ST4200

ST4200-50

HIOKI

Instruction Manual

PARTIAL DISCHARGE DETECTOR

Check for the latest edition and other language versions.

Read carefully before use.
Keep for future reference.

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EN

Feb. 2025 Edition 1
ST4200B971-00

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1 Introduction

1.1 Introduction

Thank you for choosing Hioki's Partial Discharge Detector ST4200. Preserve this manual carefully and keep it handy to make full use of this instrument for a long time.

The latest edition of the instruction manual
The contents of this manual are subject to change, for example as a result of product improvements or changes to specifications.
The latest edition can be downloaded from Hioki's website.
https://www.hioki.com/global/support/download/

Product registration
Register your product in order to receive important product information.
https://www.hioki.com/global/support/myhioki/registration/

Read the following Operating Precautions carefully before using the instrument.
Refer to the instruction manuals below as relevant to your purpose.

Type	Contents	Format
Operating Precautions	This provides information on the instrument for safe operation.	Print
Startup Guide	This guide contains information on how to safely use the instrument, basic operating instructions, and specifications (excerpt).	Print
ST4200 Instruction Manual (this document)	This manual contains an product overview, operating instructions, function descriptions, and specifications. https://manual.hioki.com/en/ST4200-50/manual	HTML
SW2001 Instruction Manual	This manual contains an SW2001 product overview, operating instructions, function descriptions, and specifications. https://manual.hioki.com/en/SW2001/manual	HTML

Type	Contents	Format
ST9210 Instruction Manual	This manual contains a product overview, operating instructions, function descriptions, and specifications of the ST9210. Download this manual from Hioki's website. https://www.hioki.com/global/support/download/	PDF

Target audience

This manual has been written for use by individuals who use the product in question or who teach others to do so. It is assumed that the reader possesses basic electrical knowledge (equivalent to that of someone who graduated from an electrical program at a technical high school).

Trademarks

- Windows is a corporate trademark of the Microsoft Group.
- The SD logo is a trademark of SD-3C, LLC.
- Other product names and company names are trade names, registered trademarks or trademarks of the respective companies.

1.2 Confirming Package Contents

When the instrument arrives, inspect it carefully to ensure that everything is in good condition and there is no damage.
If the instrument seems to have been damaged or does not work as specified, contact your authorized Hioki distributor or reseller.
Confirm that the package contents are correct.

Instrument

□ Partial Discharge Detector ST4200-50

Included accessories

□ Power cord

□ Operating Precautions (0990A905)

□ Startup Guide

1.3 Options (Sold Separately)

The following options are available for the instrument. Use the product available as Hioki's option only. To buy, contact your authorized Hioki distributor or reseller.
The options are subject to change without prior notice. Visit our website (https://www.hioki.com) for updated information.

High voltage multiplexer with PD sensor (Option available only when ordered with the instrument)

Specify one of two types of PD sensors when ordering.

- High Voltage Multiplexer SW2001-04 (4 channels)
- High Voltage Multiplexer SW2001-08 (8 channels)
- High Voltage Multiplexer SW2001-16 (16 channels)
- High Voltage Multiplexer SW2001-24 (24 channels)

External storage devices (Option available only when ordered with the instrument)

- SSD Unit U8332

External storage devices

- SD Memory Card Z4001 (2 GB)
- SD Memory Card Z4003 (8 GB)
- USB Drive Z4006 (16 GB)

Communication cables

- RS-232C Cable L9637
- USB Cable (A-B) L1002

PD sensor

- PD Sensor ST9210

1.4 Notations

Safety notations

In this document, risk levels are classified as follows.

Notation	Description
⚠ DANGER	Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury or potential risks of damage to the supported product (or to other property).
IMPORTANT	Indicates information or content particularly important from the standpoint of operating or maintaining the product.
	Indicates a high-voltage hazard. Failure to verify safety or improper handling of the product could lead to an electric shock, a burn, an injury, or a death.
	Indicates a prohibited action.
	Indicates a mandatory action.

Symbols affixed to the instrument

Notation	Description
	Indicates the presence of a potential hazard. See the "Operation Precautions" and safety notes listed at the beginning of operating instructions in the instruction manual(s), and the accompanying document entitled Operating Precautions.
	Indicates the push-button switch that can turn the product on and off.

Notation	Description
	Indicates an earthing terminal.

Symbols for Standards

Notation	Description
	Indicates that the product is subject to the Directive on Waste Electrical and Electronic Equipment (WEEE) in EU member nations. Dispose of the product in accordance with local regulations.
	Indicates that the product complies with standards imposed by EU directives.
	Indicates that the product complies with Korean regulations. Declarer: HIOKI KOREA CO., LTD. http://www.rra.go.kr/selform/HKO-ST4200-50

Notation of terms for partial discharge

Notation	Description
PD	Abbreviation for “partial discharge.”
AC PD	Indicates the partial discharge generated when high voltage is applied to the object under measurement.

Other notations

Notation	Description
Settings button	 Indicates the settings button at the top left of the screen.
Flash drive eject button	 Indicates the flash drive eject button at the bottom right of the screen.
	Indicates useful functions and advice you should know.
*	Indicates that additional information is described below.
See: (Title)	Takes you to a reference page.
START (Boldface)	Indicates on-screen names and keys.
[ ]	On-screen user interface names are displayed in brackets (**[ ]**).
Windows	Unless otherwise noted, the term “Windows” is used generically to refer to Windows 7, Windows 8, Windows 10, and Windows 11.
pcs	Unit representing pieces.
pps	Unit representing pulses per second.

Notation	Description
div	Unit representing one division on the temporal axis of a graph.
S/s	Unit representing samples per second (S/s), the number of times per second the analog input signals are digitized by the instrument. Example: "20 MS/s" indicates that the signal is digitized 20×10^6 times per second.

1.5 Safety Information

The instrument is designed in accordance with the IEC 61010 international standard and their safety was confirmed during pre-shipment inspections.
However, using the instrument in a way not described in this manual may diminish their safety.
Read the following safety notes carefully before using the instrument.

⚠ DANGER

Mishandling the instrument could result in bodily injury or even death, as well as damage to the instrument. Familiarize yourself with the instructions and precautions in this manual before using the instrument.

⚠ WARNING

Electricity can cause potentially serious events such as an electric shock, heat generation, fire, and an arc flash due to a short-circuit. If you have not used electrical measuring instruments before, you should be supervised by a technician who has experience in electrical measurement.

Protective gear

⚠ WARNING

The PD test performed using this instrument is measured on a live line. To prevent an electric shock, use appropriate protective insulation and adhere to applicable laws and regulations.

1.6 Operation Precautions

Follow these precautions to ensure safe operation of the instrument and to obtain the full benefits of its various functions.
Ensure that your use of the instrument falls within the specifications not only of the instrument itself, but also of any included accessories and options being used.

Installing the instrument

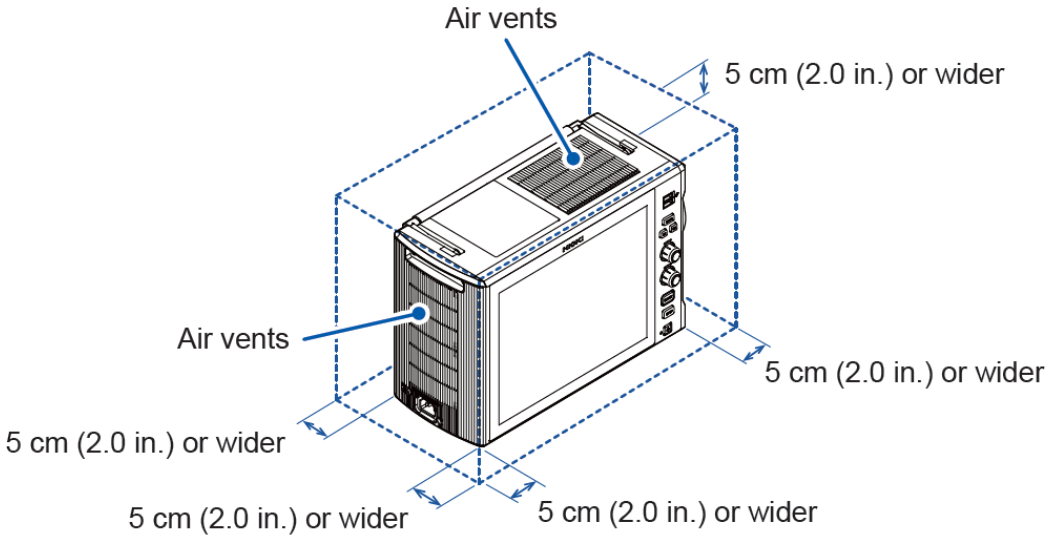
⚠ WARNING

Installing the instrument in inappropriate locations could cause a malfunction of the instrument or an accident. Avoid locations that are:

- Exposed to direct sunlight or high temperatures
- Exposed to corrosive or combustible gases
- Exposed to strong electromagnetic fields or electrostatic charges
- Near induction heating systems (such as high-frequency induction heating systems and IH cooking equipment)
- Susceptible to vibration
- Exposed to water, oil, chemicals, or solvents
- Exposed to high humidity or condensation
- Exposed to high quantities of dust particles
- On top of unstable platforms or inclined surfaces

Unplugging the power cord kills power to the instrument. Be sure to provide enough unobstructed space to unplug the power cord immediately in an emergency.

- Do not stack multiple instruments.
- Place the instrument with the bottom or rear side downwards.
- Leave at least 5 cm (2 inches) of space on every surface other than the underside to ensure that the air vents are not obstructed to keep the instrument's temperature from rising.



Handling the instrument

⚠ WARNING

The input terminals on this instrument are used only for signal inputs from the High Voltage Multiplexer SW2001 or the PD Sensor ST9210. Do not use inputs from devices or sensors other than the SW2001 and the ST9210. Damage to the instrument or overheating can cause bodily injury.

The instrument is an EN 61326 Class A product. When using in a home environment such as a residential area, it may interfere with the reception of radio and television broadcasts. In such cases, workers should implement appropriate measures.

Before connecting the instrument to external equipment

⚠ CAUTION

- Connect the ground terminal of the instrument and the ground terminal of connected equipment to a single grounding point with sufficiently low impedance. Using different ground circuits will result in a ground potential difference between the instrument and the connected equipment. If a cable is connected while such a potential difference between grounds exists, it may result in equipment malfunction or failure.
- Before connecting or disconnecting any cable, always turn off the instrument and your device to be connected. Failure to do so could result in an equipment malfunction or damage to the equipment.
- To prevent damage to the equipment, use the recommended type of wires to connect your external equipment to the external control terminals, or otherwise ensure that the wires have sufficient withstand voltage and current capacity.

Precautions during measurement

⚠ DANGER

- Do not use the instrument to measure circuits that exceed those ratings or specifications. Damage to the instrument or overheating can cause bodily injury.
- Connect the functional ground terminal to the ground if subject to the impact of noise.

Precautions during shipment

Store the packaging materials after unpacking. Use the packaging materials that came with instrument when transporting it.

⚠ CAUTION

To avoid damage to the instrument, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock due to dropping it.

2 Overview

2.1 Product Overview

This Partial Discharge Detector is equipped with the functionality to perform both AC PD measurements in conformance with IEC 60270 (2015) and IEC 60034-27-1 (2017).

2.2 Features

Noise resistance performance that withstands noise when used on a production line

Generally, a PD detector is sensitive to noise, which makes measurement in a noisy environment such as a production line difficult. This instrument realizes high noise resistance performance that can withstand noise when used on a production line due to its sensor part (option) and detection and calculation parts that are insusceptible to noise.

Measurement conforms to IEC standards

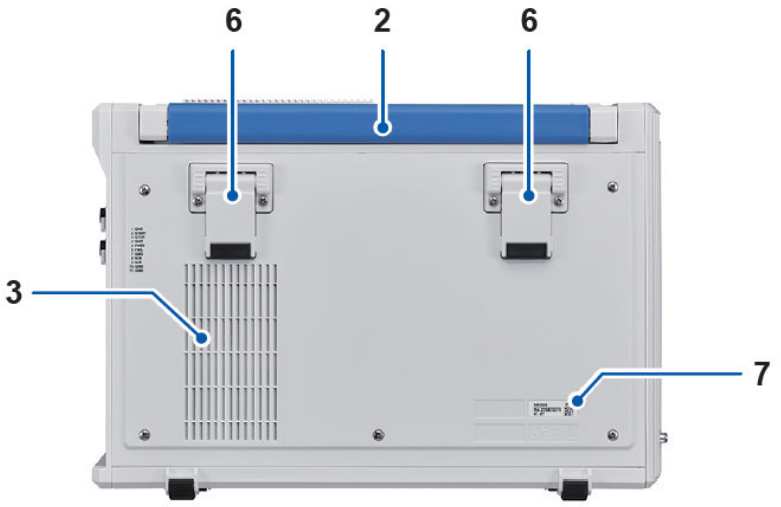
Measurements that conform to PD-related IEC standards and for which interpretation and measurement is complex are simple to perform with this instrument.

Provides analysis for both production line testing and research and development

The instrument is equipped with a simple screen mode (function) suitable for use on a production line. The measurement system used at the research and development stage can be applied as is to production lines.

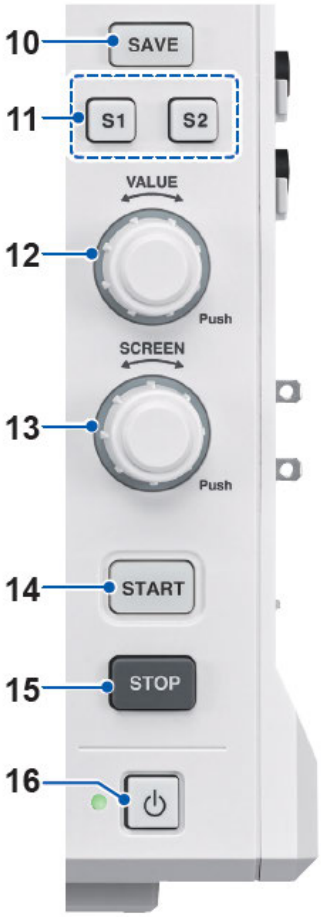
2.3 Name and Function of Each Part

Overall appearance



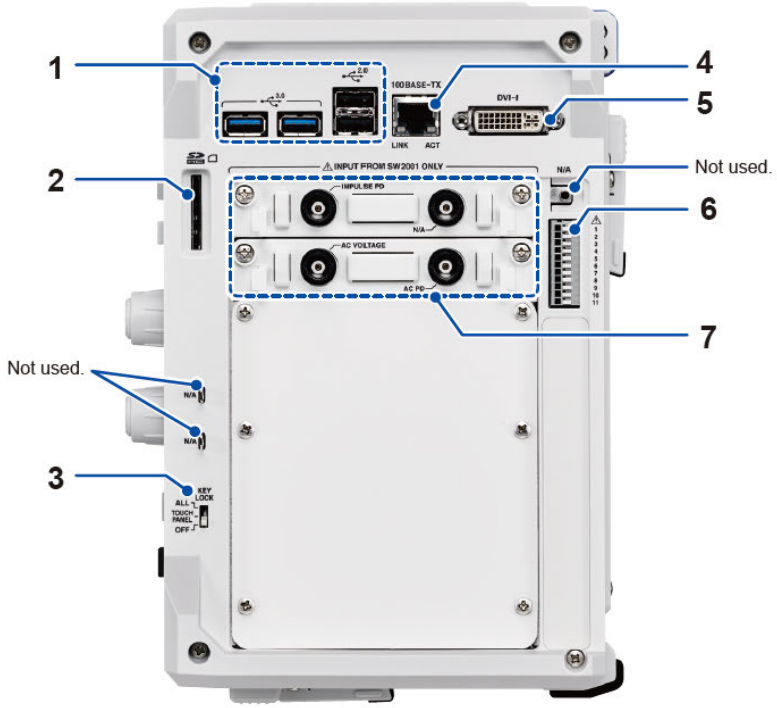
No.	Name	Function	Reference
1	Media box	Holds the SSD unit. One port is available for USB 3.0 connector (dedicated to USB flash drives). Always use the instrument with the cover closed.	How to Open the Media Box
2	Handle	The handle used to carry the instrument.	-
3	Air vents	These holes provide ventilation to prevent the internal temperature of the instrument from increasing to a high temperature.	Installing the instrument
4	USB connector	Connect a USB flash drive, USB mouse, or USB keyboard.	USB flash drive
5	Display	A 12.1-inch TFT color LCD equipped with a capacitive touch panel.	-
6	Feet	These feet are used to incline the instrument for better visibility of the screen. These feet are used for easier operation of the touch panel.	-
7	Serial number	For the latest information, check Hioki's website. This label is needed for administrative purposes. Do not remove this label. Inform your authorized Hioki distributor or reseller of this number if required.	-
8	GND terminal (Functional earth terminal)	Ground this terminal.	Supplying Power to the Instrument
9	Power inlet	Connects the power cord provided.	Supplying Power to the Instrument

SAVE key



No.	Name	Function	Reference
10	SAVE key	Opens the manual saving dialog box. Lights up in blue while accessing the storage device.	-
11	Shortcut keys	Frequently-used settings can be registered on the keys.	Shortcut keys
12	VALUE rotary knob	Changes the setting value for the slider bar.	VALUE
13	SCREEN rotary knob	Transitions the displayed screen.	SCREEN
14	START key	Starts measurement. Lights up in green during a measurement.	-
15	STOP key	Stops the measurement.	-
16	Power key	Used to turn the instrument on and off.	Supplying Power to the Instrument

Right side



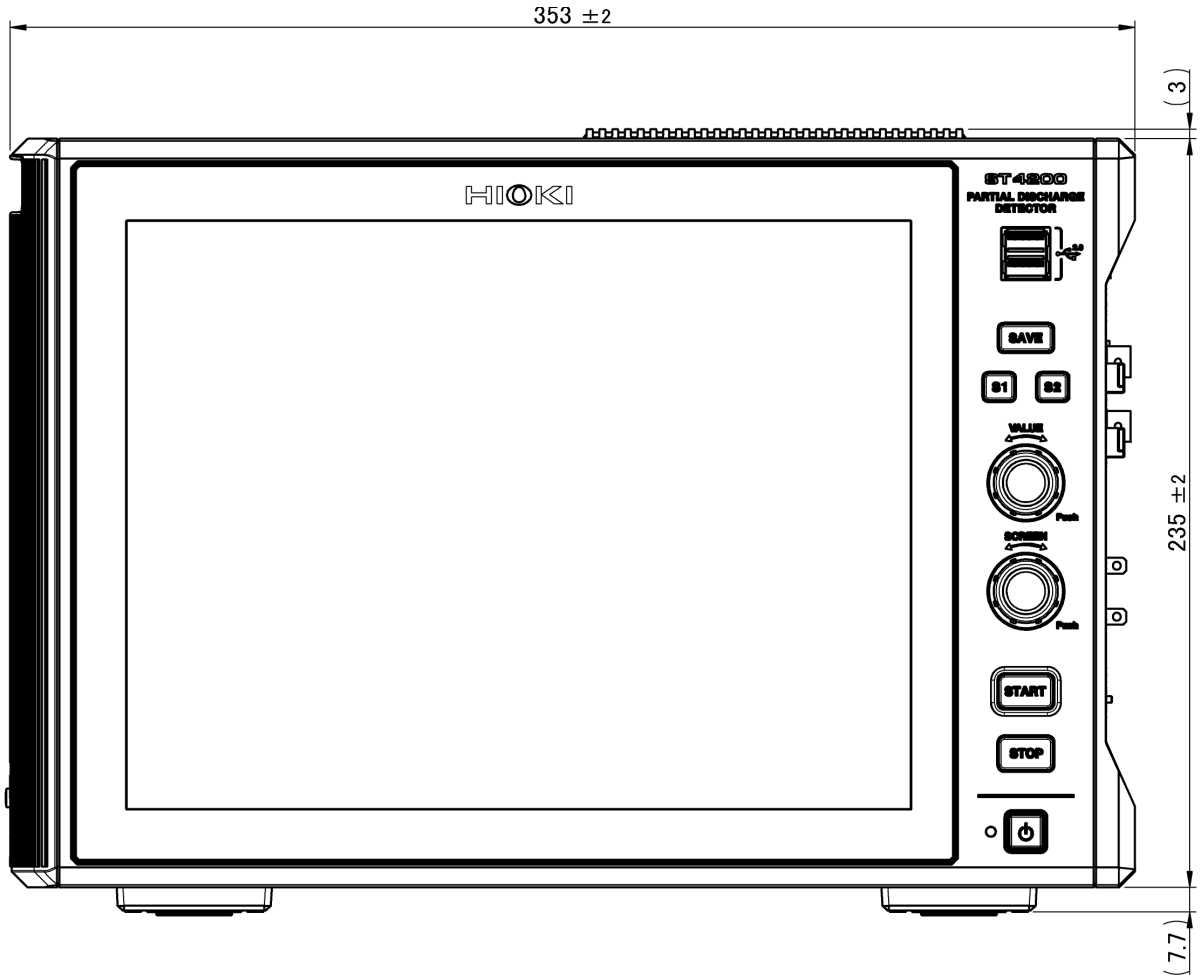
No.	Name	Function	Reference
1	USB connector	Connect a USB flash drive, USB mouse, or USB keyboard.	USB flash drive
2	SD memory card slot	Insert an SD memory card.	SD memory card
3	KEY LOCK	Disables the touch panel and key operation.	Key lock
4	LAN connector (100BASE-TX)	Plug a LAN cable to connect the instrument to your network. **ACT LED** Blinking: Communicating data **LINK LED** Orange light: 100BASE Off: 10BASE	Connecting the Instrument With Computers
5	DVI-I terminal	Outputs the screen display.	-
6	External control terminals	Enables to control the instrument by inputting external signals, or output signals externally.	Connecting the External Control Terminals
7	Measurement signal input terminal	Terminal used to input measurement signals from the SW2001 or the ST9210.	Connecting Connection Cables

⚠ CAUTION

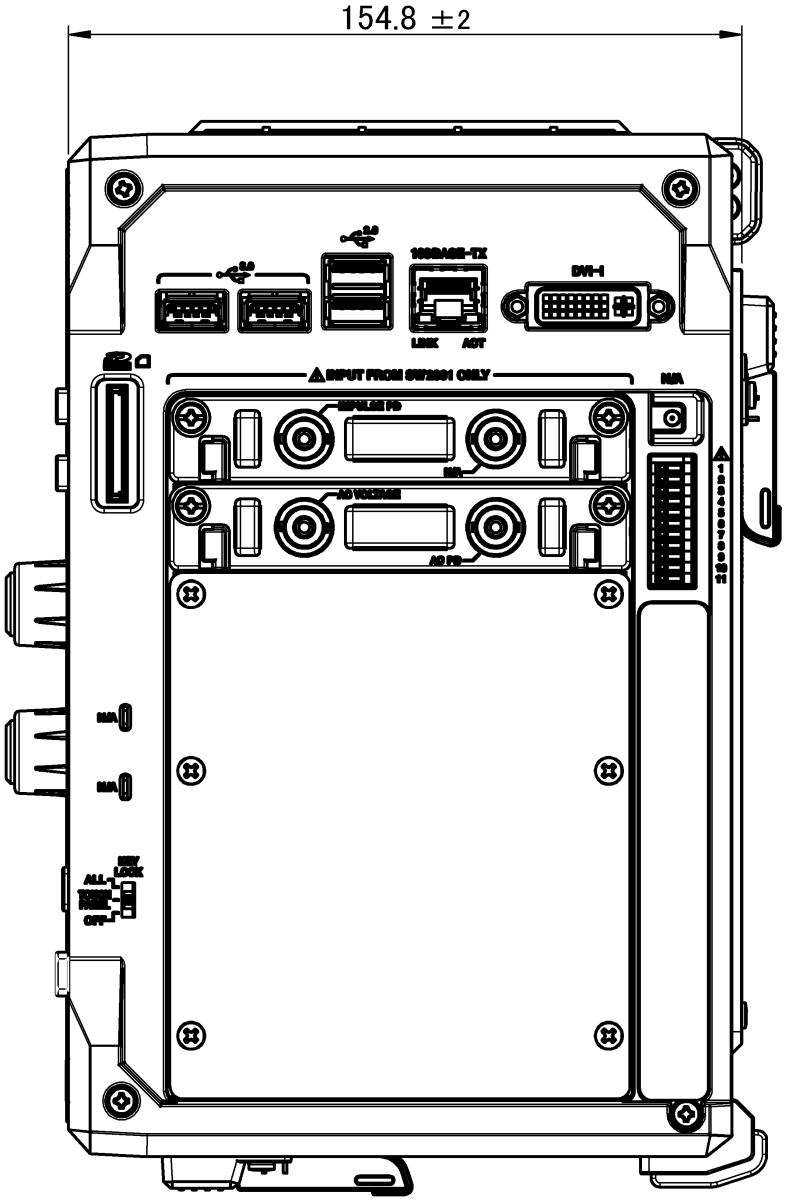
- Do not use the terminals for which N/A is displayed. This may result in damage to the instrument or connected equipment.
- Do not connect any equipment other than the SW2001 or the ST9210 to the measurement signal input terminal. This may result in damage to the instrument or connected equipment.

2.4 Appearance Drawings

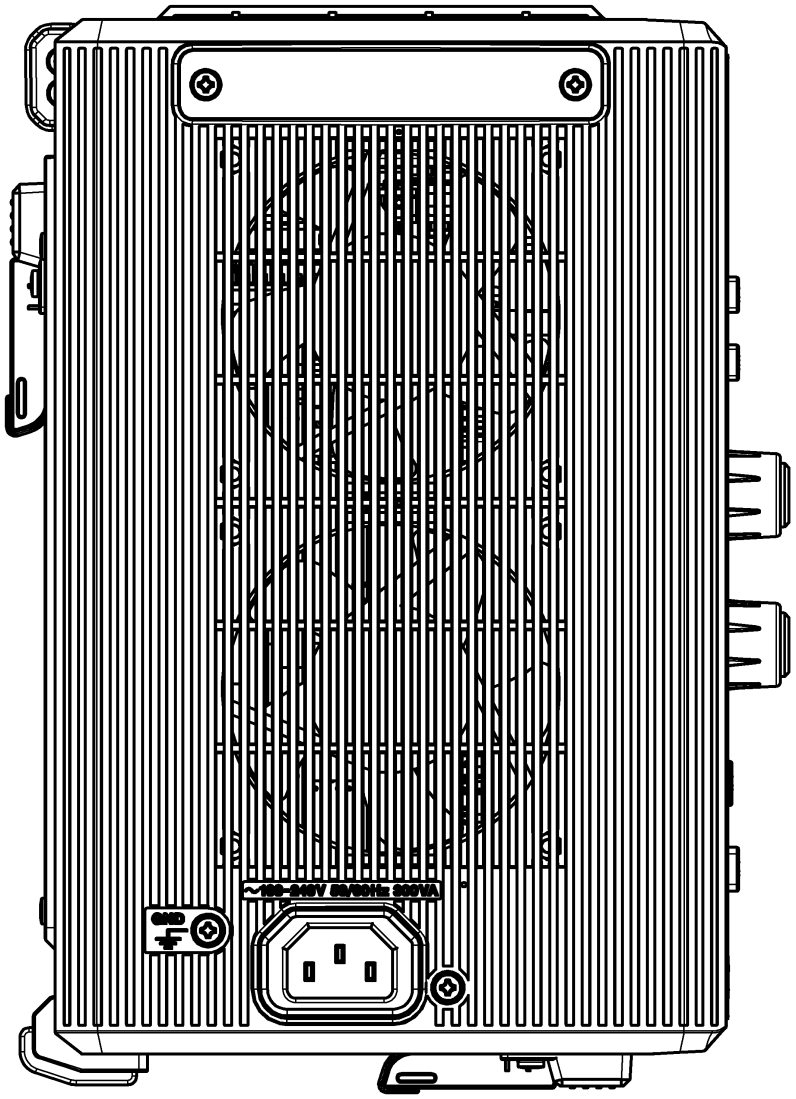
Front



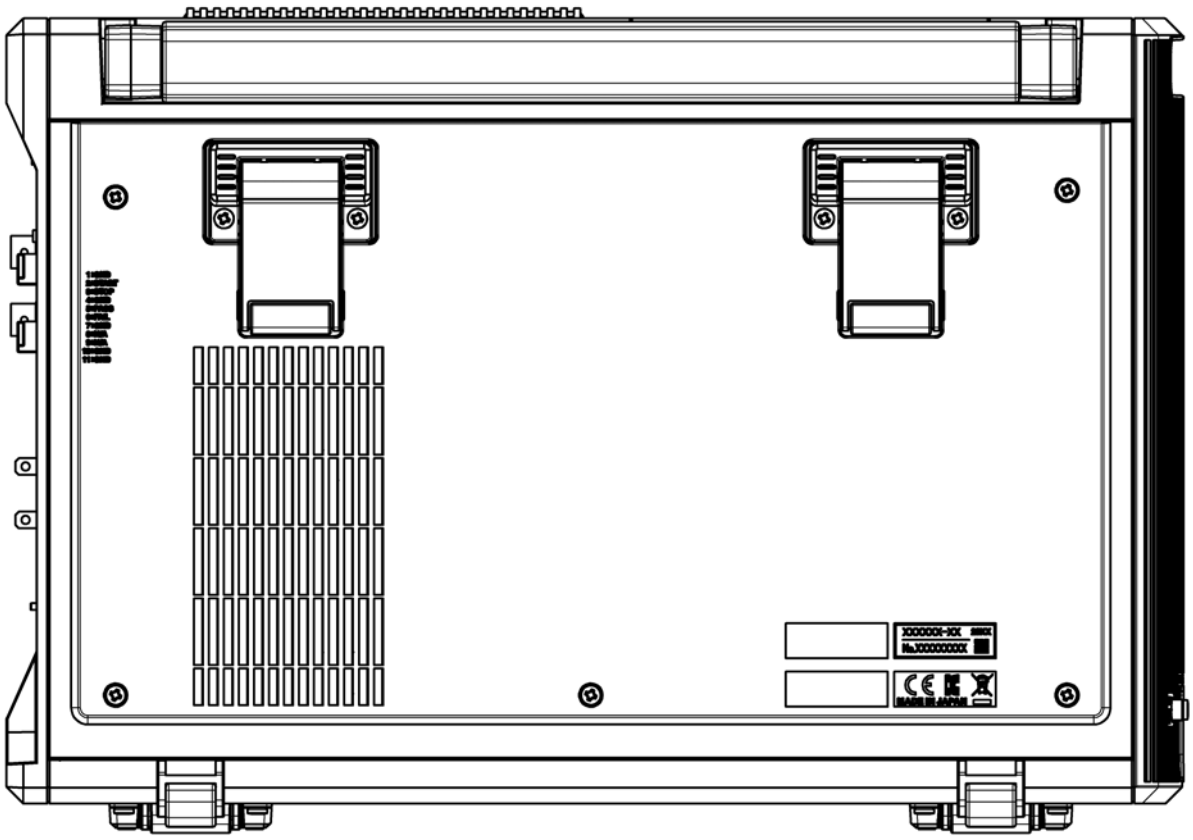
Right side


154.8 ±2
100BASE-TX
LINK
ACT
DVI-I
INPUT FROM GW2001 ONLY
N/A
N/A
N/A
ALL
OFF

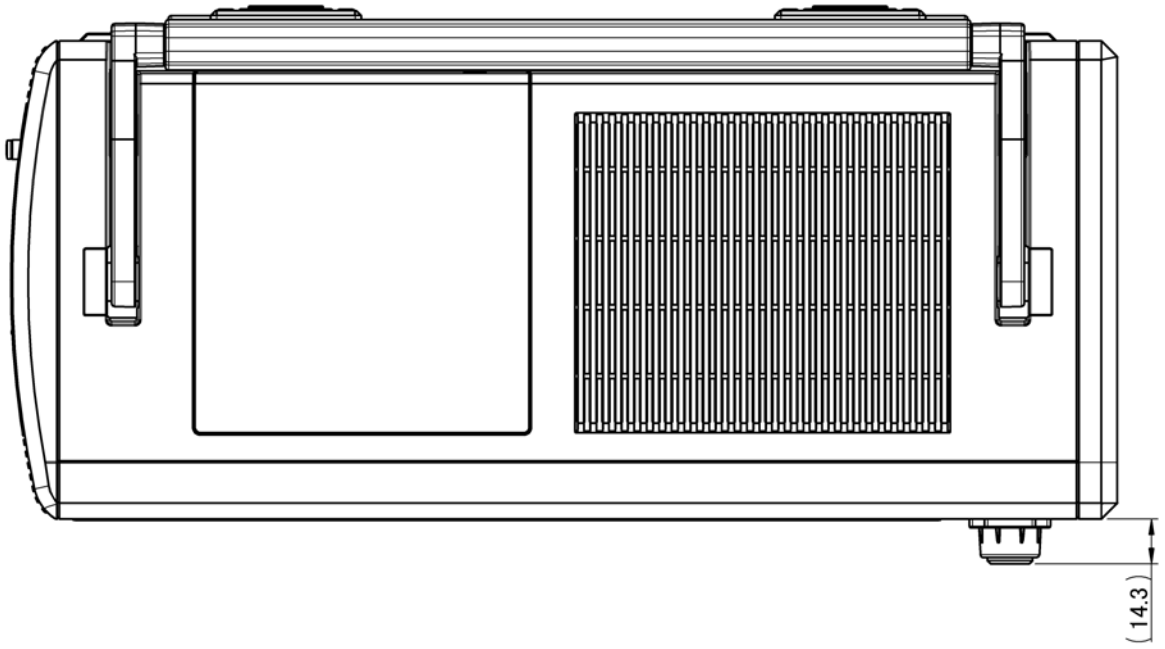
Left side



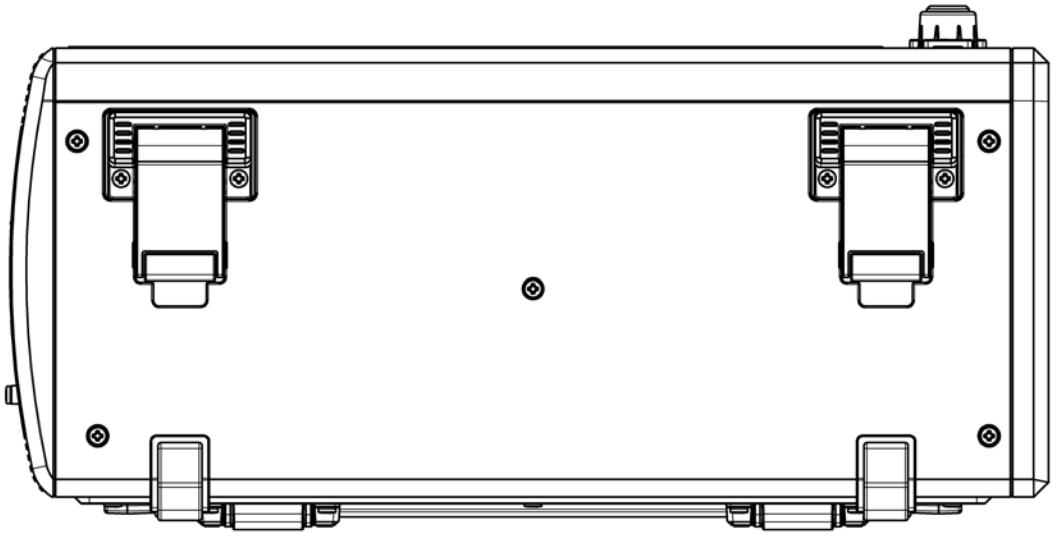
Rear



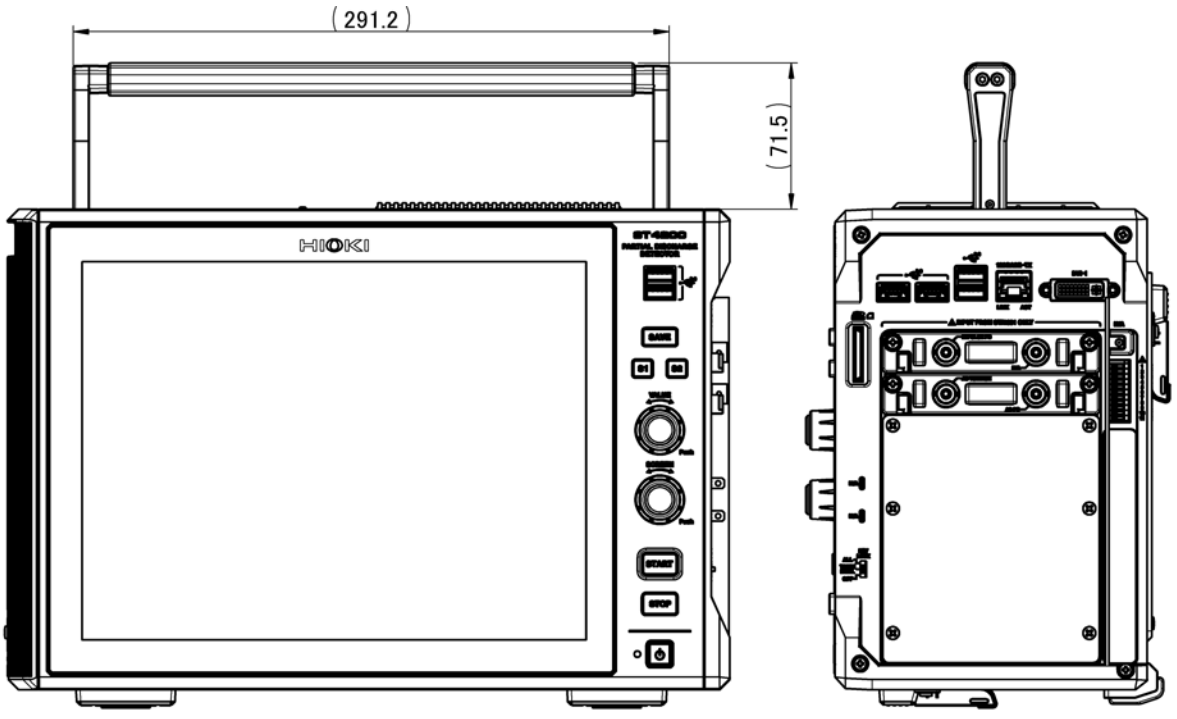
Top



Bottom



Handle

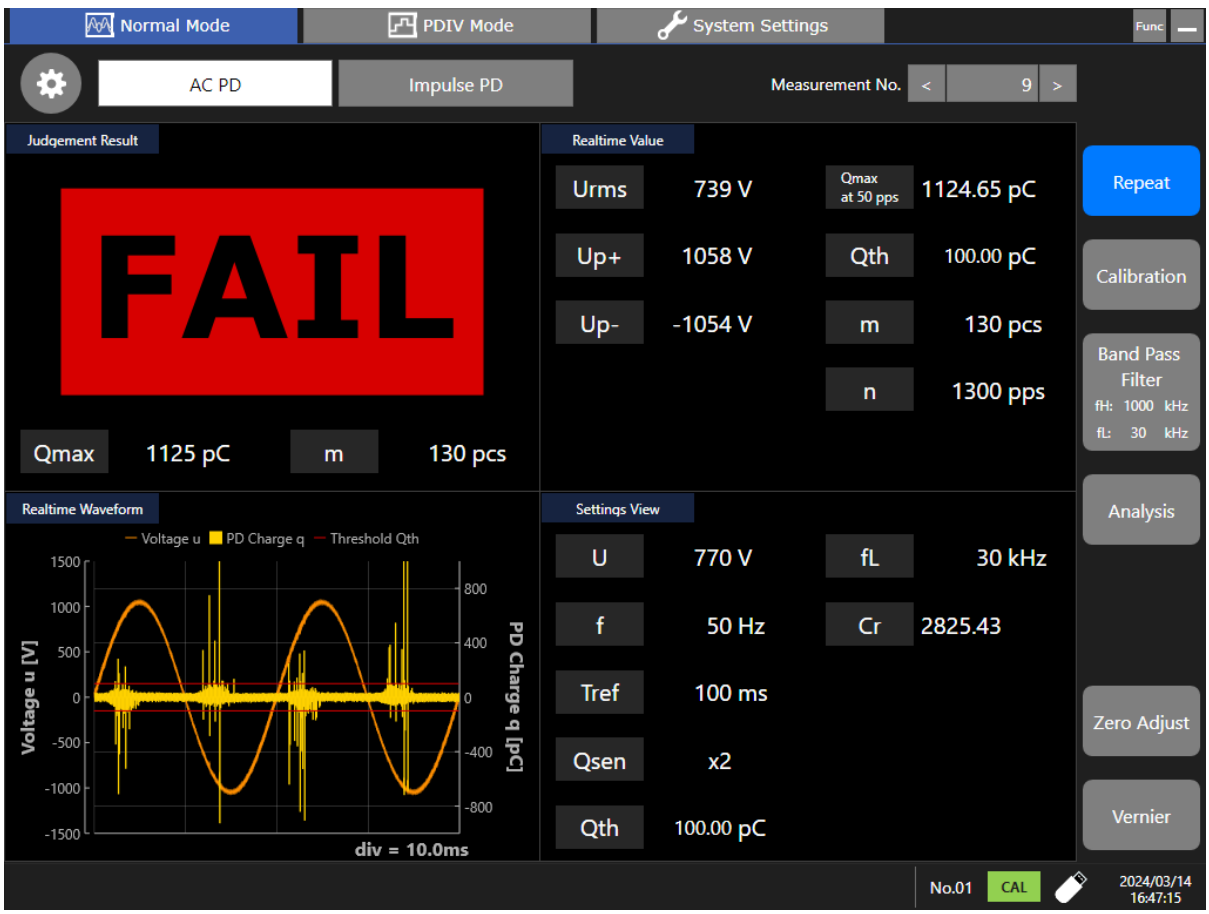


2.5 Types of Measurement Modes

This instrument has the following two measurement modes.
Normal mode: This mode applies constant voltage to measure the magnitude of a partial discharge.
PDIV mode: This mode performs measurement while adjusting measurement voltage up and down to measure partial discharge inception voltage (PDIV) and partial discharge extinction voltage (PDEV).
Each measurement mode has an AC PD measurement function.
The partial discharge value when performing an AC PD measurement will be displayed as Qmax (repeatedly occurring maximum PD intensity).

Normal mode

This mode applies constant voltage to measure the magnitude of a partial discharge. Press the **START** key to control the high-voltage power supply, apply voltage to the object under measurement, and begin measuring. For single measurements, high-voltage output and the measurement operation will stop automatically once measurement is complete. For repeat measurements (freely running), measurement will continue until the **STOP** key is pressed.



PDIV mode

This mode performs automatic PDIV and PDEV measurements in conformance with IEC standards. For AC PD measurements, output voltages will be consecutively increased and decreased to measure PDIV and PDEV.

