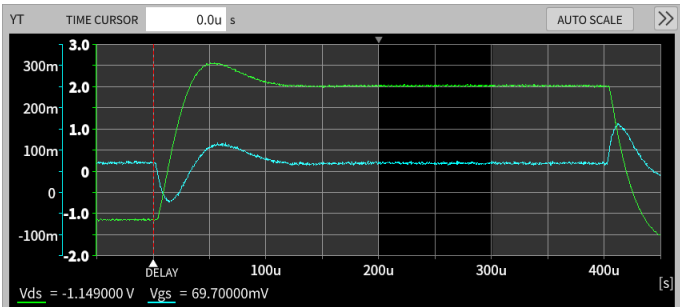


Figure 3.16: YT display

3.3.4.3 DATA LIST Display

Figure 3.17 shows the DATA LIST display.

See Section 3.4.7 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.

To select a line in the DATA LIST, drag 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.

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.

In the status column, the character **Err** is displayed if there is data that exceeds the measurement range, and the character **Lim** is displayed if there is data that exceeds the source limit area of the LIMIT setting of each SUPPLY UNIT. The measured value is displayed in red for the data that exceeds the measurement range, and the measured value is underlined for the data that exceeds the LIMIT.

The measured value displays the item selected on the detail screen, but the display order can be changed by dragging the title part of the item.

DATA LIST		MARKER ☐								>>	
index		Vce	Ic	Vbe	Ib	Vce(out)	Vbe(out)	R(on)		status	
3,	3	610.00m	912.60m	4.5990	125.00u	600.00m	4.6000	668.42m			
3,	2	414.00m	887.10m	4.5970	120.00u	400.00m	4.6000	466.69m			
3,	1	201.00m	750.80m	4.6030	140.00u	200.00m	4.6000	267.71m			
3,	0	-14.000m	-900.00u	4.6090	-395.00u	0.0000	4.6000	15.556			
2,	50	10.054	378.50m	4.4000	75.000u	10.000	4.4000	26.563			
2,	49	9.8530	381.10m	4.4020	100.00u	9.8000	4.4000	25.854			
2,	48	9.6540	378.00m	4.4010	105.00u	9.6000	4.4000	25.540			
2,	47	9.4520	378.20m	4.4050	120.00u	9.4000	4.4000	24.992			
2,	46	9.2540	377.70m	4.3990	110.00u	9.2000	4.4000	24.501			
2,	45	9.0440	380.10m	4.4020	85.000u	9.0000	4.4000	23.794			
2,	44	8.8470	379.80m	4.4000	75.000u	8.8000	4.4000	23.294			
2,	43	8.6470	378.50m	4.4010	105.00u	8.6000	4.4000	22.845			
2,	42	8.4470	380.30m	4.4050	100.00u	8.4000	4.4000	22.211			
2,	41	8.2430	376.20m	4.4030	120.00u	8.2000	4.4000	21.911			

Figure 3.17: DATA LIST display

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 3.4.8 for configuration details.

Figure 3.18 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 of the closest measurement points are complemented and calculated.

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 V_{gs} you want to pay attention to.

Tap the $\gg$ 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 tapping the cursor and then entering or dragging a number, and use the FUNCTION knob for accurate positioning.

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 (V_{gs} value in the example in the figure), the X value, Y value, and Z value (V_{gs} 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).

Furthermore, if the SECONDARY INDEX of L1 and L2 is different, the value of $(Y2-Y1) / (Z2-Z1)$ is displayed after the character of β or gm:, and if they are the same, the value of $(Y2-Y1) / (X2-X1)$ is displayed after the character of GRADIENT:.

Figure 3.19 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.

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 V_{ds} value or V_{gs}

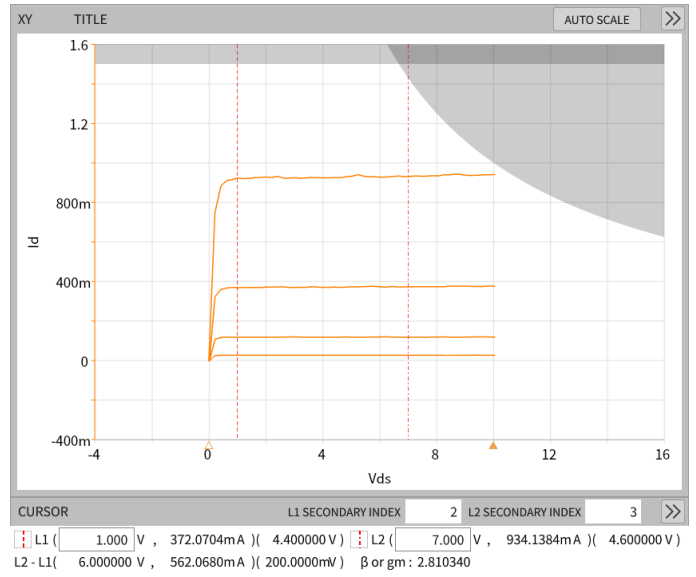


Figure 3.18: FREE mode cursor measurement and XY display

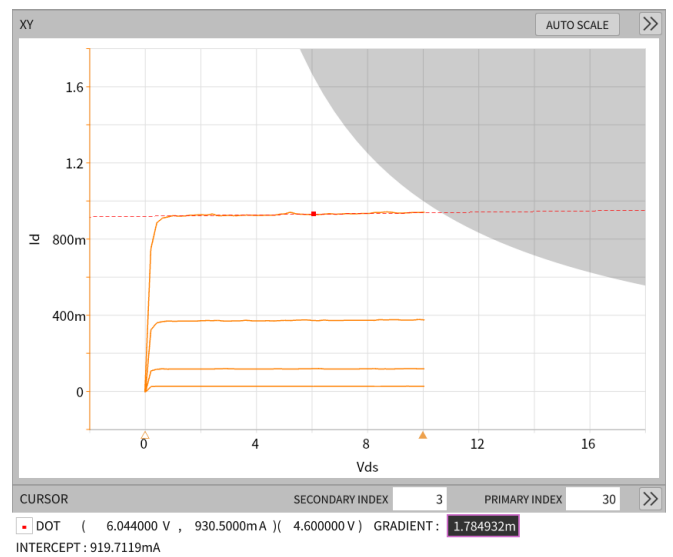


Figure 3.19: DOT mode cursor measurement and XY display

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 (In the example shown, the V_{gs} value) is displayed as ■DOT (X, Y) (Z).

As shown in the figure, when it is set to display a dashed line on the cursor, GRADIENT: and its value setting display field will appear after this, and INTERCEPT: and its value display field will appear in the lower line.

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: V_{ds} -Y: I_d , or X: V_{ce} -Y: I_c , the GRADIENT: value indicates the output conductance, 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 3.4.13.3).

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.

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 3.20 will be displayed on the left side of the measured value display area.

Table 3.5 MENU list and operation details

(1/2)

Item	Content
HOME	Display the HOME screen
CONFIGURATION	Set the measurement target, etc. on the CONFIGURATION setting screen (see Section 3.4.1).
ACQUISITION	Set the measurement order and timing on the ACQUISITION setting screen (see Section 3.4.2).
DRAIN/COLLECTOR SUPPLY	Set the source voltage and current on the DRAIN/COLLECTOR SUPPLY setting screen (see Section 3.4.3).
GATE/BASE SUPPLY	Set the source voltage and current on the GATE/BASE SUPPLY setting screen (see Section 3.4.4).
AXIS (XY)	Set the XY graph display method and display sensitivity on the AXIS (XY) setting screen (see Section 3.4.5).
AXIS (YT)	Set the display selection and display sensitivity of the YT graph on the AXIS (YT) setting screen (see Section 3.4.6).
DATA LIST	Select the marker display and display data on the DATA LIST setting screen (see Section 3.4.7).
CURSOR	Set the cursor display and position of the XY graph on the CURSOR setting screen (see Section 3.4.8).
DISPLAY	Set the display screen selection and display color of the measurement result on the DISPLAY setting screen (see Section 3.4.9).
SAVE	Display the current setting list and SETUP SAVE setting screen, and set the save contents, save format, and save destination (see section 3.4.10).
RECALL	Display the current setting list and the SETUP RECALL selection screen, and select the measurement result or measurement condition file to be recalled (see section 3.4.11).