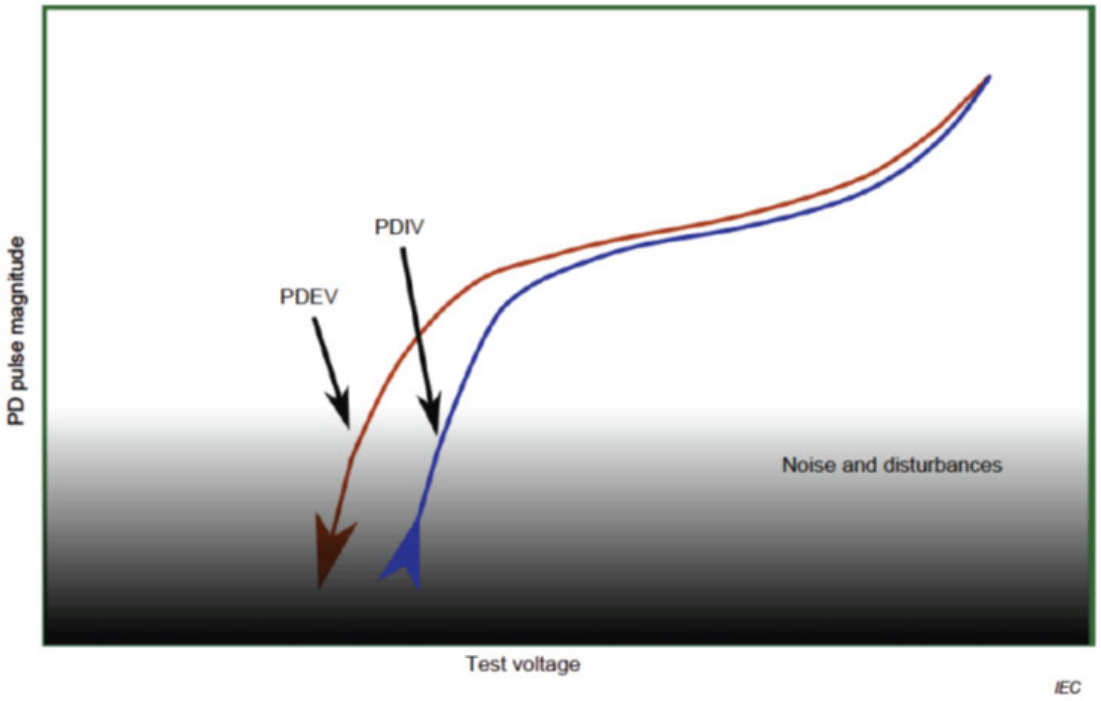
PDIV: Partial Discharge Inception Voltage

PDEV: Partial Discharge Extinction Voltage

2.6 Finding PDIV Mode Parameters

Finding PDIV and PDEV for AC PD measurement

The following graph shows the relationship between the applied voltage and maximum PD charge, and Qmax, when AC PD is repeatedly measured while changing the applied voltage.
(Horizontal axis: Applied voltage, Vertical axis: Repeated PD pulse magnitude)



IEC 60034-27-1

- PDIV value Ui is the voltage when the voltage increases and Qmax exceeds the set threshold value Qth
- PDEV value Ue is the voltage when the voltage decreases and Qmax is lower than the set threshold value Qth

2.7 Basic Operation

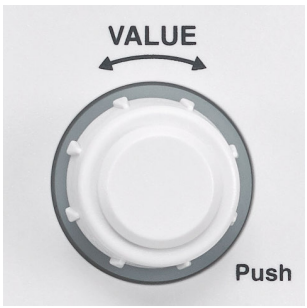
Touch panel

The touch panel allows the following operations.

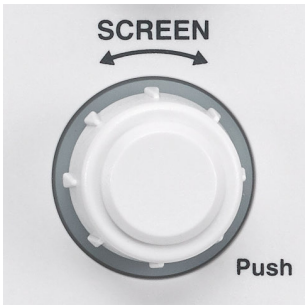
Touch operation	Operation name	Description
	Tap	“Tap” means to touch the display and then to lift the finger quickly.
	Drag	“Drag” means to select something shown on the display with a finger by touching it and to slide the finger while toughing the display.

Rotary knob

VALUE



While the slider bar setting screen is displayed, rotate the **VALUE** rotary knob to change by increments of **[100]**.
Press the rotary knob to change by increments of **[10]** when the knob is rotated. Press the knob again to return the increment to **[100]**.
When configuring using the slider bar, the **VALUE** LED rotary knob will light up in green and become enabled for operation.



Use the **SCREEN** rotary knob to change the **[Measurement No.]**. Every time this rotary knob is pressed, the Measurement No. is set to the default value.
When **[Measurement No.]** is displayed on the measurement screen, the **SCREEN** rotary knob is lit in red and its operation is enabled.

Changing screens and settings

Switching the setting screens

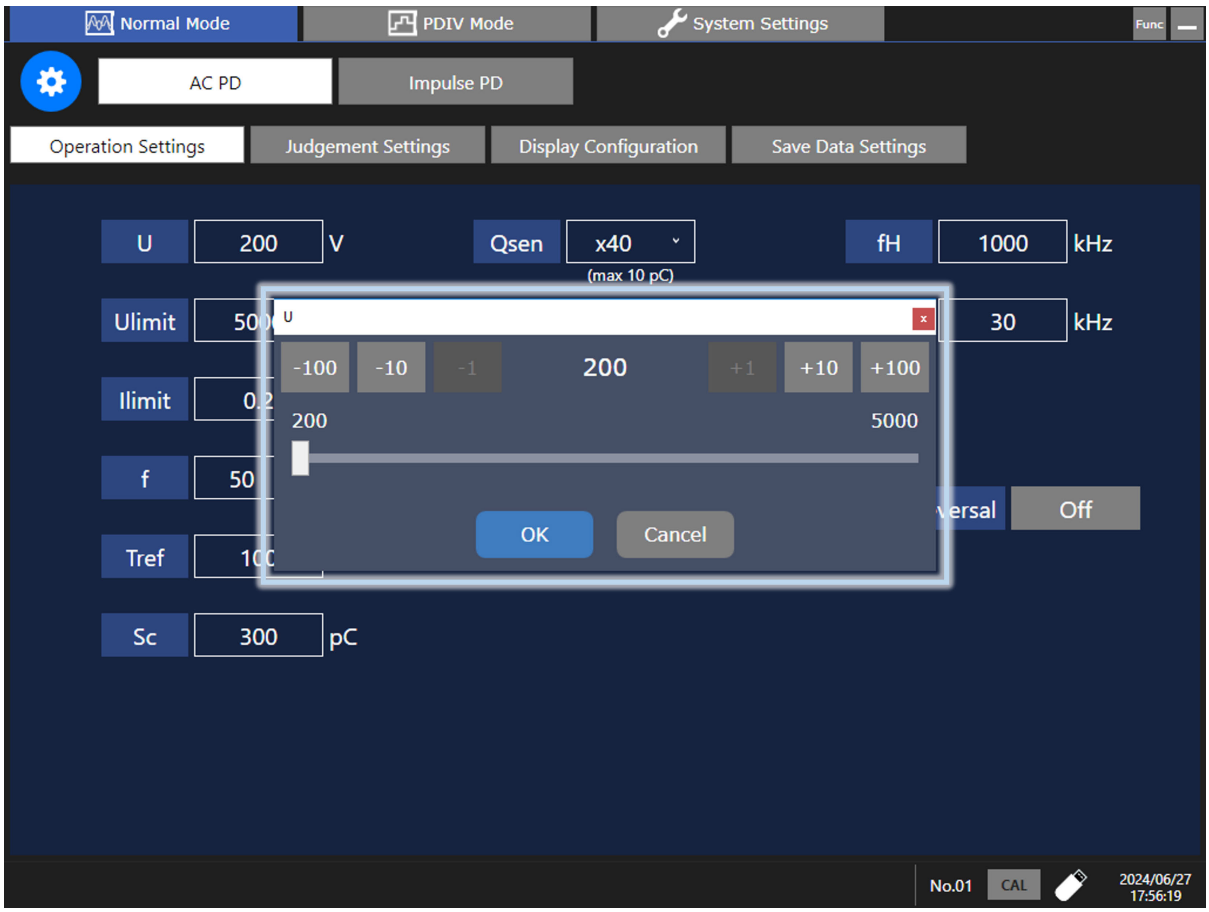
Tap a tab to switch the setting screens.

Selecting using a slider bar

This is used when setting integer values. The following three setting methods are available:

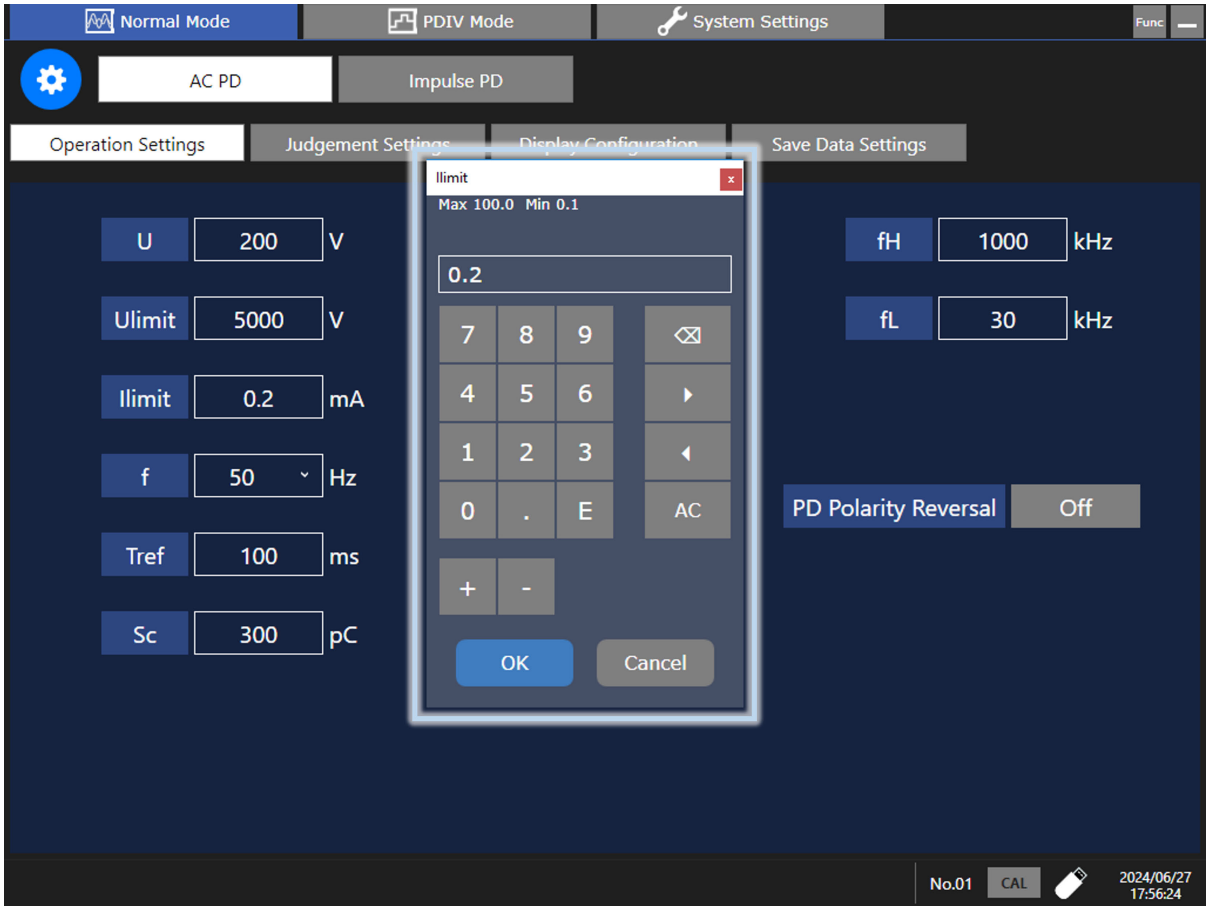
1. Tapping the six buttons to increase and decrease the value above the slider bar.
2. Moving the slider bar knob by dragging it.
3. Turning the **VALUE** rotary knob.

Example: When inputting a test voltage



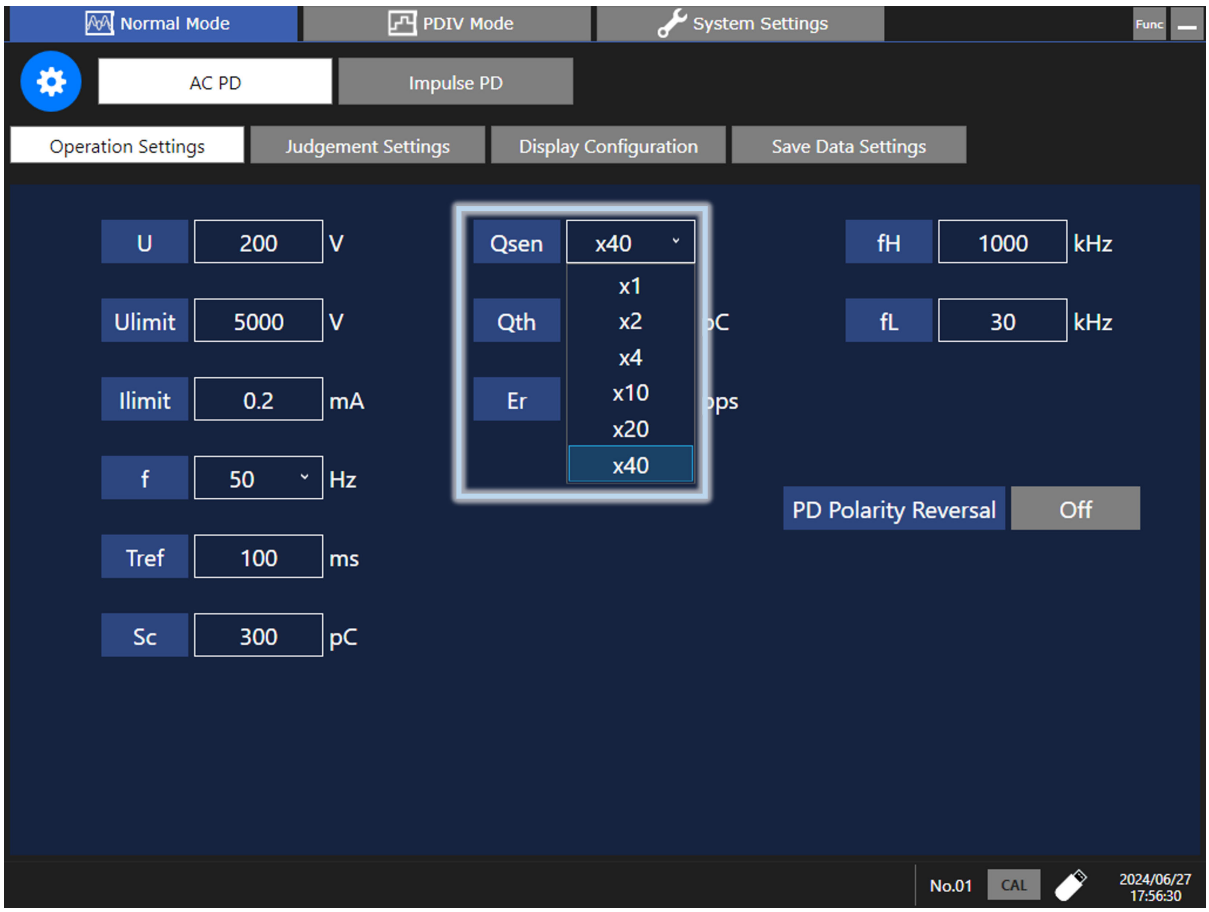
Inputting using a numeric keypad

This is used when setting values with decimal points. Select a value by tapping on the numerical keypad.
Example: When setting the upper limit current value



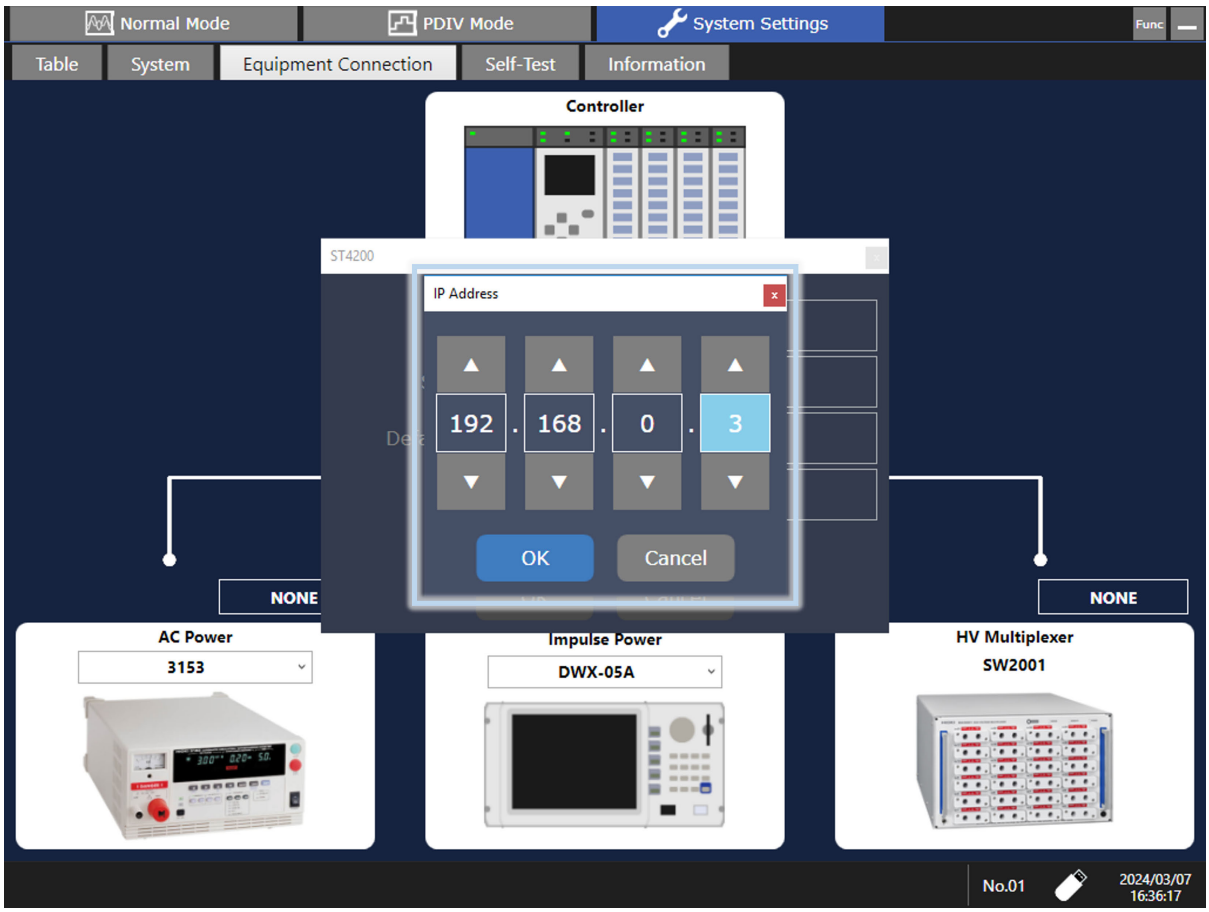
Selecting an option from a list

Select an option by tapping on the drop-down list box.
Example: When selecting the measurement sensitivity



Entering numerical values

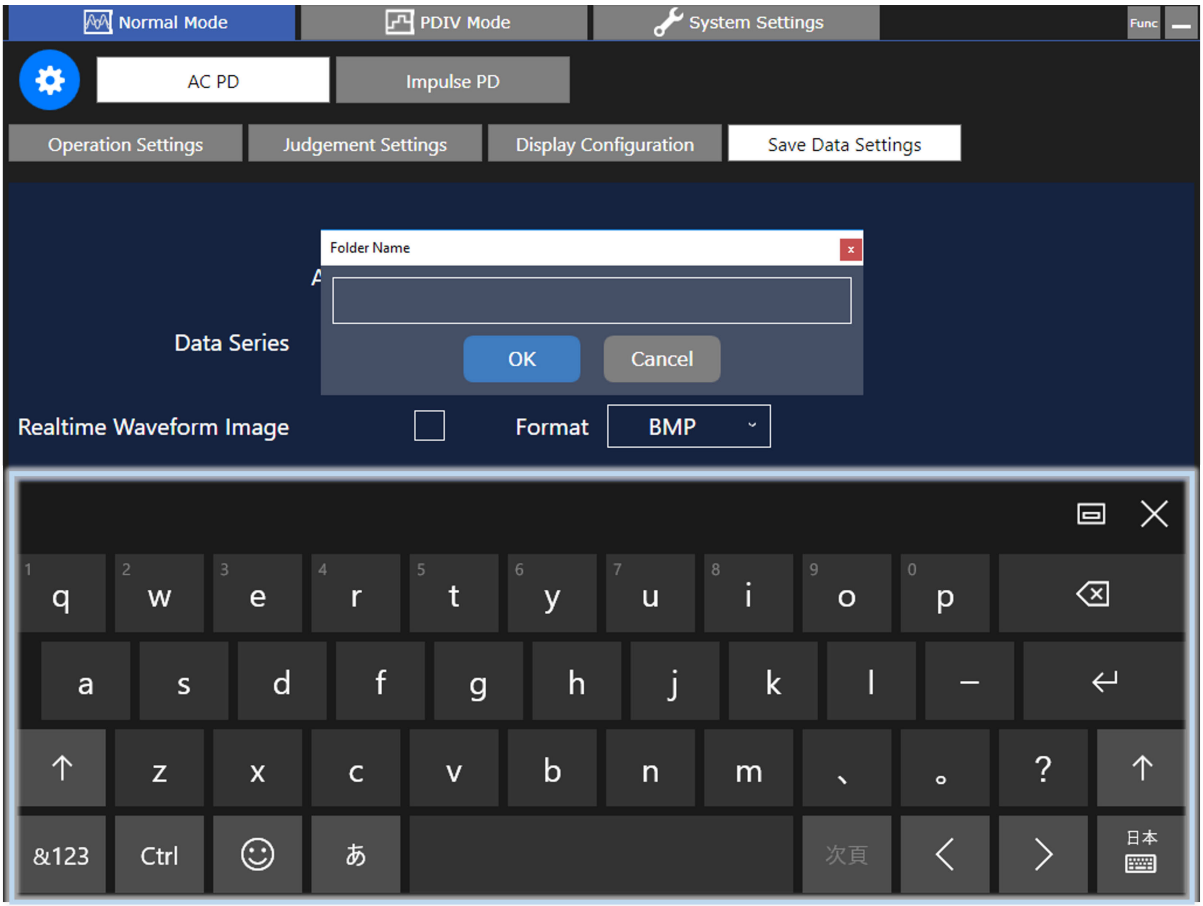
Select a value by tapping on the up and down keys for each number.
Example: When selecting an IP address
See: Equipment Connection

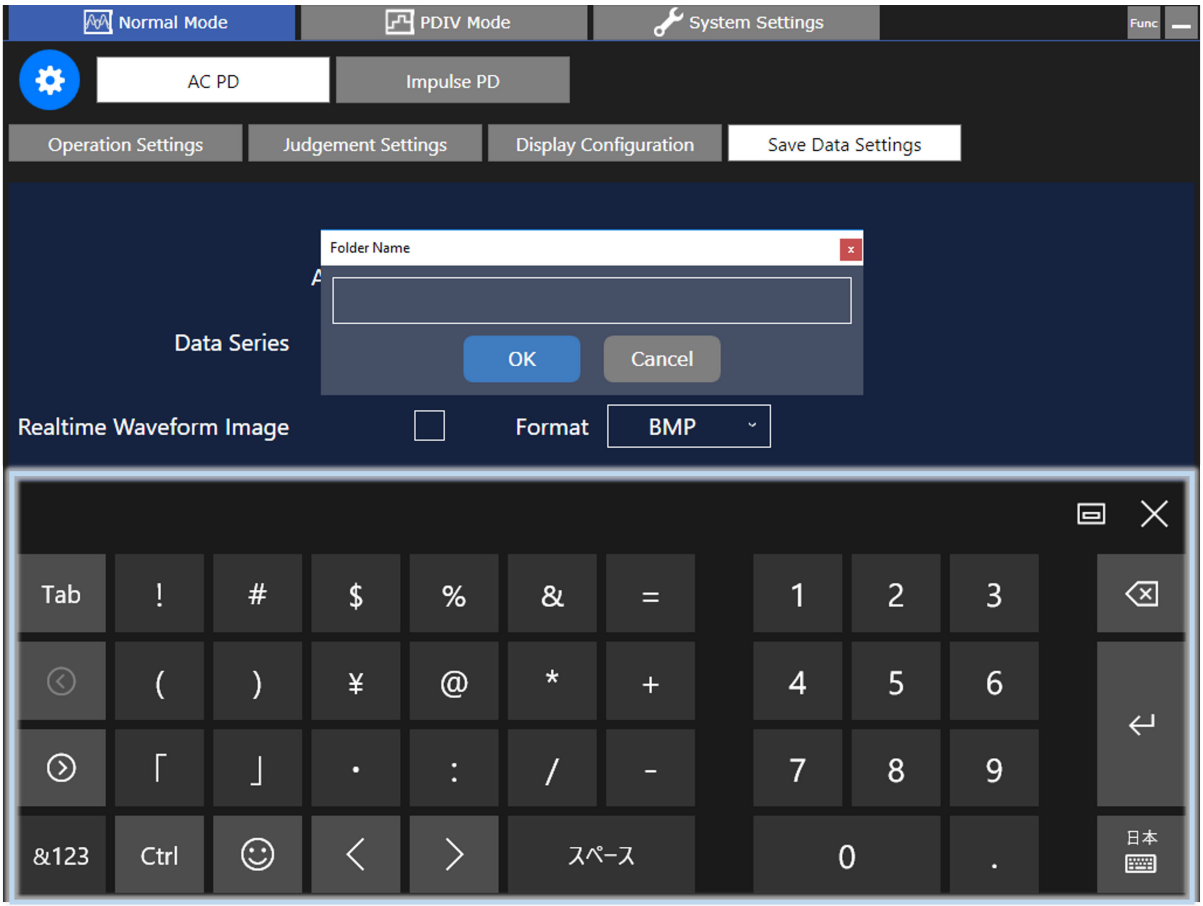


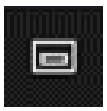
Touch keyboard

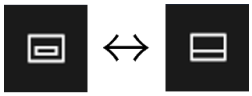
This is used for inputting the name of the folder and file to which the measured data is saved. Tapping an input box allows you to enter characters with the touch keyboard. The touch keyboard can be used to enter letters and numbers. Each time the square icon to the top right of the touch keyboard is tapped, the keyboard switches between fixed and floating on the screen.

See: Setting Measurement Conditions and Judgment Conditions





Icon	Description
	You can drag the keyboard.
	You cannot drag the keyboard.

Icon	Description
	Each tap switches the keyboard switches between **fixed and floating on the screen**.
	Closes the keyboard.

Mouse operation

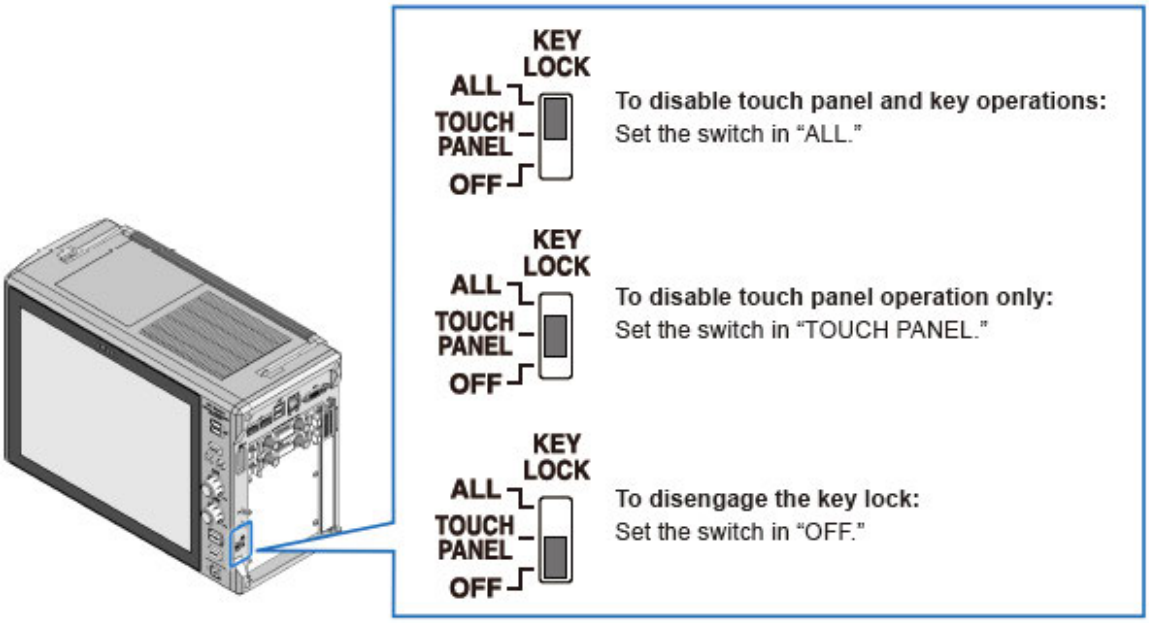
Using a commercially available USB mouse enables you to operate the instrument as with the touch panel. Mouse operation for the instrument is as follows:

Mouse operation	Touch operation	Description
 Click	Same action as tapping the screen	Allows you to select a menu or execute an action.
 Center wheel	-	Scrolls through data series and tables.
 Up/down/left/right	-	Moves the mouse cursor around.

External noise may cause the mouse to malfunction. Keep the mouse and mouse cable as far away as possible from sources of noise.
Use the mouse on an insulated table. Some mouses commercially available are susceptible to noise and using such a mouse on a metal table may cause the instrument to malfunction.

Key lock

The key lock function disables touch panel operation and key operation to prevent an operation error during measurement. Even if the key lock is engaged, the external control terminals and remote operation are enabled. Slide the KEY LOCK switch until it clicks.

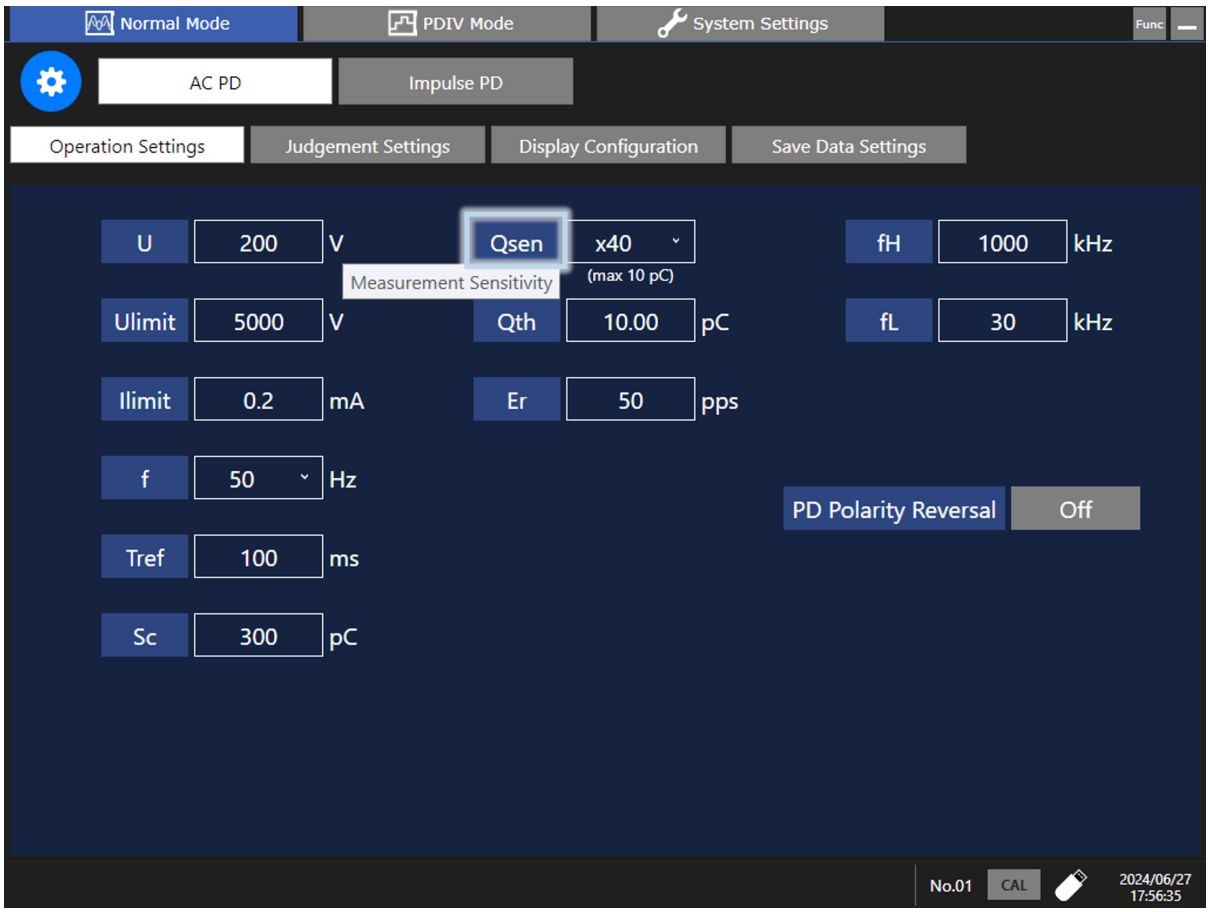


Depending on the key lock engaged, the following icons are displayed on the bottom right of the screen.

Icon	Description
	Displayed when the ALL key lock is engaged.
	Displayed when the TOUCH PANEL key lock is engaged.

Item Explanation Function

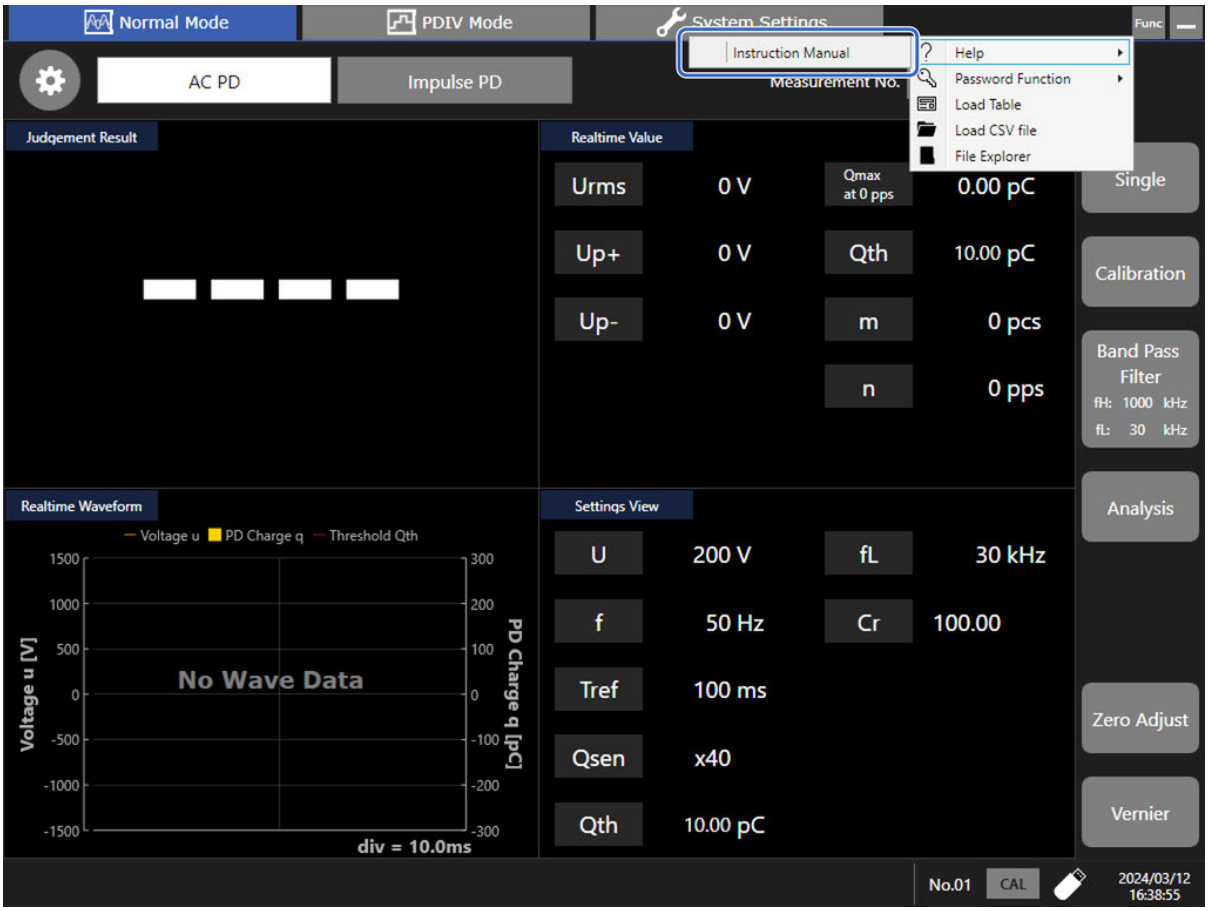
Tapping on a measurement parameter or setting parameter on the setting screen displays a balloon explaining that parameter.



Instruction Manual Display Function

Use this function to display an HTML file of the instruction manual.

1 **Tap [Func] > [Help] > [Instruction Manual].**



Open Explorer and use it to manage data saved to the media.

Explorer functions

Item	Description
Change Media	Changes the media.
Sort	Sorts the files in the file list in the selected order.
Move to Folder	Moves to the selected folder.
Copy	Copies the file to the specified folder. Or, if the selected item is a folder, it copies the entire folder to the specified folder.
Create Folder	Creates a new folder.
Rename	Renames a file or folder.
Delete	Deletes a file or folder.
Initialize	Formats the selected media.

Opening Explorer

1 Tap **[Func]** > **[File Explorer]**.

2.8 Measurement Procedure

The basic measurement procedure is as follows.

AC PD measurement

Preparing for measurement

See: Preparing for AC PD Measurement

Warming up and zero adjustment

1. Turn the instrument on and allow it to warm up for about 30 minutes. See: Supplying Power to the Instrument
2. Execute zero-adjustment. See: Executing zero-adjustment

Band Pass Filter Settings

1. Power on the Hipot tester and check that the output is OFF.
2. Tap **[AC PD]** > **[Band Pass Filter]** to display the band pass filter setting screen.
3. Input the high cutoff frequency in **[fH]** and the low cutoff frequency in **[fL]**.
4. Tap **[OK]** to close the band pass filter setting screen.

See: Configuring the Band Pass Filter

Charge calibration

1. Connect the calibration pulse generator to the object under measurement and determine the calibration pulse to use in settings.
2. Tap **[Calibration]** to display the calibration screen and input the charge to be applied to the object under measurement in **[Charge Value]**.
3. The calibration pulse is generated from the calibration pulse generator. Tap **[Start]** to execute calibration. If calibration fails, increase the charge amount for calibration and execute calibration again.
4. Once calibration is complete, tap **[Close]** to close the calibration screen and return to the measurement screen.
5. Output from the calibration pulse generator stops. Disconnect the generator from the object under measurement.

See: Calibration

Settings for measurement conditions, judgment conditions, display conditions and storage conditions

Tap the **Settings button** to open the setting screen and input the measurement conditions, judgment conditions, display conditions, and storage conditions.
Once input is complete, tap the **Settings button** again to close the settings screen and return to the measurement screen.

Executing Measurement

Check that there are no persons in the vicinity of the object under measurement and press the **START** key. High voltage is automatically output from the Hipot tester and AC PD measurement starts. In the case of a single measurement, when measurement is complete, the Hipot tester output and measurement by the instrument stops. For repeat measurements (freely running), measurement will continue until the **STOP** key is pressed.

2.9 Loading Measurement Data

Measurement data loading function

This function loads a previously saved **data series** and displays it on the instrument.

1. When the measurement screen is displayed, tap **[Func]** at the top-right of the screen.
2. Tap **[Load CSV File]**.
   Explorer opens.
3. Select a data series file with the CSV extension. You cannot load a CSV file that is not a data series.
   The measurement data is loaded.

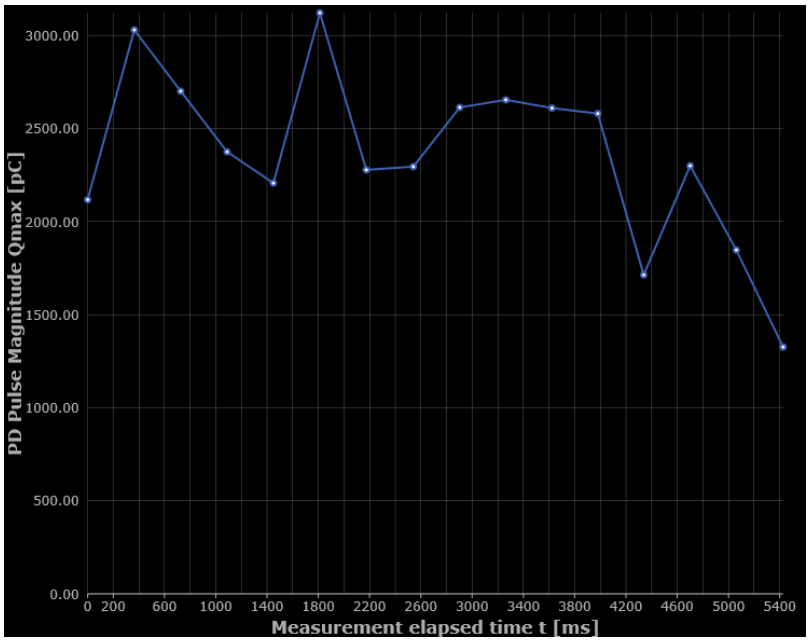
If the data is loaded successfully, **[Load Success.]** is displayed. If you then tap **[OK]**, the measurement result is displayed on the measurement screen.
If loading the data failed, **[Warning No.14 Cannot load this file.]** is displayed on the screen.

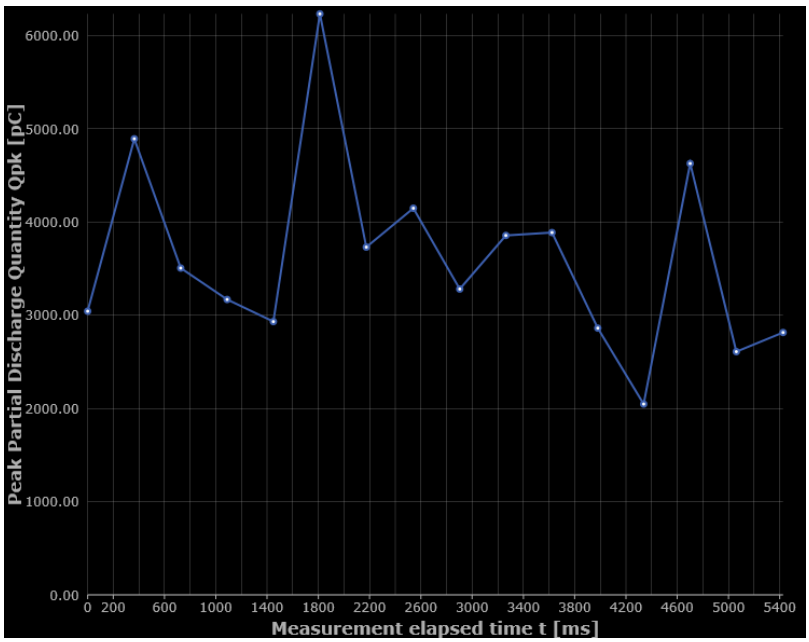
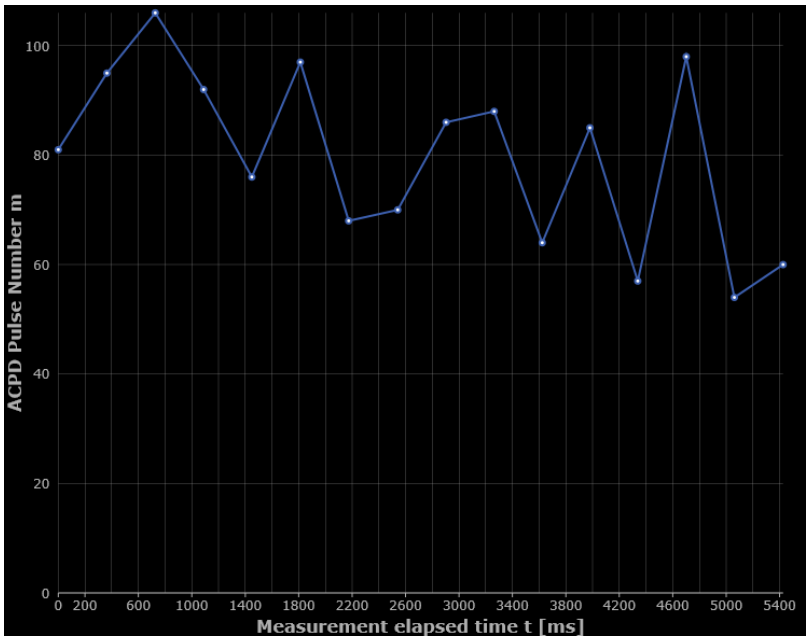
You cannot use this function while other functions, such as calibration or the band pass filter, are being used. First close the screen of the function being used, and then use this function.

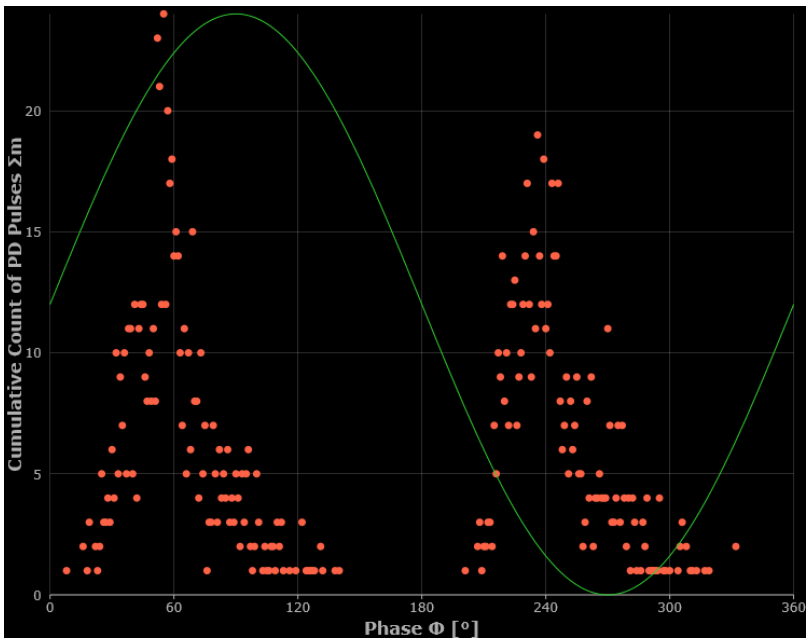
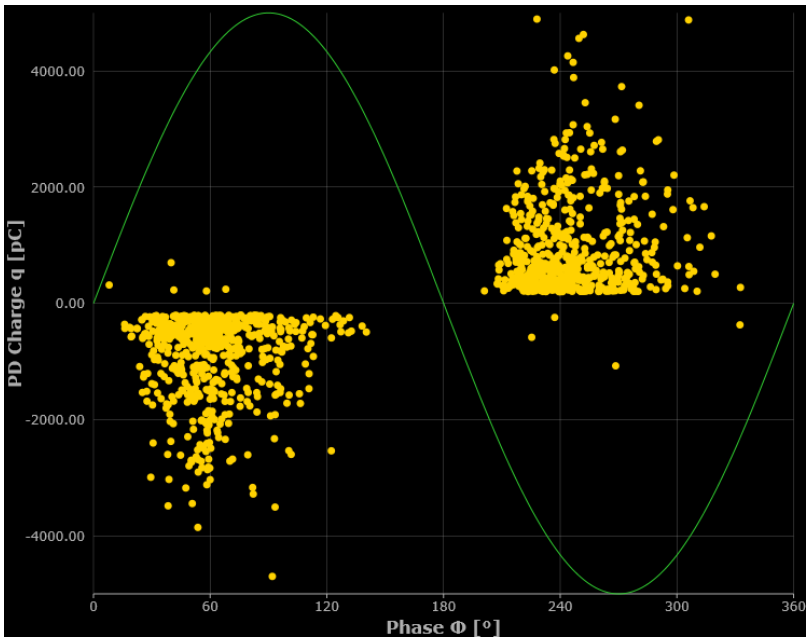
2.10 Analysis Functions

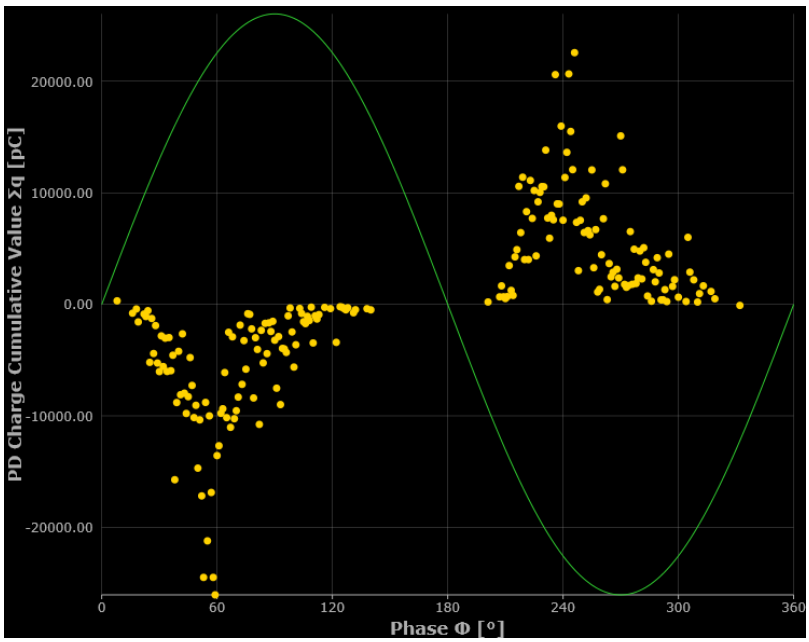
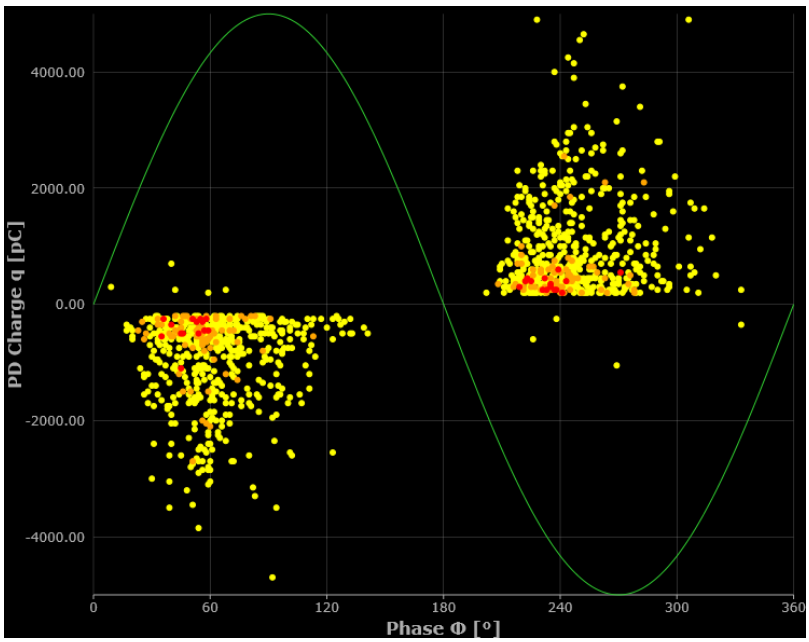
Normal mode AC PD analysis functions

With the measurement data displayed on the normal mode AC PD measurement screen,tap **[Analysis Functions]** on the right side of the screen to display the following items that can be analyzed. Select an item to automatically perform the analysis.

Analysis Item	Description
Qmax-t	Repeatedly occurring maximum PD intensity – Elapsed measurement time characteristic 

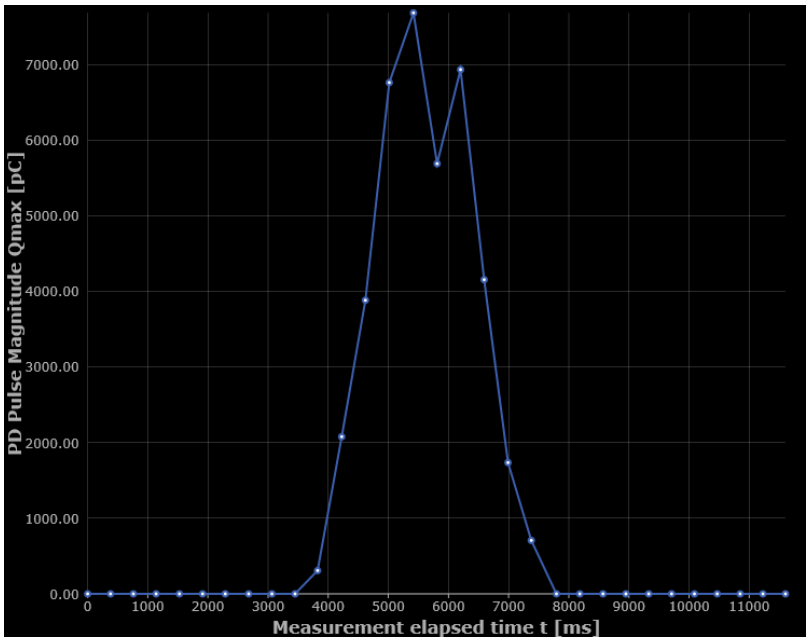
Analysis Item	Description
Qpk-t	PD charge peak – Elapsed measurement time characteristic 
m-t	Number of PD pulses generated – Elapsed measurement time characteristic 

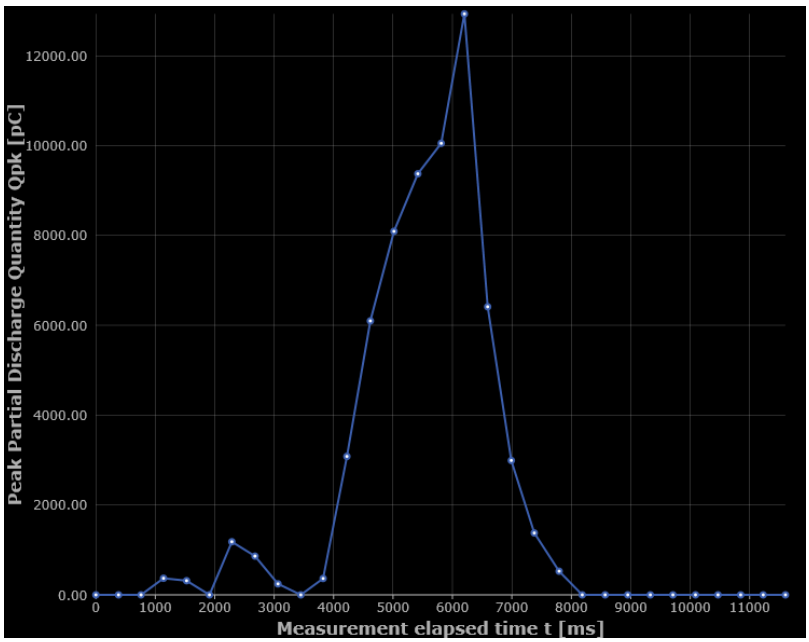
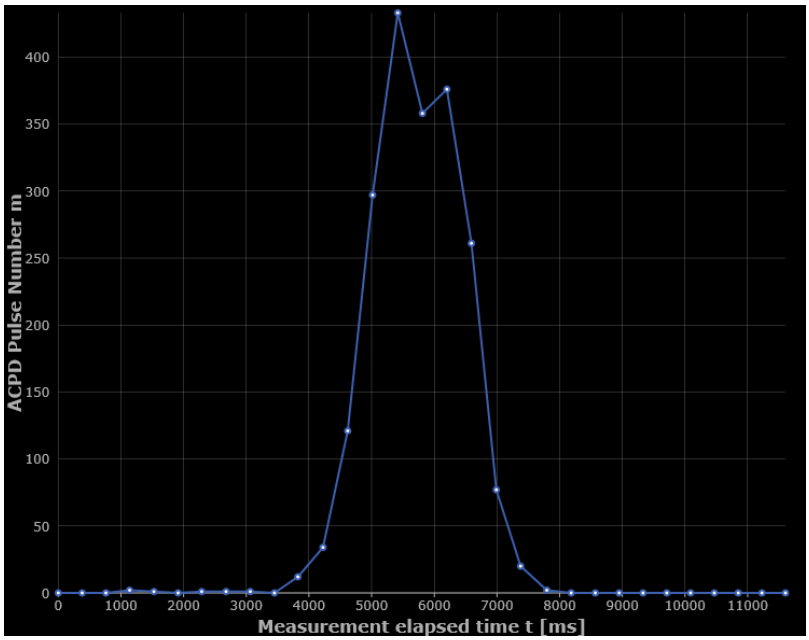
Analysis Item	Description
Σm-ϕ	Integrated value characteristic of number of PD pulses generated per phase 
q-ϕ	Apparent charge characteristic per phase The vertical axis is created with a range of -Sc to +Sc based on the PD axis scale **Sc**. 

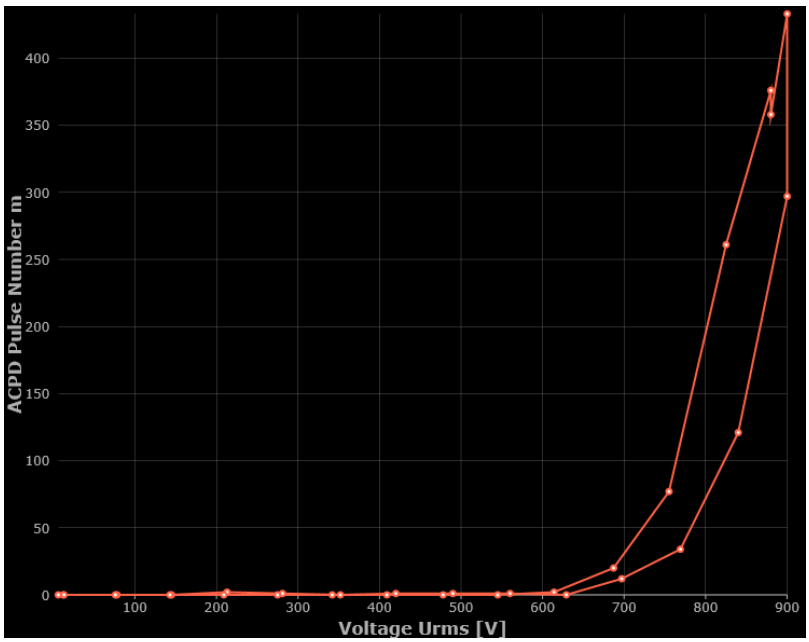
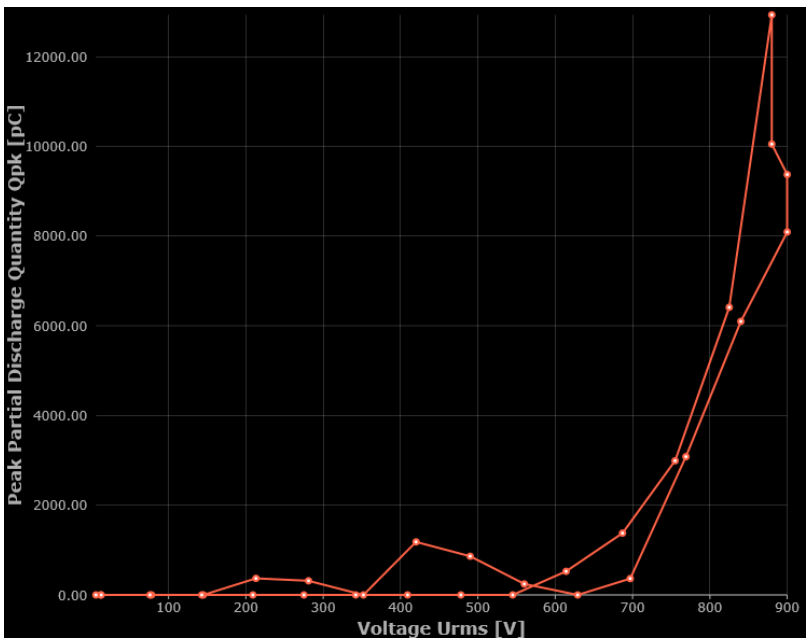
Analysis Item	Description
Σq-ϕ	Integrated value characteristic of apparent charge per phase 
q-ϕ-m	Apparent charge – Phase – Number of PD pulses generated characteristic (PRPD characteristic) The vertical axis of the PRPD graph (PD charge) is created with a range of -Sc to +Sc based on the PD axis scale **Sc**. The resolution of the vertical axis is 1/100th of **Sc**. 

PDIV mode AC PD analysis functions

With the measurement data displayed on the PDIV mode AC PD measurement screen, tap **[Analysis Functions]** on the right side of the screen to display the following items that can be analyzed. Select an item to automatically perform the analysis.

Analysis Item	Description
Qmax-t	Repeatedly occurring maximum PD intensity – Elapsed measurement time characteristic 

Analysis Item	Description
Qpk-t	PD charge peak – Elapsed measurement time characteristic 
m-t	Number of PD pulses generated – Elapsed measurement time characteristic 

Analysis Item	Description
m-Urms	Number of PD pulses generated – Applied voltage RMS value characteristic 
Qpk-Urms	PD charge peak – Applied voltage RMS value characteristic 

Common Function

Background Color Change Function

Tap **[BG Color]** to switch the graph's background color between **[White]** and **[Black]**.
The selected background color will also apply to other analysis items and be saved in the table settings.

Image Save Function

Tap **[Save Image]** to save the graph as an image. Set the **[Save in]** and **[Folder Name]** from the **[Data Save Settings]** screen of **[AC PD]**.

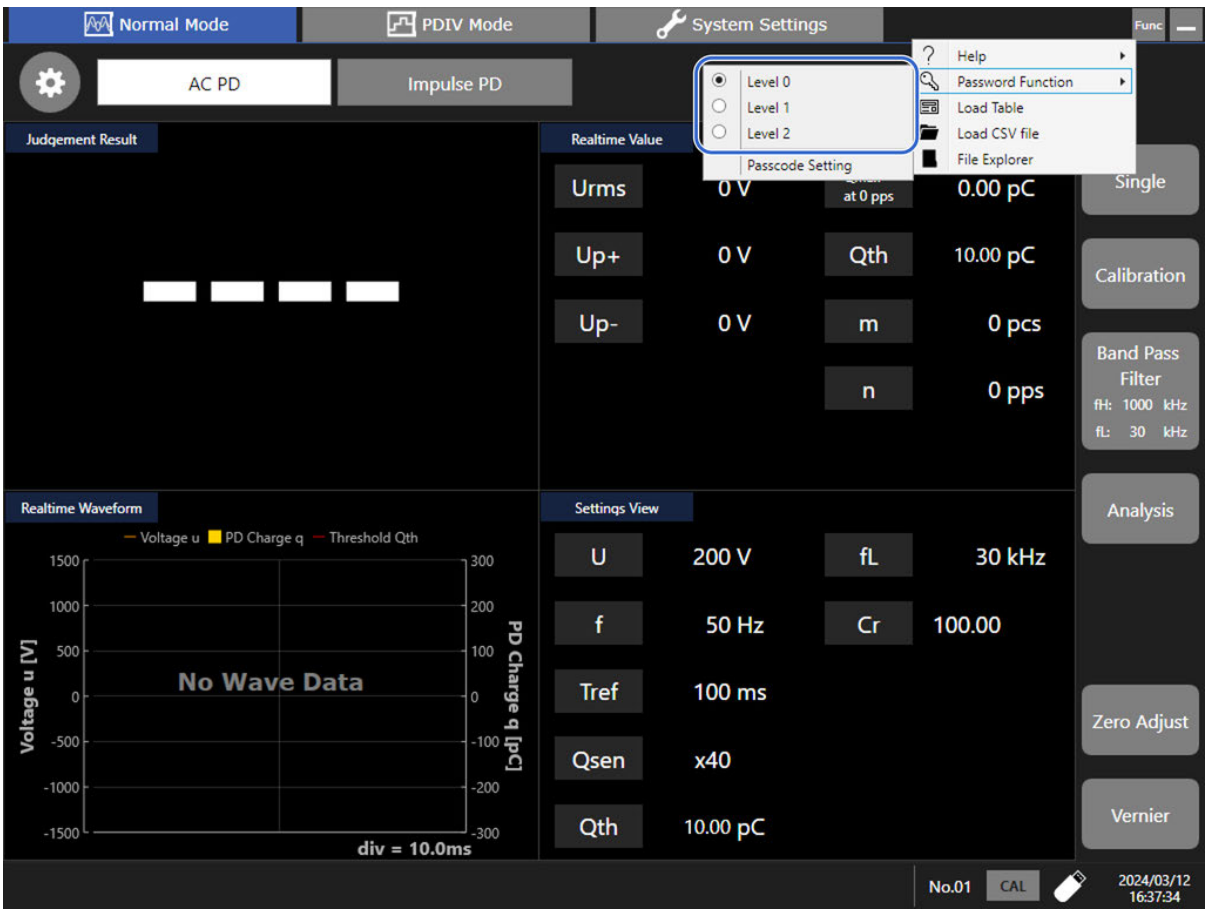
2.11 Password Function

The password function restricts the functions that can be used and the range of settings that can be changed.
The passcode can also be set.

Changing the level

1 **Tap [Func] > [Password Function] > [Level 0], [Level 1] or [Level 2].**

The password function is changed to the specified level.



If the passcode is set:

2 **Enter the passcode on the numeric keypad and tap [OK].**

The entered passcode appears as **[*]** on the screen.

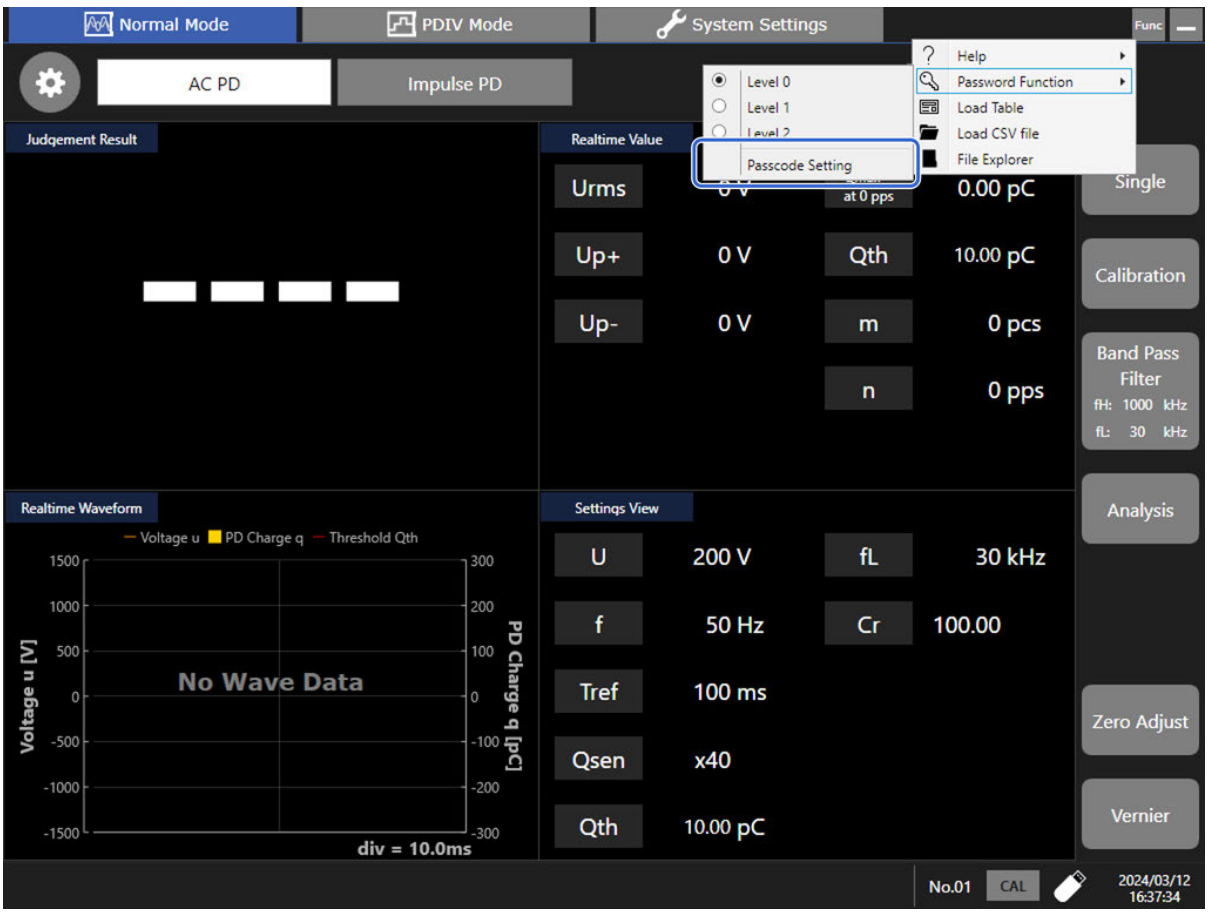
Setting the passcode

The passcode required when changing the level can be set.

Settable range: 1 to 4 digits
Default passcode: 4200

> When the passcode is set, it must be entered when changing the level.
> Make sure you do not forget the passcode.

1 **Tap [Func] > [Password Function] > [Passcode Setting].**



If the passcode is set:

2 **Enter the old passcode on the numeric keypad and tap [OK].**

The entered passcode appears as [*] on the screen.

3 **Enter the new passcode on the numeric keypad and tap [OK].**

The entered passcode appears as [*] on the screen.

If the passcode is not set:

2 **Enter the new passcode on the numeric keypad and tap [OK].**

The entered passcode appears as [*] on the screen.

Restrictions by level

There are three levels. Use the appropriate level for the intended usage.

Category	Function	Level 0	Level 1	Level 2
Measurement mode	Normal mode	✓	✓	✓
	PDIV mode	✓	✓	-
Functions	Load CSV file	✓	✓	✓
Settings	Measurement settings	✓	-	-
	Judgment settings	✓	-	-
	Display configuration	✓	-	-
	Save data settings	✓	-	-

Category	Function	Level 0	Level 1	Level 2
AC PD measurement	Single/repeat	✓	-	-
	Calibration	✓	✓	✓
	Band pass filter	✓	-	-
	Noise check	✓	-	-
	Analysis	✓	-	-
	Zero adjustment	✓	✓	✓
	Vernier	✓	✓	✓
System settings	Table	✓	*1	*2
	System	✓	-	-
	Equipment connection	✓	-	-
	Self-check	✓	✓	✓
	Information (update)	✓	-	-

✓: Can be used, -: Cannot be used

*1: Only select, save, and load can be used.

*2: Only save can be used.

3 Preparing for Measurement

3.1 Inspection Before Measurement

⚠ DANGER

If the connection cables or the instrument are damaged, there is a risk of an electric shock.
Perform the following inspection before using the instrument:

- Check that the insulation of the connection cables is neither ripped nor torn and that no metal parts are exposed.
  Replace the connection cords with those specified by Hioki.
- Check if there is any damage to the instrument occurred during storage or shipping and verify that it operates normally before using the instrument.
  If you find any damage, contact your authorized Hioki distributor or reseller.

3.2 Connecting Connection Cables

⚠ DANGER

If the insulation on a connecting cable melts, the metal conductor may be exposed. Do not use any cables whose metal conductor is exposed. Doing so could result in an electric shock, burn, or other hazards.

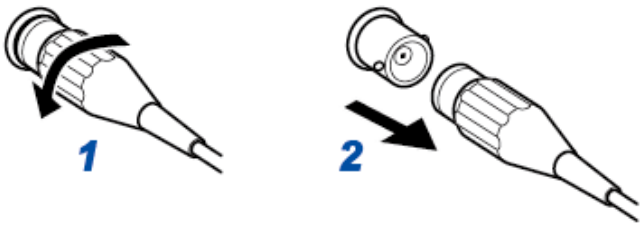
⚠ WARNING

Use only the connection cables specified by Hioki when using the instrument. Using a non-specified cable may result in unsafe measurements.

⚠ CAUTION

To prevent cable damage, do not step on cables or pinch them between other objects. Do not bend or pull on cords at their base.

- The cable is hardened in freezing temperatures. Do not bend or pull it to avoid tearing its shield or cutting the cable.
- Connect the plastic connector (black) or Connection Cable L9218 to the input terminal (green BNC connector) of the instrument. Connecting a metal connector to an insulated BNC connector may cause the insulated BNC connector and instrument to be damaged.
- When removing a BNC cable, pull it out by holding the head of the BNC connector (other than the cable) after being sure to disengage the lock to prevent damage to the BNC connector or the contact.



IMPORTANT

Use only the connection cables specified by Hioki when using the instrument. Using a non-specified cable may also result in incorrect measurements due to poor connection or other reasons.

Connecting the instrument with the SW2001

Connecting with a LAN Cable

Use a LAN cable to connect the LAN connector (**100BASE-TX**) on the right side of the instrument to the LAN connector on the rear of the SW2001.

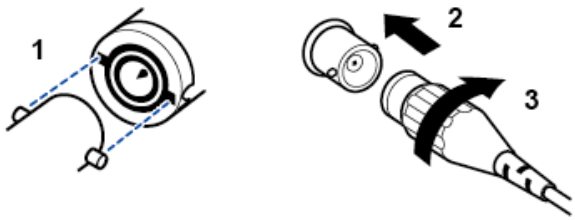
Connecting with a USB Cable

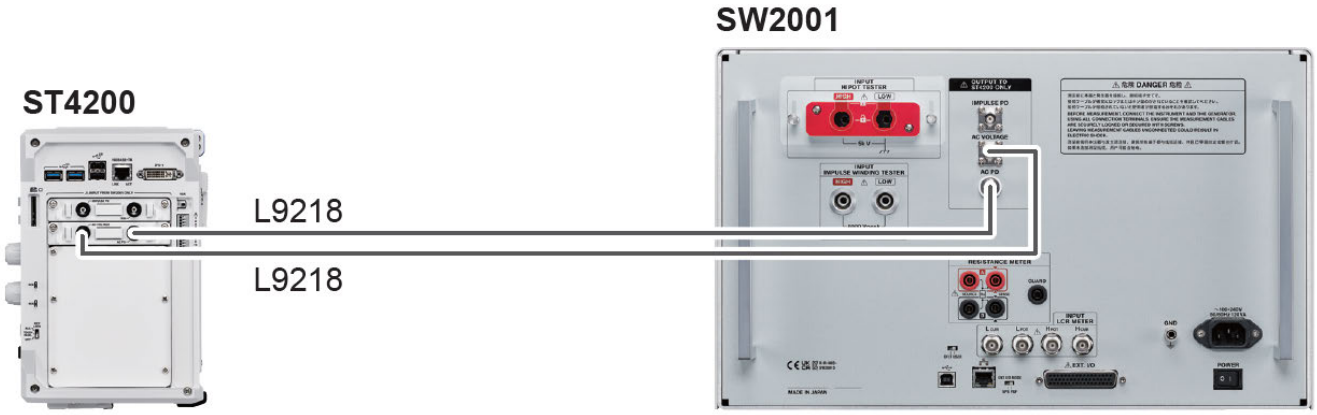
Use a LAN cable to connect the USB connector on the right side of the instrument to the USB connector on the rear of the SW2001.

Preparing for AC PD measurement

1 **Connect the SW2001 to the instrument.**

- Connect the **AC PD** terminal on the right side of the instrument to the **AC PD** terminal on the SW2001 using the L9218.
- Connect the **AC VOLTAGE** terminal on the right side of the instrument to the **AC VOLTAGE** terminal on the SW2001 using the L9218.
  Connect the plastic connector (black) to the ST4200 and the metal connector to the SW2001.

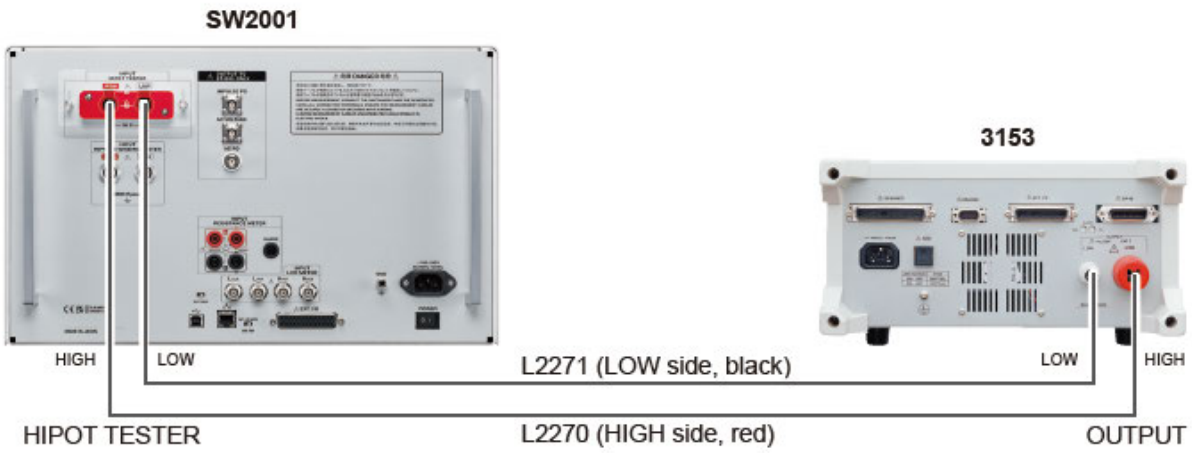




2 Connect the SW2001 and AC power (insulation/withstand voltage tester).

- Connect the LOW terminal for the **HIPOT TESTER** on the rear of the SW2001 to the LOW **OUTPUT** terminal on the 3153 using the L2271.
- Connect the HIGH terminal for the **HIPOT TESTER** on the rear of the SW2001 to the LOW **OUTPUT** terminal on the 3153 using the L2270.
  For further details, see "3.3. Connecting Connection Cables" in the SW2001 instruction manual.

SW2001 Instruction Manual



IMPORTANT

If using another company's AC power supply, modify cables to suit the shape of the terminals.

3 Connect the SW2001 and the object under measurement.

Connect the output terminal on the front of the SW2001 to the measurement points on the object under measurement using Unterminated Lead Cable L2265.
For further details, see "3.2. Connecting Measurement Cables" in the SW2001 instruction manual.

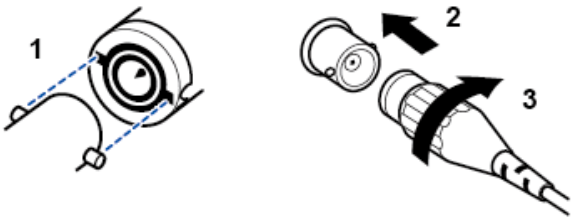
SW2001 Instruction Manual

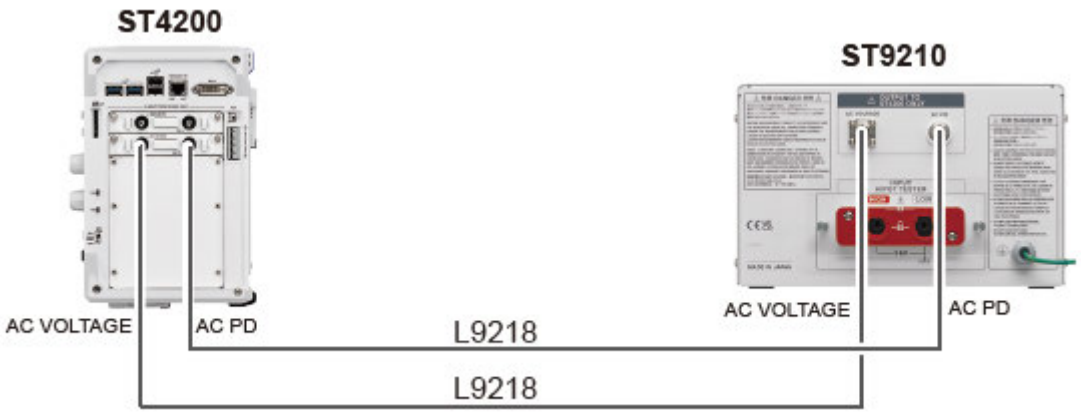
Connecting the instrument with the ST9210

Preparing for AC PD measurement

1 **Connect the ST9210 to the instrument.**

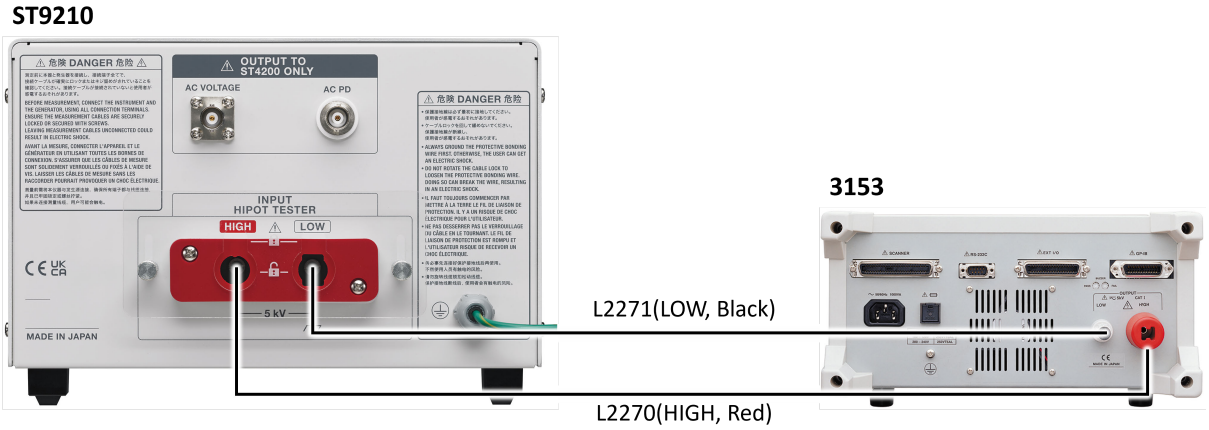
- Connect the **AC PD** terminal on the right side of the instrument to the **AC PD** terminal on the ST9210 using the L9218.
- Connect the **AC VOLTAGE** terminal on the right side of the instrument to the **AC VOLTAGE** terminal on the ST9210 using the L9218.
  Connect the plastic connector (black) to the ST4200 and the metal connector to the ST9210.





2 Connect the ST9210 and AC power (insulation/withstand voltage tester).

- Connect the LOW terminal for the **HIPOT TESTER** on the rear of the ST9210 to the LOW **OUTPUT** terminal on the 3153 using the L2271.
- Connect the HIGH terminal for the **HIPOT TESTER** on the rear of the ST9210 to the LOW **OUTPUT** terminal on the 3153 using the L2270.
  For further details, see "2.4. Connecting Connection Cables" in the ST9210 instruction manual.



IMPORTANT

If using another company's AC power supply, modify cables to suit the shape of the terminals.

3 Connect the ST9210 and the object under measurement.

Connect the output terminal on the front of the ST9210 to the measurement points on the object under measurement using Unterminated Lead Cable L2265 or L2266.
For further details, see "2.3. Connecting Measurement Cables" in the ST9210 instruction manual.

IMPORTANT

The ST9210 supports only AC PD measurements.

3.3 Connecting the External Control Terminals

This section describes the procedure and the external control terminal function to control the instrument externally. Connecting the external control terminals with external devices allows the instrument to start and stop a measurement. Signals inputted into the external control terminals operate the instrument even when the key lock function is enabled.
The term “external control terminals” is used to see all of these terminals collectively.

⚠ DANGER

To avoid electrical hazards and damage to the instrument, do not apply voltage exceeding the rated maximum to the external control terminals.

I/O terminals	Maximum input voltage
START	10 V DC
STOP	10 V DC
PASS	50 V DC, 50 mA, 200 mW
FAIL	50 V DC, 50 mA, 200 mW

⚠ WARNING

Do not use the instrument to measure circuits that exceed those ratings or specifications. Damage to the instrument or overheating can cause electric shock.

To avoid an electric shock or damage to the equipment, always observe the following precautions when connecting your external equipment to external control terminals.

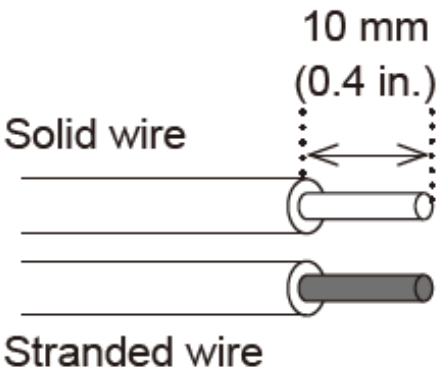
- Always turn off the instrument and any equipment to be connected before making connections.
- Be careful to avoid exceeding the ratings of the external control terminals.
- The ground is shared between the instrument and the external control terminals. Isolate the devices and systems to be connected to the external control terminals from one another, as needed.

⚠ CAUTION

Only changes described in the instruction manual can be made to Windows settings. Do not configure any Windows settings that are not instructed in these manuals. In addition, do not install any software other than the pre-installed software. Doing so will cause instable operation of the system, with the result that the instrument cannot launch.

- Before connecting or disconnecting any cable, always turn off the instrument and your device to be connected. Failure to do so could result in an equipment malfunction or damage to the equipment.
- To prevent damage to the equipment, use the recommended type of wires to connect your external equipment to the external control terminals, or otherwise ensure that the wires have sufficient withstand voltage and current capacity.

Wires to be connected



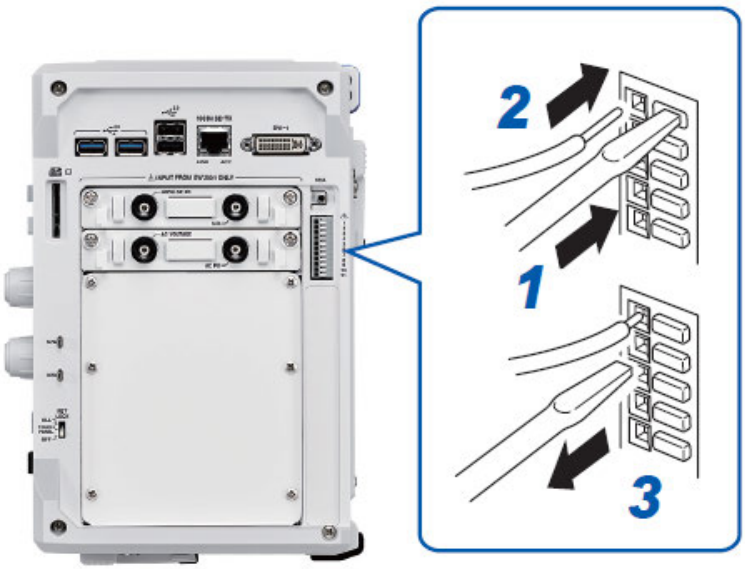
Item	Description
Acceptable wire	Solid wire: 0.32 mm to 0.65 mm in diameter (AWG28 to AWG22) Stranded wire: 0.08 mm^2 to 0.32 mm^2 in diameter (AWG28 to AWG22) Strand diameter 0.12 mm in diameter or more (per wire)
Stripped length	9 mm to 10 mm
Button pressing tool	Flat-blade screwdriver (tip width: 2.6 mm)

1 **Depress a button of the external control terminals with a flat-blade screwdriver.**

2 **Insert the wire into the wire connection hole while depressing the button.**

3 **Release the button.**

The wire is secured.



Terminal block

See: Pin Layout of External Control Terminals

3.4 Connecting the Instrument With Computers

Connecting the instrument with computers via LAN cables allows the computers to control and monitor the instrument. Connect LAN cables to the instrument LAN connector (**100BASE-TX**) and computer LAN connectors.

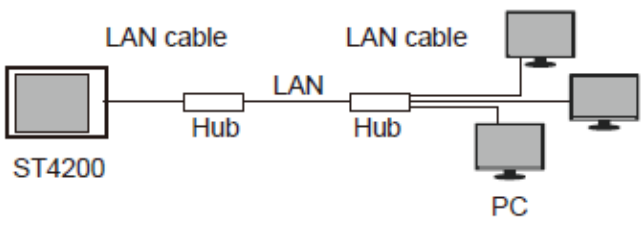
⚠ CAUTION

To avoid damage to the instrument, do not unplug the communication cable during communication.

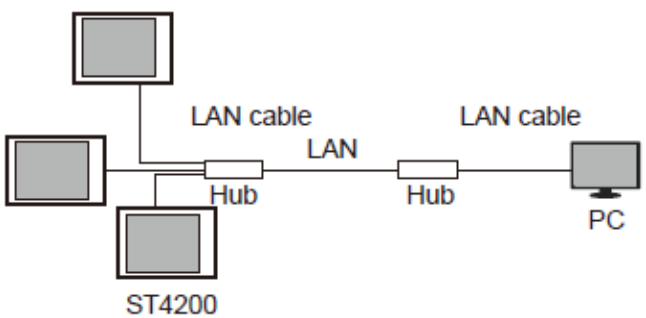
- Ground the ground terminal of the instrument and the ground terminal of the computer to a single location. Using different ground circuits will result in a ground potential difference between the instrument and the PC. If a cable is connected while such a potential difference between grounds exists, it may result in equipment malfunction or failure.
- Before connecting or disconnecting a communication cable, always turn off the instrument and the PC. Failure to do so could result in an equipment malfunction or damage to the equipment.
- Securely connect the communication cable connector. Failure to securely connect the connector could result in a malfunction or damage.
- Use a LAN cable with a length of 3 m or less. Using a cable longer than 3 m may cause malfunctions due to the effects of noise.