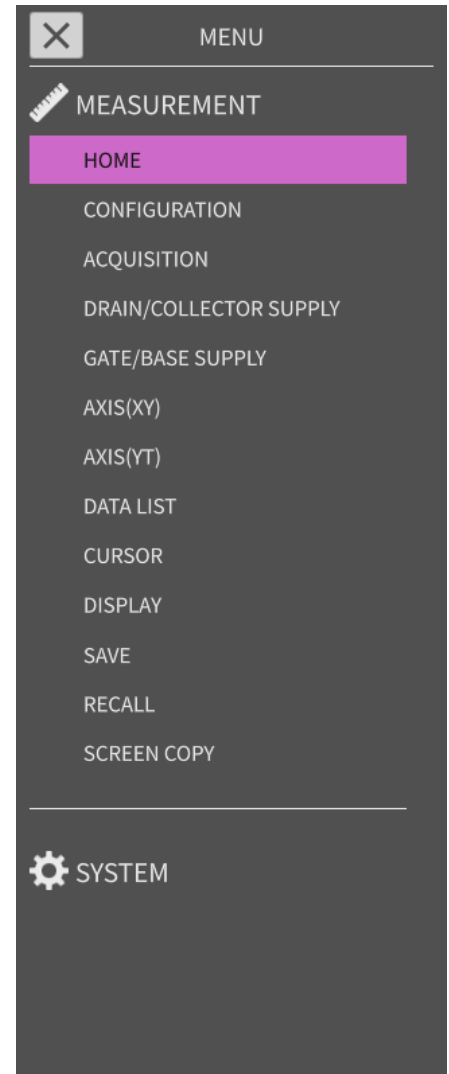


Figure 3.20: Menu list

(2/2)

Item	Content
SCREEN COPY	Set the screen save format and save destination on the SCREEN COPY setting screen (see Section 3.4.12).
⚙️SYSTEM	Display the SYSTEM MENU (see section 3.4.13).

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), but tap other menus to display the respective detailed setting screens

3.4.1 Detailed Settings in the CONFIGURATION Menu

Figure 3.21 shows the CONFIGURATION detailed setting screen. Click the  button on the left end of the title bar labeled CONFIGURATION to switch off this screen.

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 and GATE/BASE SUPPLY 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 3.6.

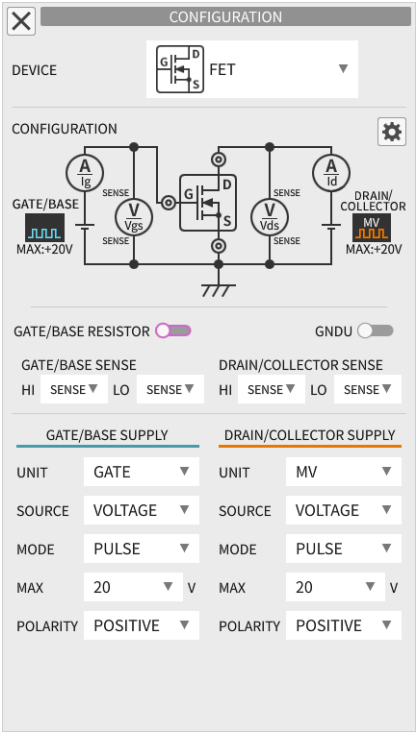
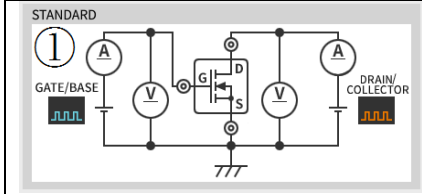
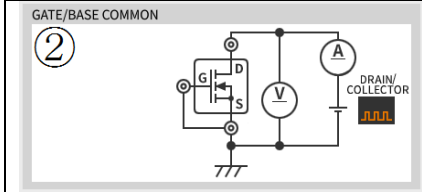
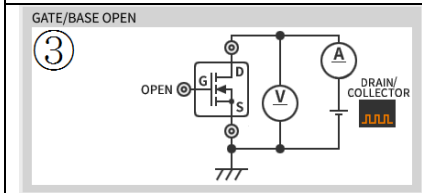
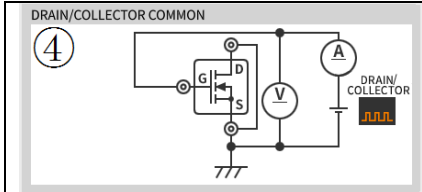
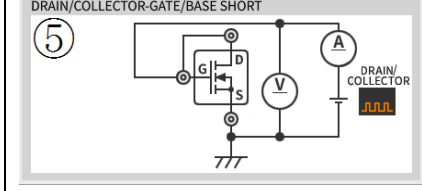
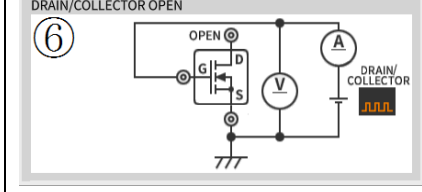
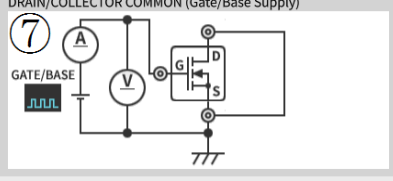
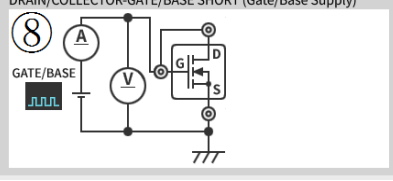
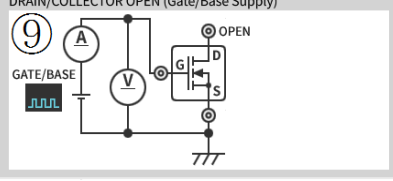
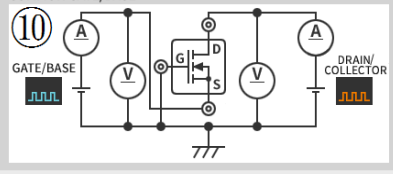
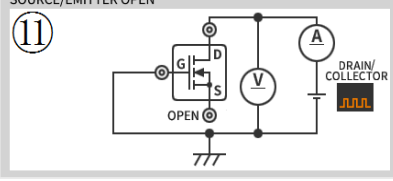


Figure 3.21:
CONFIGURATION
detailed setting screen

Table 3.6: Category and circuit configuration table

(1/2)

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_{CE0} 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 $I_C = 0A$

CATEGORY CONFIGURATION	Connection destination of each terminal of the DUT DRAIN / COLLECTOR = D/C GATE / BASE = G/B SOURCE / EMITTER = S/E	Measurement
 <p>7 DRAIN/COLLECTOR COMMON (Gate/Base Supply)</p>	D/C : COMMON G/B : GATE / BASE SUPPLY S/E : COMMON	Measurement of I_{GSS} , V_{GSS} , etc. at $V_{DS} = 0V$
 <p>8 DRAIN/COLLECTOR-GATE/BASE SHORT (Gate/Base Supply)</p>	D/C : GATE / BASE SUPPLY G/B : GATE / BASE SUPPLY S/E : COMMON	Measurement under the condition of $V_{DG} = 0V$
GATE / BASE TEST	Circuit that connects SUPPLY UNIT only to G/B	
 <p>9 DRAIN/COLLECTOR OPEN (Gate/Base Supply)</p>	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	
 <p>10 COMMON GATE/BASE</p>	D/C : DRAIN / COLLECTOR SUPPLY G/B : COMMON S/E : GATE / BASE SUPPLY	Measurement of I_{CBO} , V_{CBO} , etc. at $I_E = 0A$
 <p>11 SOURCE/EMITTER OPEN</p>	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 and GATE / BASE SUPPLY 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 3.22) 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.

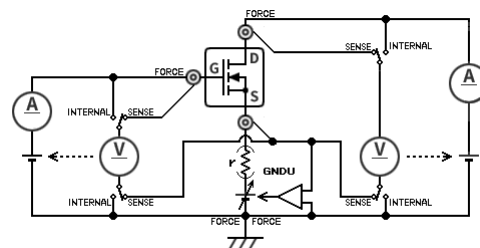


Figure 3.22: Switching the GNDU compensation circuit and measurement voltage detection point

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. 3.22). 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.

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 $\pm 1\text{V}$ can be applied.