The following two ways are available:

(1) Connecting the instrument to the existing network



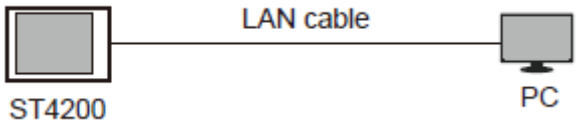
Connecting one ST4200 unit to multiple PCs



Connecting multiple ST4200 units to a single PC

*: Use commercially available 100BASE-TX-compatible or 10BASE-T-compatible LAN cables (either straight or crossover cables can be used).

(2) One-to-one connection of the instrument and your computer



*: Use commercially available 100BASE-TX-compatible or 10BASE-T-compatible LAN cables (either straight or crossover cables can be used).

Configuration instructions

1 **Set the computer's IP address on the instrument [System Settings] > [Equipment Connection] screen.**

2 **Configure the communications settings for the computer based on the settings shown on the instrument's [System Settings] screen.**

Tips

Communication between the instrument and computer may not be possible due to noise at the work site.
This may be due to the communication cable. Change to a CAT7 LAN cable for the LAN cable between the instrument and LAN hub.

3.5 Preparing Storage Devices (Recording Media)

You can use the following recording media on the instrument: SD memory cards, USB flash drives, and the internal drive.
Use only the following Hioki options, which are more reliable than their commercial equivalents.
SD Memory Card Z4001 (2 GB), SD Memory Card Z4003 (8 GB), USB Drive Z4006 (16 GB)

⚠ CAUTION

- Do not carry the instrument with a USB flash drive inserted. Damage could result.
- Do not subject the instrument to extreme shock or vibration. Shock can cause damage to the SSD unit.
- Do not accidentally force storage devices in upside down or backwards. Doing so may damage the storage device and instrument.

- Exercise care when using such products because static electricity could damage the external storage media or cause a malfunction of the instrument.
- Power on the instrument and then insert an SD memory card or a USB flash drive. If the power is turned on while an SD memory card or USB flash drive is inserted, the instrument may not start up depending on the SD memory card or USB flash drive.
- If an SD memory card or USB flash drive not manufactured by Hioki is used, the instrument may not recognize the storage device.

IMPORTANT

- Do not extract any external storage device or turn off the instrument while the instrument is accessing the storage device (while the blue **SAVE** key is lighting up). Data stored in the device could be lost.
- No compensation is available for loss of data stored on any external storage device (USB flash drive, SD card) or the built-in SSD unit of the instrument, regardless of contents or causes of damage or loss. Be sure to back up any important data stored on the external storage device (USB flash drive, SD card), and the built-in SSD unit of the instrument.
- When the instrument is left powered off for a long period of time (about one year or more), the data saved to the built-in SSD may be lost. Be sure to back up the data if the instrument is to be left powered off for a long time.
- Proper operation of the instrument is only guaranteed when using Hioki optional SD Memory Cards and USB Drives. Proper operation is not guaranteed with other recording media.
- With some external storage devices, the instrument may not start up if power is turned on while the device is inserted. In such a case, turn off and cycle the instrument.
- The instrument does not support certain types of USB flash drives, such as those that require fingerprint authentication or a password.
- Number of writes for the external media (USB flash drive, SD memory card) and the built-in SSD unit of the instrument is limited by their flash memory. If data has been rewritten many times, data reading and writing capabilities will be degraded. In that case, replace the device. Only use storage devices available as Hioki options for storing data.

See: Options (Sold separately)

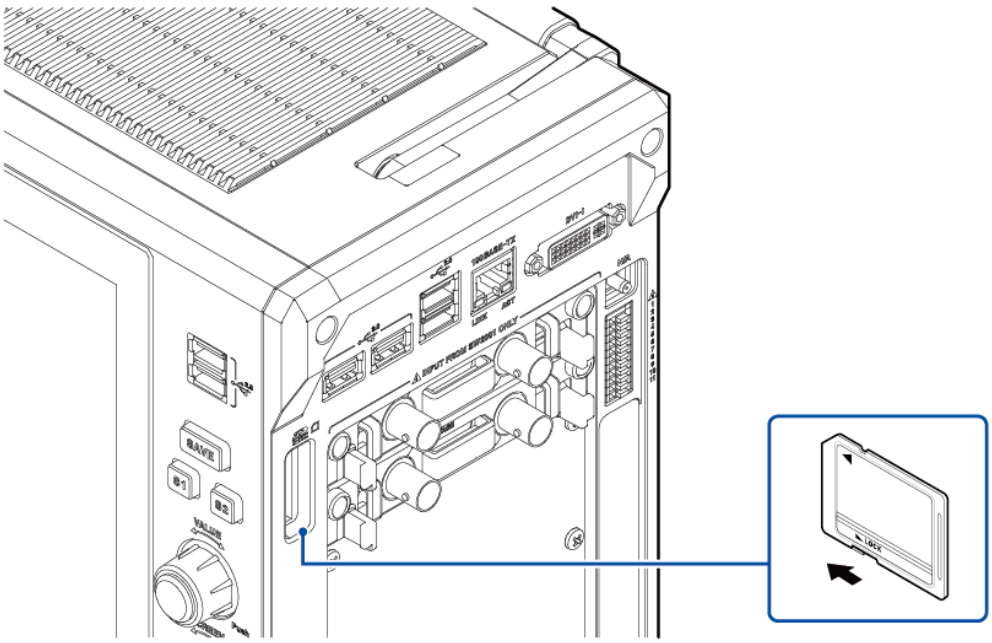
SD memory card

You have to configure the SD memory card setting on the instrument to use SD memory cards.

How to insert a USB flash drive

1 **Orient the face with triangle marked of the SD memory card toward the front of the instrument.**

2 **Fully insert the SD memory card.**

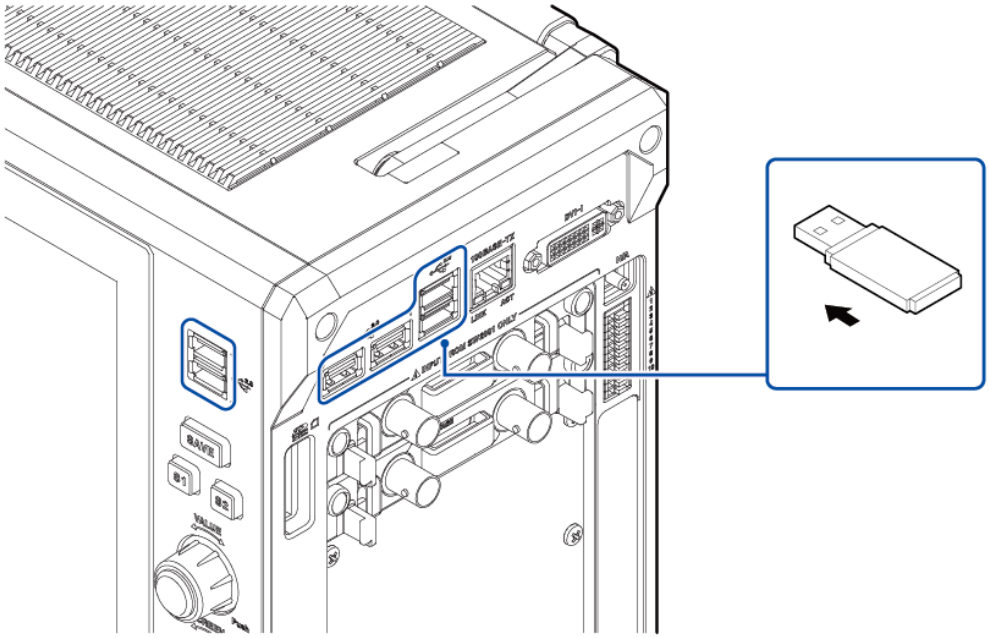


USB flash drive

You have to configure the USB flash drive setting on the instrument to use USB flash drives.
Before handling a USB flash drive, eliminate any static on your body.

How to insert a USB flash drive

Align the USB flash drive with the connector, and fully insert it.



Internal drive

The internal drive is factory-formatted.

SSD Unit U8332 (capacity: 256 GB*, option available only when ordered with the instrument)

*: Once the drive has been formatted, the actual capacity available decreases.

You cannot remove the internal drive.

Removing storage devices

Use the following procedure to remove the SD memory card and USB flash drive.

1 **Tap the flash drive eject button at the bottom right of the screen.**

2 **Tap the media to be removed.**

3 **Remove the storage device according to the message.**

Message	Response
This device can now be safely removed from the ST4200.	Remove the storage device.
This device is currently in use.	Check whether the storage device is being accessed.

Be sure to use the remove button to remove any storage device. Do not use Windows Explorer or an icon on the Windows taskbar to remove the storage device.

Formatting storage devices

Format the storage device on the computer.

IMPORTANT

Note that formatting a storage device deletes all the information stored on the storage device, and deleted information cannot be recovered.

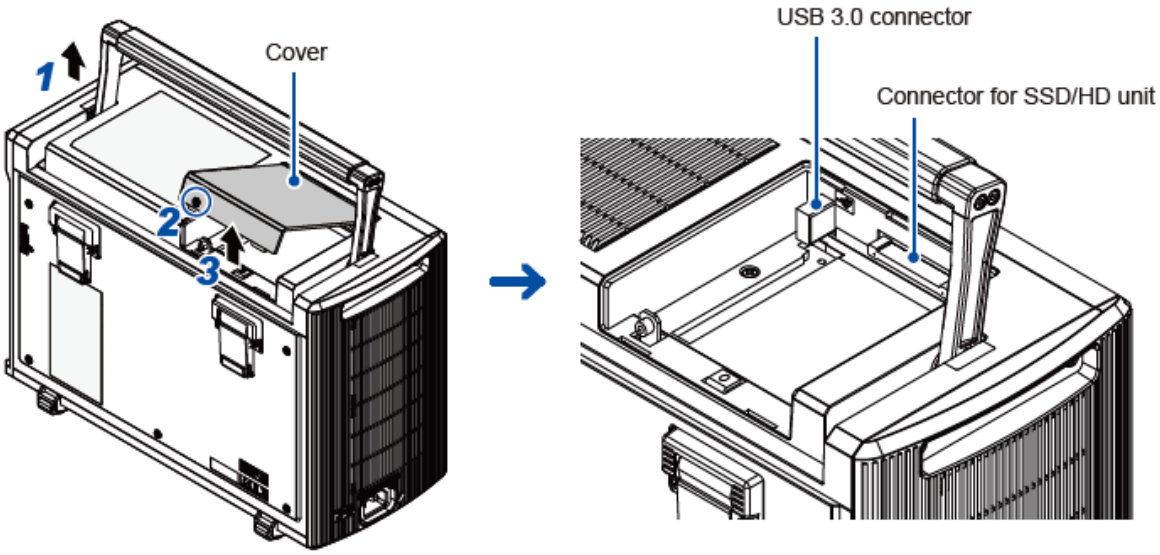
3.6 How to Open the Media Box

The USB 3.0 connector in the media box is specifically for USB flash drives.
Be sure to use the instrument with the cover closed. Before handling a USB flash drive, eliminate any static on your body.

1 **Extend the handle.**

2 **Loosen the cover screw until its head is completely removed from the cover.**

3 **Lift the front of the cover.**



3.7 Supplying Power to the Instrument

⚠ WARNING

To prevent electrical shock and to maintain the safety specifications of this instrument, connect the accompanying power cord only to a 3-prong grounded-type (2-pole) power outlet.

⚠ CAUTION

Do not operate the instrument on any of the power sources that provide rectangular-wave or pseudo-sine-wave power (UPS or uninterruptible power supply, DC/AC inverter). Doing so may damage the instrument.

- Supply power to the instrument in combination with an uninterruptible power supply (UPS) if instantaneous power interruptions occur frequently. If the power to the ST4200 goes off during the operation, the built-in system disc will be damaged.
- Before connecting the power cable, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.

IMPORTANT

The instrument can malfunction if the power goes off for over 40 ms.

Turning on the instrument

1 **Confirm that the power supply voltage is within the range specified on the left side and connect the power cord to the power inlet.**

2 **Insert the power cord plug into the outlet.**

3 **Ground the GND terminal (functional earth terminal) to the earth.**

4 **Press the power key to turn on the instrument.**

Wait around 30 minutes for the instrument's interior temperature to stabilize for an accurate measurement. (Warming up)

5 **Execute zero-adjustment.**

See: Executing zero-adjustment

GND terminal (Functional earth terminal)

If you perform measurement in a noisy environment, grounding the GND terminal (functional earth terminal) allows the instrument to be less susceptible to noise.

Turning off the instrument

IMPORTANT

- If the instrument is shut down while saving files onto an external storage device, it cannot save data correctly. Supply power to the instrument in combination with an uninterruptible power supply (UPS) if instantaneous power interruptions occur frequently.
- Turning off the instrument causes data recorded in the internal memory to be deleted. To retain the recorded data, save the data to an external storage device before turning off the instrument.

1 **To retain the recorded data, save the data to an external storage device.**

2 **Press the power key.**

Following the message, tap **[OK]** to turn off the instrument.
When the key lock is engaged, hold down on the power key to turn the power off.
After the instrument has been turned on again, it loads the settings configured before turned off.

3.8 Setting the Clock

Specify the date, time, and time zone. The instrument has an automatic calendar with leap year correction and 24-hour clock.

How to set the clock

1 **Tap [System Settings] > [System].**

The **[Date and time]** dialog box will appear.

2 **Set the [Date] and [Time].**

3 **Tap [Set].**

Confirm the date and time.

4 **Tap [Normal Mode] or [PDIV Mode].**

This returns you to the measurement screen.

IMPORTANT

The instrument regulates the date and time internally. Ensure the date and time are set according to the method above. If the date and time are set any other way, the settings will not be applied.

3.9 Executing Zero-Adjustment

Adjust the zero positions of the instrument's input channels to suit the reference potential of the instrument.

Before executing zero-adjustment

- Warm up the instrument for about 30 minutes after the power-on to stabilize the internal temperature of the instrument.
- Execute zero-adjustment with no signals inputted.
  Zero-adjustment may not correctly be executed with a signal inputted.
- Note that you can not execute zero-adjustment during measurement.
- No key operation is acceptable during zero-adjustment.

To execute zero-adjustment

1 **On the measurement screen, tap [Zero Adjust].**

The Zero Adjust pop-up window will appear.

2 **Tap [Execute].**

Zero-adjustment will be performed automatically. Once zero-adjustment is complete, the **[Success]** message will be displayed.

3 **Tap [Close].**

The Zero Adjust pop-up window will close.

IMPORTANT

Re-execute zero-adjustment in the following cases:

- After cycling the instrument
- After initializing the instrument
- When the ambient temperature has significantly changed

The zero position may drift.

Drift
A phenomenon where a shift in the operating point of an operational amplifier causes a change in output. Drift can result from a change in temperature and component aging over a period of use.

3.10 Configuring the Band Pass Filter (for AC PD measurement only)

During AC PD measurement, this instrument performs noise processing and signal integration processing on the PD signal waveforms using a Digital Band Pass Filter (DBPF).
This instrument enables high-accuracy AC PD measurement insusceptible to noise by setting a BPF cutoff frequency suitable for the noise frequency band in the environment in which the instrument is used.

First measure at the default values (fH = 1000 kHz and fL = 30 kHz). If noise affects the measurement, set the cutoff frequency with the following procedure.

IMPORTANT

The electric charge calibration value differs depending on the band pass filter settings. When the band pass filter settings are changed, review the electric charge calibration.

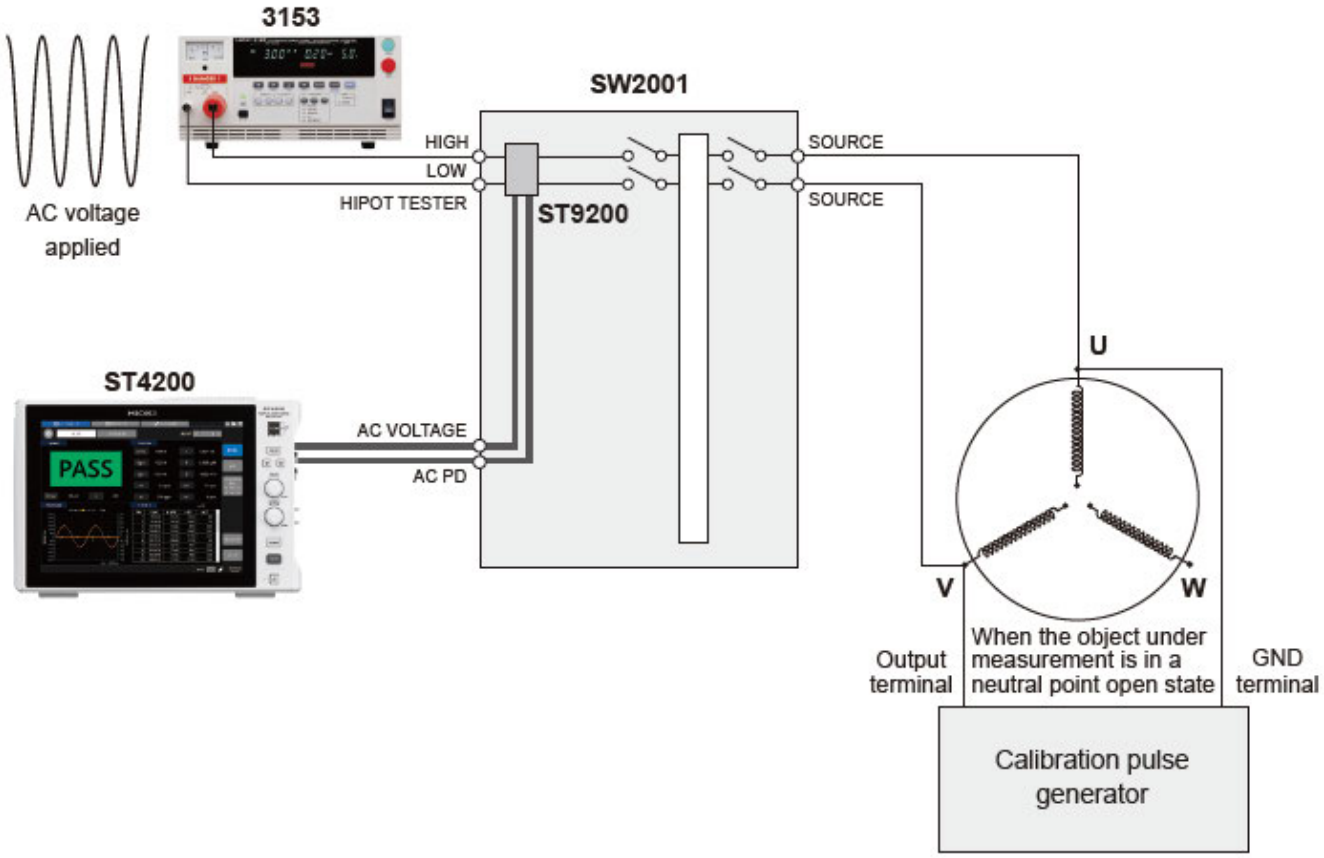
Prepare a calibration pulse generator. We recommend the following calibration pulse generators.

Name of manufacturer	Model
Fujikura Dia Cable, Ltd.	D-208
Nihon Keisokuki Seizosho Co.,Ltd	NPG-3

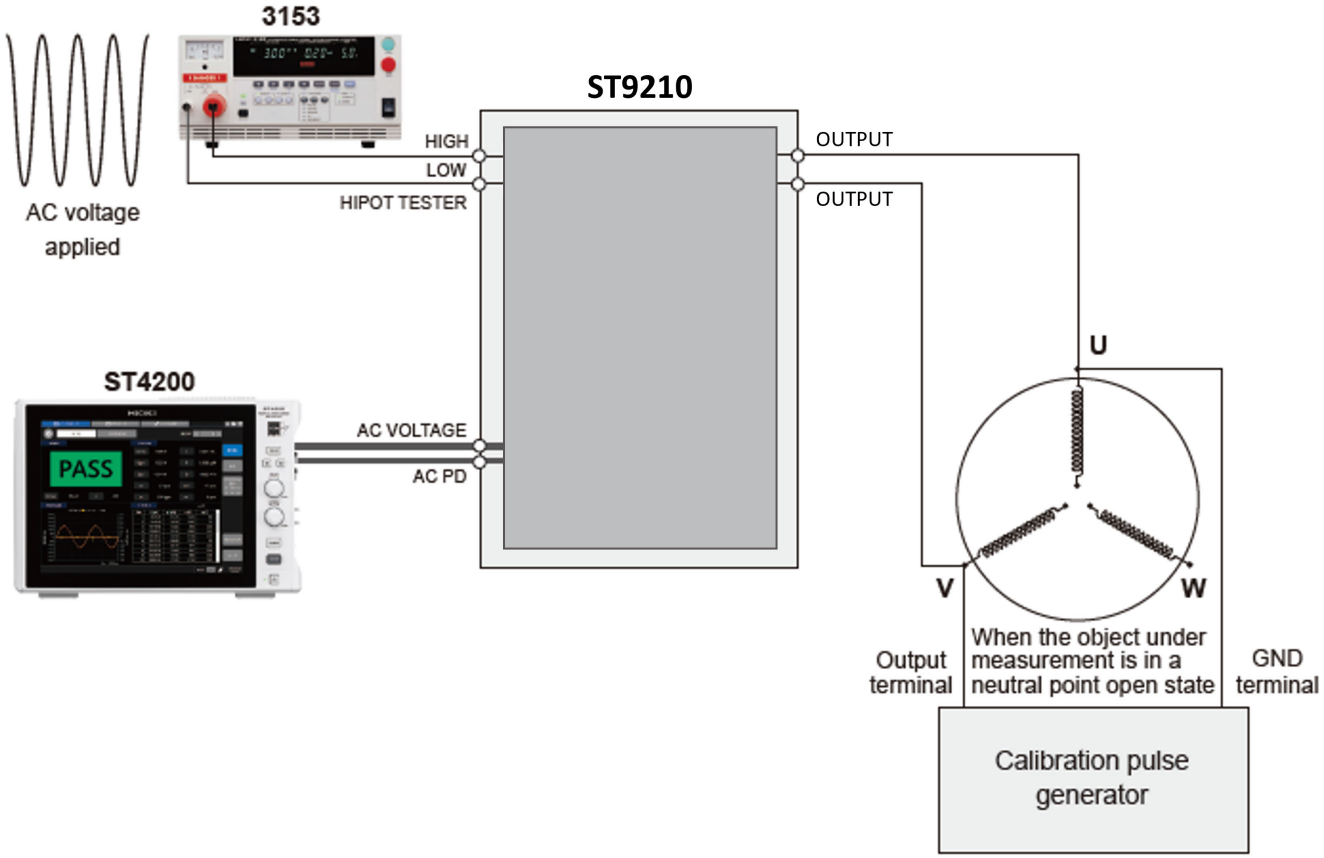
1 **Confirm that the withstand voltage tester is powered ON and that output is OFF, and confirm that the cables are connected as shown in the following diagram.**

Example of connections when the object under measurement is in a neutral point open state:
Prepare for AC PD measurement.
See: Preparing for AC PD Measurement
(Connect the output terminal and GND terminal of the calibration pulse generator to the part of the object under measurement that will be measured.)

Connection diagram for the SW2001



Connection diagram for the ST9210



Tips

In order to take into account the effects of noise generated by the withstand voltage tester's power supply and control units, it is recommended that the withstand voltage tester be turned ON.

2 **Tap [AC PD] > Setting key > [Operation Settings].**

Set Qth to a minimum value of 10 pC.

3 **Choose the calibration pulse charge to be used for configuration.**

The largest value in the charge range to be measured is recommended.
Using the calibration pulse generator, configure the pulse charge [pC] to be generated.

4 **Tap [AC PD] > [Band Pass Filter].**

The band pass filter settings screen will be displayed.

5 **Turn [BPF Setting Mode] to ON.**

If this mode is OFF when measurement is started in step 7, high voltage is generated from the withstand voltage tester and this may damage the calibration pulse generator.

6 **Input the High Cutoff Frequency into [fH] and the Low Cutoff Frequency into [fL].**

7 **Tap [OK].**

The band pass filter setting screen closes.

8 Measure the Qmax of the noise only.

Leave the calibration pulse generator output OFF.
Press the **START** key to start a measurement to determine Qmax.

9 Measure the Qmax of calibration pulse.

The calibration pulse generator will generate a calibration pulse.
Press the **START** key to start a measurement to determine Qmax.

10 Determine the S/N ratio.

The S/N ratio can be determined based on the Qmax values calculated in steps 8 and 9.

11 Repeat steps 3 to 10 as necessary to determine the cutoff frequency.

Find the settings at which the S/N ratio is largest.

> **Tips**
>
> The narrower the passband, the lower the PD pulse measurement sensitivity. Choose a cutoff frequency at which the S/N ratio is large and the passband is as wide as possible.

12 Turn [BPF Setting Mode] to ON.

3.11 Calibration (only for AC PD measurement)

During AC PD measurement, choose a calibration value for converting the PD waveform signal that is input into a charge.
The calibration values depend on the capacitance of the object under measurement, including connection cables, clips, etc. The correct values will also depend on the value set for the Band Pass Filter. Therefore, decide on the routing of the connection cables and connect the object under measurement, configure the Band Pass Filter, and perform calibration.

⚠ CAUTION

Connect the output terminal and GND terminal of the calibration pulse generator to the part of the object under measurement that will be measured.

1 **Confirm that the withstand voltage tester is powered ON and that output is OFF, and confirm that the cables are connected.**

In order to take into account the effects of noise generated by the withstand voltage tester's power supply and control units, it is recommended that the withstand voltage tester be turned ON.

2 **Choose the calibration pulse charge to be used for configuration.**

The largest value in the charge range to be measured is recommended.
Using the calibration pulse generator, configure the pulse charge [pC] to be generated.

3 **Tap [AC PD] > [Calibration].**

The Calibration screen will be displayed.

4 **Input the charge to be applied to the object under measurement into [Charge Value].**

> **IMPORTANT**
> The charge value must be the same as the setting value and charge determined in step 2. If calibration is performed when they are not the same, an incorrect calibration will be performed.

5 **The calibration pulse generator will output a calibration pulse.**

6 **Tap [Start].**

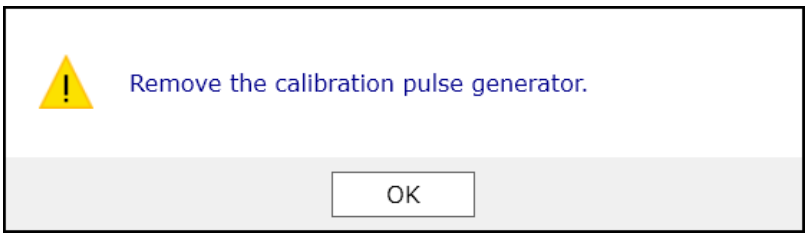
The execution screen will be shown and the calibration will be performed automatically. Calibration can take anywhere from a few seconds to a minute to complete. Wait until the calibration completion message is displayed.
If the calibration fails, increase the charge to be calibrated and re-calibrate.
Depending on the results of the calibration, the following icons are displayed on the bottom right of the screen.

Icon	Description
	Displayed when calibration is not executed.
	Displayed when calibration is successful.
	Displayed when calibration fails.

7 **Stop the calibration pulse generator.**

8 Tap [Close] and detach the calibration pulse generator.

Review the warning message, and then tap **[OK]**. The calibration screen closes.



⚠ CAUTION

Start AC PD measurement after detaching the calibration pulse generator. Failure to do so may damage the calibration pulse generator.

3.12 Executing Vernier

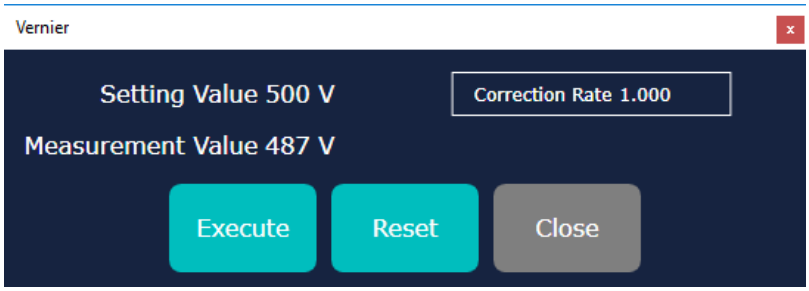
Vernier is a function for compensating voltage values during AC PD measurement.
Use after executing AC PD measurement in normal mode.
See: AC PD Measurement in Normal Mode

The vernier **correction rate** is also used for AC PD measurement in PDIV mode.

Executing vernier

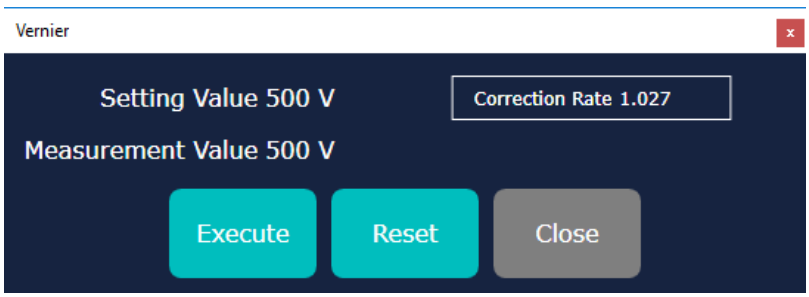
1 **Tap [Vernier].**

The vernier pop-up window opens.
Input the applied voltage (U) in **[Setting Value]** and the voltage RMS value (Urms) in **[Measurement Value]**.



2 **Tap [Execute].**

The value of **[Measurement Value]**conforms to that of **[Setting value]** and the correction ratio is displayed.
However, **[Execute]** is disabled if the value of **[Measurement Value]** is 0 V.



3 **Tap [Close].**

Resetting vernier

1 **Tap [Vernier].**

The vernier pop-up window opens.

2 **Tap [Reset].**

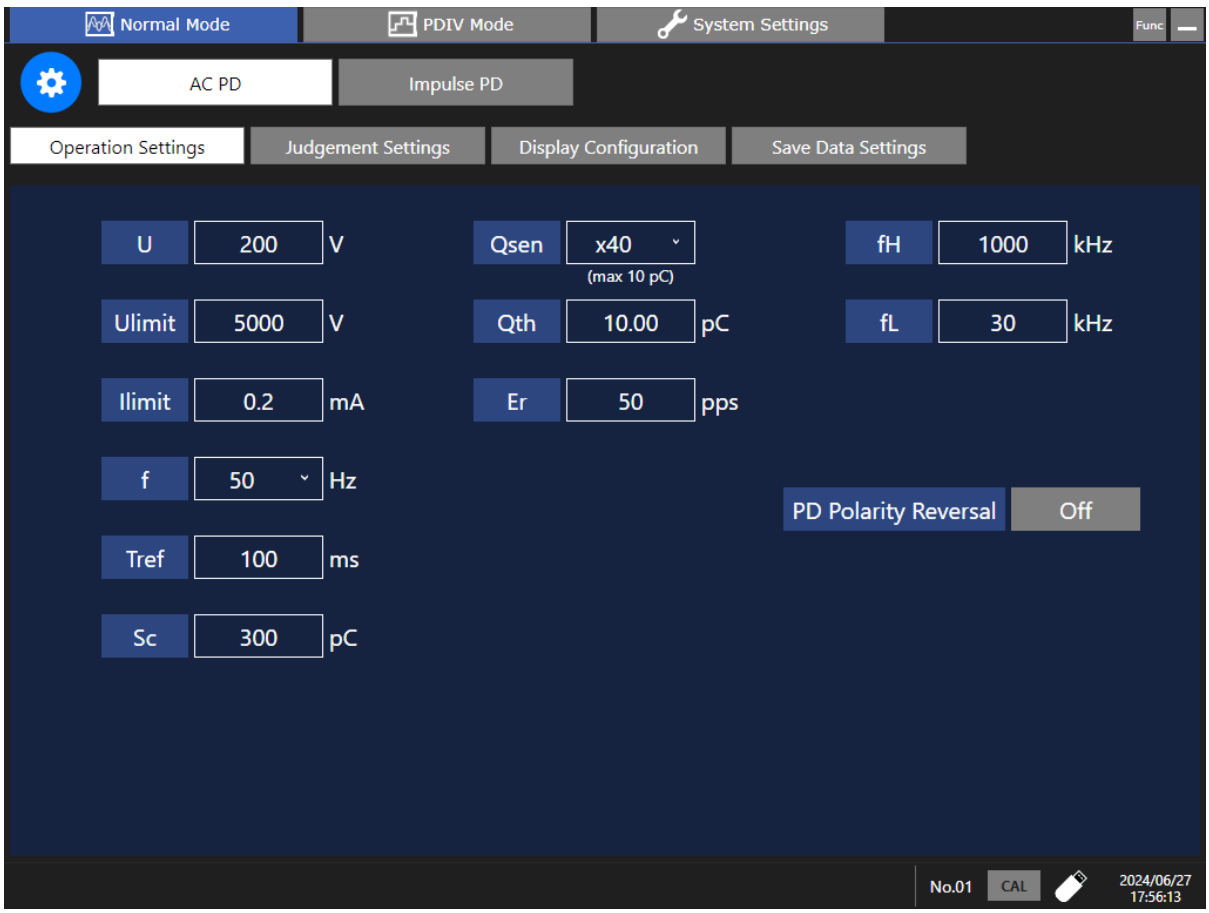
The values are reset to before compensation.

3 **Tap [Close].**

3.13 Configure the Settings for AC PD Measurement in Normal Mode

Tap the **Settings button** to open the setting screen.
The Setting screen is separated into the four tabs: **[Operation Settings]**, **[Judgment Settings]**, **[Display Configuration]** and **[Save Data Settings]**. An explanation of the items included under each tab follow.

Operation settings



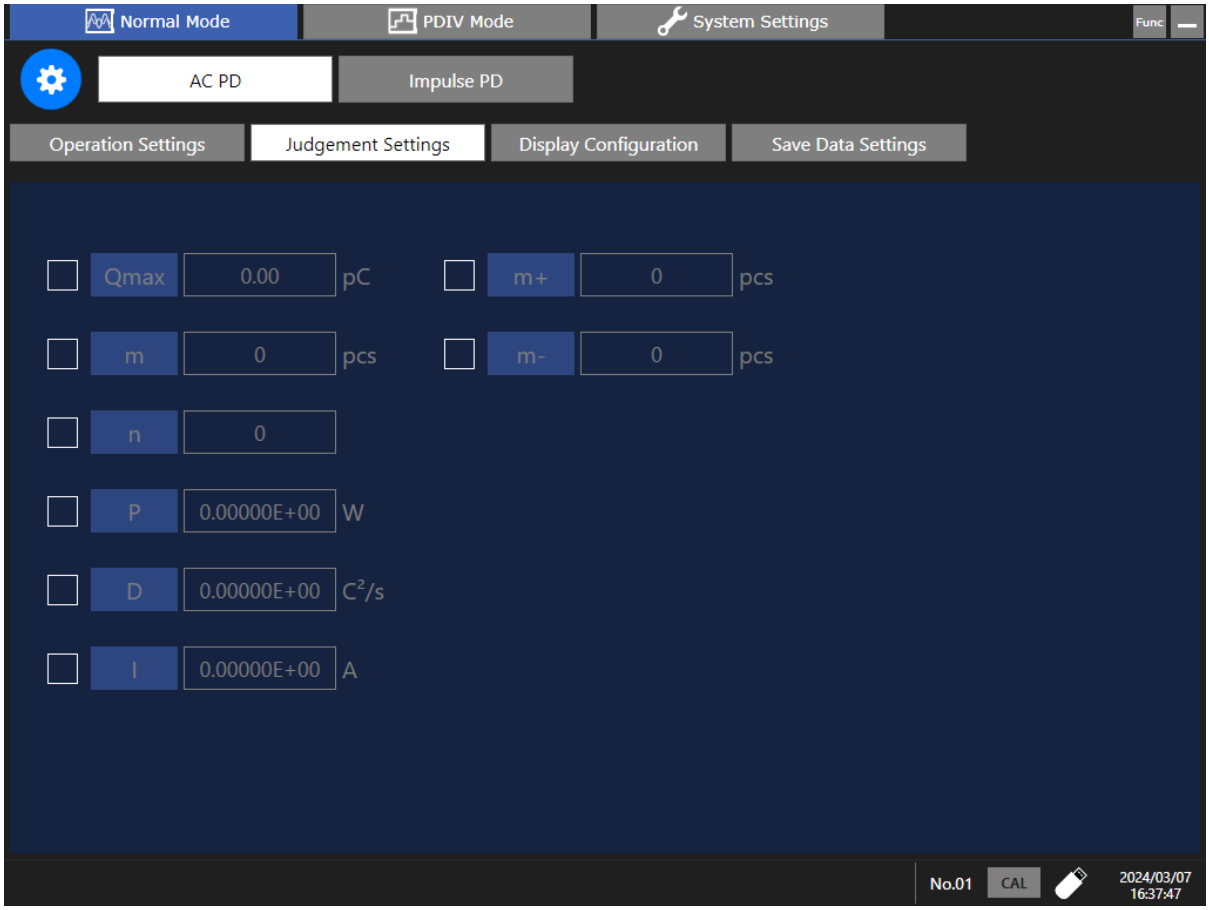
Symbol	Parameter name	Content/description	Unit	Setting range	Default value
U	Applied voltage	Voltage applied to the object under measurement from the Hipot tester (RMS value)	V	200 to 5000 The starting voltage differs depending on the Hipot tester.	200
Ulimit	Voltage Upper Limit	The upper limit that can be set for the applied voltage.	V	200 to 5000	5000

Symbol	Parameter name	Content/description	Unit	Setting range	Default value
Ilimit	Voltage Current Limit	The upper limit current value for the devices controlled. If a current greater then this flows, then measurement will stop.	mA	0.1 to 100.0	0.2
f	Voltage Frequency	Voltage frequency applied to the object under measurement from the Hipot tester	Hz	50.60	50
Tref	Sampling Time Width	Sampling time width for primary data when executing PD calculation	ms	100 to 1000	100
Sc	PD Axis Scale	PD axis scale when plotting realtime waveforms	pC	10 to 5000	300
Qsen	Measurement Sensitivity	AC PD measurement sensitivity (gain) The measurable amount of discharge is displayed below the setting value.	-	×1, ×2, ×4, ×10, ×20, ×40	×40
Qth	AC PD Threshold Value	Threshold value assuming PD generation Pulses below Qth are considered to be noise.	pC	10 to 5000	10
Er	Qmax Evaluation Rate	Set the occurrence frequency for evaluation of partial discharge. This is usually the same as the test voltage frequency.	pps	1 to 9999	50
fH	High Cutoff Frequency	Band pass filter high cutoff frequency	kHz	130 to 1000	1000
fL	Low Cutoff Frequency	Band pass filter low cutoff frequency	kHz	30 to 900	30

PD Polarity Reversal Setting

This function sets the PD Polarity Reversal. Tapping **[OFF]** changes it to **[ON]**, and the polarity of the PD to be measured will be reversed.

Judgment settings



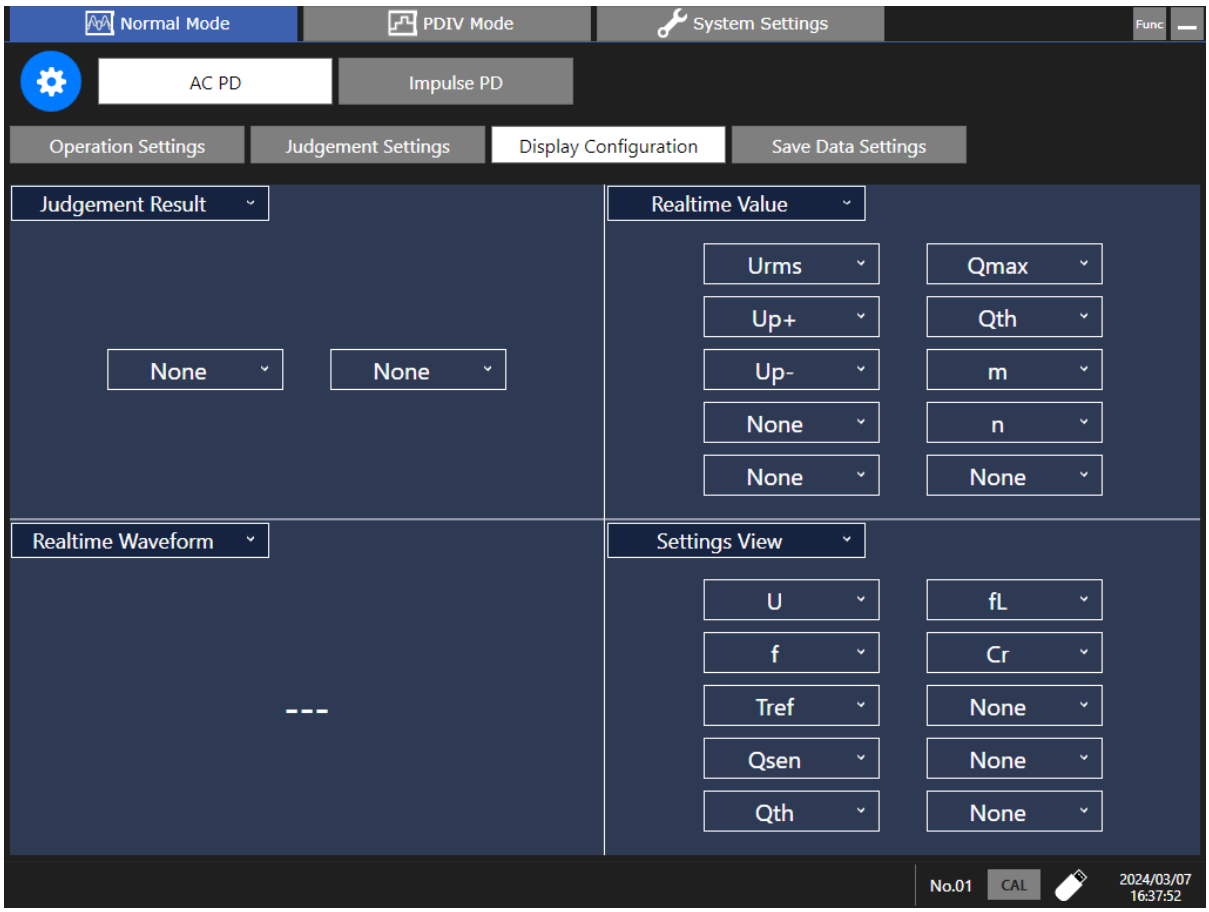
Check the check boxes for the measurement items to be judged to enable settings. When multiple items are selected, overall judging results are shown on the judging results screen.
Judging is available for the following items. The default value for all items is "0".

Symbol	Parameter name	Unit	Setting range
Qmax	Repeatedly occurring maximum PD intensity (Maximum PD charge exceeding the occurrence frequency set for the evaluation rate Er)	pC	0 to 5000
m	Number of PD pulses exceeding the threshold value	pcs	0 to 9999
n	ACPD Pulse Repetition Rate	pps	0 to 99999
m+	Positive Pole ACPD Pulse Count	pcs	0 to 9999
m-	Negative Pole ACPD Pulse Count	pcs	0 to 9999
P	Discharge Power	W	-999999 to 999999
D	Quadratic Rate	C^2/s	0 to 999999

Symbol	Parameter name	Unit	Setting range
I	Average Discharge Current	A	-999999 to 999999

When the setting value is a positive value, the result is judged as PASS if below the setting value and as FAIL if above the setting value.
When the setting value is a negative value, the result is judged as PASS if above the setting value and as FAIL if below the setting value.

Display configuration



Configure the display configuration. The screen is separated into four parts and the following content can be displayed. However, the same content cannot be displayed more than twice, and all of the content cannot be set as not to be displayed.

<table>
<tr><th>Display Contents</th><th>Content/description</th></tr>
<tr><td>Judgment Result</td><td>Display the overall judgment result for up to two measurement items.
Results display
<table><tr><td>----</td><td>Not judged.</td></tr><tr><td>PASS, FAIL</td><td>Judgment result</td></tr><tr><td>OVER</td><td>The measured current is over the measurement range.
Change the Qsen setting and measure again.</td></tr></table></td></tr>
<tr><td>Realtime Value</td><td>Results measured within the sampling time are shown in real-time.</td></tr>
<tr><td>Realtime Waveform</td><td>Some of the waveforms measured within the sampling time are shown in real-time.</td></tr>
<tr><td>Settings View</td><td>Displays the setting items for which measurement was executed.</td></tr>
<tr><td>Data Series</td><td>The PD pulse charge measured within the sampling time is shown in a table along the time at which the PD pulses were generated, the voltage, and phase data.</td></tr>
</table>

Judgment Result

The following measurement items can be displayed.

Symbol	Parameter name
Qmax	Maximum recurring PD intensity (Maximum PD charge exceeding the occurrence frequency set for the evaluation rate Er)
m	Number of PD Pulses Exceeding The Threshold Value
n	PD Pulse Repetition Rate
m+	Positive Pole PD Pulse Count
m-	Negative Pole PD Pulse Count
P	Discharge Power
D	Quadratic Rate
I	Average Discharge Current

Realtime Value

The following measurement items can be displayed.

Symbol	Parameter name
Urms	Applied Voltage RMS Value
Up+	Positive Voltage Peak Value
Up-	Negative Voltage Peak Value
Upp	Voltage peak-to-peak (Upp = Up+ - Up-)
Qmax	Repeatedly occurring maximum PD intensity (Maximum PD charge exceeding the occurrence frequency set for the evaluation rate Er)
m	Number of PD Pulses Exceeding The Threshold Value
n	PD Pulse Repetition Rate
m+	Positive Pole PD Pulse Count
m-	Negative Pole PD Pulse Count
P	Discharge Power
D	Quadratic Rate
I	Average Discharge Current

Settings View

The following setting items can be displayed.

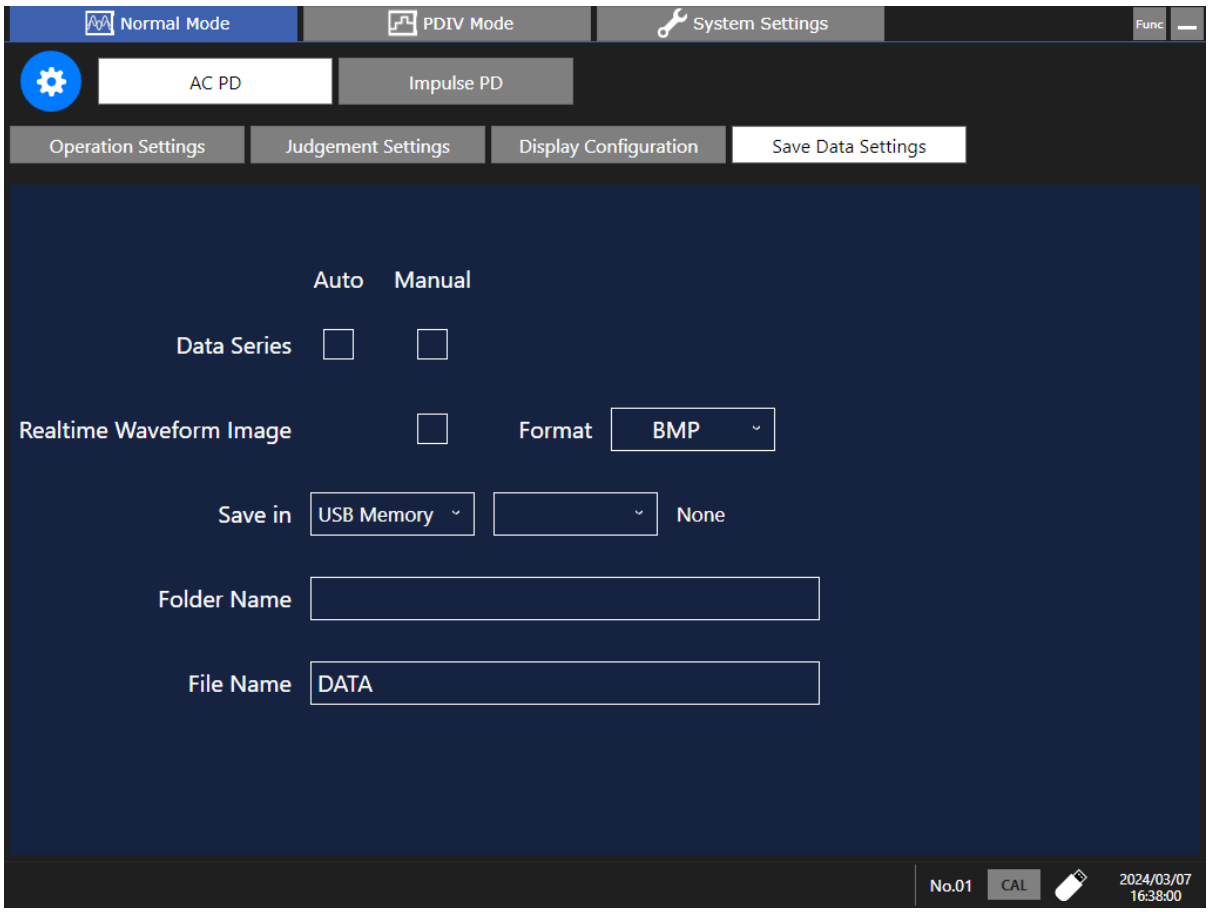
Symbol	Parameter name	Content/description
U	Applied voltage	Voltage applied to the object under measurement from the Hipot tester (RMS value)
f	Voltage Frequency	Voltage frequency applied to the object under measurement from the Hipot tester
Tref	Sampling Time Width	Sampling time width for primary data when executing PD calculation

Symbol	Parameter name	Content/description
Qsen	Measurement Sensitivity	AC PD measurement sensitivity (gain) The maximum measurable amount of discharge is displayed below the setting value.
Qth	AC PD Threshold Value	Threshold value assuming PD generation
Er	Qmax Evaluation Rate	Set the occurrence frequency for evaluation of partial discharge. This is usually the same as the test voltage frequency.
fL	Low Cutoff Frequency	Band pass filter low cutoff frequency
fH	High Cutoff Frequency	Band pass filter high cutoff frequency
Cr	Calibration Rate	The Calibration rate for converting the measured AC PD peak value to charge. Calibration is required prior to measurement.

Save data settings

Configure the save settings for data series and realtime waveform images. Auto-save and manual save are possible.

Save Type	Content/Description
Auto-save	The instrument automatically saves the acquired data after measurement is complete.
Manual save	Press the **SAVE** key to save.



To save data other than data series, it needs to be displayed on the setting screen. When the data is not displayed, review the settings in Display Configuration.

Data Series

If the check box is selected, measurement data is included in the contents of the storage file. Some of the setting values, all measurement results, and each judgment result are saved as CSV files.

Realtime Waveform Image

If the check box is selected, a screenshot of the realtime waveform image is included in the contents of the storage file.
Specify the storage file format (BMP, PNG or JPEG) from the **[Format]** drop-down box.

Saving destination

Specify the storage device (SSD, SD memory card, USB flash drive) to which the files will be saved. When using multiple USBs, you can select the USB to be used.
When a storage device for saving to is connected to the instrument, a **[HIOKI_ST4200]** folder is created automatically. When a save folder is not specified, files are saved in the **[AC PD]** folder.

Save folder

Specify a folder to save the files to. Create a new folder in **[HIOKI_ST4200]** and save the file.

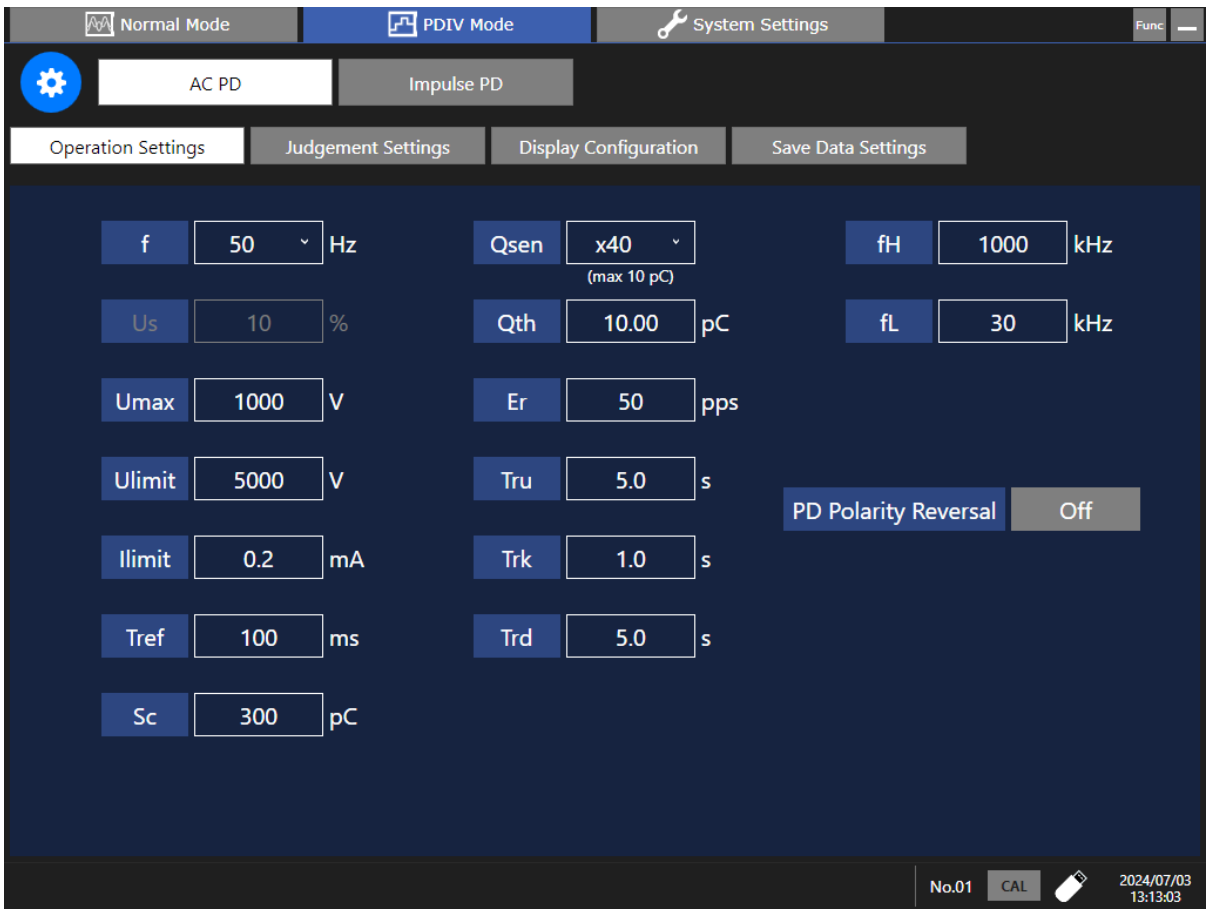
File name

Specify a file name for the file to be saved. When specifying **[DATA]**, the name is set automatically according to the content being saved. For example, the name of the file to which a data series is saved is **[SER_DATA_serial number]** and the name of the file to which a realtime waveform image is saved is **[REA_DATA_serial number]**. The file name is automatically allocated a serial number.

3.14 Configure the Settings for AC PD Measurement in PDIV Mode

Tap the **Settings button** to open the setting screen.
The Setting screen is separated into the four tabs: **[Operation Settings]**, **[Judgment Settings]**, **[Display Configuration]** and **[Save Data Settings]**. An explanation of the items included under each tab follow.

Operation settings



Symbol	Parameter name	Content/description	Unit	Setting range	Default value
f	Voltage frequency	Voltage frequency applied to the object under measurement from the Hipot tester	Hz	50, 60	50

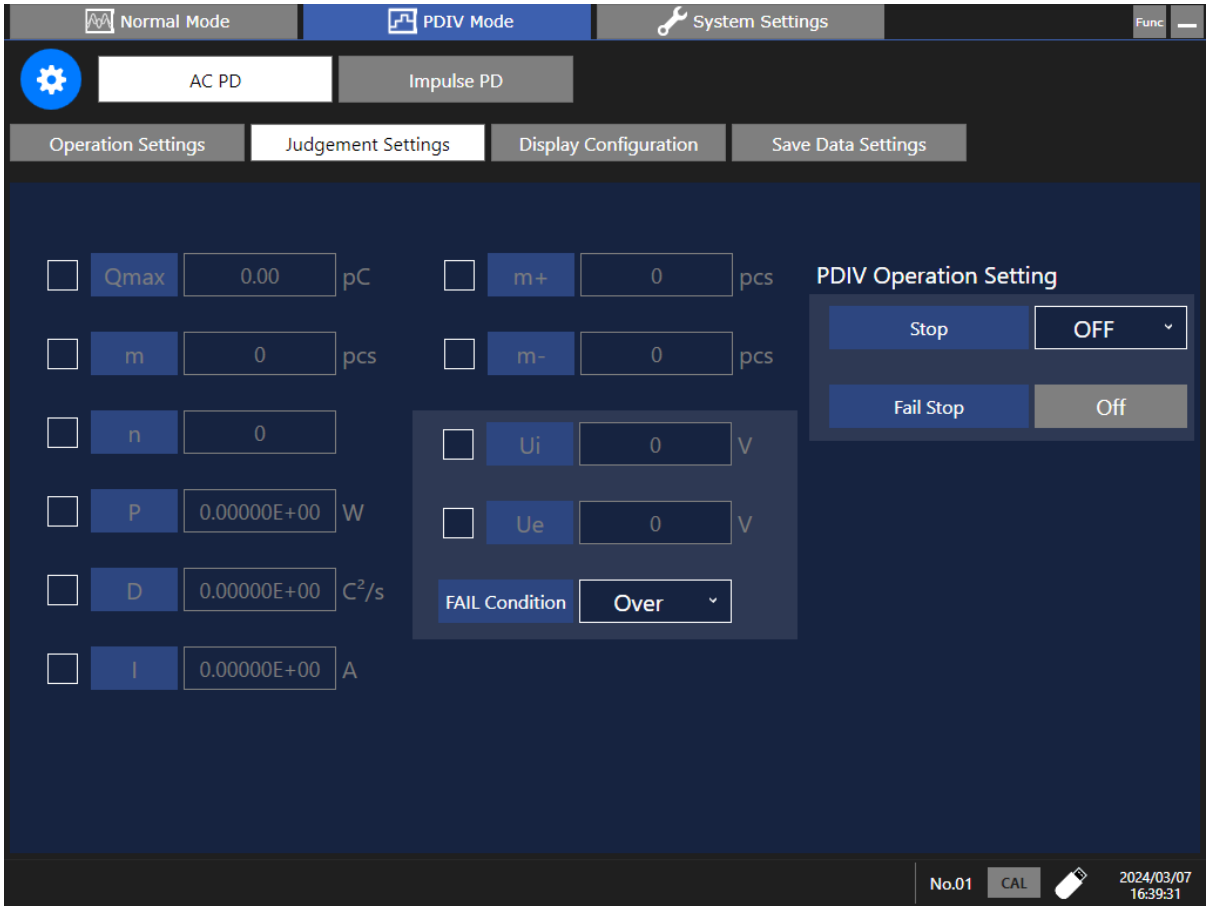
Symbol	Parameter name	Content/description	Unit	Setting range	Default value
Us	Starting Voltage	Starting voltage for the test in PDIV mode	%	0 to 100 Cannot be set for the Hioki 3153. (fixed at 0%) Kikusui Electronics Hipot Tester 1 to 99	10
Umax	Maximum Test Voltage Value	Maximum test voltage value in PDIV mode	V	(200 to 5000) Kikusui Electronics Hipot Tester 50 to 5000	1000
Ulimit	Voltage Upper Limit	The upper limit that can be set for the applied voltage.	V	200 to 5000	5000
Ilimit	Voltage Current Limit	The upper limit current value for the devices controlled. If a current greater then this flows, then measurement will stop.	mA	0.1 to 100.0	0.2
Tref	Sampling Time Width	Sampling time width for primary data when executing PD calculation	ms	100 to 1000	100
Sc	PD Axis Scale	PD axis scale when plotting realtime waveforms	pC	10 to 5000	300
Qsen	Measurement Sensitivity	AC PD measurement sensitivity (gain) The maximum measurable amount of discharge is displayed below the setting value.	-	×1, ×2, ×4, ×10, ×20, ×40	×40
Qth	AC PD Threshold Value	Threshold value assuming PD generation Pulses below Qth are considered to be noise.	pC	10 to 5000	10

Symbol	Parameter name	Content/description	Unit	Setting range	Default value
Er	Qmax Evaluation Rate	Set the occurrence frequency for evaluation of partial discharge. This is usually the same as the test voltage frequency.	pps	1 to 9999	50
Tru	Ramp Up Time	Time from starting voltage to maximum test voltage value	s	0.1 to 99.9	5.0
Trk	Maximum Voltage Holding Time	-	s	0.1 to 99.9 The Hioki 3153 is 0.3 to 99.9	1.0
Trd	Ramp Down Time	Time from maximum test voltage value to 0 V	s	0.1 to 99.9	5.0
fH	High Cutoff Frequency	Band pass filter high cutoff frequency	kHz	130 to 1000	1000
fL	Low Cutoff Frequency	Band pass filter low cutoff frequency	kHz	30 to 900	30

PD Polarity Reversal Setting

This function sets the PD Polarity Reversal. Tapping **[OFF]** changes it to **[ON]**, and the polarity of the PD to be measured will be reversed.

Judgment settings



Check the check boxes for the measurement items to be judged to enable settings. When multiple items are selected, overall judging results are shown on the judging results screen.
Judging is available for the following items. The default value for all items is "0".

Symbol	Parameter name	Unit	Setting range
Qmax	Repeatedly occurring maximum PD intensity (Maximum PD charge exceeding the occurrence frequency set for the evaluation rate Er)	pC	0 to 5000
m	Number of PD pulses exceeding the threshold value	pcs	0 to 9999
n	ACPD Pulse Repetition Rate	PPS	0 to 999999
Ui	PD Inception Voltage	V	0 to 9999
Ue	PD Extinction Voltage	V	0 to 9999
m+	Positive Pole ACPD Pulse Count	pcs	0 to 9999
m-	Negative Pole ACPD Pulse Count	pcs	0 to 9999

Symbol	Parameter name	Unit	Setting range
P	Discharge Power	W	-999999 to 999999
D	Quadratic Rate	C^2/s	0 to 999999
I	Average Discharge Current	A	-999999 to 999999

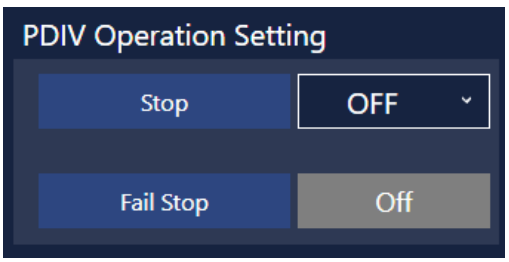
FAIL condition

Normally, the judgment is **FAIL** at the setting value or more and **PASS** at less than the setting value. However, for PD inception voltage **Ui** and extinction voltage **Ue**, a **FAIL** judgment can be made at less than the setting value.

FAIL Condition	Description
Over	**FAIL** at the setting value or more and **PASS** at less than the setting value.
Under	**PASS** at the setting value or more and **FAIL** at less than the setting value.

PDIV measurement stop function

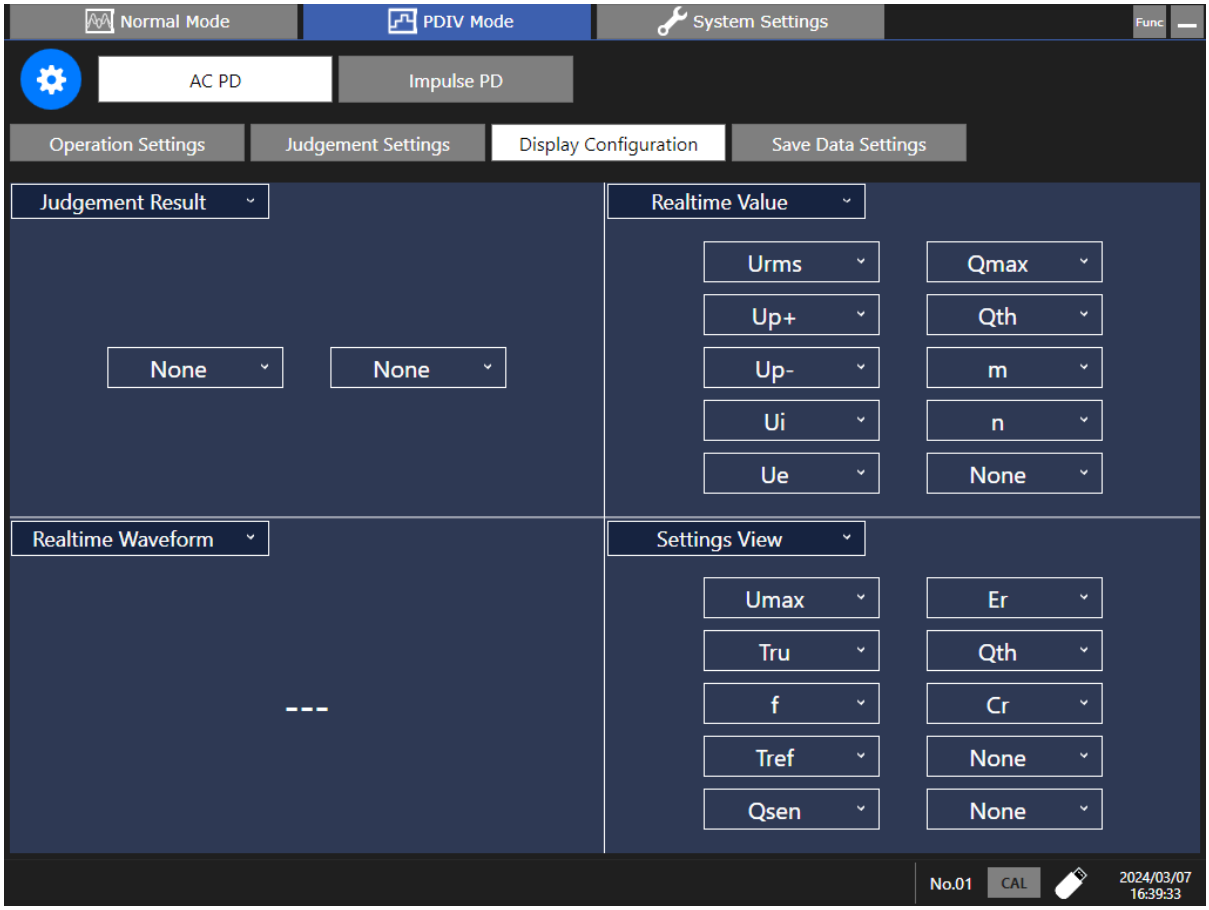
The PDIV measurement is performed by raising the applied voltage to the maximum voltage and then lowering the voltage, but the measurement can be stopped with the set condition.



Stop	Description
OFF	The measurement in progress is not stopped. (Default value)
Ui	The measurement is stopped when **Ui** is recorded while raising the voltage.
Umax	The measurement is stopped when the voltage is raised to the maximum voltage.
Ue	The measurement is stopped when **Ue** is recorded while lowering the voltage. Even if PD stops occurring once, PD may occur when the measurement is continued. If **Ue** is set for the stop condition, the measurement is stopped when PD stops occurring once.

Fail Stop	Description
Off	The measurement is not stopped even if the judgment is FAIL.
On	The measurement is stopped if the judgment is FAIL.

Display configuration



Configure the display configuration. The screen is separated into four parts and the following content can be displayed. However, the same content cannot be displayed more than twice, and all of the content cannot be set as not to be displayed.

<table>
<tr><th>Display Contents</th><th>Content/description</th></tr>
<tr><td>Judgment Result</td><td>Display the overall judgment result for up to two measurement items.
Results display
<table><tr><td>----</td><td>Not judged.</td></tr><tr><td>PASS, FAIL</td><td>Judgment result</td></tr><tr><td>OVER</td><td>The measured current is over the measurement range.
Change the Qsen setting and measure again.</td></tr></table></td></tr>
<tr><td>Realtime Value</td><td>Results measured within the sampling time are shown in real-time.</td></tr>
<tr><td>Realtime Waveform</td><td>Some of the waveforms measured within the sampling time are shown in real-time.</td></tr>
<tr><td>Settings View</td><td>Displays the setting items for which measurement was executed.</td></tr>
<tr><td>Data Series</td><td>The PD pulse charge measured within the sampling time is shown in a table along the time at which the PD pulses were generated, the voltage, and phase data.</td></tr>
<tr><td>Q=f(U) Graph</td><td>Measurement results that conform with IEC standards are shown in a two-dimensional graph.
Voltage is displayed on the X axis and maximum PD charge on the Y axis.</td></tr>
</table>

Judgment Result

The following measurement items can be displayed.

Symbol	Parameter name
Qmax	Maximum recurring PD intensity (Maximum PD charge exceeding the occurrence frequency set for the evaluation rate Er)
m	Number of PD Pulses Exceeding The Threshold Value
n	PD Pulse Repetition Rate
m+	Positive Pole PD Pulse Count
m-	Negative Pole PD Pulse Count
P	Discharge Power

Symbol	Parameter name
D	Quadratic Rate
I	Average Discharge Current
Ui	PD Inception Voltage
Ue	PD Extinction Voltage

Realtime Value

The following measurement items can be displayed.

Symbol	Parameter name
Urms	Applied Voltage RMS Value
Up+	Positive Voltage Peak Value
Up-	Negative Voltage Peak Value
Upp	Voltage peak-to-peak (Upp = Up+ - Up-)
m	Number of PD Pulses Exceeding The Threshold Value
n	PD Pulse Repetition Rate
Qmax	Maximum recurring PD intensity (Maximum PD charge exceeding the occurrence frequency set for the evaluation rate Er)
P	Discharge Power
D	Quadratic Rate
I	Average Discharge Current
m+	Positive Pole PD Pulse Count
m-	Negative Pole PD Pulse Count
Ui	PD Inception Voltage
Ue	PD Extinction Voltage
Qth	AC PD Threshold Value

Settings View

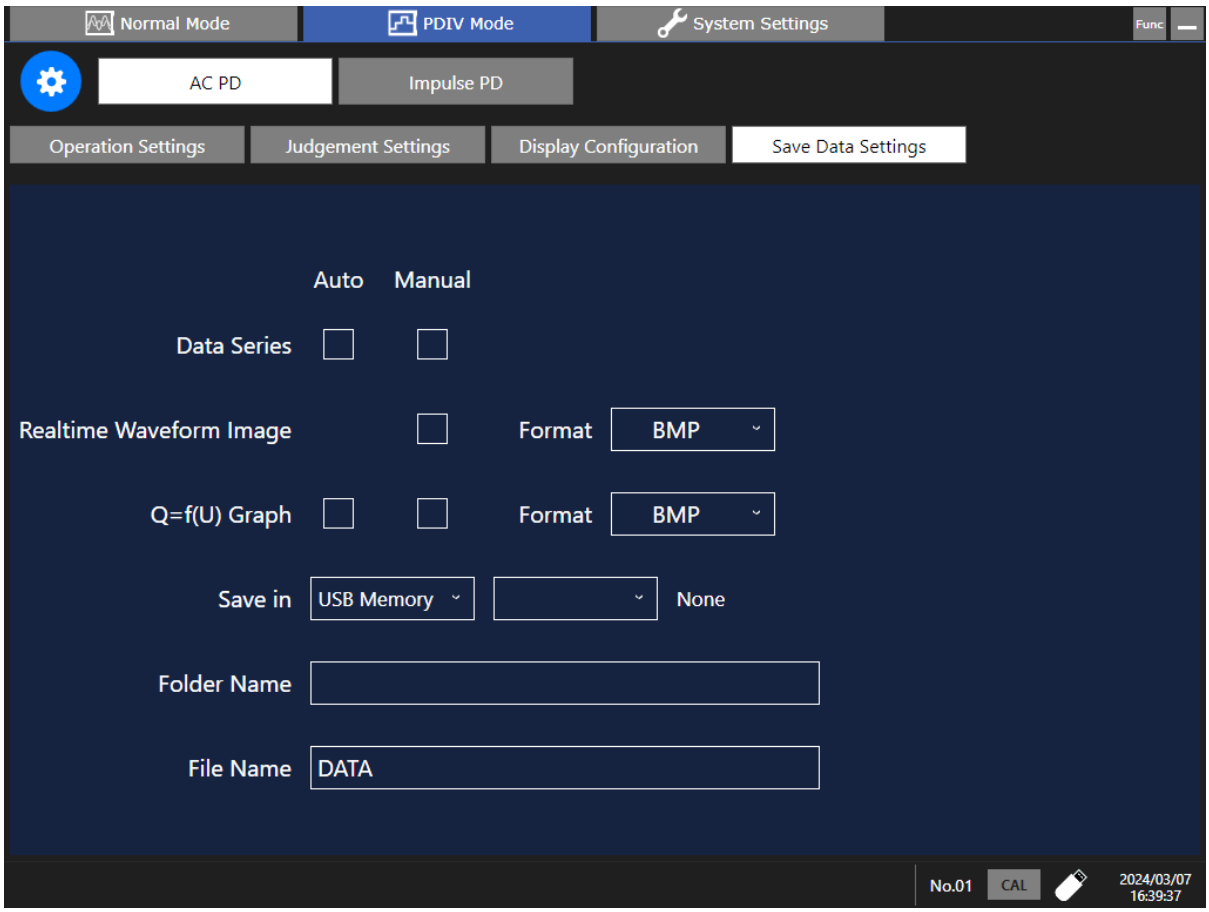
The following setting items can be displayed.

Symbol	Parameter Name	Content/Description
f	Voltage Frequency	Frequency of the voltage applied to the object under measurement from the Hipot tester
Tref	Sampling Time Width	Sampling time width for primary data when executing PD calculation
Qsen	Measurement Sensitivity	AC PD measurement sensitivity (gain) The maximum measurable amount of discharge is displayed below the setting value.
Qth	AC PD Threshold Value	PD Threshold value assuming PD generation
Er	Qmax Evaluation Rate	Set the occurrence frequency for evaluation of partial discharge. This is usually the same as the test voltage frequency.
fL	Low Cutoff Frequency	Band pass filter low cutoff frequency
fH	High Cutoff Frequency	Band pass filter high cutoff frequency
Us	Starting Voltage	Starting voltage for the test in PDIV mode
Umax	Maximum Test Voltage Value	Maximum test voltage value in PDIV mode
Tru	Ramp Up Time	Time from starting voltage to maximum test voltage value
Trk	Maximum Voltage Holding Time	-
Trd	Ramp Down Time	Time from maximum test voltage value to 0 V
Cr	Calibration Rate	Calibration Rate for converting the measured AC PD peak value to charge. Calibration is required prior to measurement.

Save data settings

Configure the saving settings for data series, real-time waveform images and Q=f(U) graph images. Auto-save and manual save are possible.

Save Type	Content/Description
Auto-save	The instrument automatically saves the acquired data after measurement is complete.
Manual save	Press the **SAVE** key to save.



To save data other than data series, it needs to be displayed on the setting screen. When the data is not displayed, review the settings in Display Configuration.

Data Series

If the check box is selected, measurement data is included in the contents of the storage file. Some of the setting values, all measurement results, and each judgment result are saved as CSV files.

Realtime Waveform Image

If the check box is selected, a screenshot of the realtime waveform image is included in the contents of the storage file.
Specify the storage file format (BMP, PNG or JPEG) from the **[Format]** drop-down box.

Q=f(U) Graph

If the check box is selected, a screenshot or the measured values of the Q=f(U) graph are included in the contents of the storage file.
Specify the storage file format (BMP, PNG, JPEG, or CSV) from the **[Format]** drop-down box.

Saving destination

Specify the storage device (SSD, SD memory card, USB flash drive) to which the files will be saved. When using multiple USBs, you can select the USB to be used.
When a storage device for saving to is connected to the instrument, a **[HIOKI_ST4200]** folder is created automatically. When a save folder is not specified, files are saved in the **[AC PD]** folder.

Save folder

Specify a folder to save the files to. Create a new folder in **[HIOKI_ST4200]** and save the file.

File name

Specify a file name for the file to be saved. When specifying **[DATA]**, the name is set automatically according to the content being saved. For example, the name of the file to which a data series is saved is **[SER_DATA_serial number]**, the name of the file to which a real-time waveform image is saved is **[REA_DATA_serial number]**, and the name of the file to which an Q=f(U) graph image is saved is **[QFU_DATA_serial number]**. The file name is automatically allocated a serial number.

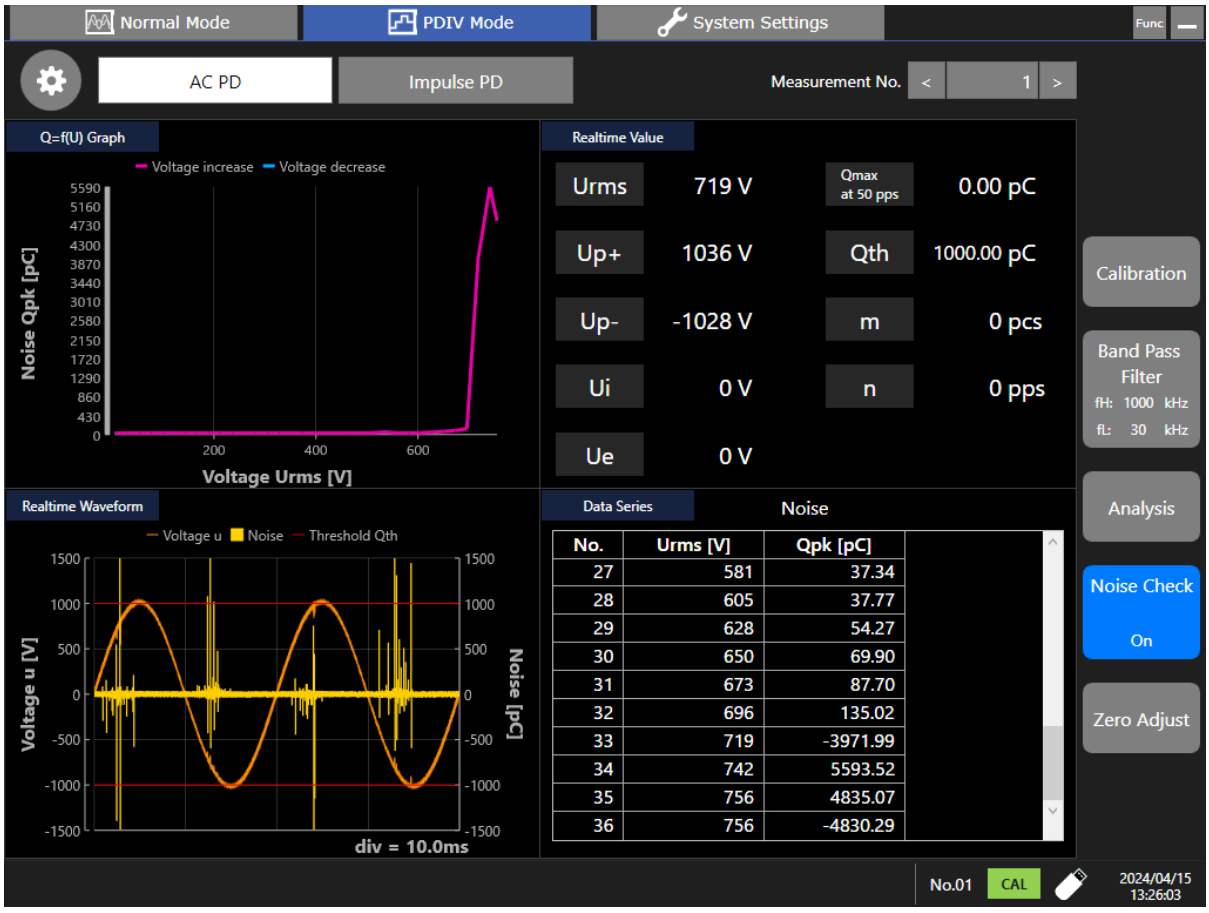
Noise level check function

The noise level check function is effective for determining the threshold value **Qth** for separating noise and PD.

To detect PD, set the threshold value **Qth** for separating noise and PD.
In order to do this, you must check the magnitude of the noise.
When you turn **ON** the noise level check function and take a measurement, the pulse peak value **Qpk** that includes noise can be recorded.

The noise level check function takes the measurement using the same settings as a normal measurement, so configure the settings on the **[Operation Settings]** screen.

When you start the measurement by pressing the **START** key, the applied voltage gradually rises from **Us** (or 0 V) to **Umax**, and when the measurements are taken up to **Umax**, the function stops.
The result of the applied voltage and peak value **Qpk** (includes noise and also PD when PD occurs) can be checked with the **Q=f(U) Graph** and **Data Series**.



When PD occurs, the value of **Qpk** rapidly increases. Decide on a suitable value for the threshold value to separate noise and PD from the value of **Qpk** before and after this rapid increase.

If PD does not occur in the object under measurement or if you do not want to apply much of a load to the object under measurement, lower the maximum applied voltage **Umax**, measure just the noise, and then decide on a value larger than the noise for the threshold value.

Turn **OFF** the noise level check function before you set threshold value **Qth**.
A judgment is not made when taking a measurement during the noise level check.

The noise level check cannot be performed when the BPF setting mode is **ON**.

4 Making Measurements

4.1 Overview

The two measurement modes, **[Normal Mode]** and **[PDIV Mode]**, are available with this instrument.
AC PD measurement can be performed in both these modes.
An overview of each mode follows.

Normal mode

This mode applies constant voltage to measure the magnitude of partial discharge generated.
Generally, AC power is controlled from the instrument, and voltage is automatically applied to the object under measurement when testing. When using with power controlled from a PC or PLC, or by using manual control, it is also possible to use only the partial discharge detection function of this instrument.

PDIV mode

This mode automatically increases and decreases the test voltage to find the PD inception voltage and PD extinction voltage.
The following measurement results can be obtained.

With AC PD measurement:
PD Inception Voltage (Ui)
PD Extinction Voltage (Ue)

4.2 Normal Mode

AC PD measurement

1 **Prepare for measurement.**

See: Connecting Connection Cables
See: Configuring the Band Pass Filter
See: Calibration
See: Configure the Settings for AC PD Measurement in Normal Mode

⚠ DANGER

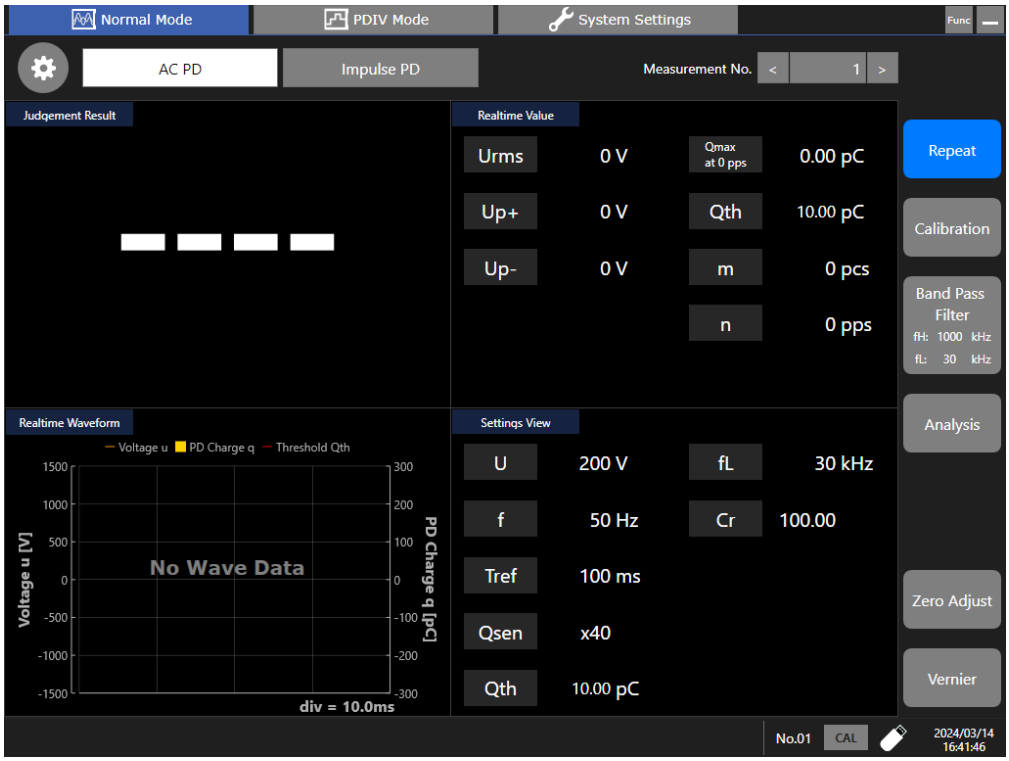
Before starting measurement, check that no one is touching the connection cables or the object under measurement, and that the object under measurement and its surroundings are insulated. Once measurement is started, the AC power supply (insulation/withstand voltage tester) will automatically output high voltage, which may cause a shock.

2 Navigate to the measurement screen.

Tap **[Normal Mode]** > **[AC PD]** to navigate to the measurement screen for normal mode AC DC measurement.

3 Select the trigger mode.

Tap to select **[Single]** or **[Repeat]**.
The instrument operates as follows for each mode.



Trigger Mode	Trigger Behavior	Sampling
Single	Each time the **START** key is pressed triggers a single measurement.	Sampling is performed for the time period specified in **[Tref]**.
Repeat	Measurement is triggered repeatedly from when the **START** key is pressed to when the **STOP** key is pressed.	-

4 Perform measurement.

Press the **START** key.
Voltage will automatically be output to the object under measurement from AC power insulation withstand voltage tester and AC PD measurement will begin.

IMPORTANT

When the trigger mode is **[Single]** voltage output also automatically ends once a single measurement is completed.
When the trigger mode is **[Repeat]** measurement and voltage output continues until the **STOP** key is pressed.
When finished measurement make sure to press the **STOP** key.

Tips

The voltage value can be compensated for using the vernier function.
See: Executing Vernier

4.3 PDIV Mode

AC PD measurement

1 **Prepare for measurement.**

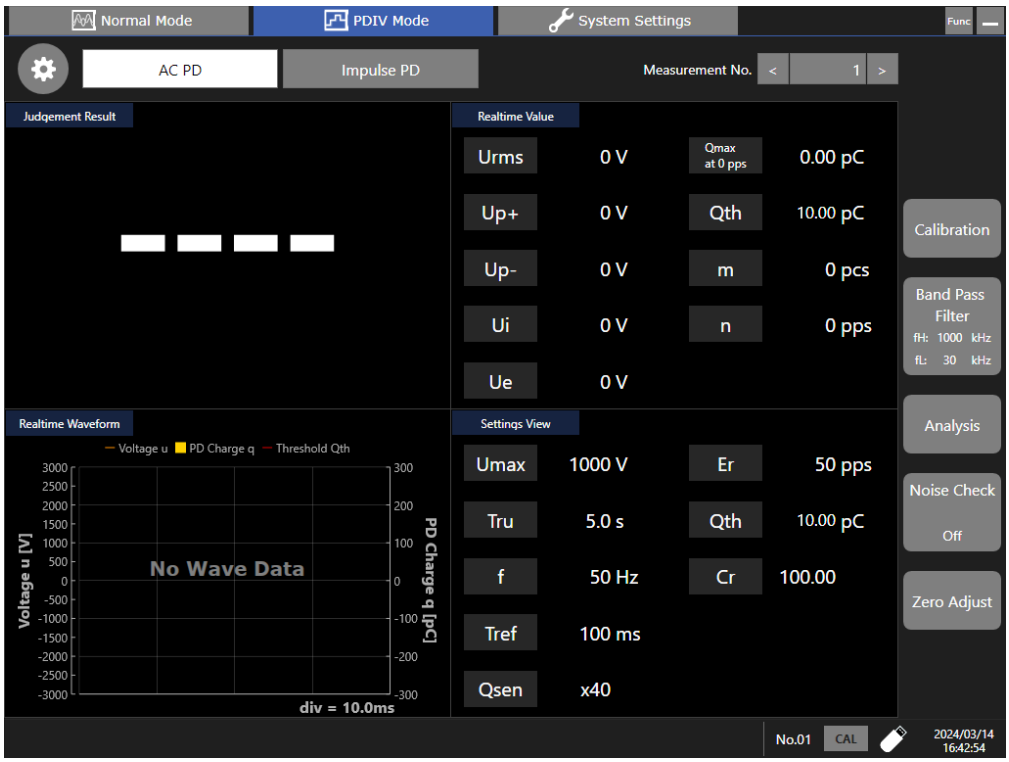
See: Connecting Connection Cables
See: Configuring the Band Pass Filter
See: Calibration
See: Configure the Settings for AC PD Measurement in PDIV Mode

⚠ DANGER

Before starting measurement, check that no one is touching the connection cables or the object under measurement, and that the object under measurement and its surroundings are insulated. Once measurement is started, the AC power supply (insulation/withstand voltage tester) will automatically output high voltage, which may cause a shock.