In the POLARITY field, you can select POSITIVE, NEGATIVE, BIPOLAR for GATE. 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 and CURRENT when applying as a current source. The VOLTAGE power supply is represented by the battery symbol ($\frac{\perp}{\text{I}}$) for DC, PULSE, PULSE (LONG) on the schematic, the AC voltage source symbol (ϕ) for AC, and the current source symbol (ϕ) 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.

You can select POSITIVE, NEGATIVE, or BIPOLAR in the POLARITY field, but some items may not be selectable depending on the settings.

3.4.2 Detailed Settings in the ACQUISITION Menu

Figure 3.23 shows the detailed setting screen.

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

PRIMARY SWEEP

Set the measurement order when a circuit configuration that uses both DRAIN / COLLECTOR SUPPLY and GATE / BASE SUPPLY power supplies is selected in the CONFIGURATION settings. Select the power supply to sweep the SUPPLY power supply value first.

For the V_{ds} - I_d characteristics of FETs and the V_{ce} - I_c characteristics of BJTs, it is common to select DRAIN / COLLECTOR SUPPLY.

In the figure, DRAIN / COLLECTOR SUPPLY is selected, and  (DC MODE),  (PULSE MODE), and  (RECTIFIED SINE MODE) are displayed in orange waveforms on the left side, indicating changes in pulse height and level.

In the case of GATE / BASE SUPPLY that was not selected in PRIMARY SWEEP, it becomes SECONDARY SWEEP, and  (PULSE MODE) and  (DC MODE) are displayed in green-blue waveforms on the second line.

When GATE / BASE SUPPLY is selected in PRIMARY SWEEP, DRAIN / COLLECTOR SUPPLY is automatically set to SECONDARY SWEEP.

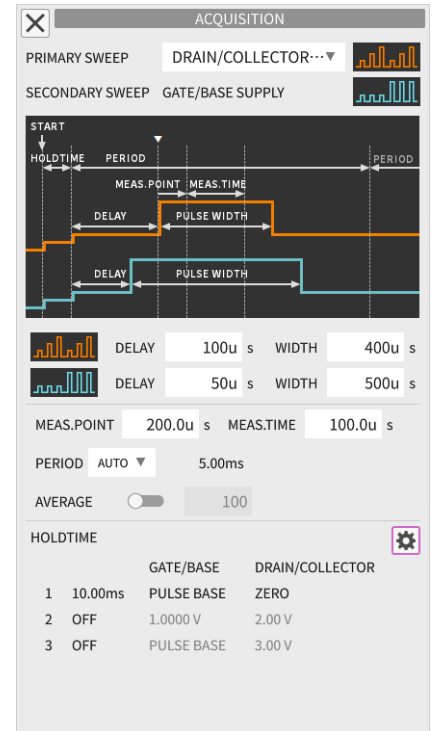


Figure 3.23: ACQUISITION detailed setting screen

Timing Chart

The figure shows the waveform timing of DRAIN / COLLECTOR SUPPLY and GATE / BASE SUPPLY from the start of measurement to the end of the first cycle when both SUPPLY power supplies are in pulse mode. 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)

The upper row is the PRIMARY SWEEP DELAY setting and WIDTH setting. The bottom row is the SECONDARY SWEEP DELAY setting and WIDTH setting.

You can set the pulse output delay time and pulse width from the start of one period (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.

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, and DRAIN/COLLECTOR SUPPLY 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 3.7: 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

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

Figure 3.24 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).

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.

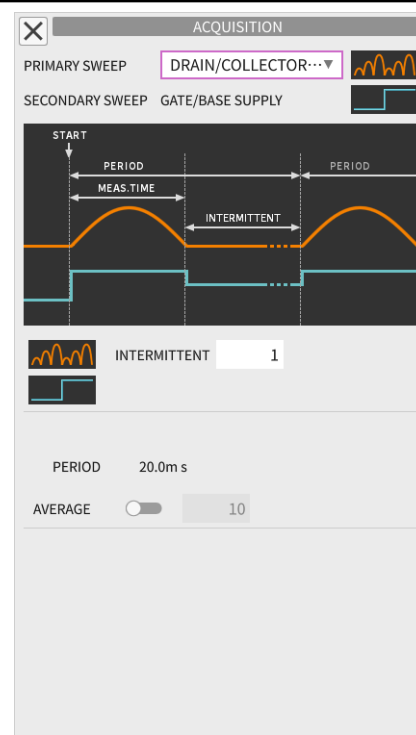


Figure 3.24: ACQUISITION detailed setting screen (rectified waveform mode)

Table 3.8 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 DRAIN / COLLECTOR SUPPLY Menu

Figure 3.25 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.

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) or LOG (geometric interval), SINGLE (one-way sweep) or DOUBLE (reciprocal sweep) in 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.

Figure 3.25:
DRAIN/COLLECTOR SUPPLY
detailed setting screen

ACQUISITION RANGE

Set the measurement range and the name of the measured value of the voltage and current actually applied from DRAIN / COLLECTOR SUPPLY.

In the V: and I: fields, select from AUTO (automatic setting), FIX (fixed range), and SYSTEM (linked to the output value). Some items cannot be selected depending on the UNIT and SOURCE settings in 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.

In the TITLE field, set the name of the measured voltage / current within 32 characters. The name set here will be used in the CONFIGURATION diagram and tables and graphs in the measured value display area.

LIMIT

Set the operation to protect the device when the voltage, current, or power applied to the DUT exceeds the maximum rated value.

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 RECTIFIED 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 3.26 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.

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) or LOG (geometric interval) 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 [$\downarrow$ $\uparrow$] 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.

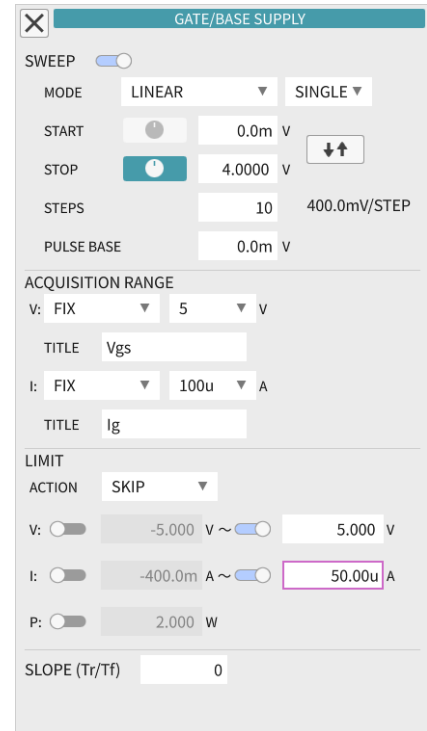


Figure 3.26:
Detailed setting screen of
GATE/BASE SUPPLY

ACQUISITION RANGE

Set the measurement range of the voltage and current actually applied from GATE / BASE SUPPLY, and the name of the measured value.

Select the V: and I: fields from AUTO (automatic setting), FIX (fixed range), and SYSTEM (linked to the output value). Some items may not be selectable depending on the CONFIGURATION setting.

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 measurement 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.

In the TITLE field, set the name of the measured voltage / current within 32 characters. The name set here is used in the CONFIGURATION diagram and the tables and graphs in the measured value display area.

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 AXIS (XY) Menu

Figure 3.27 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.

The TITLE field sets the chart title to 32 characters or less. This title is displayed in the title bar of the XY display.

The MULTI TRACE switch is OFF in this example and is a single trace setting. When turned on, the multi-trace screen shown in Figure 3.29 appears, and the XY display section also enters a mode in which up to 5 traces can be displayed on the graph sheet. Figure 3.29 will be discussed later.

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  button on the XY title bar is tapped.

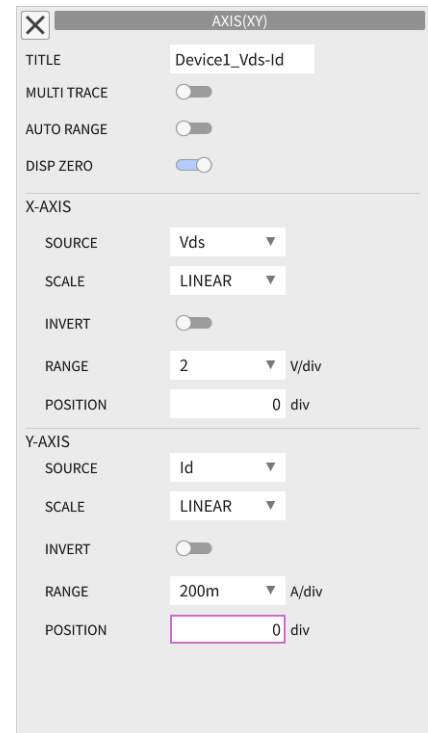


Figure 3.27: AXIS (XY) detailed setting screen

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.