2 Navigate to the measurement screen.

Tap **[PDIV Mode]** > **[AC PD]** to navigate to the measurement screen for PDIV mode AC DC measurement.



3 Perform measurement.

Press the **START** key.
Voltage will automatically be output to the object under measurement from AC power insulation withstand voltage tester and AC PD measurement will begin.

5 System Settings

5.1 Table Function

The table function records, and can call up for use, setting values such as calibration values, operation settings and display settings.
Using the table function makes it possible to switch to different measurement conditions for multiple objects being tested.

Table function overview

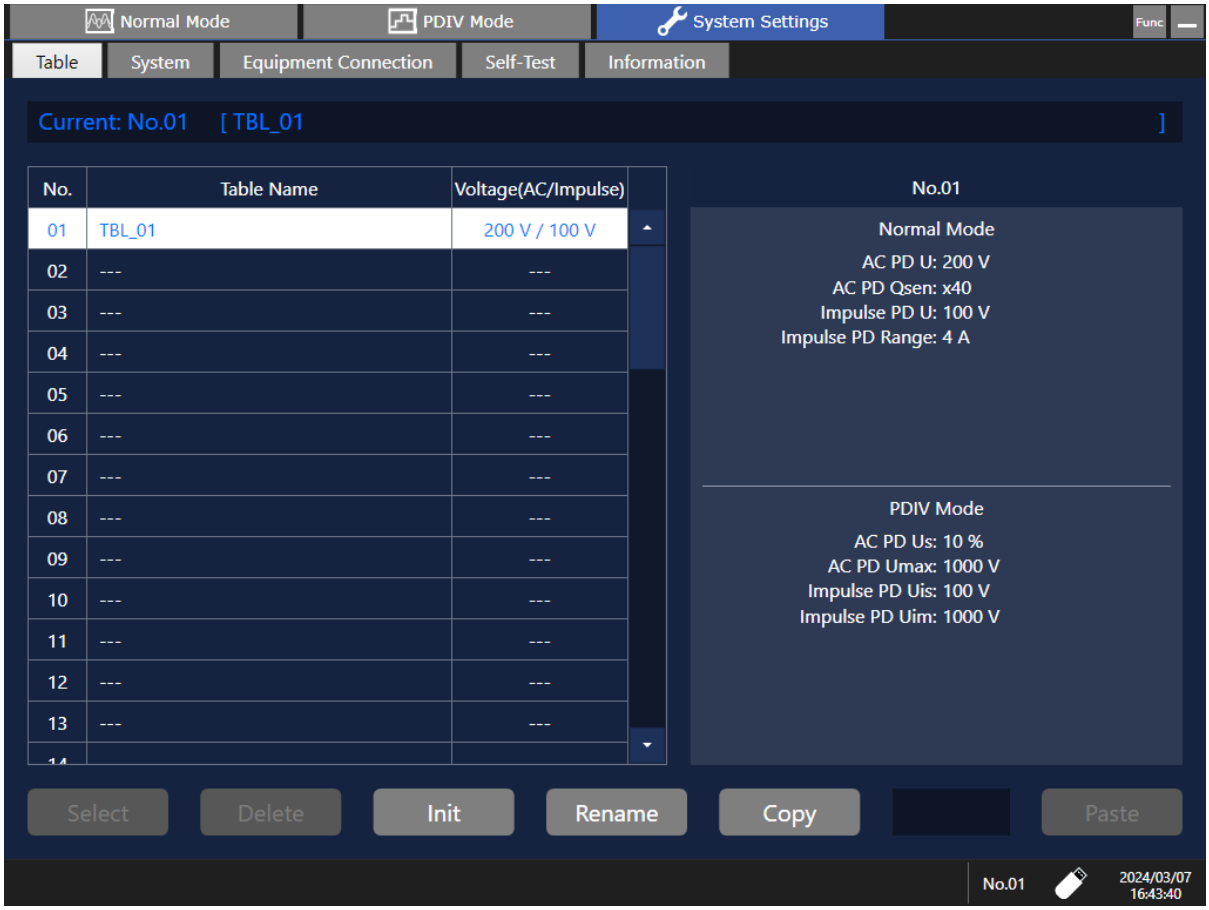
A set of setting values held within the instrument is referred to as a "table".
This instrument references any one of the tables, and this is called the "current table".
Any changes made to setting values through screen operation or communications commands are immediately applied (saved) to the current table.

Tips

A table is different to the concept of a "file" on a computer.
With a computer file, data in the memory at that time is saved using the save operation, but instrument tables do not have a save operation. Current setting values and values in the current table are continuously synchronized.
Therefore, to try conditions different than previous measurement conditions while also saving current measurement conditions, we recommend changing the current table for the instrument to a separate newly created table before changing the settings.

Table function setting method

Tap **[System Settings]** > **[Table]**.



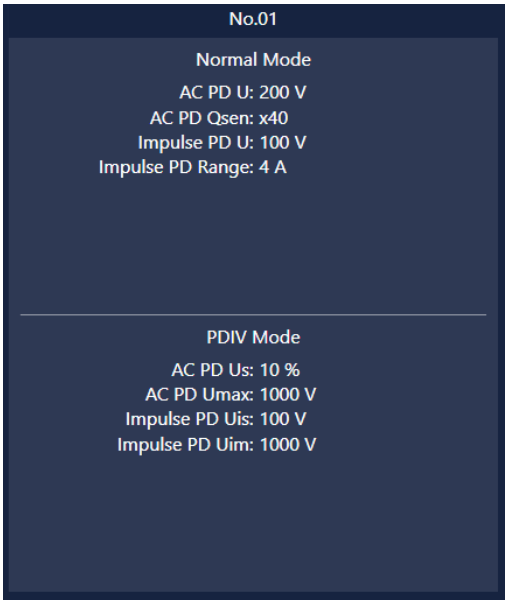
Each Part and Function of the Table Setting Screen

Current Table No., Table Name

The number and name of the current table are displayed.

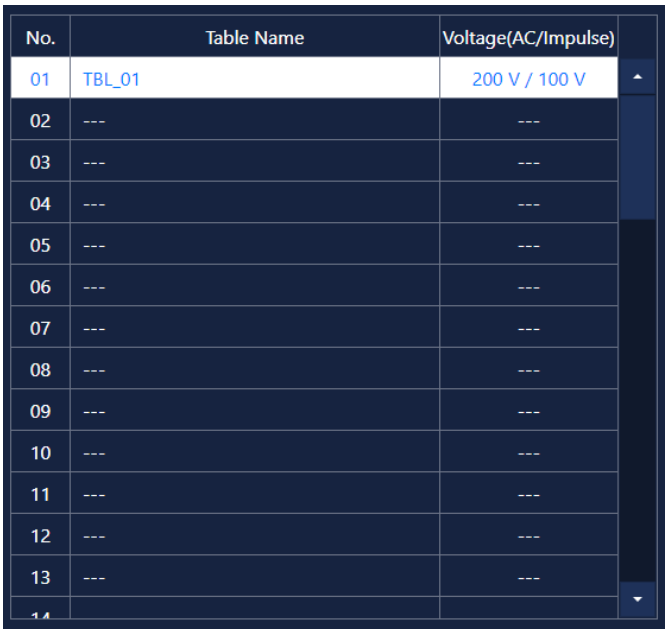
Current table setting contents

The typical setting values for the current table are displayed.



List of Tables

This is a list of tables registered in the instrument.
Tap on any of the rows to change the table in that row to the current table.
Tap on any of the rows to highlight the table in that row in white, which allows you to select, delete, initialize, rename, copy, or paste that table.



No.	Table Name	Voltage(AC/Impulse)
01	TBL_01	200 V / 100 V
02	---	---
03	---	---
04	---	---
05	---	---
06	---	---
07	---	---
08	---	---
09	---	---
10	---	---
11	---	---
12	---	---
13	---	---

Select

Changes the highlighted table to the current table.
The table number for the selected table is displayed at the bottom right of the screen.

Delete

Deletes the highlighted table.
When the current table is highlighted, the **[Delete]** button is grayed out and the table cannot be deleted.

Initialization

The highlighted table settings are restored to the default values.

Rename

Renames the highlighted table.
The table name can be up to 40 characters.

Copy

Contents of the highlighted table are copied to the buffer.

Paste

Table content copied to the buffer using **[Copy]** is pasted to the highlighted table.

Saving/loading a table

Measurement conditions set in a table can be saved to a file, and measurement conditions saved to a file can be loaded into a table.

Save

A table can be saved to a file when the **SAVE** key is pressed while the table screen is displayed.

Save Table	Description
Save Current Table	Saves the measurement conditions in the current table to a file. The file extension is **TB1**.
Save All Tables	Saves the measurement conditions in all tables to a file. The file extension is **TBL**.
Cancel	Do not save a table.

Load

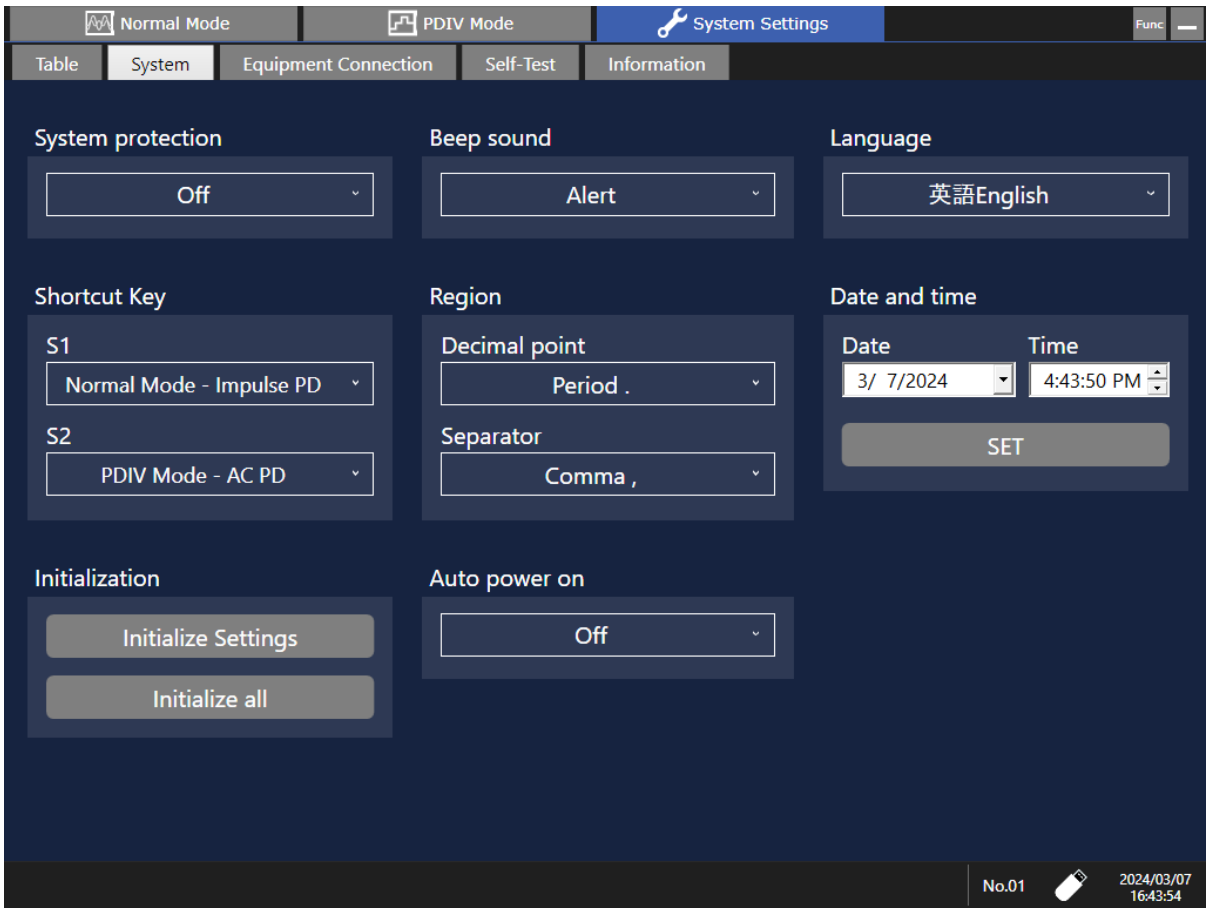
Tap **[Func]** at the top-right of the screen and select **[Load Table]** to open Explorer. Select a file and load it.

If the file extension is **TB1**, the measurement conditions saved to the file are loaded into the **current table**. To load measurement conditions into a different table, first change the **current table**.

If the file extension is **TBL**, the measurement conditions saved to the file are loaded into all tables.

5.2 System

Items relating to the system of the instrument can be set.
The setting items are as follows.



System protection

Selects the system protection function for when there is a power interruption. The factory default setting is **[ON]**.
This function uses the UWF (Unified Write Filter) installed in Windows. When operated for more than a month continuously, we recommend turning this function **[OFF]** and preparing an external UPS.
When changing settings, the instrument shuts down.

Setting Value	Description
ON	The system is protected against an unexpected shutdown.
OFF	The system is not protected against an unexpected shutdown.

Beep sound

Select the beep sound operation setting. The factory default setting is **[Alert]** .

Setting Value	Description
OFF	A beep sound does not sound.
Alert	A beep sound will sound next time. • When an error message or warning message is displayed • When the judgment is FAIL
Alert + action	In addition to when there is an alert, a beep sound sounds at start, trigger, stop, and when auto-save is complete.

Language

Select the language to be displayed on the instrument screen.
You can select from the following three languages. The factory default setting is Japanese.

- Japanese
- English
- Chinese

To change the language, first set system protection to **[OFF]**. When changing settings, the instrument shuts down.

Shortcut Key

The **S1** Key and **S2** key on the front of the instrument are assigned shortcuts for migrating to each screen.
The following screens can be selected as shortcut destinations.

- Normal Mode - AC PD
- PDIV Mode - AC PD
- System Settings - Equipment Connection
- System Settings - System
- System Settings - Table

Region

Settings for decimal points and separators in data saved to file.
The following settings can be selected. However, the same setting cannot be used for both decimal points and separators.

Decimal Point

Setting Value	Description
Period .	A period (.) is used as a decimal point in numerical values.
Comma ,	A comma (,) is used as a decimal point in numerical values.

Separator

Setting Value	Description
Comma ,	A comma (,) is used as a separator.
Semicolon ;	A semicolon (;) is used as a separator.
Space _	A space (_) is used as a separator.
Tab	A tab is used as a separator.

Date and time

Set the system date and time for the instrument. Tap on the box and select the date and time then tap on **[Set]** to apply the selected date and time.

Initialization

Restores instrument settings to factory settings.
See: List of Initial Settings

Auto startup

Set the startup method.

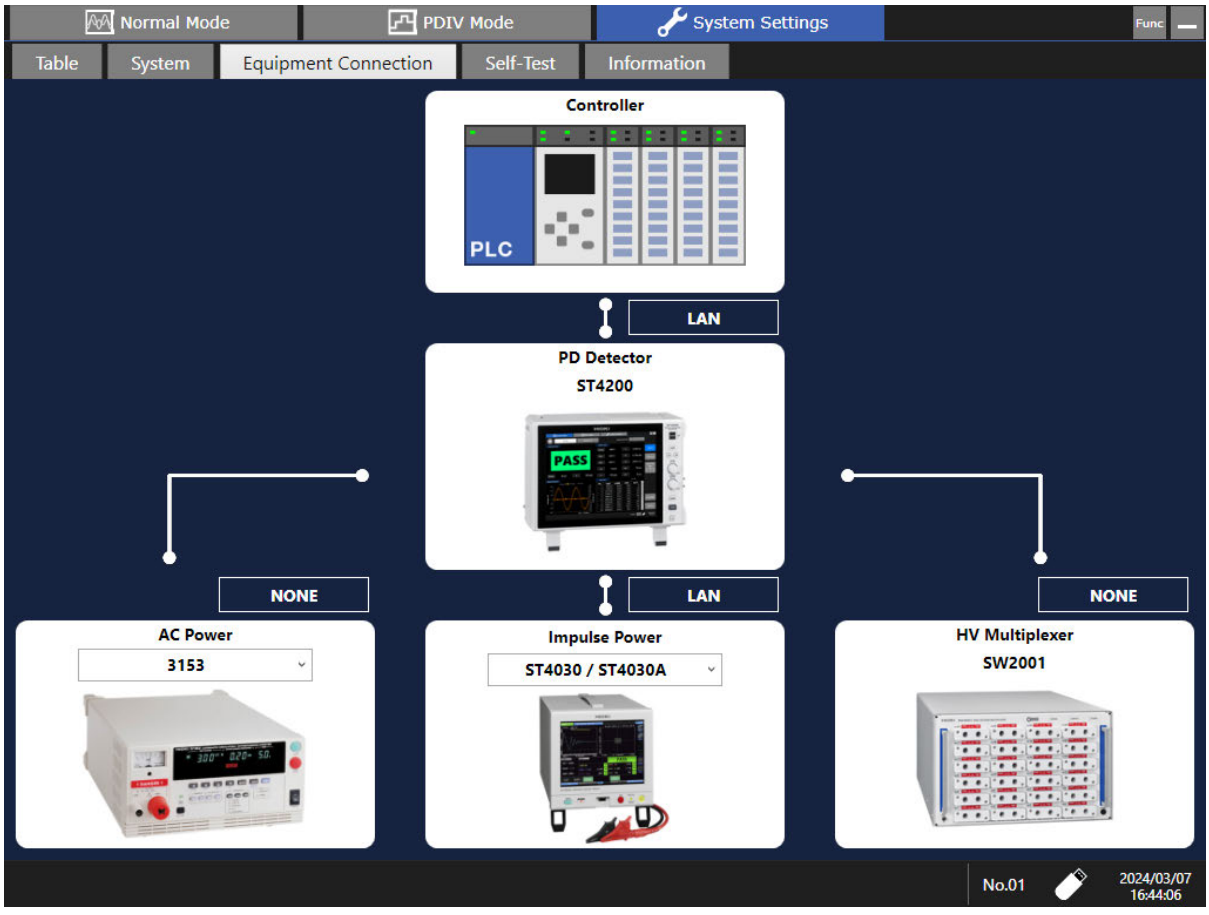
Setting Value	Description
OFF	Do not use the automatic startup function.
ON	Use the automatic startup function. When power is supplied to the instrument, Windows will start automatically and be ready to take measurements. The power key on the instrument does not need to be used.

5.3 Equipment Connection

Configure the communication settings for the instrument and for the measuring instruments and controllers that link with and control the instrument.

Tips

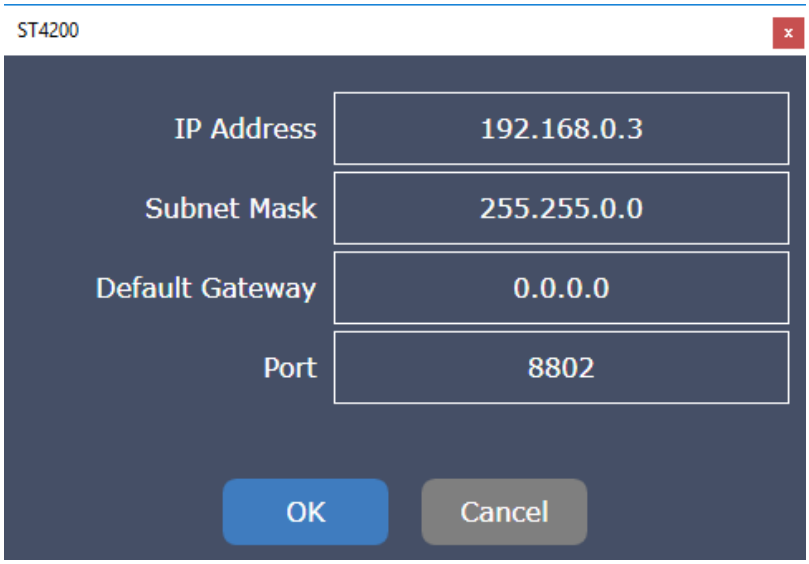
When it is not necessary to link with and control the instrument, set the communication settings for each measuring instrument to **[NONE]**.
When communication settings are set correctly, AC power and high voltage multiplexer will operate automatically according to operation commands from the instrument.



Communication between the instrument and controller

The instrument and controller are connected via LAN. Configure the IP address for the instrument LAN port, as well as the connecting port.

Configure the LAN settings in accordance with the network connected to the instrument.

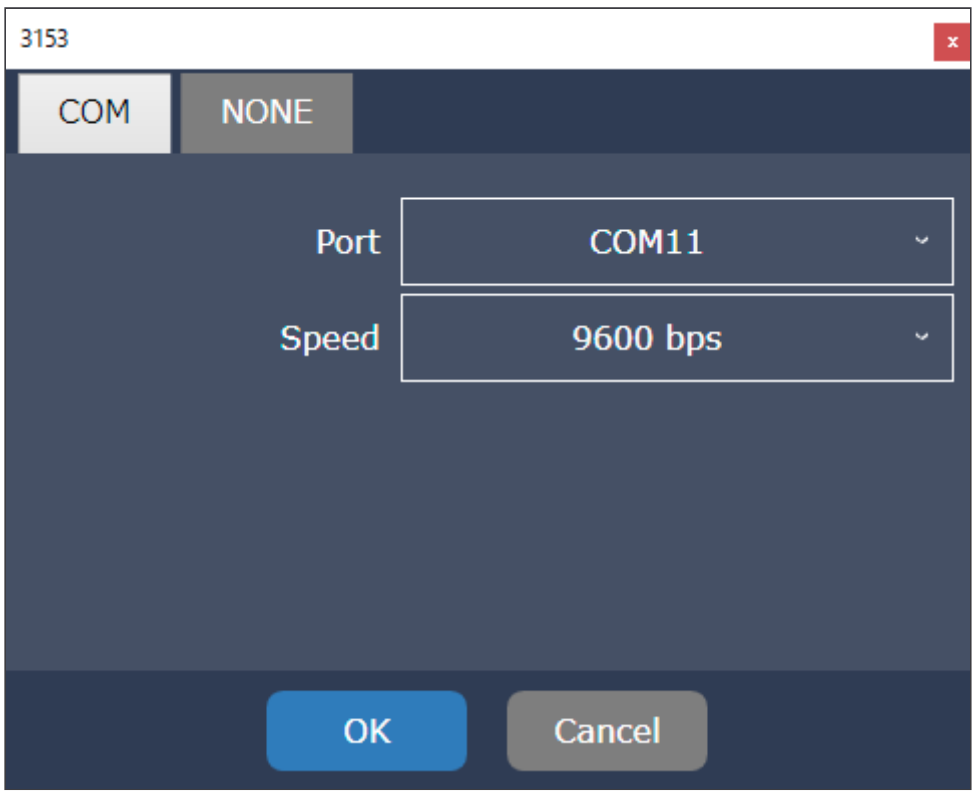


Communication between the instrument and AC power

The instrument and AC power supply equipment are connected via LAN, COM, or VISA. Configure the communication settings for the instrument according to the communication settings for the AC power supply equipment.
For equipment that communicates using RS-232C, use a commercially available USB serial conversion cable to connect with the instrument, and select to use COM.
When communication is not possible, install a USB serial conversion cable driver.
When using a VISA communication interface with the TOS series, a Kikusui Electronics VISA driver is required. Install a dedicated driver and connect the instrument with the TOS series using a USB cable before configuring settings.

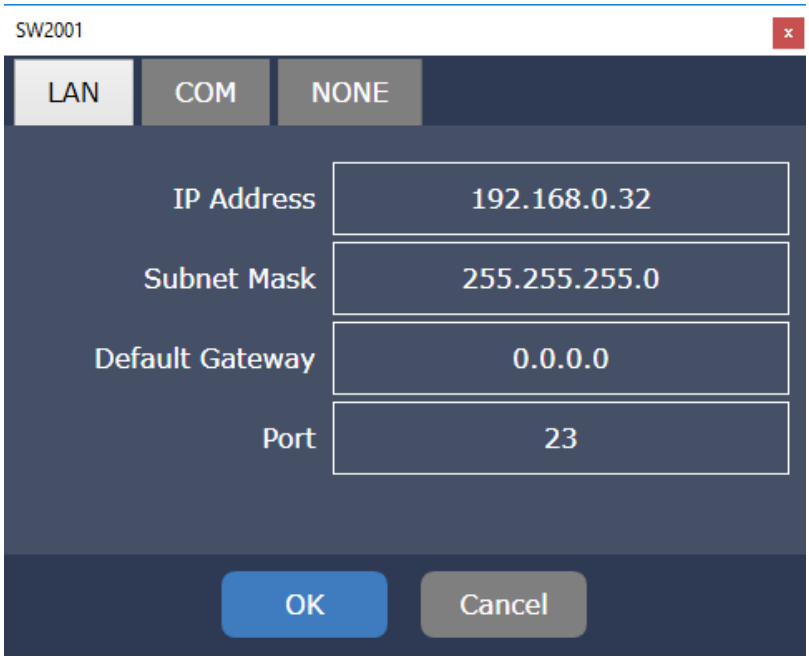
AC power supply control equipment and the communication interfaces are as follows.

Controller	Communication Interface
Automatic Hipot Tester 3153	COM
TOS5200 Series, TOS5300 Series Hipot Testers	COM, VISA
TOS9300 Series Hipot Tester	LAN, COM, VISA



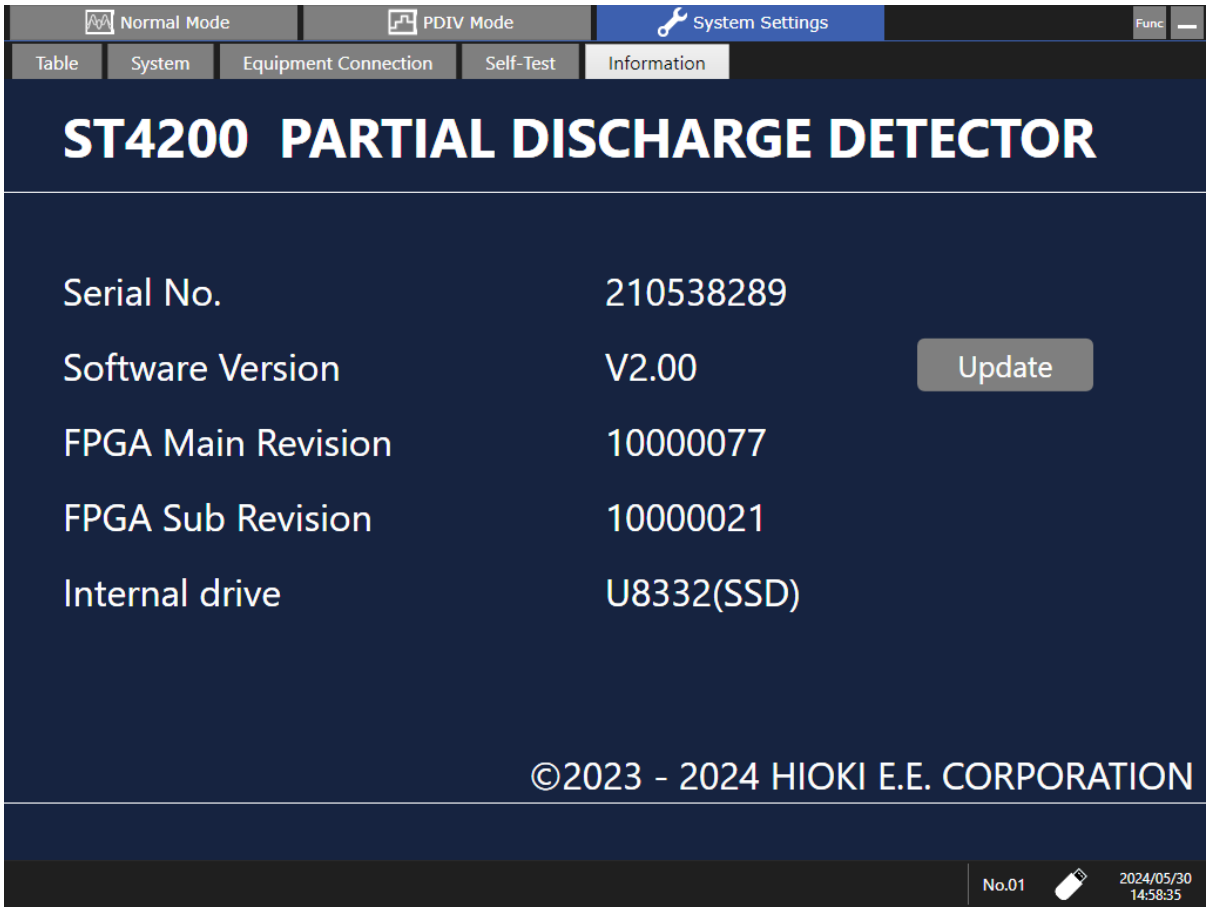
Communication between the instrument and high voltage multiplexer

The instrument and high voltage multiplexer are connected via LAN or USB. When connected using USB, select COM. Configure the communication settings for the instrument according to the communication settings for the high voltage multiplexer.



5.4 Information

Displays system information for the instrument.
It is also possible to upgrade the firmware version.
Tap **[System Settings]** > **[Information]** to open the Information screen.



Displayed items

Item	Description
Serial No.	The serial number of the instrument. For the latest information, check Hioki's website.
Software Version	Indicates the firmware version for the instrument.
FPGA Main Revision	Indicates the firmware version for the main FPGA.
FPGA Sub Revision	Indicates the firmware version for the sub FPGA.
Internal drive	Indicates whether the internal drive option was installed when shipped. The drive installed is displayed. When a drive is not installed, "None" is displayed.

Firmware update

The procedure for firmware updates is as follows.

1 **Prepare a USB flash drive.**

Use for saving and loading the update file.

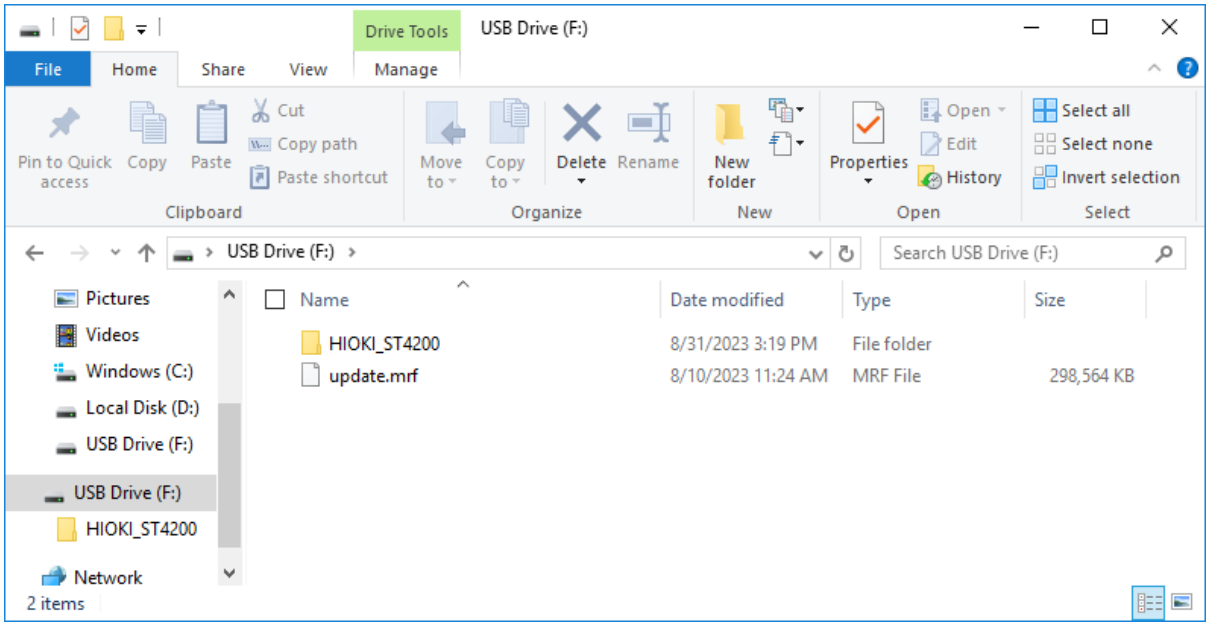
2 **Download the update file.**

The latest version can be downloaded from Hioki's website.
Hioki Website Software Download Page

3 Save the update file to the USB flash drive.

Compress the downloaded update file in ZIP format.
Unzip the ZIP file using the Windows Explorer function and save the "update.mrf" file in the root directory[*1] on the USB flash drive.
*1: Indicates the directory at the highest level of the file hierarchy.

The figure below is an example of saving the file in Windows Explorer in the root directory of the USB flash drive identified as the F drive.



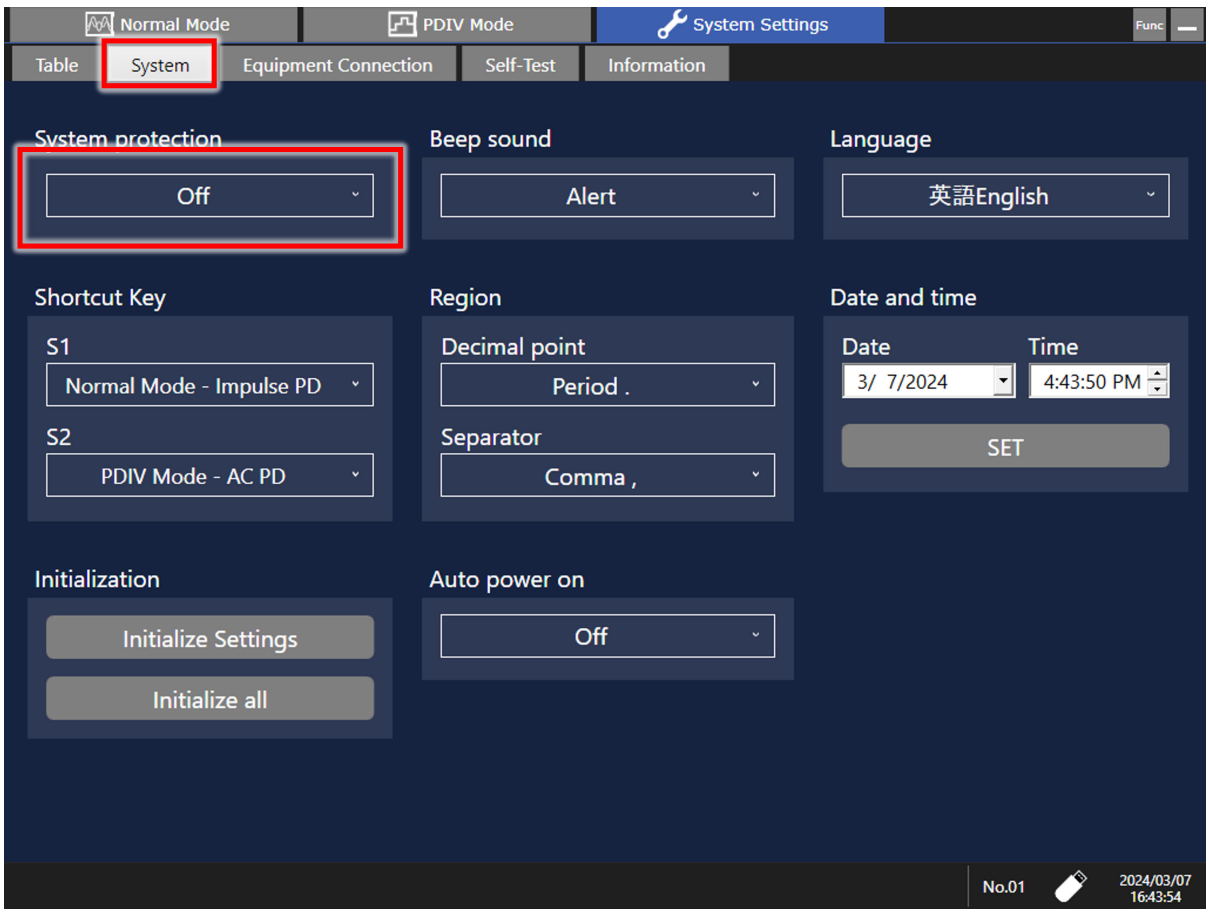
4 Back up the settings.

The instrument settings may initialize all settings after the update.
Back up the settings as required.
Refer to the update file for the back-up method.

5 Switch OFF the system protection function.

Tap **[System Settings]** > **[System]** and set **[System Protection]** on the system setting screen to **[OFF]**

> If **[System Protection]** is set to **[ON]** the internal drive cannot be overwritten and the update is not possible.



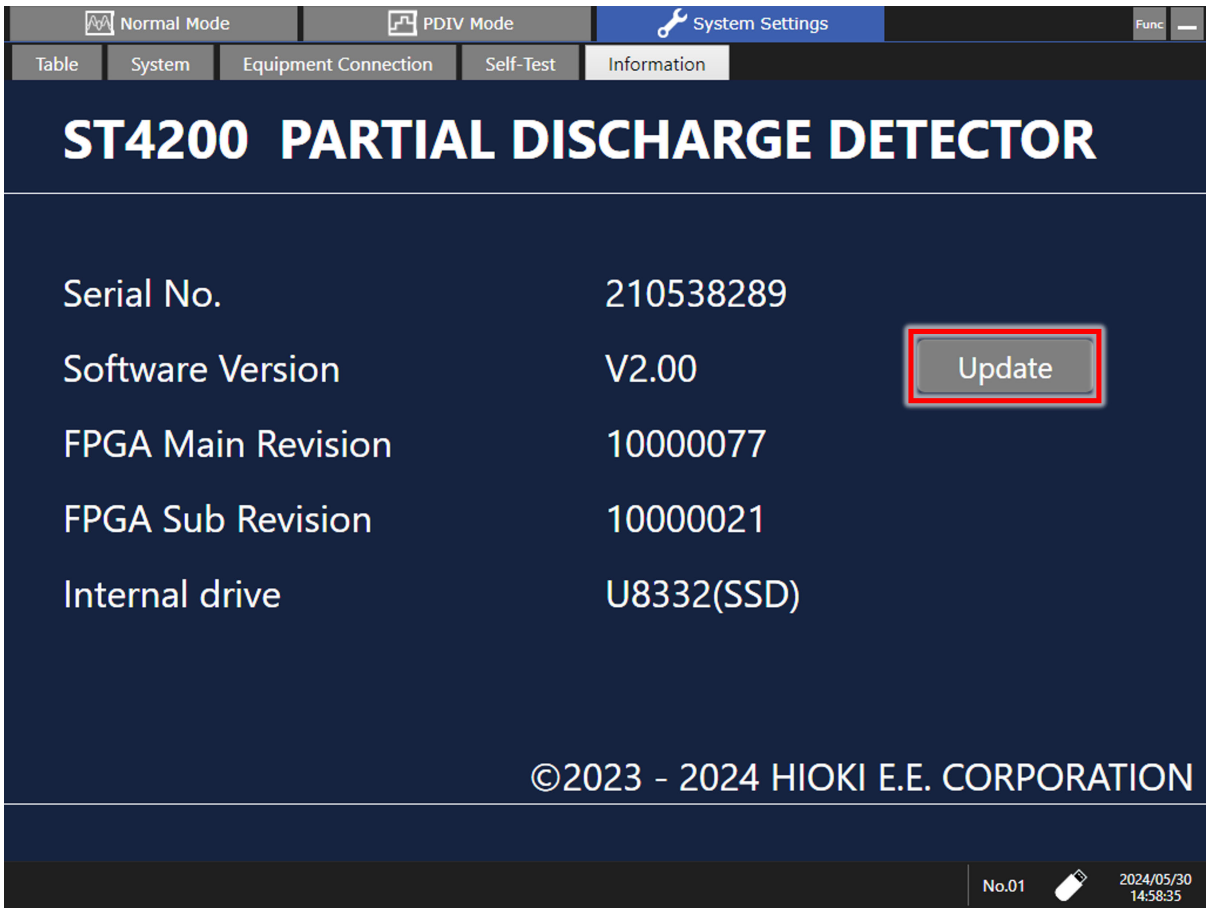
6 Insert a USB flash drive into the instrument.

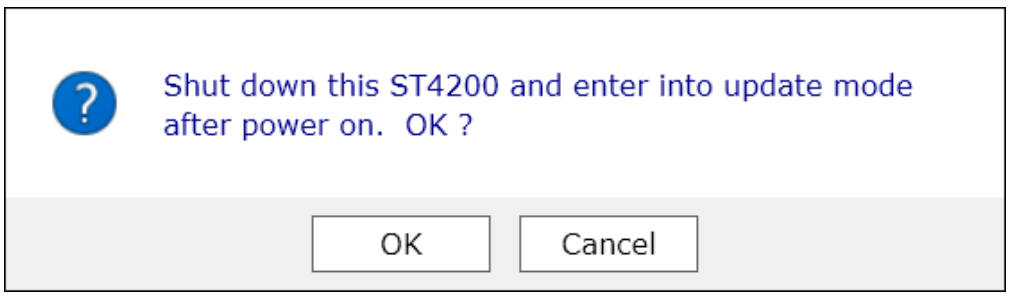
Insert the USB flash drive on which the update file is saved in to the USB connector of the instrument. The instrument has more than one USB connector. Any can be used.

> When updating firmware do not connect a USB device to a USB connector other than the USB flash drive used for the update.
> The update will not be executed properly.

7 Start the update.

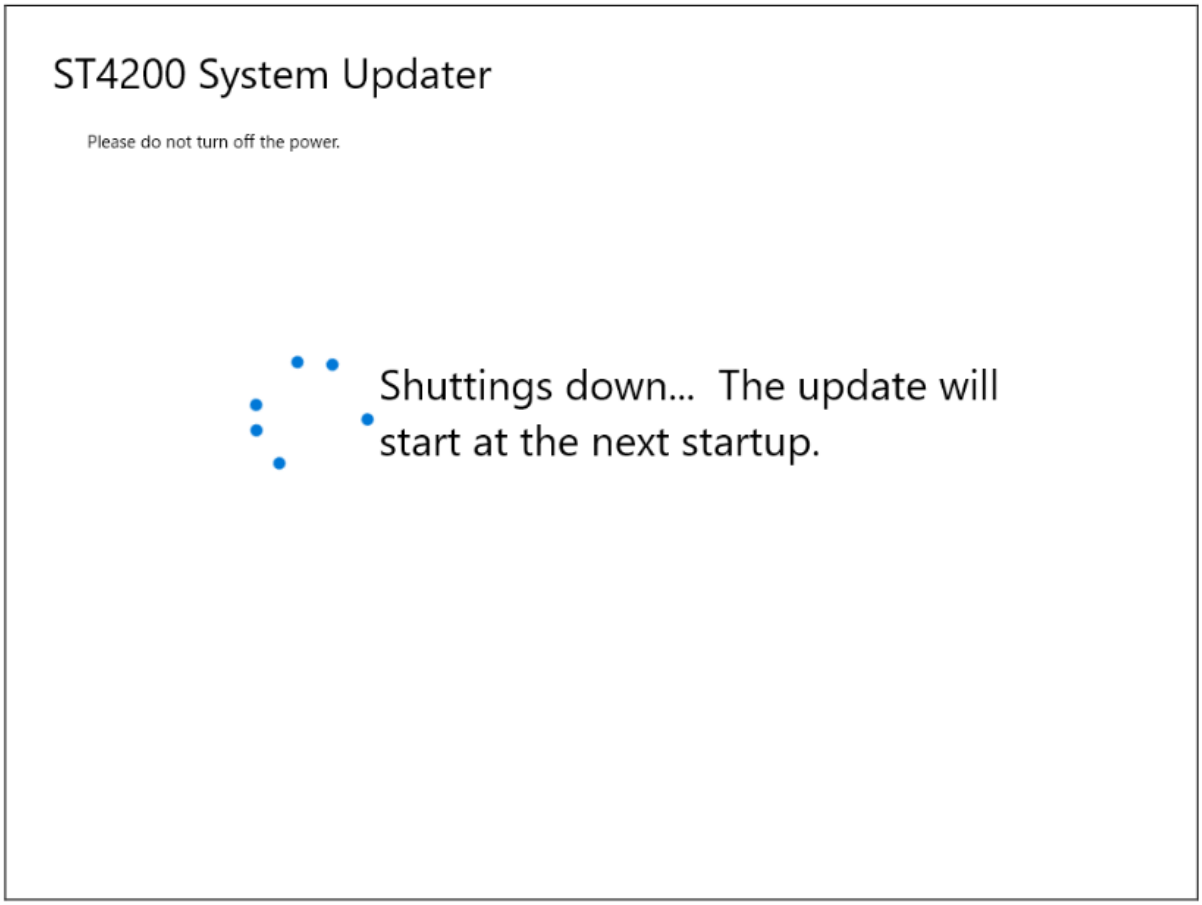
Tap **[System Settings]** > **[Information]** and then tap **[Update]** on the system information screen.
A dialog box will appear confirming that you want to execute the update.Tap **[OK]** to start the update.