R (on) calculates and displays the ON resistance value. The calculated value is the voltage of DRAIN / COLLECTOR SUPPLY divided by the current.

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 HORIZONTAL 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).

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 3.28 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 TRACE5.

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 through TRACE5 buttons below the ACTIVE field are selected 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.

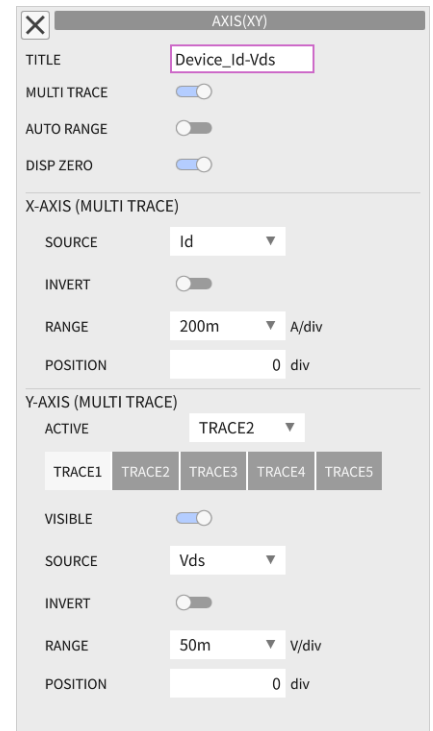


Figure 3.28:
Detailed setting screen
for AXIS (XY)
MULTI TRACE

3.4.6 Detailed Settings in the AXIS (YT) Menu

Figure 3.29 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  button on the YT title bar is tapped.

Setting of each voltage / current waveform display

Set the display of the voltage / current waveform applied from DRAIN / COLLECTOR SUPPLY and GATE / BASE SUPPLY.

The first setting block sets the voltage waveform display of DRAIN/COLLECTOR SUPPLY. In this example it is the name of Vds. 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 position of the display waveform as an integer as the div value from the bottom.

The second block sets the current waveform display for DRAIN / COLLECTOR SUPPLY. In this example, it is the name of the Id.

The setting of the VISIBLE switch is the same as the first block, but the RANGE field sets the current value per div, and the POSITION field sets the 0A position with the div value from the bottom.

The third setting block sets the voltage waveform display of GATE / BASE SUPPLY. In this example it is the name of Vgs.

The fourth setting block sets the current waveform display of GATE / BASE SUPPLY. In this example it is the name of Ig.

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.

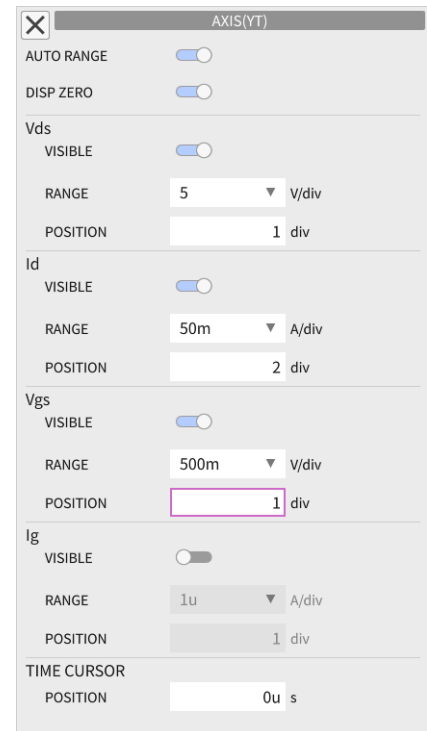


Figure 3.29: AXIS (YT) detailed setting screen

3.4.7 Detailed Settings in the DATA LIST Menu

Figure 3.30 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.

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 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 switch on the first line is the display selection of the voltage measurement value of DRAIN / COLLECTOR SUPPLY. In this example it is the Vds value.

The switch on the second line is the display selection of the current measurement value of DRAIN / COLLECTOR SUPPLY. In this example it is Id.

The switch on the third line is the display selection of the voltage measurement value of GATE / BASE SUPPLY. In this example it is Vgs.

The switch on the 4th line is the display selection of the current measurement value of GATE / BASE SUPPLY. In this example it is Ig.

The switch on the 5th line is the display selection of the value obtained by dividing the voltage measurement value of DRAIN / COLLECTOR SUPPLY by the current measurement value of DRAIN / COLLECTOR SUPPLY. This calculated value is named R (on) because it corresponds to the ON resistance when the DUT input is biased to ON.

The switch on the 6th line is the selection of whether to display the power setting value of DRAIN / COLLECTOR SUPPLY. This is the set value or the value calculated from the set value, which is named Vds (out) in the figure.

The switch on the 7th line is for selecting whether to display the power setting value of GATE / BASE SUPPLY. This is also a set value or a value calculated from the set value, which is named Vgs (out) in the figure.

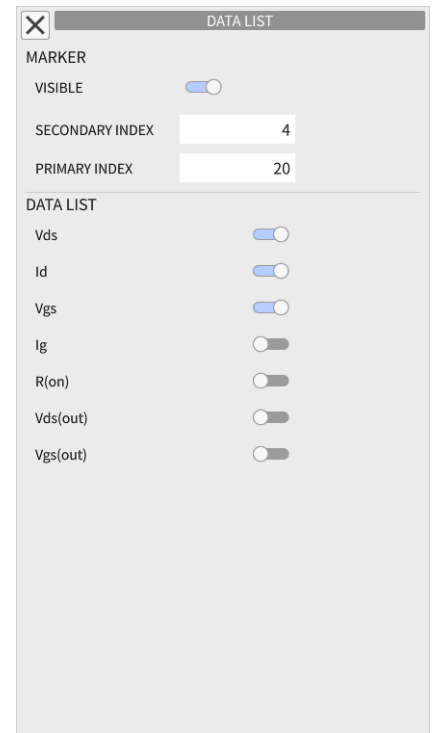


Figure 3.30: DATA LIST detailed setting screen

3.4.8 Detailed Settings in the CURSOR Menu

Figure 3.31 shows of 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.

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 3.32 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.

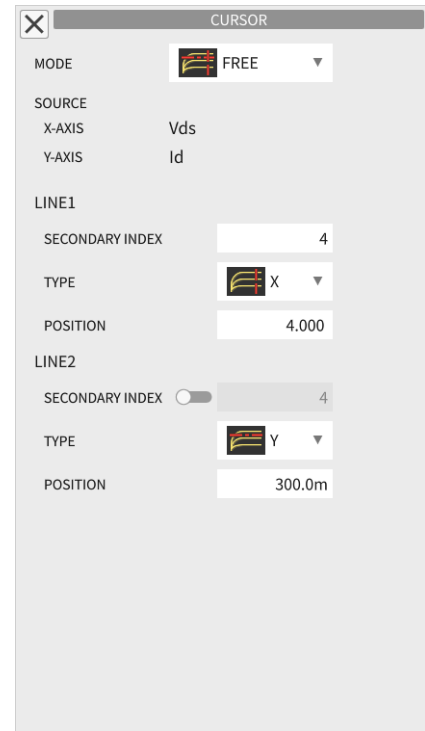


Figure 3.31:
CURSOR FREE mode de-
tailed setting screen

When DOT is selected in MODE of the cursor, the screen shown in Figure 3.32 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.

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.

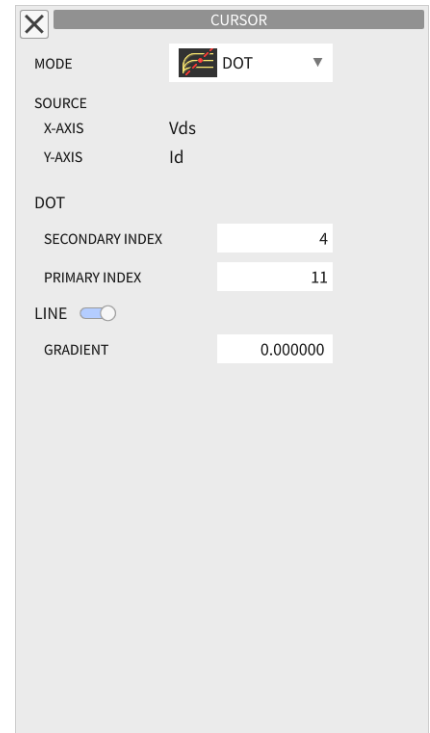


Figure 3.32:
CURSOR DOT mode
detailed setting screen

3.4.9 Detailed Settings in the DISPLAY Menu

Figure 3.33 shows of 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.

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 , , , and  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.

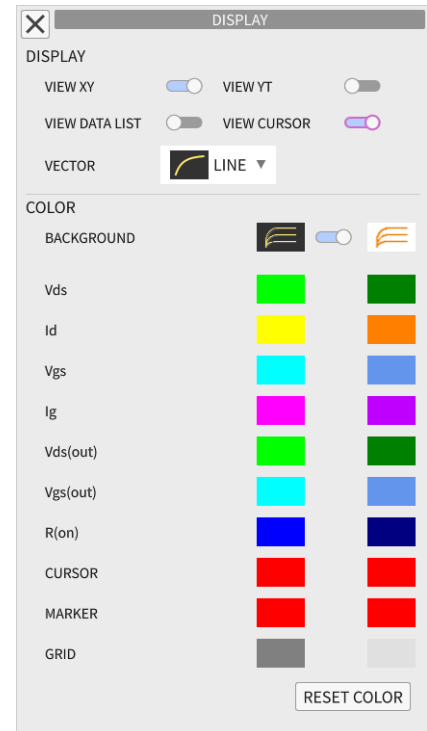


Figure 3.33: DISPLAY detailed setting screen

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.

RESET COLOR

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

3.4.10 Detailed Settings in the SAVE Menu

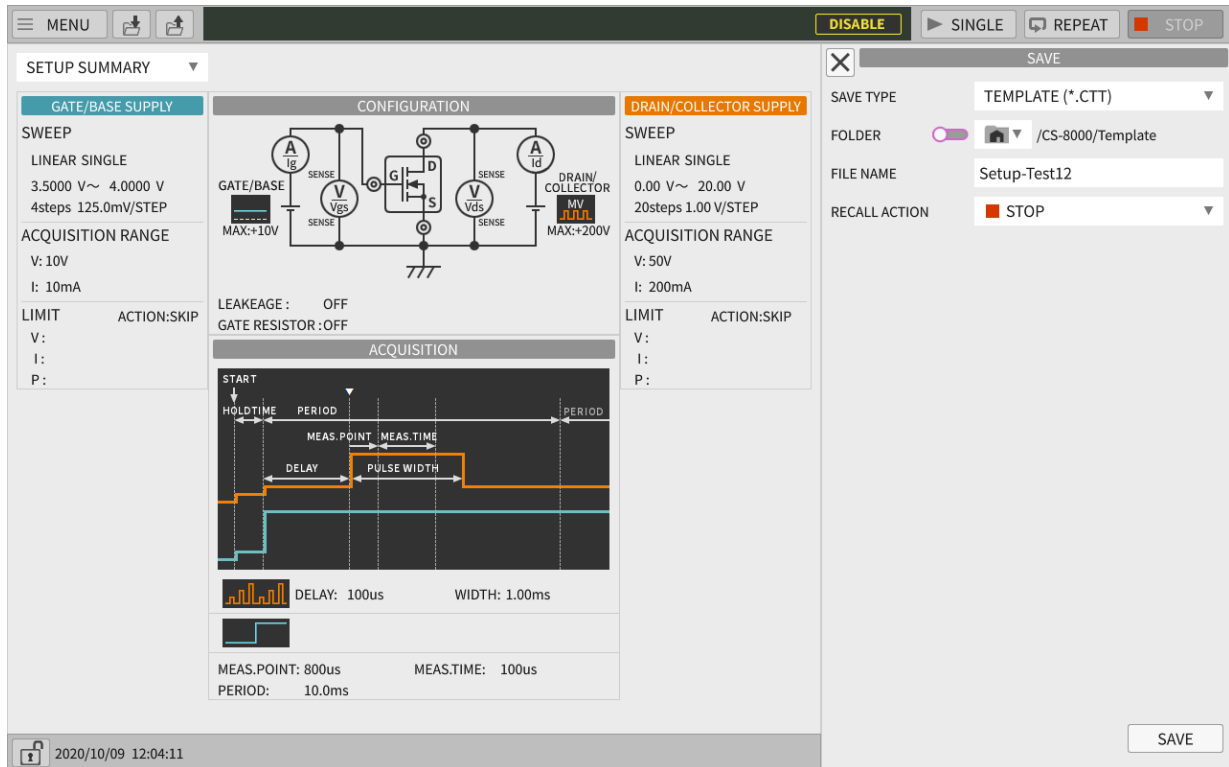


Figure 3.34: Screen when SAVE Menu is selected

Figure 3.34 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)

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.

When the FOLDER switch is OFF, save it in the standard save folder (/CS-8000/Template).

In the selection field behind the FOLDER switch, select  (INTERNAL) for the internal folder and  (USB) for the USB memory. If there is no /CS-8000/Template in the USB memory directory, create this directory and save it.

When you want to save to any other folder, turn on the FOLDER switch. The name of the previously used save folder is displayed in the field on the right. Tap the FOLDER field to change the save folder. The SELECT TEMPLATE FILE FOLDER pop-up screen shown in Figure 3.35 is displayed.

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, tap the field at the bottom left, set the folder name on the character string edit pop-up screen (see section 3.3.2.3), and create it with the ADD FOLDER button.

When you want to cancel this folder selection, you can always quit by pressing the CANCEL button.

Select the desired save folder and tap the OK button to close the SELECT TEMPLATE FILE FOLDER pop-up screen and change the FOLDER field on the SAVE screen to the desired folder name.

In the FILE NAME field, specify the file name to save.

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 3.36 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.

Specify the settings for the FOLDER switch, FOLDER type field, and FILE NAME field in the same way as for TEMPLATE (*.CTT) type save operations.

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.



Figure 3.35: SELECT TEMPLATE FILE FOLDER pop-up screen

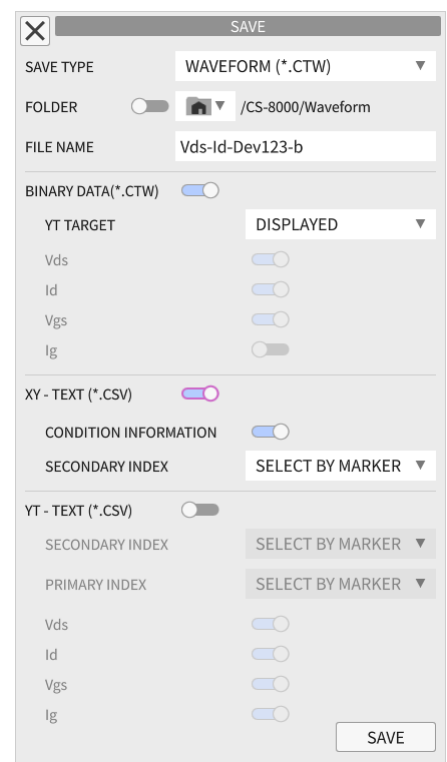


Figure 3.36: SAVE menu WAVEFORM (*.CTW) type detailed setting screen

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.

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.

There are four switches (Vds, Id, Vgs, Ig in this figure). From the top, turn it ON to include the voltage waveform data of DRAIN/COLLECTOR SUPPLY (Vds waveform in this figure). Turn this ON to include the current waveform data of DRAIN / COLLECTOR SUPPLY (Id waveform in this figure). Turn on to include GATE / BASE SUPPLY voltage waveform data (Vgs waveform in this figure). Turn on to include GATE/BASE SUPPLY current waveform data (Ig waveform in this figure).

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.

In the SECONDARY INDEX field, you can select SELECT BY MARKER or ALL.

If the secondary sweep only saves data for a specific value, set the SECONDARY INDEX field in the MARKER setting section of the DATA LIST menu screen to the corresponding INDEX number, and select SELECT BY MARKER.

YT-TEXT (*.CSV) switch related settings

You can select SELECT BY MARKER or ALL in the SECONDARY INDEX and PRIMARY INDEX fields. When you want to save only a specific value of the secondary or primary sweep, set the INDEX number corresponding to that value in the SECONDARY INDEX field and PRIMARY INDEX field in the MARKER setting section of the DATA LIST menu screen. Then select SELECT BY MARKER.