8 After the power automatically switches off, turn the power ON again.

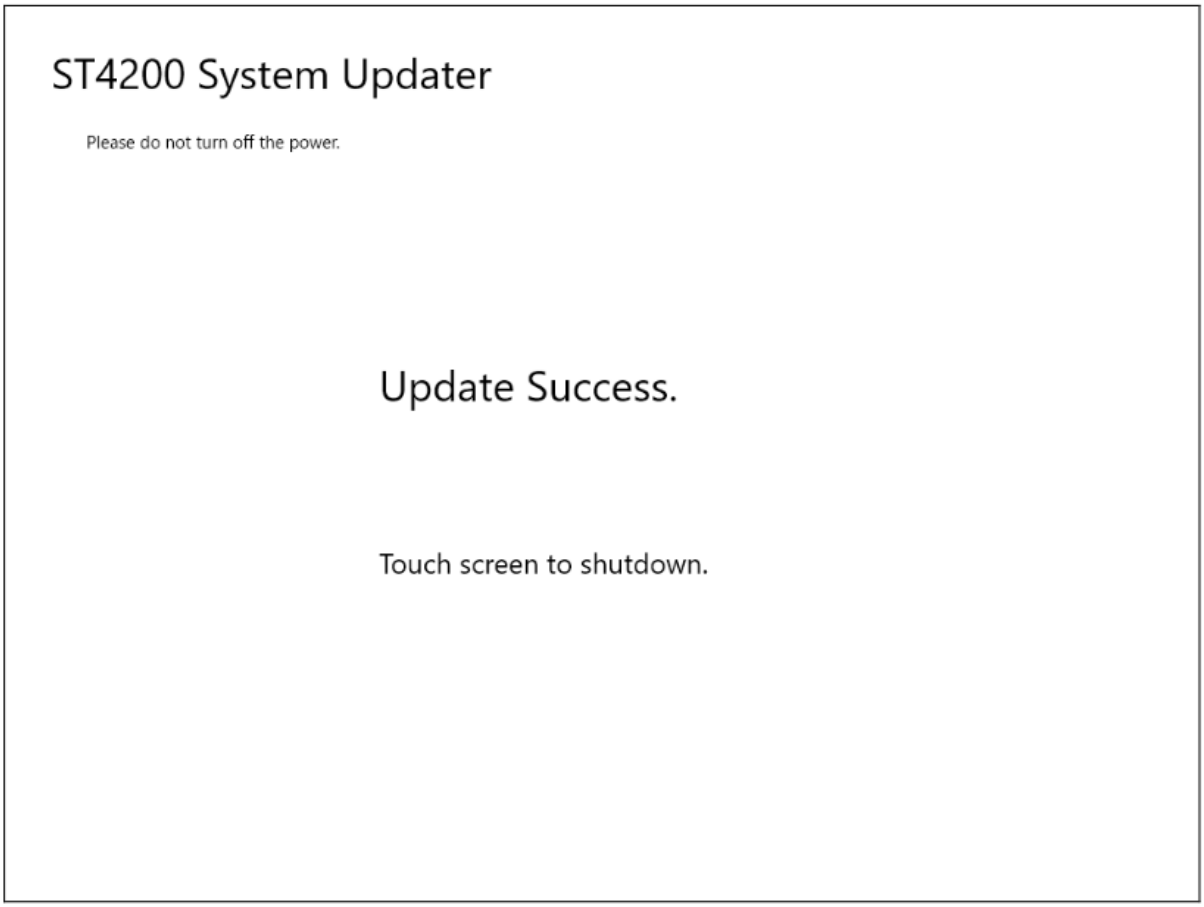
While the update proceeds, the instrument shuts down after the next screen appears.
With the USB flash drive inserted, turn the power ON.
When the instrument starts up, update processing proceeds automatically.



9 After the update is finished, turn the power ON again.

When the update is finished, the next screen appears.
Tap on the screen to shut down the instrument.
After shutting down, extract the USB flash drive and turn the power ON.

The update is complete.



When the update does not finish
If the update is still not finished more than 40 minutes after it started, it is likely that the update has failed.
Perform the following steps.

1. If you have a USB keyboard and USB mouse available, connect them to the USB connectors on the instrument.
   Press the Windows key and D key at the same time to display the desktop screen then shut the instrument down from the start menu.
   If you do not have a USB keyboard and USB mouse available, hold down on the instrument power key and turn the power OFF.
2. Turn ON the power again.
   When the update screens are displayed successively, wait until this is finished.
   When the measurement screen is displayed, execute the update again.
   If any other screen is displayed, contact your authorized Hioki distributor or reseller.

6 External Control（EXT. I/O）

6.1 Overview

Connecting the external control terminals with external devices allows the instrument to start and stop a measurement.
This section describes the procedure and the external control terminal function to control the instrument externally.
The term “external control terminals” is used to see all of these terminals collectively.
Signals inputted into the external control terminals operate the instrument even when the key lock function is enabled.

For further details on how to connect to external control terminals, refer to "Connecting the External Control Terminals" in "Preparing for Measurement".
See: Connecting the External Control Terminals

6.2 External Control Functions

Start trigger and stop trigger

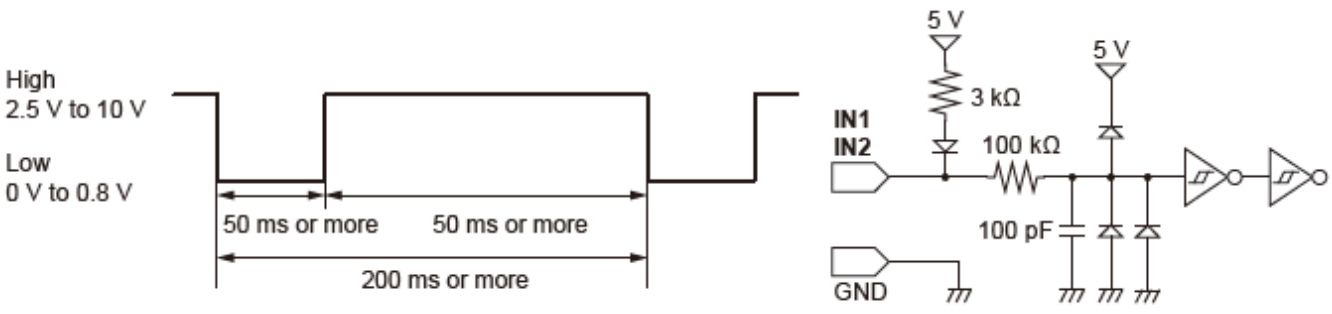
External signals can be input to start and stop measurement.

Signal Input Method

Connect the terminal and GND to each other.
See: Connecting the External Control Terminals

Alternatively, input high-level (2.5 V to 10 V) or low-level (0 V to 0.8 V) pulse waves or a rectangular wave to the terminal.
The electrical characteristics are as follows.

Item	Description
Working voltage range	High level: 2.5 V to 10 V, Low level: 0 V to 0.8 V
Pulse width	High-level period: 50 ms or more
Pulse width	200 ms or more
Maximum input voltage	10 V DC



Judgment result output

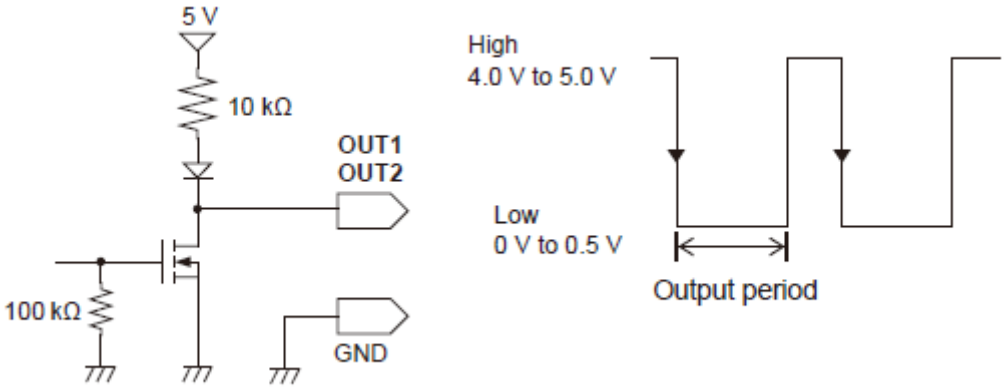
A signal can be output according to the state of the instrument.

Signal Output Method

Connect the PASS terminal or FAIL terminal and the GND terminal to the equipment to be controlled using the respective cables.
See: Connecting the External Control Terminals

A signal is output according to the state of the instrument. The electrical characteristics are as follows.

Item	Description
Output signal	Open-drain output (with voltage output) active-low
Output voltage range	High level: 4.0 V\ to 5.0 V Low level: 0 V\ to 0.5 V
Pulse width	200 ms or more
Maximum input voltage	50 V DC, 50 mA, 200 mW

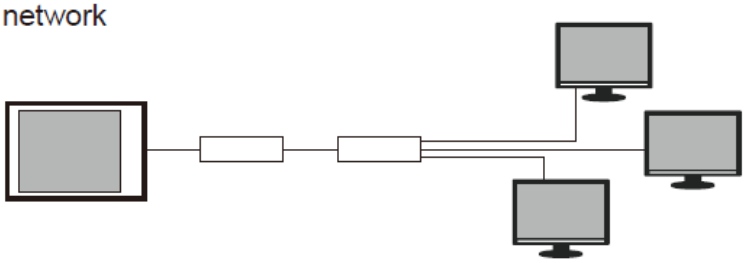


7 Communications Function

7.1 Interface Overview and Features

This instrument is equipped with Ethernet 100BASE-TX as an interface. The instrument can be controlled from a PC by connecting to a network with a LAN cable supporting 10BASE-T or 100BASE-TX. The following two connection methods are available:

- Connecting the instrument to your computer via the network



- Directly connecting the instrument to your computer

7.2 LAN Settings and Connection

Before command communication using a computer, configure the instrument LAN settings and then connect the instrument and computer with a LAN cable. Ensure that LAN settings are configured before connecting to the network. If settings are changed while connected, there is a risk that the IP addresses of other equipment on the LAN may be duplicated, and that incorrect address information may be sent. For further details on how to connect the instrument with computers, see Connecting the Instrument With Computers.

IMPORTANT

Do not change any Windows settings that are not instructed in this manual.
Doing so may cause unstable behavior of the system.

Instrument LAN settings

Items to check before configuring settings

Settings will differ when connecting to an existing network and when forming a new network with the instrument and a single computer.

When connecting the instrument to an existing network

It is necessary to have the network system administrator (department) assign the following items in advance. Ensure the IP address does not duplicate that of another device.

- Computer name and address settings on the instrument
  Computer name (up to 15 characters)
  IP address
  Subnet mask
- Gateway (if using)
  IP address

When forming a new network with the instrument and a single computer

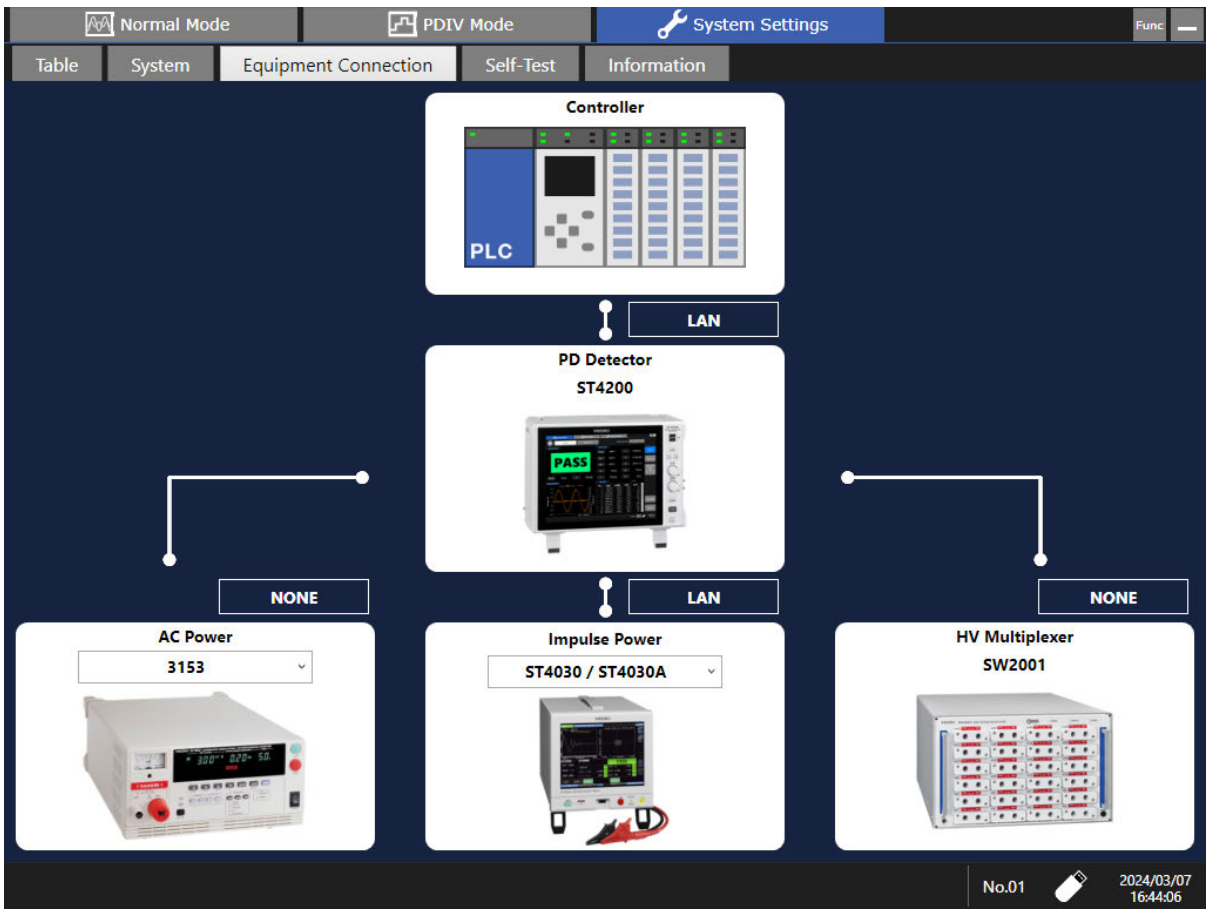
(When using a local network not connected externally) The following addresses are recommended in cases where there is no administrator or cases where discretion is given for settings.

Example setting:

Equipment	IP Address	Subnet mask	Gateway
PC	192.168.0.1	255.255.255.0	OFF
ST4200 First device	192.168.0.2	255.255.255.0	OFF
ST4200 Second device	192.168.0.3	255.255.255.0	OFF
...	Append consecutive numbers to the end.	255.255.255.0	OFF

How to configure

[System Settings] > **[Equipment Connection]**



1 **Tap [LAN].**

The instrument LAN settings window opens.

2 Set the required information.

Item	Description
IP Address	This is the address for identifying individual devices connected to a network. Configure so that it does not duplicate that of another device.
Subnet mask	This is a setting for separating the IP address into the address part indicating the network and the address part indicating the device. Configure so that it is the same subnet mask as other devices on the same network.
Default gateway	**When connecting to a network** When the computer (device for communication) being used is connected to a separate network from the network connecting the instrument, specify the gateway device. If the computer is on the same network, this is generally set to the same default gateway as in the computer settings. **When connecting the instrument and computer 1-to-1, or when not using a gateway** Set the IP address to **[0.0.0.0]**.
Port	Specify the TCP/IP port number to be used for connection for communication commands. You can set the port number in the range of 1002 to 49002.

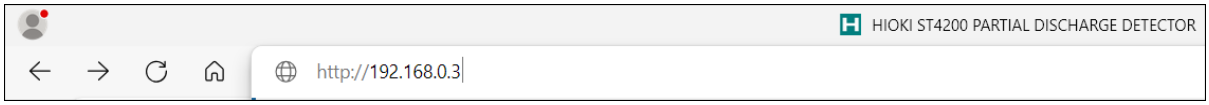
3 Tap [OK].

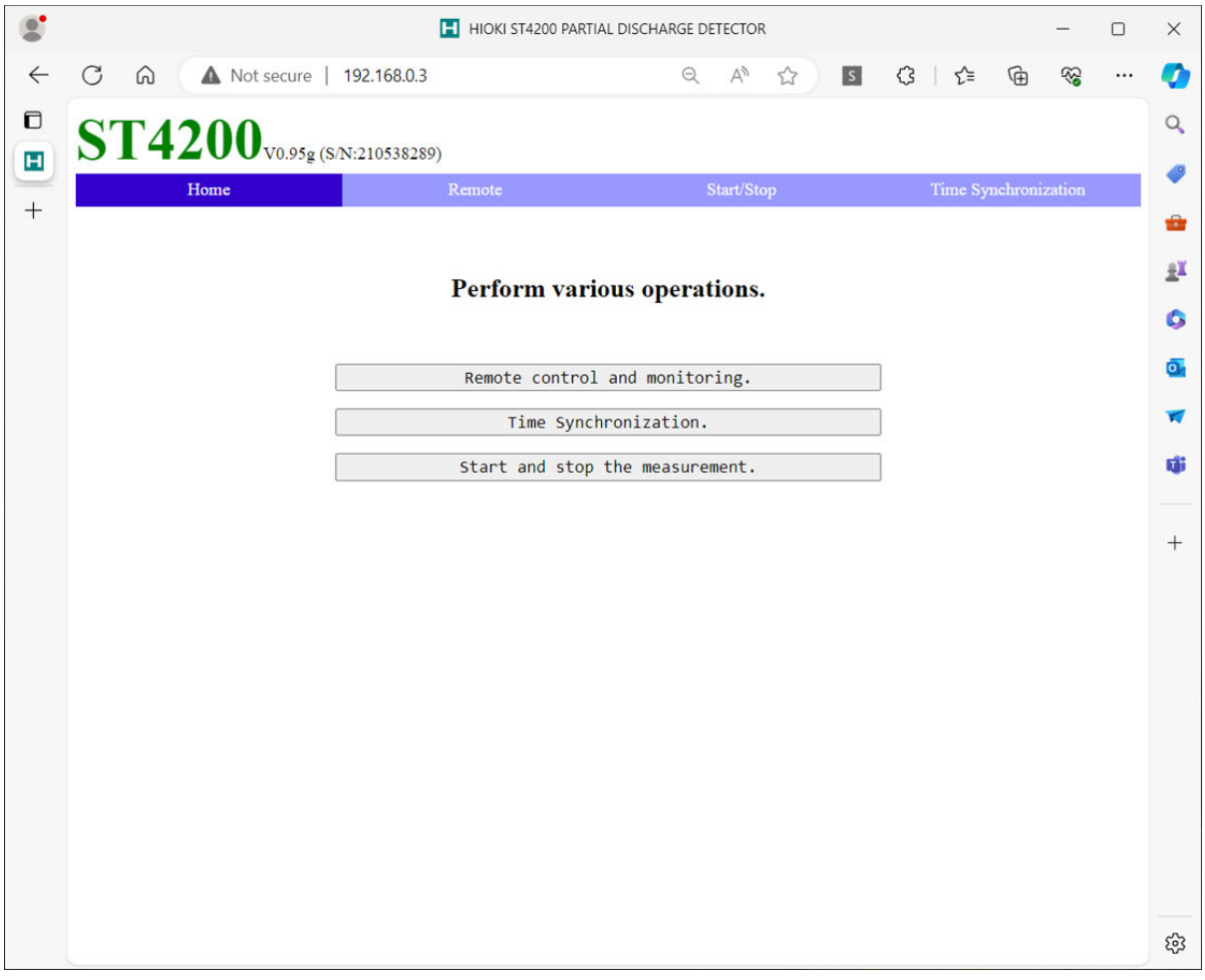
7.3 Operating the Instrument With a Browser Installed in a Computer

You can configure the instrument settings and operate the instrument from a computer with a web browser. Microsoft Edge is recommended.

Connecting your computer to the instrument with a web browser

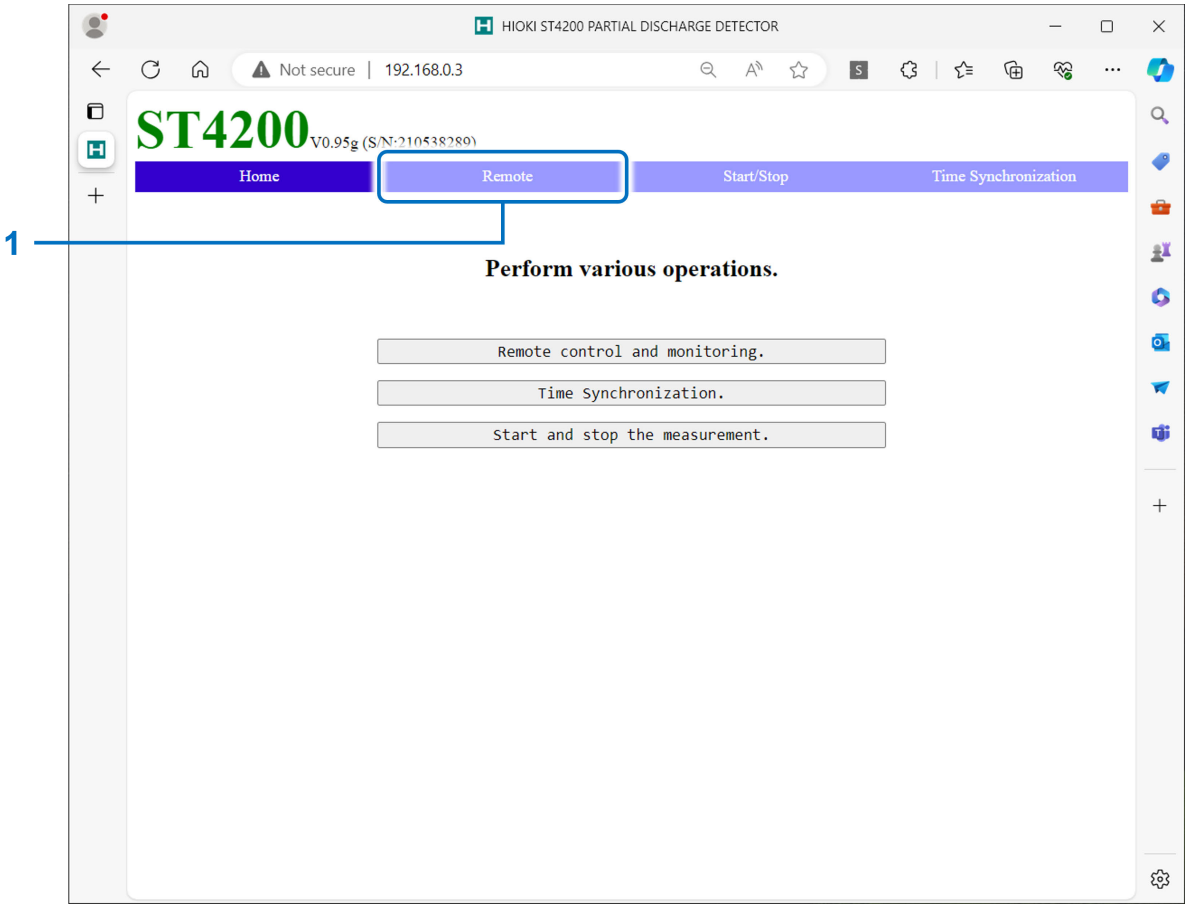
When the IP address of the instrument is “192.168.0.3”





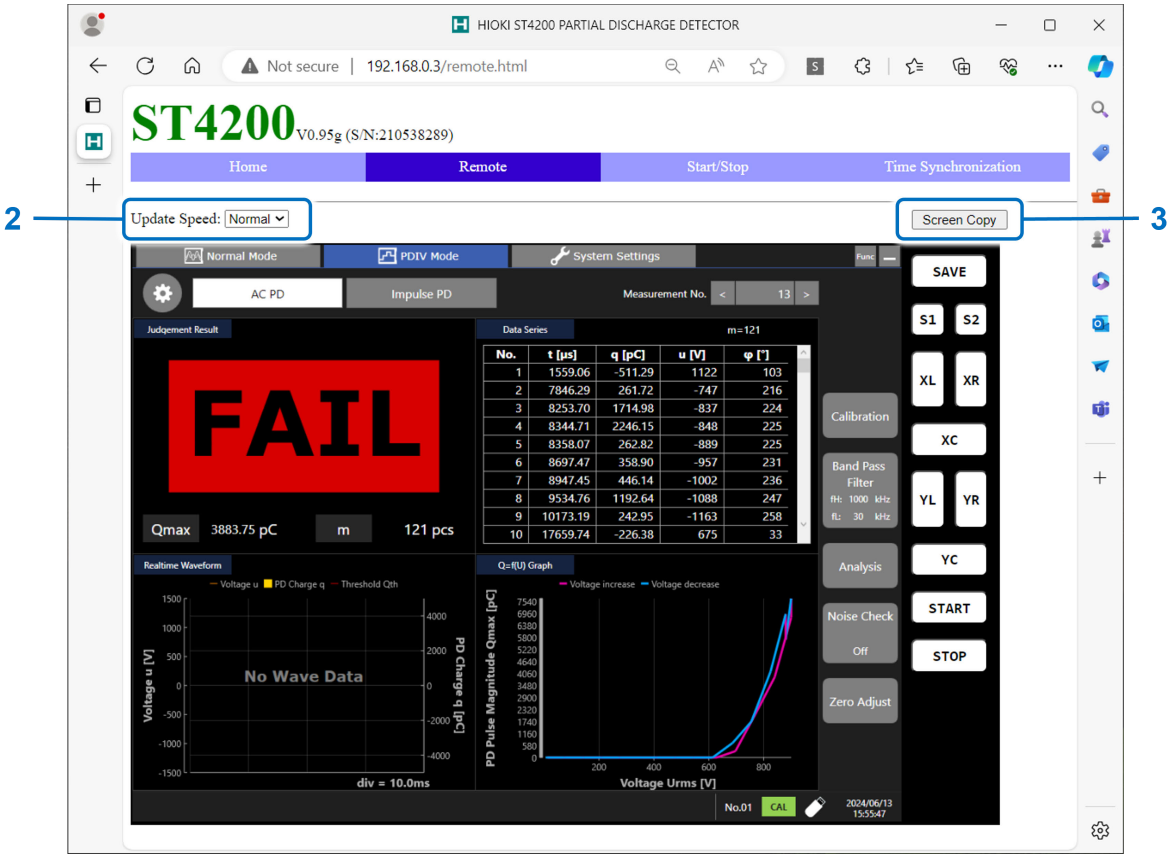
With authorization, enter your username and password in the **[Username]** and **[Password]** fields on the main screen to log in.

Remotely operating the instrument



1 **Click [Remote] on the menu.**

The screen switches to the remote operation screen, displaying the instrument's screen on the browser. The operation panel buttons correspond to the buttons on the instrument. Clicking the screen with a mouse (the same as tapping the screen on the instrument) allows you to operate the instrument remotely.

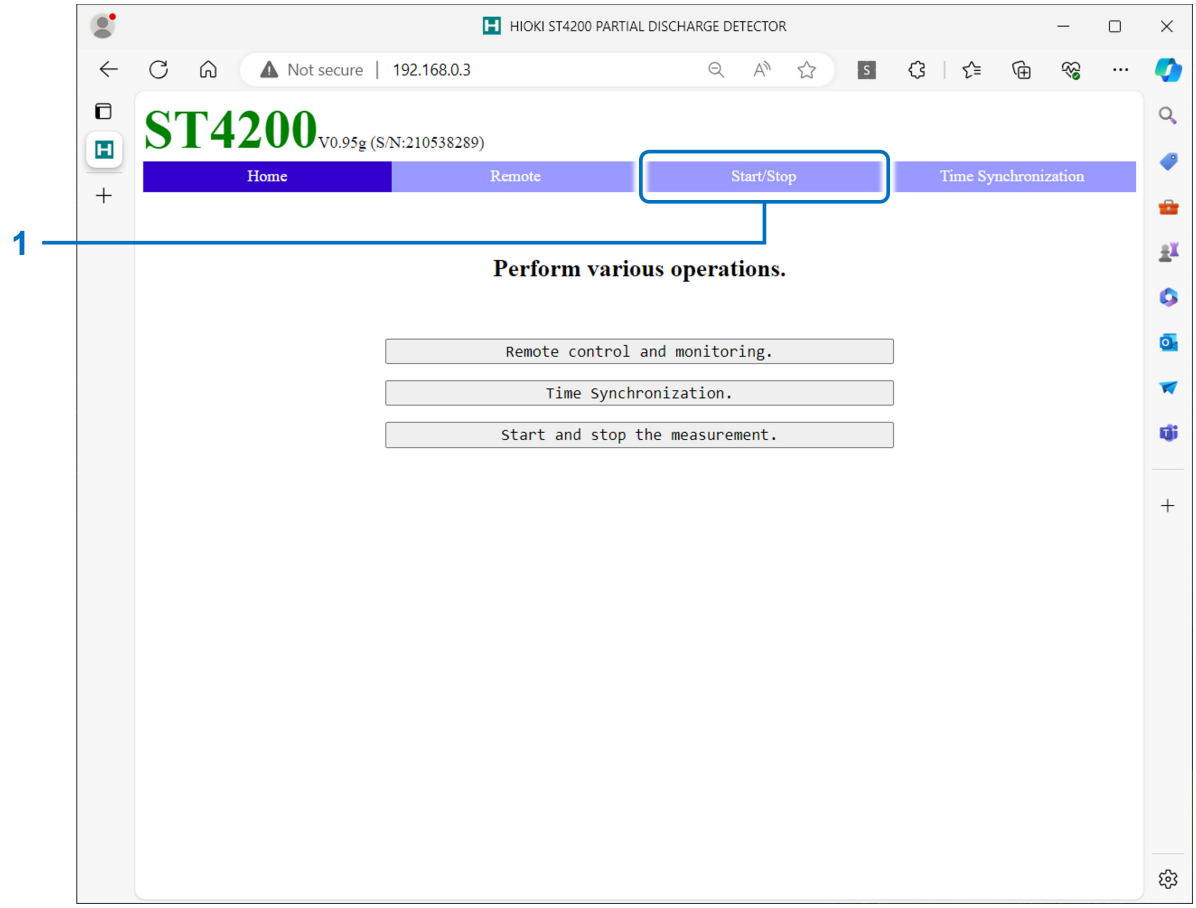


2 Choose a screen update speed from the [Update Speed] drop-down list.

3 To save a screenshot, click [Screen Copy].

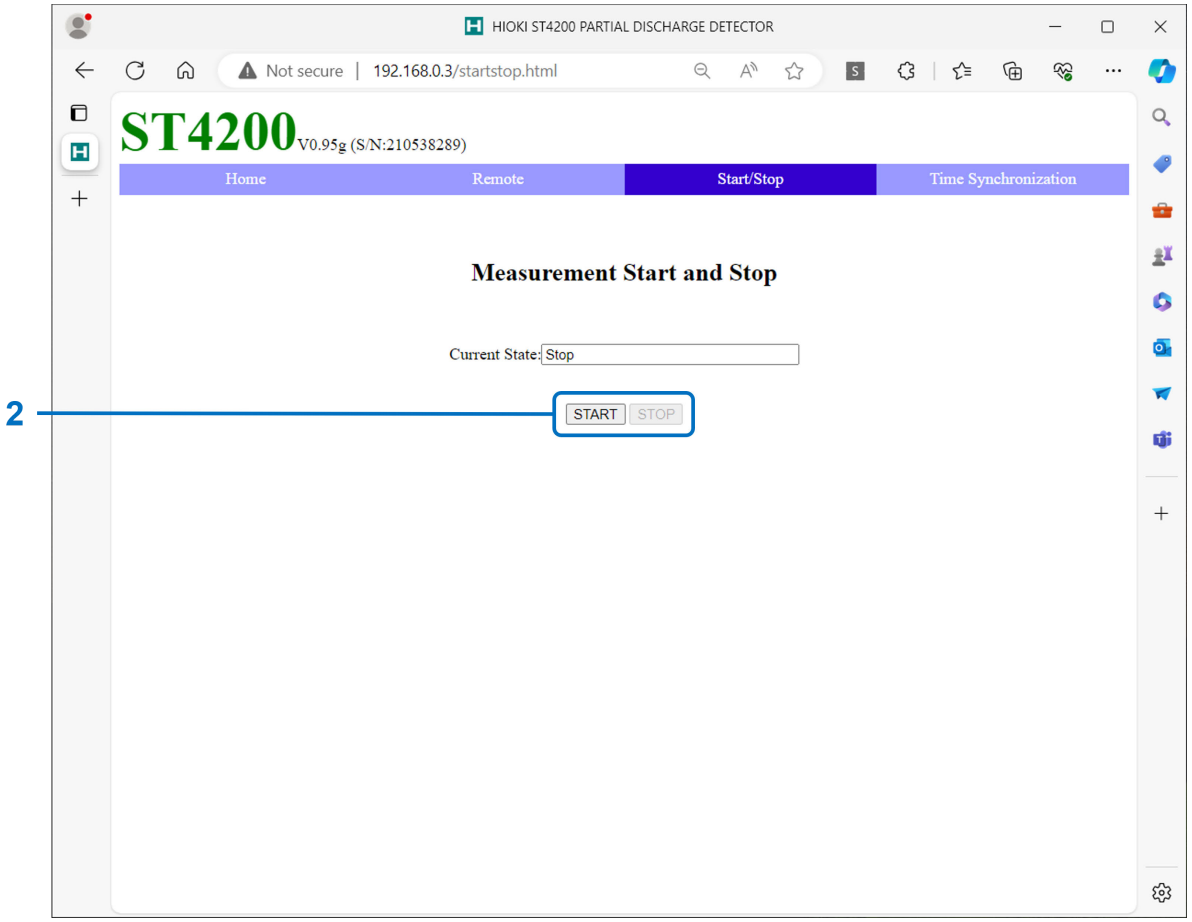
Starting/Stopping measurement

You can start and stop measurement.



1 **Click [Start/Stop] on the menu.**

The **[Measurement Start and Stop]** screen appears.



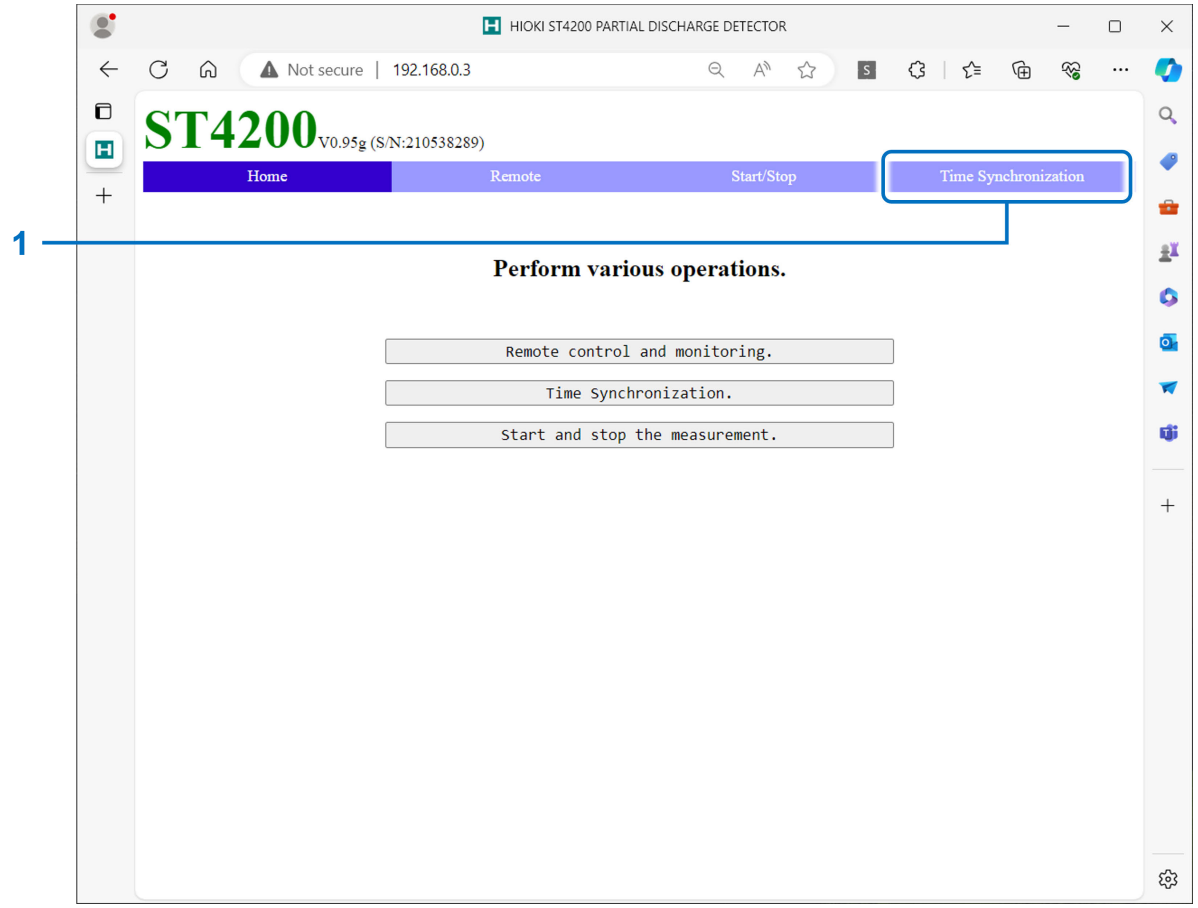
2 Choose an action.

START	Starts a measurement.
STOP	Stops the measurement.

No post-measurement processes such as numerical calculations and automatic saving are performed.

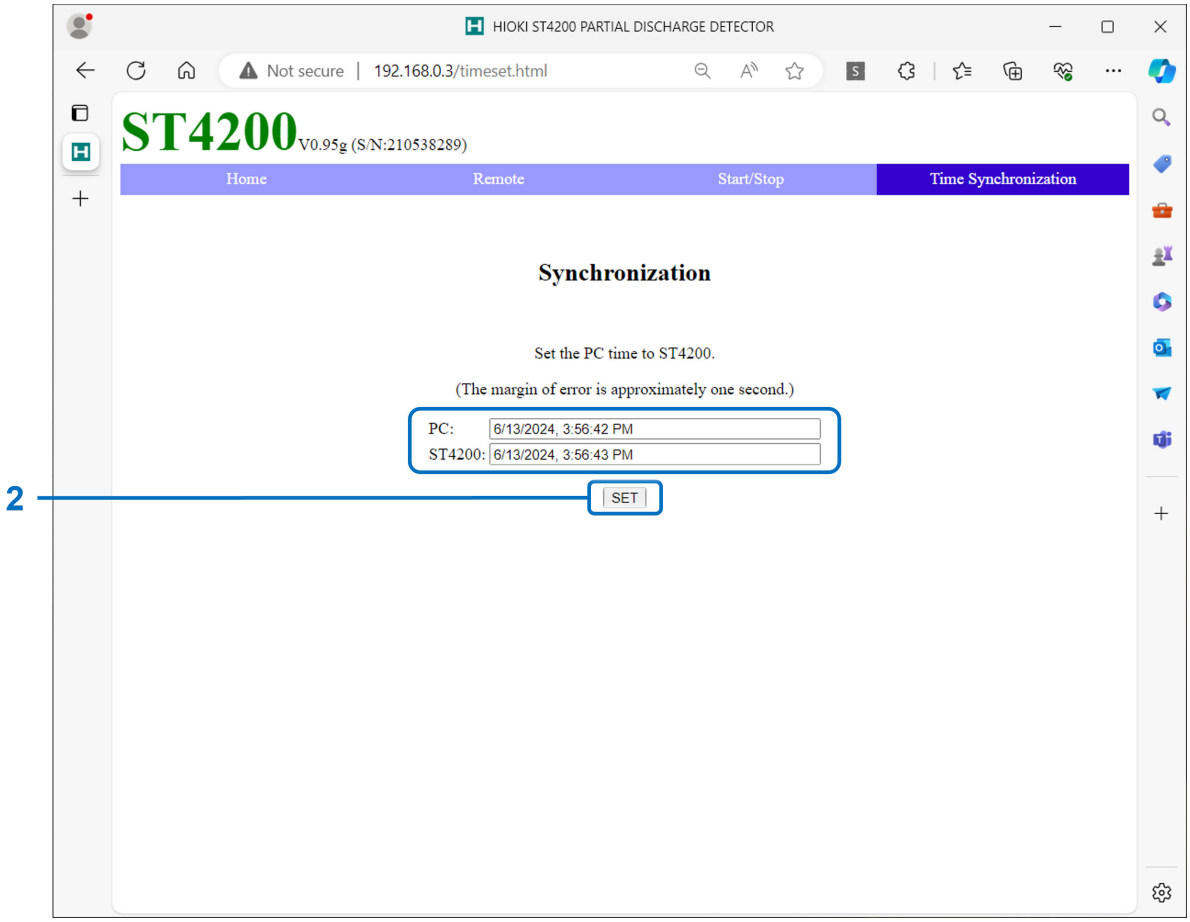
Setting the clock

The time of the clock on your computer can be set by that in the instrument. You cannot set the clock during measurement.



1 **Click [Time Synchronization] on the menu.**

The **[Synchronization]** screen appears, and the time of the clock on the computer and the ST4200 (instrument) appear.

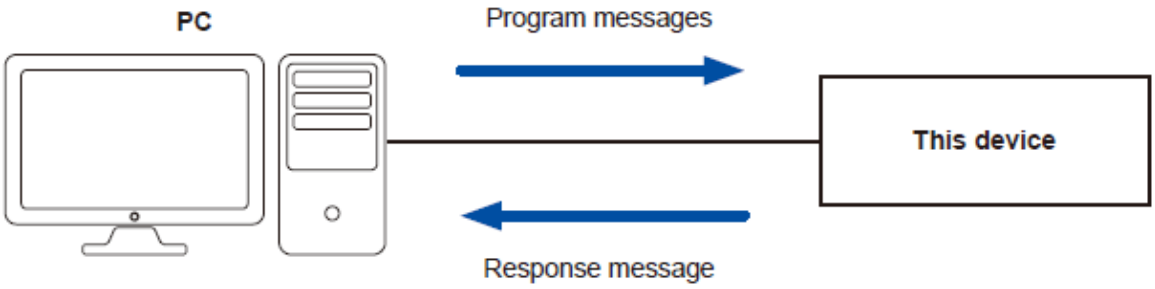


2 Click [SET].

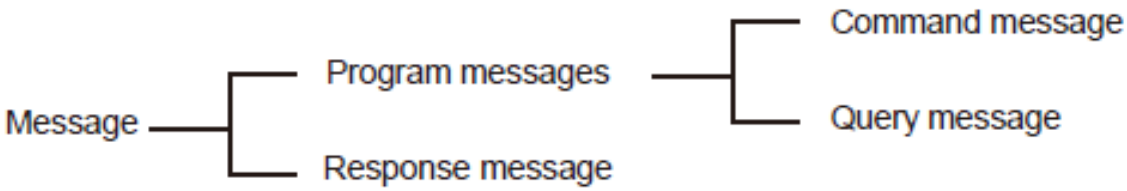
The time of the clock on the computer is set by that in the ST4200 (instrument). However, an error of one second may occur.