There are four switches (Vds, Id, Vgs, Ig in this figure). Turn this ON to include the voltage waveform data of DRAIN / COLLECTOR SUPPLY (Vds waveform in this figure). Turn this ON to include the current waveform data of DRAIN / COLLECTOR SUPPLY (Id waveform in this figure). Turn on to include GATE / BASE SUPPLY voltage waveform data (Vgs waveform in this figure). Turn on to include GATE / BASE SUPPLY current waveform data (Ig waveform in this figure).

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.

The file name actually created at the time of saving is the name specified in the FILE NAME field, followed by the year, month, day, hour, minute, and second at the time of saving added in the yyyy-mm-dd hh-mm-ss format. Therefore, even if you repeat the save operation with the same settings, if there is

an interval of 1 second or more, the file will not be overwritten with the same file name.

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 3.4.13.3. Never remove the USB memory while it is being accessed.

3.4.11 Detailed Settings in the RECALL Menu

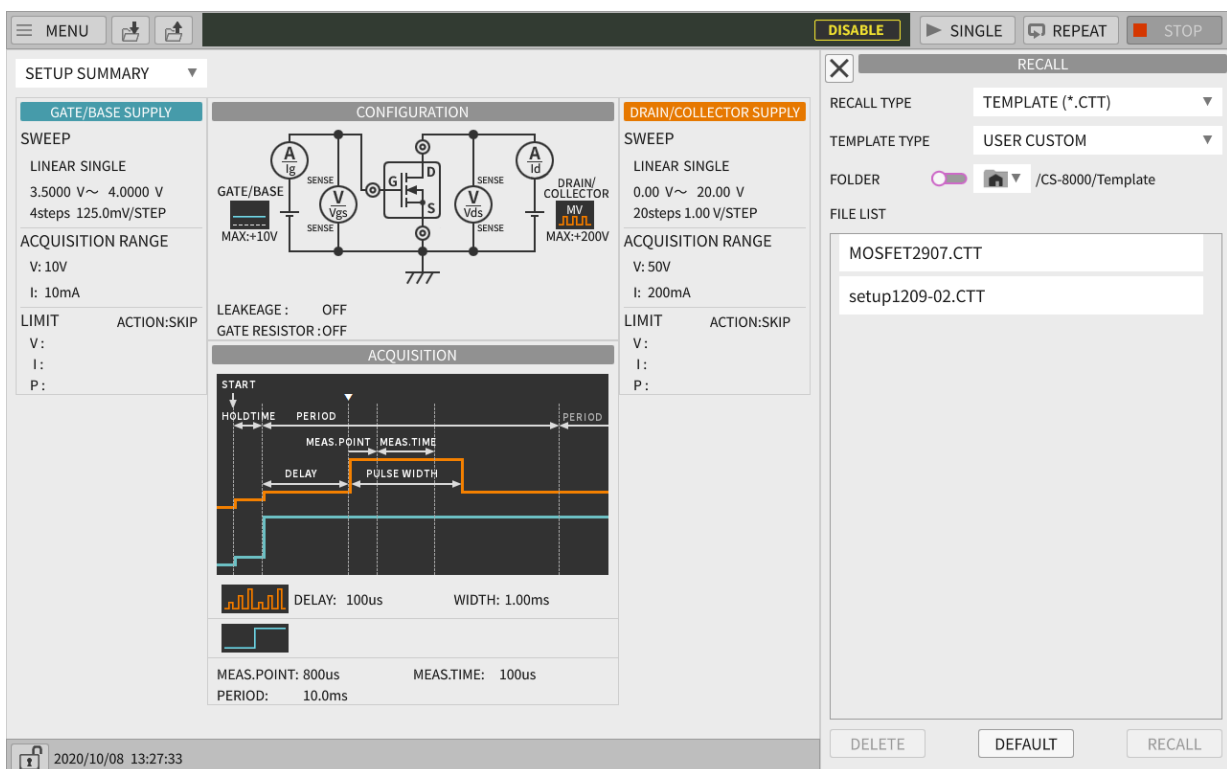


Figure 3.37: Screen when RECALL Menu is selected

Figure 3.37 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.

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.

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.

When the FOLDER switch is OFF, all TEMPLATE (*.CTT) files in the /CS-8000/Template folder are displayed in the FILE LIST folder. In the selection field to the right of the FOLDER switch, you can select the internal folder with  INTERNAL and the USB memory with  USB.

When the FOLDER switch is ON, any save folder name will be displayed in the right field and all previously saved TEMPLATE (*.CTT) files will be displayed in the FILE LIST field.

Tap the FOLDER field to change the save folder. The SELECT TEMPLATE FILE FOLDER pop-up screen shown in Figure 3.36, which was also used in the detailed settings of the SAVE menu in the previous section, is displayed.

The  button represents the internal folder, and  represents the folder of the connected USB memory.

When you tap the built-in folder,  is displayed in the folder field, the Name field shows the name of the folder in the current folder, the Size field shows the folder size, and the Date field shows the date and time when it was created.

When you tap the USB memory,  will be displayed in the folder field and will be displayed in the same way as the internal folder.

You can go to a lower folder by tapping the line of the lower folder.

Also, by tapping the  button on the far right, you can move to a folder one level higher than the current one.

Since this is a screen that displays folders, individual files are not displayed side by side with folders like on a PC.

When you want to cancel this folder search, you can always quit with the CANCEL button.

Tap the desired folder and tap the OK button to close the SELECT TEMPLATE FILE FOLDER pop-up screen and display all TEMPLATE (*.CTT) files in the desired folder in the FILE LIST field.

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 3.9 in Section 3.4.14 for the items recalled by the TEMPLATE restore operation and the settings recalled by DEFAULT.CTT.

WAVEFORM file restore operation

When the FOLDER switch is OFF, all WAVEFORM (*.CTW) files in the standard save folder /CS-8000/Waveform are displayed in the FILE LIST field. In the selection field to the right of the FOLDER switch, select the internal folder with  INTERNAL and the  USB memory with USB.

When the FOLDER switch is ON, any save folder name will be displayed in the right field and all previously saved WAVEFORM (*.CTW) files will be displayed in the FILE LIST field.

Tap the FOLDER field to change the save folder. The SELECT TEMPLATE FILE FOLDER pop-up screen shown in Figure 3.36 appears. The operation method is the same as for TEMPLATE.

By selecting / deselecting a file in the FILE LIST field, the contents of the left measured value display area change from the recall setting / current setting as in the case of TEMPLATE. However, when you tap SETUP MEMS in the upper left column to set it to XY CHART, the contents of the left measurement value display area will be the XY waveform display of the measurement result. 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.

3.4.12 Detailed Settings in the SCREEN COPY Menu

Figure 3.38 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.

When the FOLDER switch is OFF, it will be saved in the standard save folder /CS-8000/ScreenCopy.

In the selection field to the right of the FOLDER switch, select the internal folder with  INTERNAL and the USB memory with  USB. If /CS-8000/ScreenCopy folder does not exist in the USB memory directory, it will be created and save it.

The most recently set folder name and file name are initially displayed in the FOLDER folder and FILE NAME folder. When you want to save to a different folder, tap the FOLDER folder and enter the folder name in the field under the title bar of the SELECT SCREEN COPY FILE FOLDER pop-up screen (almost the same as Figure 3.36 explained in the restore operation). To change the file name, tap the FILE NAME field and change it on the character string input pop-up screen (see Section 3.3.2.3).

The folder name and file name most recently set in this menu are initially displayed in the FOLDER and FILE NAME fields. When you want to save to a different folder, tap the FOLDER field and enter the desired folder name in the field under the title bar of the SELECT SCREEN COPY FILE FOLDER pop-up screen (Figure 3.36 explained in the restore operation). To change the file name, tap the FILE NAME field and change it on the text edit screen that appears.

In the name of the file created by the COPY key, the year, month, day, hour, minute, and second at the time of saving are added in the yyyy-mm-dd hh-mm-ss format after the specified file name.

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.

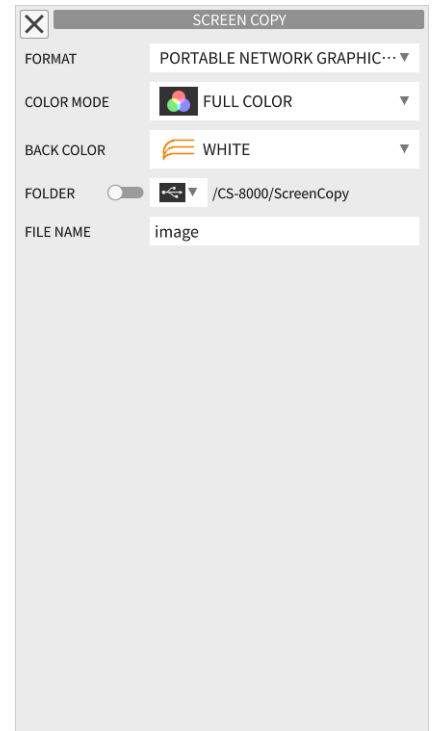


Figure 3.38:
Detailed setting screen of
SCREEN COPY Menu

3.4.13 Detailed Settings in the SYSTEM Menu

Figure 3.39 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 TOOLEES

3.4.13.1 SYSTEM STATUS

The right side of Figure 3.39 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 3.40, 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.

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.

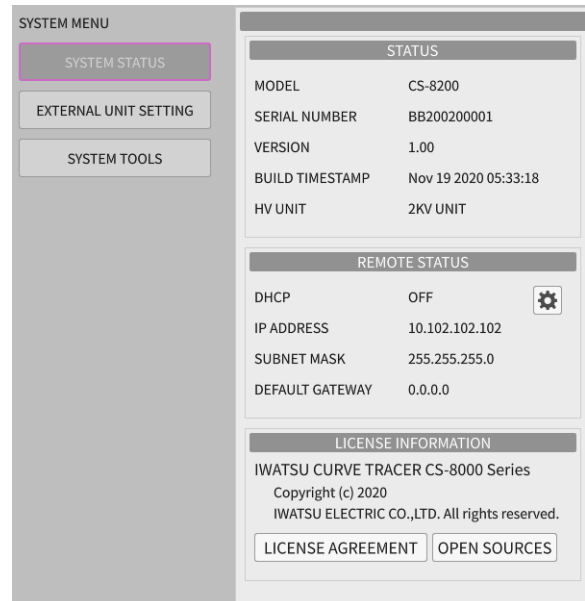


Figure 3.39: SYSTEM submenu (left side) and SYSTEM STATUS screen (partial)

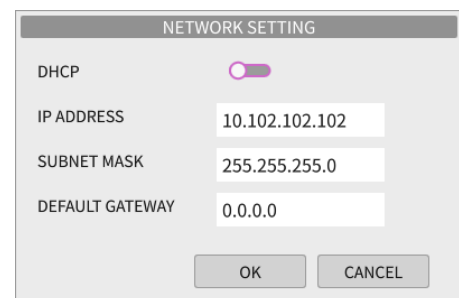


Figure 3.40:
NETWORK SETTING
pop-up screen

3.4.13.2 EXTERNAL UNIT SETTING

UNIT TYPE	MODEL	Serial No.	Active	Version
FIXTURE	CS-322(HV/HC)	000047601	☒	--/--

Figure 3.41: EXTERNAL UNIT SETTING screen

Figure 3.41 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.

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.

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.

Set the unit to use by checking the Active field. Up to one unit can be set to Active with the same UNIT TYPE. It is automatically set to Active at the time of registration. 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

3.4.13.3 SYSTEM TOOLS

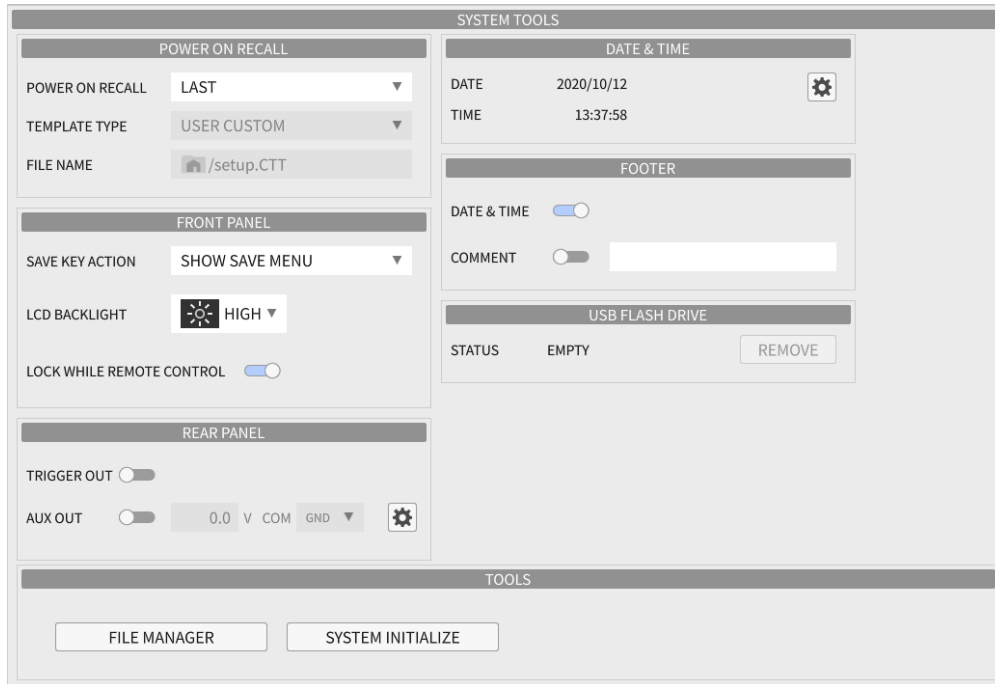


Figure 3.42: SYSTEM TOOLS screen

Figure 3.42 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 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.

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.

SHOW SAVE MENU performs the same action as tapping the SAVE menu from the MENU list.

The button at the top of the screen changes to  icon display.

EXEC SAVE (WAVEFORM) saves the measurement results in the folder specified by the WAVEFORM (*.CTW) type in the SAVE menu with the specified file name plus the date, minute, and second.

The button at the top of the screen changes to  icon display. This setting allows for quick measurement actions and data storage.

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.

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 3.43 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.

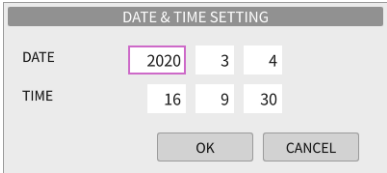


Figure 3.43: DATE and TIME SETTINGS screen

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.

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 3.44. 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.

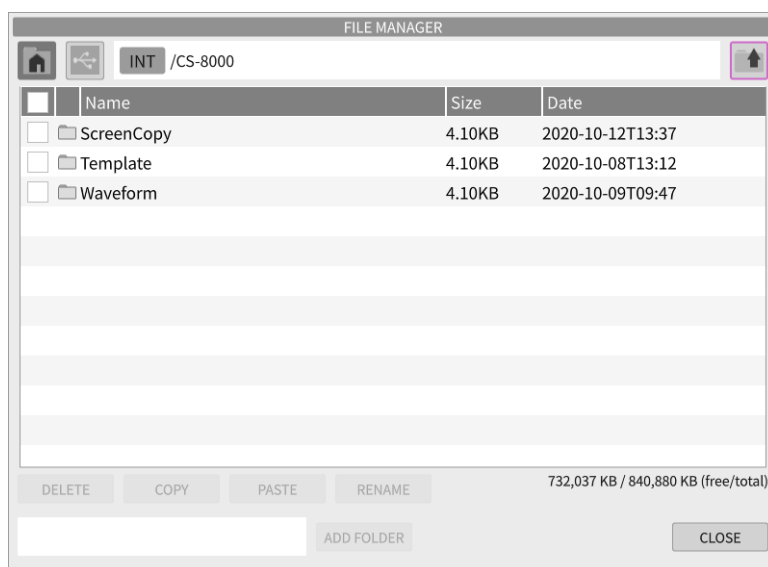


Figure 3.44: FILE MANAGER screen

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.

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 cancel the deletion, and 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 3.9 RECALL operation, the default settings, and the items and initial values that are not subject to SYSTEM INITIALIZE and are not subject to Table 3.10 RECALL operation.

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

3.4.14 DEFAULT and the INITIALIZE Settings

In this section, Table 3.9 shows the items set by the RECALL operation and their default settings.

Table 3.10 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 3.11.

Table 3.9: 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
DRAIN / COLLECTOR SUPPLY	DELAY	0 μ
	PULSE WIDTH	400 μ
GATE / BASE SUPPLY	DELAY	0
	PULSE WIDTH	400 μ

(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 switch			OFF	
	AVERAGE times			10	
	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	

(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		

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Category	Item	Default Setting
AXIS-YT	AUTO RANGE	ON
	DISP ZERO	ON
	Vds	VISIBLE switch
		RANGE (V/div)
		POSITION (div)
	Id	VISIBLE switch
		RANGE (A/div)
		POSITION (div)
	Vgs	VISIBLE switch
		RANGE (V/div)
		POSITION (div)
	Ig	VISIBLE switch
		RANGE (A/div)
		POSITION (div)
	TIME CURSOR	POSITION (s)
DATA LIST		
MARKER	VISIBLE switch	ON
		SECONDARY INDEX
		0
	PRIMARY INDEX	0
		0
		0
	DATA LIST	Vds switch
		ON
		Id switch
		ON
		Vgs switch
		ON
		Ig switch
		ON
	R(on) switch	ON
		ON
		ON
	Vds(out) switch	ON
		ON
		ON
	Vgs(out) switch	ON
		ON
		ON
	Display Order	Vds, Id, Vgs, Ig, R(on), Vds(out), Vgs(out)
CURSOR	MODE	OFF
DISPLAY	VIEW XY switch	ON
	VIEW YT switch	ON
	VIEW DATA LIST switch	OFF
	VIEW CURSOR switch	OFF
	VECTOR	LINE

Table 3.10: Items that are not subject to RECALL operations and
are subject to SYSTEM INITIALIZE and initial values (1/2)

Category	Item	Default Setting
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	INT/
	FILENAME	setup
	RECALL ACTION	STOP
WAVEFORM	FOLDER	INT/
	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
SCREEN COPY	FORMAT	PNG
	COLOR MODE	FULL COLOR
	BACK COLOR	BLACK
	FOLDER	INT/
	FILENAME	image

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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
	DEFAULT 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 selecting SYSTEM menu → SYSTEM TOOLS → TOOLS SYSTEM INITIALIZE.

Table 3.11: Items not covered by SYSTEM INITIALIZE and factory settings

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

3.4.15 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 and a USB keyboard with a copy of the firmware zip file.

For information on how to obtain the latest version of the firmware, please refer to our sales staff or our website URL: https://www.it.iwatsu.co.jp/index_e.html.

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 3.3.13.1

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 3.4.13.1 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 $+60^{\circ}\text{C}$
- Storage humidity: 5% to 80% RH (40°C , without dew condensation)

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	

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 μ A (1-2-5 steps)
	Setting resolution	1/ $\pm$ 20000
	Mode	DC, PULSE
	Polarity	POSITIVE, NEGATIVE
	Setting Accuracy	$\pm$ (Set value x 1.2% + Set range x 0.4%)
	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 μ A (1-2-5 steps) However, 2 mA to 5 nA (1-2-5 steps) when LEAKAGE is set
	Measurement Resolution	1/ $\pm$ 20000
	Measurement Accuracy ^(Note3,4,5)	$\pm$ (Set value x 1.2% + Set range x 0.4%)
	Note 1: Can 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 $\pm$ (measurement range x 5.0% + 200 pA) addition	

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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: Measurement is possible up to 125% of the measurement range	
	Note 2: Specified within the measurement range	
SIN output	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.	
	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

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 μ s to 10 ms
	Duty ratio	≤ 10 %
PULSE (LONG)	Pulse width (Note 1)	50 μ s 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 HOLDDTIME1, HOLDDTIME2, HOLDDTIME3 Each stage 0-5 s, each voltage can be set
DISPLAY	Display	12.1 inch TFT-LCD with touch panel
	Dimensions (H $\times$ V)	261.12 mm $\times$ 163.2 mm
	Number of pixels	1280 $\times$ 800 (WXGA)
	Screen display	XY, YT, DATA LIST, CURSOR
SYSTEM	user interface	Operation panel, touch panel, mouse, keyboard (alpha-betic)
	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

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Item		Specifications
Power Source	Power Voltage Range/ Frequency	AC 100 V to 240 V $\pm$ 10%, 50/60Hz
	Power line consumption	220 VA max (CS-8200 / 8500) 200 VA max (CS-8020)
Physical	Dimensions (W $\times$ H $\times$ D)	424 mm $\times$ 221 mm $\times$ 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, No condensation)
	Operating Humidity	upper limit 55% RH (40 °C, No condensation)
	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 condensation)
	Altitude	Operating: Up to 2000 m
Accessory		Control interface terminator : 1 Protective cover right : 1 Protective cover left : 1 Fixed belt : 1 Instruction manual (this manual) : 1 CD (Instruction Manual / Remote Control Manual) : 1 Power Cord : 1 Cord Strap : 1

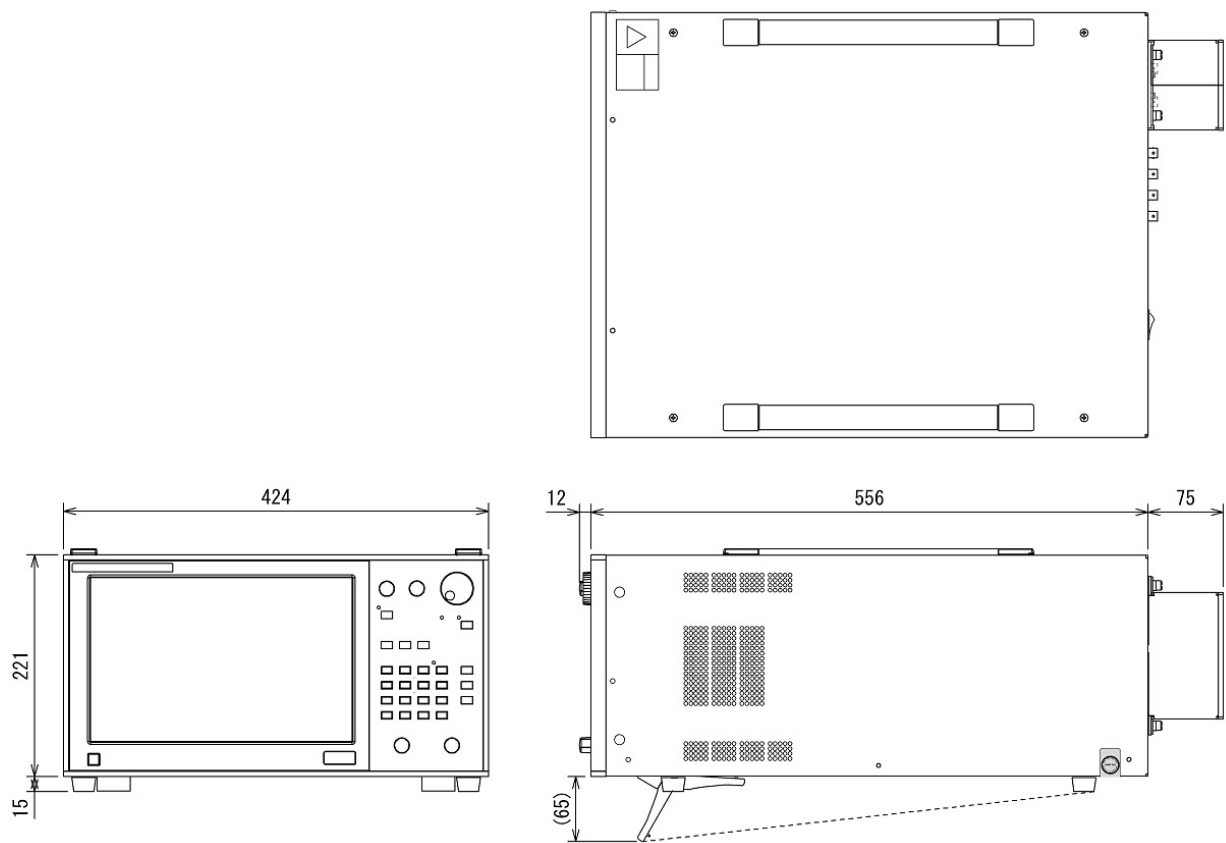
5.2 Compliance information

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: 2013 (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

IWATSU