7.4 Communication Method

Various messages are provided for controlling the instrument via LAN interface. Messages include program messages sent from the computer to the instrument, and response messages sent from the instrument to the PC.



Messages are categorized as follows.



Message format

Program messages

Program messages can be divided into command messages and query messages.

Command messages

Commands for controlling instruments such as for configuring and resetting instruments

Format

[Header part] ␣ [Data part]

Example: Command to set the AC PD applied voltage
:ACPD:VOLTage 1000

Query messages

Commands for querying operation results, measurement results or the status of instrument settings

Format

[Header part] ?

Example: Command to query the AC PD applied voltage
:ACPD:VOLTage?

Response messages

These are created when a query message is received and the syntax has been checked.
If an error occurs when receiving a query message, no response message will be created for that query message.

Command syntax

Commands are written in the two following forms.

- Long form that can be associated with the function
- Abbreviated short form

In this document, the short form portion is written in upper case and the remainder in lower case. Both upper case and lower case are accepted.

Command text sent to the instrument	Content/description
:ACPD:THREsh:VALUe	Expression in this document
:ACPD:THRESH:VALUE	OK (long form)
:ACPD:THRE:VALU	OK (short form)
:ACPD:THRES:VALUE	Causes a command error.
:ACPD:THRE:VAL	Causes a command error.

Response messages from the instrument are returned in the long form in upper case.

Header part

Program messages require a header.

Command program header

There are three types as follows.

Command Type	Example	Description
Simple command-type header	**:PDKInd**	Header made up of one word starting with an alphabetical character
Compound command header	**:ACPD:BPF:UPPEr**	A header made up of multiple simple headers separated by a colon (:)
Simple command-type header	***RST**	A header starting with an (*)indicating that it is a common command (specified by IEEE 488.2)

Query command headers

This is used to query the status of settings of the instrument. As shown below, a query is recognized when a question mark (?) is placed after the program header.

Example:
:ACPD:SENSitivity?

Message terminators

The instrument accepts the following as message terminators(delimiter).
LF, **CR+LF**
The terminator for response messages is fixed as **CR+LF**.

Separators

Command program header

Multiple messages can be written on a single line by connecting them with a semicolon (;).

Example:
:ACPD:DATA:VAR? 01;QMAX

When messages are written in succession, if an error occurs midway, the message from there until the terminator is not executed.

Header separator

For messages with a header and data, the header part and the data part are separated using a space.

Example:
:ACPD:VLIMit 1000

Data separator

In messages containing multiple data items, a comma is required between data items.

Example:
:ACPD:DATA:SERies? 0,2

Data part

The instrument uses "text data" and "base 10 numerical data" in the data part and differentiates these by command.

Text data

Data that must start with an alphabetical character and is made up of alphabetical and numerical characters. Text data is accepted in both upper case and lower case, but responses from the instrument are always returned in upper case. There is a long form and a short form in the same way as command syntax, and both are accepted.

Example:
:PDMOde NORMal

Base 10 numerical data

Formats of numerical data include NR1 format, NR2 format and NR3 format. Both signed numerical values and unsigned numerical values are accepted for each of these. Unsigned numerical values are treated as positive numerical values. Numerical values after the decimal point that cannot be handled by the instrument are rounded up to the nearest whole number and input.

- NR1 Integer data (Examples: +12, –23, 34)
- NR2 Decimal data (Examples: +1.23, –23.45, 3.456)
- NR3 Floating point index representation data (Examples +1.0E-2, –2.3E+4)

The term "NRf format" incorporates all three of the formats above. The instrument accepts NRf format numerical values.

Response data is sent in the format specified for each command.

Example:
:ACPD:BPF:UPPEr 1000

Output queue and input buffer

Output queue

Response messages are stored in the output queue. The output queue is cleared in the following cases.

- When data is read with a controller
- When the power is turned on
- When a query error occurs

The buffer size of the instrument's output queue is 65536 bytes. When there is no remaining buffer space, query operations are suspended until a response message is received.

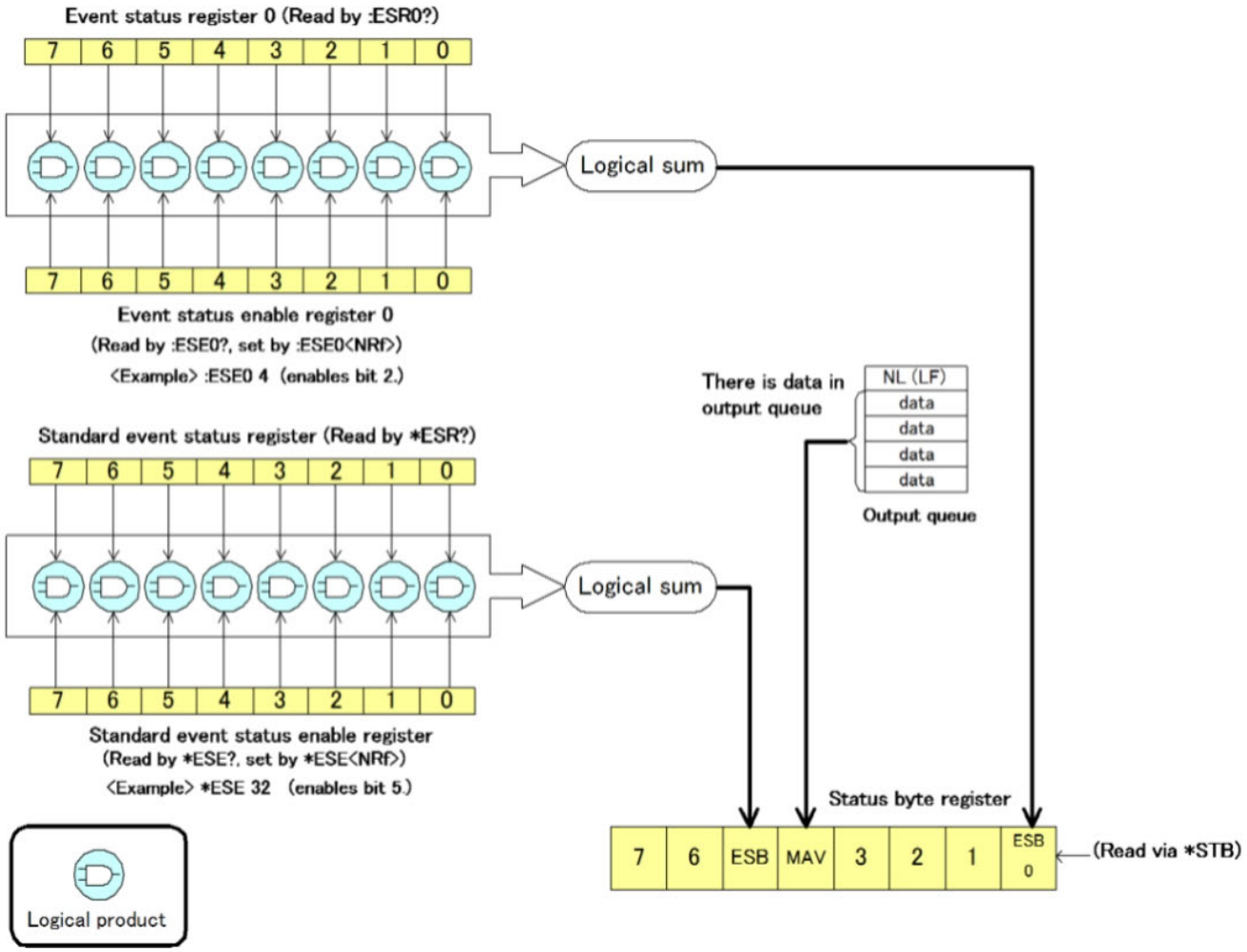
Input buffer

The instrument's buffer size is 4096 bytes. Messages received are input to this buffer and executed in sequence. When there is no free buffer space, operations are suspended until the space can be used.

However, they are executed when an **:ABORT** command is received.

Status system

The instrument's status system uses the status model specified by IEEE 488.2 as a reference.



Status Byte Register (STB)

The Status Byte Register (STB) is an 8-bit register that holds information from the event register and output queue.
The Status Byte Register (STB) is not cleared even when the ***STB?** query is executed.
It is cleared when the ***CLS** command is executed, but the ERR bit is not cleared when a instrument anomaly error occurs.

Each bit of the status byte is a summary (logical sum) of the event registry corresponding to that bit.

Bit number	Bit name	Description of function
Bit 7	-	Not used

Bit number	Bit name	Description of function
Bit 6	RQS MSS	Reserved
Bit 5	ESB	Standard event summary bit Represents the logical sum of the standard event status register. Cleared by ***ESR?**.
Bit 4	MAV	Message available Set to "1" when there is a message in the output queue.
Bit 3	-	Not used
Bit 2	-	Not used
Bit 1	-	Not used
Bit 0	ESB0	Event Summary Bit 0 This indicates the logical OR of event status register 0.

Use the following command for status byte reading.

Function	Command
Status byte reading	***STB?**

Standard Event Status Register (SESR)

The logical OR of this register is set to bit 5 of the status byte register.
The content of the Standard Event Status Register (SESR) is cleared in the following cases.

1. When the ***CLS** command is received
2. When the ***ESR?** query is read
3. When the power is turned on again

Bit number	Bit name	Description of function
Bit 7	PON	Power ON flag When the unit recovers from a power file since this register was last read. Becomes 1 when the power is turned ON.
Bit 6	URQ	Not used
Bit 5	CME	Command error There is an error with the command received. Syntax error, meaning error

Bit number	Bit name	Description of function
Bit 4	EXE	Execution error There is an error with the command being executed by the instrument. Range error, mode error
Bit 3	DDE	Not used
Bit 2	QYE	Query error Queue is empty, data is lost (queue overflow)
Bit 1	RQC	Not used
Bit 0	OPC	Operation complete This is set only when the ***OPC** command is executed.

The occurring events can be masked by the standard event status enable register (0 when the power is turned on).
Use the following commands for reading the standard event status register, and configuring and reading the standard event status enable register.

Function	Command
Reading of the Standard Event Status Register	***ESR?**
Setting of the Standard Event Status Register	***ESE**
Reading of the Standard Event Status Enable Register	***ESE?**

Event Status Register 0 (ESR0)

The logical OR of this register is set to bit 0 of the status byte register.
The content of Standard Event Status Register 0 is cleared in the following cases.

1. **When the *CLS command is received**
2. **When the *ESR0? query is read**
3. When the power is turned on again

Bit number	Description of function
Bit 7	Reserved
Bit 6	The judgment is FAIL
Bit 5	Reserved
Bit 4	Reserved

Bit number	Description of function
Bit 3	Reserved
Bit 2	Waiting for Trigger ends (Set when the triggered is activated)
Bit 1	START Processing ends (Reset when STOP is enabled)
Bit 0	Errors not related to the signal

The occurring events can be masked by the standard event status enable register (0 when the power is turned on).
Use the following commands for reading the standard event status register, and configuring and reading the standard event status enable register.

Function	Command
Reading of the Event Status Register 0	**:ESR0?**
Event Status Enable Register 0 settings	**:ESE0**
Reading of the Event Status Enable Register 0	**:ESE0?**

7.5 Message Reference

Common commands

Clear status byte register and related queues (except output queue)

*CLS

Syntax

Command

*CLS

Details

The Status Byte Register bits corresponding to the event status registers are also cleared.
The Status Byte Register is also cleared.

Example

*CLS

Read/Write the Standard Event Status Enable Register (SESER)

***ESE A**

Syntax

Command

***ESE A**

Query

***ESE?**

Response

A<NR1>

A = 0 to 255

Details

Sets the mask pattern for the Standard Event Status Enable Register (SESER).
Returns current Standard Event Status Enable Register (SESER) values.

Example

***ESE 36**
***ESE?**
(Response)**36**(When HEADER OFF)

Read and Clear Standard Event Status Register (SESR)

***ESR?**

Syntax

Query

***ESR?**

Response

A<NR1>

A = 0 to 255

Details

Returns current Standard Event Status Register (SESR) values and clears the register.

Example

***ESR?**

(Response)**0**(When HEADER OFF)

Querying device ID (identification code)

***IDN?**

Syntax

Query

***IDN?**

Response

A$,B$,C$,D$

Details

Queries the device ID.

A$ = Manufacturer name
B$ = Model name
C$ = Serial number
D$ = Software version

Example

***IDN?**
(Response)**HIOKI,ST4200,123456789,V1.00**(When HEADER OFF)

Set the OPC bit of the Standard Event Status Register (SESR) to 1 when finished all pending operations

***OPC**

Syntax

Command

***OPC**

Query

***OPC?**

Response

A<NR1>

Details

*Sets the Standard Event Status Register (SESR) OPC bit (bit 0) to 1 when all commands prior to the OPC command have finished processing.
*Responds with 1 when all commands prior to *OPC? have finished.

Example

***OPC**
***OPC?**
(Response)**1**(When HEADER OFF)

Initialize instrument

***RST**

Syntax

Command

***RST**

Details

Sets the instrument to defaults. However, communication settings and table saved data excluding for the current table do not change.

Reference: [List of Initial Settings] »

Example

***RST**

Read Status Byte Register (STB)

***STB?**

Syntax

Query

***STB?**

Response

A<NR1>

A = 0 to 255

Details

Returns current Status Byte Register (STB) values.

Example

***STB?**

(Response)**128**(When HEADER OFF)

Event status register

Read/Write Event Status Enable Register 0 (ESER0)

:ESE0 A

Syntax

Command

:ESE0 A

Query

:ESE0?

Response

A<NR1>

A = 0 to 255

Details

Sets the mask pattern for the Event Status Enable Register 0 (ESER0).
Returns the current Event Status Enable Register 0 (ESER0) values.

Example

:ESE0 64
:ESE0?
(Response)**64**(When HEADER OFF)

Read and Clear Event Status Register 0 (ESR0)

:ESR?

Syntax

Query

:ESR?

Response

A<NR1>

A = 0 to 255

Details

Returns current Event Status Register 0 (ESR0) values and clears the register.

Example

:ESR0?

(Response)**0**(When HEADER OFF)

Set Beep Sound

:SYSTem:BEEPer A$

Syntax

Command

:SYSTem:BEEPer A$

Query

:SYSTem:BEEPer?

Response

A$

A$ = OFF, ON1, ON2

Details

Sets the beep sound.

Returns current beep sound settings.

OFF

ON1 Alert

ON2 Alert + action

Example

:SYSTem:BEEPer ON2

:SYSTem:BEEPer?

(Response)**ON2**(When HEADER OFF)

Set and query decimal point

:SYSTem:DECPoint A$

Syntax

Command

:SYSTem:DECPoint A$

Query

:SYSTem:DECPoint?

Response

A$

A$ = DOT, COMMa

Details

Sets the decimal point.

Returns current decimal point settings.

DOT Period

COMMa Comma

Example

:SYSTem:DECPoint DOT

:SYSTem:DECPoint?

(Response)**DOT**(When HEADER OFF)

Set and query separators

:SYSTem:SEPArator A$

Syntax

Command

:SYSTem:SEPArator A$

Query

:SYSTem:SEPArator?

Response

A$

A$ = COMMa, SPACe, TAB, SEMI

Details

Sets the separators.

Returns current separator settings.

COMMa Comma

SPACe Space

TAB Tab

SEMI Semicolon

Example

:SYSTem:SEPArator COMMa

:SYSTem:SEPArator?

(Response)**COMMA**(When HEADER OFF)

Set and query the date

`:SYSTem:DATE A,B,C`

Syntax

Command

`:SYSTem:DATE A,B,C`

Query

`:SYSTem:DATE?`

Response

A<NR1>,B<NR1>,C<NR1>

A = 2000 to 2080 (year)

B = 1 to 12 (month)

C = 1 to 31 (day)

Details

Sets the date.

Returns the current date.

Example

:SYSTem:DATE 2023,1,2

:SYSTem:DATE?

(Response)**2023,1,2**(When HEADER OFF)

Set and query the time

:SYSTem:TIME A,B,C

Syntax

Command

:SYSTem:TIME A,B,C

Query

:SYSTem:TIME?

Response

A<NR1>,B<NR1>,C<NR1>

A = 0 to 23 (hours)

B = 0 to 59 (minutes)

C = 0 to 59 (seconds)

Details

Sets the time.

Returns the current time.

Example

:SYSTem:TIME 12,34,56

:SYSTem:TIME?

(Response)**12,34,56**(When HEADER OFF)

Set and query HEADER ON/OFF

:HEADer A$

Syntax

Command

:HEADer A$

Query

:HEADer?

Response

A$

A$ = ON, OFF

Details

Sets whether a query message response header is enabled.
Returns whether a query message response header is currently enabled.

Example

:HEADer ON
:HEADer?
(Response)**:HEADER ON**(When HEADER ON)

Table operation command

Select table to be used

:TABLe:SELect A

Syntax

Command

:TABLe:SELect A

Query

:TABLe:SELect?

Response

A<NR1>

A = 1 to 50

Details

Selects the table number of the table to be used.
Returns the table number of the currently selected table.

Example

:TABLe:SELect 7
:TABLe:SELect?
(Response)**7**(When HEADER OFF)

Initialize table

`:TABLe:INITialize`

Syntax

Command

`:TABLe:INITialize`

Details

Initializes all items for Normal mode and PDIV mode for the currently selected table.

Example

:TABLe:INITialize

Delete table

`:TABLe:DELete A`

Syntax

Command

`:TABLe:DELete A`

Details

Deletes the table specified by A.

A<NR1>

A = 1 to 50

Example

:TABLe:DELete 20

Note

A table currently selected cannot be deleted.

Set and query table name

:TABLe:NAME A,"B$"

Syntax

Command

:TABLe:NAME A,"B$"

Query

:TABLe:NAME? A

Response

B$

B$ = Table name (maximum 40 characters)

Details

Sets table name B to the table specified by A.

Also returns the table name for the table specified by A.

A<NR1>

A = 1 to 50

Example

:TABLe:NAME 7,"Sample name"

:TABLe:NAME? 7

(Response)**"Sample name"**(When HEADER OFF)

Copy table

`:TABLe:COPY A,B`

Syntax

Command

`:TABLe:COPY A,B`

Details

Copies the table specified by A to the table for B.

A<NR1>,B<NR1>

A = 1 to 50 (copy source)

B = 1 to 50 (copy destination)

Example

:TABLe:COPY 20,30

Execution control

Start measurement

`:STARt`

Syntax

Command

`:STARt`

Details

Starts measurement.

Example

:STARt

Stop measurement

`:STOP`

Syntax

Command

`:STOP`

Details

Stops measurement when calculation is finished.

Example

:STOP

Abort measurement

`:ABORt`

Syntax

Command

`:ABORt`

Details

Forcibly ends measurement.
Stops measurement even if calculation is not complete.

Example

:ABORt

Wait for measurement complete

`:FINish?`

Syntax

Query

`:FINish?`

Response

A<NR1>

Details

Returns 1 when measurement is complete.

Example

:FINish?

(Response)**1**(When HEADER OFF)

Note

With AC PD continuous measurement, a response is not returned until the **STOP** key is pressed.

Execute zero adjustment

`:UNIT:ADJust`

Syntax

Command

`:UNIT:ADJust`

Details

Executes zero adjustment on all channels and all ranges.
Execution of this command will take time.
To check completion of zero adjustment, wait for a response of 1 to be returned with
“**:UNIT:ADJust;*OPC?**.”

Example

:UNIT:ADJust

Types of measurement modes

Set and query measurement mode

:PDMOde A$

Syntax

Command

:PDMOde A$

Query

:PDMOde?

Response

A$

A$ = NORMal, PDIV

Details

Sets the measurement mode.
Returns the current measurement mode.

Example

:PDMOde PDIV
:PDMOde?
(Response)**PDIV**(When HEADER OFF)

Set and query type of PD to be measured

:PDKInd A$

Syntax

Command

:PDKInd A$

Query

:PDKInd?

Response

A$

A$ = AC, IMPulse

Details

Sets the type of PD to be measured.
Returns the current type of PD to be measured.

Example

:PDKInd AC
:PDKInd?
(Response)**AC**(When HEADER OFF)

Operation Settings

Set and query applied voltage (U)

`:ACPD:VOLTage A`

Syntax

Command

`:ACPD:VOLTage A`

Query

`:ACPD:VOLTage?`

Response

A<NR1>

A = 200 to Voltage Upper Limit [V] (3153)

A = 10 to Voltage Upper Limit [V] (TOS5200/TOS530x/TOS930x)

Details

Sets the applied voltage.

Returns the current applied voltage.

Example

:ACPD:VOLTage 1000

:ACPD:VOLTage?

(Response)**1000**(When HEADER OFF)

Set and query voltage upper limit (Ulimit)

:ACPD:VLIMit A

Syntax

Command

:ACPD:VLIMit A

Query

:ACPD:VLIMit?

Response

A<NR1>

A = 200 to 5000 [V] (3153)

A = 10 to 5000 [V] (TOS5200/TOS530x/TOS930x)

Details

Sets the voltage upper limit.

Returns the current voltage upper limit.

Example

:ACPD:VLIMit 4000

:ACPD:VLIMit?

(Response)**4000**(When HEADER OFF)

Set and query the voltage current limit (Ilimit)

:ACPD:ILIMit A

Syntax

Command

:ACPD:ILIMit A

Query

:ACPD:ILIMit?

Response

A<NR2>

A = 0.1 to 100.0 [mA]

Details

Sets the current upper limit.
Returns the current upper limit.

Example

:ACPD:ILIMit 10.5
:ACPD:ILIMit?
(Response)**10.5**(When HEADER OFF)

Set and query the voltage frequency (f)

:ACPD:FREQuency A

Syntax

Command

:ACPD:FREQuency A

Query

:ACPD:FREQuency?

Response

A<NR1>

A = 50, 60 [Hz]

Details

Sets the voltage frequency.
Returns the current voltage frequency.

Example

:ACPD:FREQuency 60
:ACPD:FREQuency?
(Response)**60**(When HEADER OFF)

Set and query the sampling time width (Tref)

:ACPD:TIME A

Syntax

Command

:ACPD:TIME A

Query

:ACPD:TIME?

Response

A<NR1>

A = 100 to 1000 [ms]

Details

Sets the sampling time width.
Returns the current sampling time width.

Example

:ACPD:TIME 500
:ACPD:TIME?
(Response)**500**(When HEADER OFF)

Set and query the PD axis scale (Sc)

:ACPD:SCALe A

Syntax

Command

:ACPD:SCALe A

Query

:ACPD:SCALe?

Response

A<NR1>

A = 10 to 5000 [pC]

Details

Sets the PD axis scale.
Returns the current PD axis scale.

Example

:ACPD:SCALe 100
:ACPD:SCALe?
(Response)**100**(When HEADER OFF)

Set and query measurement sensitivity (Qsen)

:ACPD:SENSitivity A

Syntax

Command

:ACPD:SENSitivity A

Query

:ACPD:SENSitivity?

Response

A<NR1>

A = 1, 2, 4, 10, 20, 40 [magnification]

Details

Sets the measurement sensitivity.
Returns the current measurement sensitivity.

Example

:ACPD:SENSitivity 40
:ACPD:SENSitivity?
(Response)**40**(When HEADER OFF)

Set and query the AC PD threshold value (Qth)

:ACPD:THREsh:VALUe A

Syntax

Command

:ACPD:THREsh:VALUe A

Query

:ACPD:THREsh:VALUe?

Response

A<NR3>

A = 10.00 to 5000.00 [pC]

Details

Sets the AC PD threshold value.
Returns the current AC PD threshold value.

Example

:ACPD:THREsh:VALUe 5000
:ACPD:THREsh:VALUe?
(Response)**005.000E+03**(When HEADER OFF)

Set and query Qmax evaluation rate (Er)

:ACPD:QRATe A

Syntax

Command

:ACPD:QRATe A

Query

:ACPD:QRATe?

Response

A<NR1>

A = 1 to 9999 [pps]

Details

Sets the Qmax evaluation rate.
Returns the current Qmax evaluation rate.

Example

:ACPD:QRATe 60
:ACPD:QRATe?
(Response)**60**(When HEADER OFF)

Set and query low cutoff frequency (fL)

:ACPD:BPF:LOWEr A

Syntax

Command

:ACPD:BPF:LOWEr A

Query

:ACPD:BPF:LOWEr?

Response

A<NR1>

A = 30 to 900 [Hz]

Details

Sets the low cutoff frequency.
Returns the current low cutoff frequency.

Example

:ACPD:BPF:LOWEr 100
:ACPD:BPF:LOWEr?
(Response)**100**(When HEADER OFF)

Set and query high cutoff frequency (fH)

:ACPD:BPF:UPPEr A

Syntax

Command

:ACPD:BPF:UPPEr A

Query

:ACPD:BPF:UPPEr?

Response

A<NR1>

A = 130 to 1000 [Hz]

Details

Sets the high cutoff frequency.
Returns the current high cutoff frequency.

Example

:ACPD:BPF:UPPEr 900
:ACPD:BPF:UPPEr?
(Response)**900**(When HEADER OFF)

Set and query the band pass filter setting mode

:ACPD:BPF:MODE

Syntax

Command

:ACPD:BPF:MODE

Query

:ACPD:BPF:MODE?

Response

A$

A$ = OFF, ON

Details

Sets the band pass filter setting mode.
Returns the current band pass filter setting mode.

Example

:ACPD:BPF:MODE ON
:ACPD:BPF:MODE?
(Response)**ON**(When HEADER OFF)

Note

Do not apply voltage from an AC power supply during measurements when the band pass filter setting mode is ON.

Set and query trigger mode (repeat)

:ACPD:REPEat A$

Syntax

Command

:ACPD:REPEat A$

Query

:ACPD:REPEat?

Response

A$

A$ = ON, OFF

Details

Sets the trigger mode (repeat).
Returns the current trigger mode (repeat).
OFF is "Single", ON is "Repeat".

Example

:ACPD:REPEat ON
:ACPD:REPEat?
(Response)**ON**(When HEADER OFF)

Set and query starting voltage (Us)

:ACPD:VSTArt A

Syntax

Command

:ACPD:VSTArt A

Query

:ACPD:VSTArt?

Response

A<NR1>

A = 1 to 99 [%]

Details

Sets the starting voltage.
Returns the current starting voltage.

Example

:ACPD:VSTArt 50
:ACPD:VSTArt?
(Response)**50**(When HEADER OFF)

Note

Cannot be set with 3153, TOS5200 and TOS530x.

Set and query maximum test voltage value (Umax)

:ACPD:RAMP:VOLTage A

Syntax

Command

:ACPD:RAMP:VOLTage A

Query

:ACPD:RAMP:VOLTage?

Response

A<NR1>

A = 200 to Voltage Upper Limit [V] (3153)

A = 10 to Voltage Upper Limit [V] (TOS5200/TOS530x/TOS930x)

Details

Sets the maximum test voltage value.

Returns the current maximum test voltage value.

Example

:ACPD:VSTArt 2000

:ACPD:VSTArt?

(Response)**2000**(When HEADER OFF)

Set and query ramp up time (Tru)

:ACPD:RAMP:UP A

Syntax

Command

:ACPD:RAMP:UP A

Query

:ACPD:RAMP:UP?

Response

A<NR2>

A = 0.1 to 99.9 [s]

Details

Sets the ramp up time.
Returns the current ramp up time.

Example

:ACPD:RAMP:UP 20
:ACPD:RAMP:UP?
(Response)**20.0**(When HEADER OFF)

Set and query ramp down time (Trd)

:ACPD:RAMP:DOWN A

Syntax

Command

:ACPD:RAMP:DOWN A

Query

:ACPD:RAMP:DOWN?

Response

A<NR2>

A = 0.1 to 99.9 [s]

Details

Sets the ramp down time.
Returns the current ramp down time.

Example

:ACPD:RAMP:DOWN 30
:ACPD:RAMP:DOWN?
(Response)**30.0**(When HEADER OFF)

Set and query maximum voltage holding time (Trk)

:ACPD:RAMP:KEEP A

Syntax

Command

:ACPD:RAMP:KEEP A

Query

:ACPD:RAMP:KEEP?

Response

A<NR2>

A = 0.1 to 99.9 [s]

Details

Sets the maximum voltage holding time.
Returns the current maximum voltage holding time.

Example

:ACPD:RAMP:KEEP 40
:ACPD:RAMP:KEEP?
(Response)**40.0**(When HEADER OFF)

Set and query PDIV measurement stop condition

`:ACPD:PDIV:STOP A$`

Syntax

Command

`:ACPD:PDIV:STOP A$`

Query

`:ACPD:PDIV:STOP?`

Response

A$

A$ = OFF, UI, UMAX, UE

Details

Sets the condition to stop the PDIV measurement in progress.
OFF:Do not stop measurement in progress
UI:Stop when Ui is recorded while raising the voltage
UMAX:Stop when the voltage is raised to the maximum voltage
UE:Stop when Ue is recorded while lowering the voltage

Example

:ACPD:PDIV:STOP UI
:ACPD:PDIV:STOP?
(Response)**UI**(When HEADER OFF)

Set and query stop with FAIL judgment

:ACPD:JUDGe:STOP A$

Syntax

Command

:ACPD:JUDGe:STOP A$

Query

:ACPD:JUDGe:STOP?

Response

A$

A$ = OFF, ON

Details

Sets whether to stop the measurement when a FAIL judgment occurs.
OFF:Do not stop
ON:Stop

Example

:ACPD:JUDGE:STOP ON
:ACPD:JUDGE:STOP?
(Response)**ON**(When HEADER OFF)

Set and query FAIL condition during PDIV voltage judgment

:ACPD:JUDGe:VFAil A$

Syntax

Command

:ACPD:JUDGe:VFAil A$

Query

:ACPD:JUDGe:VFAil?

Response

A$

A$ = OVER, UNDer

Details

Sets the FAIL condition in a Ui and Ue judgment.
OVER:FAIL at setting value or more
UNDer:FAIL at less than setting value

Example

:ACPD:JUDGE:VFAIL UNDER
:ACPD:JUDGE:VFAIL?
(Response)**UNDER**(When HEADER OFF)

Set and query charge value

:ACPD:CAL:CHARge A

Syntax

Command

:ACPD:CAL:CHARge A

Query

:ACPD:CAL:CHARge?

Response

A<NR1>

A = 10 to 5000 [pC]

Details

Sets the charge value.
Returns the current charge value.

Example

:ACPD:CAL:CHARge 5000
:ACPD:CAL:CHARge?
(Response)**5000**(When HEADER OFF)

Execute calibration

:ACPD:CAL:EXECute?

Syntax

Query

:ACPD:CAL:EXECute?

Response

A$

A$ = PASS, FAIL

Details

Return the calibration execute result.

Example

:ACPD:CAL:EXECute?

(Response)**PASS**(When HEADER OFF)

Set and query calibration rate

`:ACPD:CAL:RATE?`

Syntax

Query

`:ACPD:CAL:RATE?`

Response

`A<NR3>`

Details

Returns the calibration rate.

Example

:ACPD:CAL:RATE?

(Response)**100.000E+00**(When HEADER OFF)

Set and query calibration results

`:ACPD:CAL:RESult A$`

Syntax

Command

`:ACPD:CAL:RESult A$`

Query

`:ACPD:CAL:RESult?`

Response

A$

A$ = NONE, PASS, FAIL

Details

Sets the calibration results.
Returns the current calibration results.

Example

:ACPD:CAL:RESult NONE
:ACPD:CAL:RESult?
(Response)**NONE**(When HEADER OFF)

Set and query the vernier correction rate

:ACPD:VERNier A

Syntax

Command

:ACPD:VERNier A

Query

:ACPD:VERNier?

Response

A<NR2>

Details

Sets the vernier correction rate.
Returns the current vernier correction rate.

Example

:ACPD:VERNier 1.2
:ACPD:VERNier?
(Response)**1.200**(When HEADER OFF)

Set and query judgment function ON/OFF

`:ACPD:JUDGe:A$ B$`

Syntax

Command

`:ACPD:JUDGe:A$ B$`

Query

`:ACPD:JUDGe:A$?`

Response

B$

B$ = ON, OFF

Details

Sets whether a PASS/FAIL judgment is used for measurement parameters specified in the first argument A.
Specifies ON/OFF in the second argument B.

First argument A$	Parameters for judgment
QMAX	Qmax
M	m
MP	m+
MM	m-
N	n
P	P
D	D
I	I
PDIV	Ui
PDEV	Ue

Example

:ACPD:JUDGe:QMAX ON
:ACPD:JUDGe:QMAX?
(Response)**ON**(When HEADER OFF)

Set judgment threshold

`:ACPD:JLEVel:A$ B`

Syntax

Command

`:ACPD:JLEVel:A$ B`

Query

`:ACPD:JLEVel:A$?`

Response

B<NR3>

Details

Sets judgment threshold settings for measurement parameters specified in the first argument A$.
Specifies threshold values in the second argument B.

First argument A$	Parameters for setting threshold
QMAX	Qmax
M	m
MP	m+
MM	m-
N	n
P	P
D	D
I	I
PDIV	Ui
PDEV	Ue

Example

:ACPD:JLEVel:M 100
:ACPD:JLEVel:M?
(Response)**100.000E+00**(When HEADER OFF)

Set and query noise level check function

:ACPD:NOISe A$

Syntax

Command

:ACPD:NOISe A$

Query

:ACPD:NOISe?

Response

A$

A$ = OFF, ON

Details

Sets the noise level check function.

Example

:ACPD:NOISE ON
:ACPD:NOISE?
(Response)**ON**(When HEADER OFF)

Note

The noise level check function cannot be turned ON when the BPF setting mode is ON.

Acquire the measurement count

`:ACPD:DATA:COUNT?`

Syntax

Query

`:ACPD:DATA:COUNT?`

Response

A<NR1>

Details

Acquires the measurement count for current measured data.

Example

:ACPD:DATA:COUNT?

(Response)**45**(When HEADER OFF)

Acquire measurement results and judgment results

:ACPD:DATA:VARious? A,B$

Syntax

Query

:ACPD:DATA:VARious? A,B$

Response

See the following explanation.

Details

Specifies the measurement count in the first argument A, and the item in the second argument B$, then acquires the measured values and judgment results.
The relationship between the second argument B and the response results is shown below.

Measurement item name	Second argument B$	Response results C
Date measured	**DATE**	**"YYYY/MM/DD HH:MM:SS.SSS"** (Example)**"2023/01/23 09:32:02.517"**
Test voltage	**VOLT**	Returns Urms, Upk+ and Upk- values in **<NR1>, <NR1>, <NR1>** (unit: [V]) format.
Voltage frequency	**FREQ**	**<NR2>** (Unit: [Hz])
PD charge and judgment result	**QMAX**	**<NR2>, PASS/FAIL/OVER/NONE** (Unit: [pC])
PD threshold value	**QTH**	**<NR2>** (Unit: [pC])
PD charge peak	**QPK**	**<NR2>** (Unit: [pC])
Number of PD and judgment result	**M**	**<NR1>, PASS/FAIL/OVER/NONE** (Unit: N/A)
Positive number of PD and judgment result	**MP**	**<NR1>, PASS/FAIL/OVER/NONE** (Unit: N/A)
Negative number of PD and judgment result	**MM**	**<NR1>, PASS/FAIL/OVER/NONE** (Unit: N/A)
PD occurrence rate and judgment result	**N**	**<NR1>, PASS/FAIL/OVER/NONE** (Unit: [pps])

Measurement item name	Second argument B$	Response results C
Average discharge current and judgment result	**I**	**<NR3>, PASS/FAIL/OVER/NONE** (Unit: [A])
Discharge power and judgment result	**P**	**<NR3>, PASS/FAIL/OVER/NONE** (Unit: [W])
Quadratic rate and judgment result	**D**	**<NR3>, PASS/FAIL/OVER/NONE** (Unit: [C^2/s])
Overall judgment result	**JUDGE**	**PASS/FAIL/OVER/NONE**

Example

:ACPD:DATA:VARious? 22,QMAX
(Response)**102.46,FAIL**(When HEADER OFF)

Acquire series data

`:ACPD:DATA:SERies? A,B`

Syntax

Query

`:ACPD:DATA:SERies? A,B`

Response

C<NR2>,D<NR2>,E<NR1>,F<NR1>

C = Apparent charge time position [s]
D = Apparent charge [pC]
E = Instantaneous voltage [V]
F = Voltage phase [°]

Details

Acquires series data already measured.
Specifies the measurement number (acquires the latest data if 0 is specified) in the first argument A, and the pulse number in the second argument B.

Example

:ACPD:DATA:SERies? 0,2
(Response)**0.00582409, -27.05,251.15**(When HEADER OFF)

Acquire PDIV data

:ACPD:DATA:PDIV?

Syntax

Query

:ACPD:DATA:PDIV?

Response

C<NR1>,D$,E<NR1>,F$,G$

C = PD inception voltage Ui [V]
D$ = PDIV judgment result PASS/FAIL/OVER/NONE
E = PD extinction voltage Ue [V]
F$ = PDEV judgment result PASS/FAIL/OVER/NONE
G$ = Overall judgment result PASS/FAIL/OVER/NONE

Details

Acquires PDIV data already measured and the judgment result.

Example

:ACPD:DATA:PDIV?
(Response)**114,PASS,569,FAIL,FAIL**(When HEADER OFF)

Save data settings

Set and query automatic saving for data series

`:SAVe:SERies:AUTo A$`

Syntax

Command

`:SAVe:SERies:AUTo A$`

Query

`:SAVe:SERies:AUTo?`

Response

A$

A$ = OFF, ON

Details

Sets automatic saving for data series.

Example

:SAVE:SERIES:AUTO ON

:SAVE:SERIES:AUTO?

(Response)**ON**(When HEADER OFF)

Set and query manual saving for data series

:SAVe:SERies:MANu A$

Syntax

Command

:SAVe:SERies:MANu A$

Query

:SAVe:SERies:MANu?

Response

A$

A$ = OFF, ON

Details

Sets manual saving for data series.

Example

:SAVE:SERIES:MANU ON

:SAVE:SERIES:MANU?

(Response)**ON**(When HEADER OFF)

Set and query manual saving for realtime waveform images

:SAVe:WAVe:MANu A$

Syntax

Command

:SAVe:WAVe:MANu A$

Query

:SAVe:WAVe:MANu?

Response

A$

A$ = OFF, ON

Details

Sets manual saving for realtime waveform images.

Example

:SAVE:WAVE:MANU ON
:SAVE:WAVE:MANU?
(Response)**ON**(When HEADER OFF)

Set and query format for realtime waveform images

:SAVe:WAVe:FORMat A$

Syntax

Command

:SAVe:WAVe:FORMat A$

Query

:SAVe:WAVe:FORMat?

Response

A$

A$ = BMP, PNG, JPEG

Details

Sets the format for realtime waveform images.

Example

:SAVE:WAVE:FORMAT PNG
:SAVE:WAVE:FORMAT?
(Response)**PNG**(When HEADER OFF)

Set and query automatic saving for Q=f(U) graph images

:SAVe:QFU:AUTo A$

Syntax

Command

:SAVe:QFU:AUTo A$

Query

:SAVe:QFU:AUTo?

Response

A$

A$ = OFF, ON

Details

Sets automatic saving for Q=f(U) graph images.

Example

:SAVE:QFU:AUTO ON
:SAVE:QFU:AUTO?
(Response)**ON**(When HEADER OFF)

Set and query manual saving for Q=f(U) graph images

:SAVe:QFU:MANu A$

Syntax

Command

:SAVe:QFU:MANu A$

Query

:SAVe:QFU:MANu?

Response

A$

A$ = OFF, ON

Details

Sets manual saving for Q=f(U) graph images.

Example

:SAVE:QFU:MANU ON
:SAVE:QFU:MANU?
(Response)**ON**(When HEADER OFF)

Set and query format for Q=f(U) graph

:SAVe:QFU:FORMat A$

Syntax

Command

:SAVe:QFU:FORMat A$

Query

:SAVe:QFU:FORMat?

Response

A$

A$ = BMP, PNG, JPEG, CSV

Details

Sets the format for Q=f(U) graph images.

Example

:SAVE:QFU:FORMAT JPEG

:SAVE:QFU:FORMAT?

(Response)**JPEG**(When HEADER OFF)

Set and query automatic saving for SBS graph images

:SAVe:SBS:AUTo A$

Syntax

Command

:SAVe:SBS:AUTo A$

Query

:SAVe:SBS:AUTo?

Response

A$

A$ = OFF, ON

Details

Sets automatic saving for SBS graph images.

Example

:SAVE:SBS:AUTO ON
:SAVE:SBS:AUTO?
(Response)**ON**(When HEADER OFF)

Set and query saving destination media

:SAVe:MEDia A$

Syntax

Command

:SAVe:MEDia A$

Query

:SAVe:MEDia?

Response

A$

A$ = SSD, SD, USB1 to USB23

Details

Sets the saving destination media.

Example

:SAVE:MEDIA USB1
:SAVE:MEDIA?
(Response)**USB1**(When HEADER OFF)

Set and query the save folder

`:SAVe:FOLDer "A$"`

Syntax

Command

`:SAVe:FOLDer "A$"`

Query

`:SAVe:FOLDer?`

Response

"A$"

A$ = Folder name

Details

Sets the name of the folder to save.

Example

:SAVE:FOLDER "MOTOR"
:SAVE:FOLDER?
(Response)**"MOTER"**(When HEADER OFF)

Set and query the save file name

:SAVe:NAME "A$"

Syntax

Command

:SAVe:NAME "A$"

Query

:SAVe:NAME?

Response

"A$"

A$ = File name

Details

Sets the name of the file to save.

Example

:SAVE:NAME "TEST"
:SAVE:NAME?
(Response)**"TEST"**(When HEADER OFF)

Commands to control external devices

AC power control

`:A command`

Syntax

Command

`:A command`

Query

`:A command?`

Details

Send and receive commands to the AC power source connected to the ST4200.
Enter commands into **command** to control the AC power source.
If a command has a **?** , it will get a response from the AC source.
Some devices might not use a **?** even if they expect a response.
In that case, send **:A ?** after the initial command to get the answer.

Example

:A *RST (AC power reset)
:A *IDN? (Query about AC power supply identification code)
(Response)HIOKI,3153,0,V2.01

SW2001 HV Multiplexer control

`:R command`

Syntax

Command

`:R command`

Query

`:R command?`

Details

Send and receive commands to the SW2001 connected to the ST4200.
Enter your commands into **command** to control the SW2001.
If a command contains a **?** , it will retrieve a response from the SW2001.

Example

:R *RST (SW2001 reset)
:R *IDN? (Query about SW2001 identification code)
(Response)HIOKI,SW2001-24,230241007,V1.00

Other commands

Update screen

`:DISPlay:UPDAte`

Syntax

Command

`:DISPlay:UPDAte`

Details

Updates the screen.

Example

:DISPlay:UPDAte

Set and query the character code used for communication

:INTErface:TXTCode

Syntax

Command

:INTErface:TXTCode

Query

:INTErface:TXTCode?

Response

A$

A$ = character code (AUTO/SJIS/UTF8)

Details

Set the character code use for communication.
Returns the character code used in the current communication.
When set to AUTO, SJIS is used if the ST4200 display language is Japanese, and UTF8 is used if it is other than Japanese.

Example

:INTErface:TXTCode UTF8
:INTErface:TXTCode?
(Response)**UTF8**

8 Maintenance and Service

8.1 Maintenance and Service

⚠ WARNING

Touching any of the high-voltage points inside the instrument is very dangerous.
Do not attempt to modify, disassemble, or repair the instrument. Doing so may cause a fire, electric shock, or injury.

Backing up the data

The instrument may be initialized (returned to the factory default settings) when it is repaired. Before you ask for repairs, it is recommended to back up (save or record) the measurement conditions and measured data.

Precautions During Shipment

⚠ CAUTION

Be sure to observe the following precautions: *To avoid damage to the instrument, remove any accessories and optional equipment from the instrument. Use the original packing materials the instrument was shipped in and be sure to use double packaging. Damage during transportation is not covered by warranty. *When requesting repairs, be sure to include a memo that describes the problem in detail.

Replaceable parts and operating lifetimes

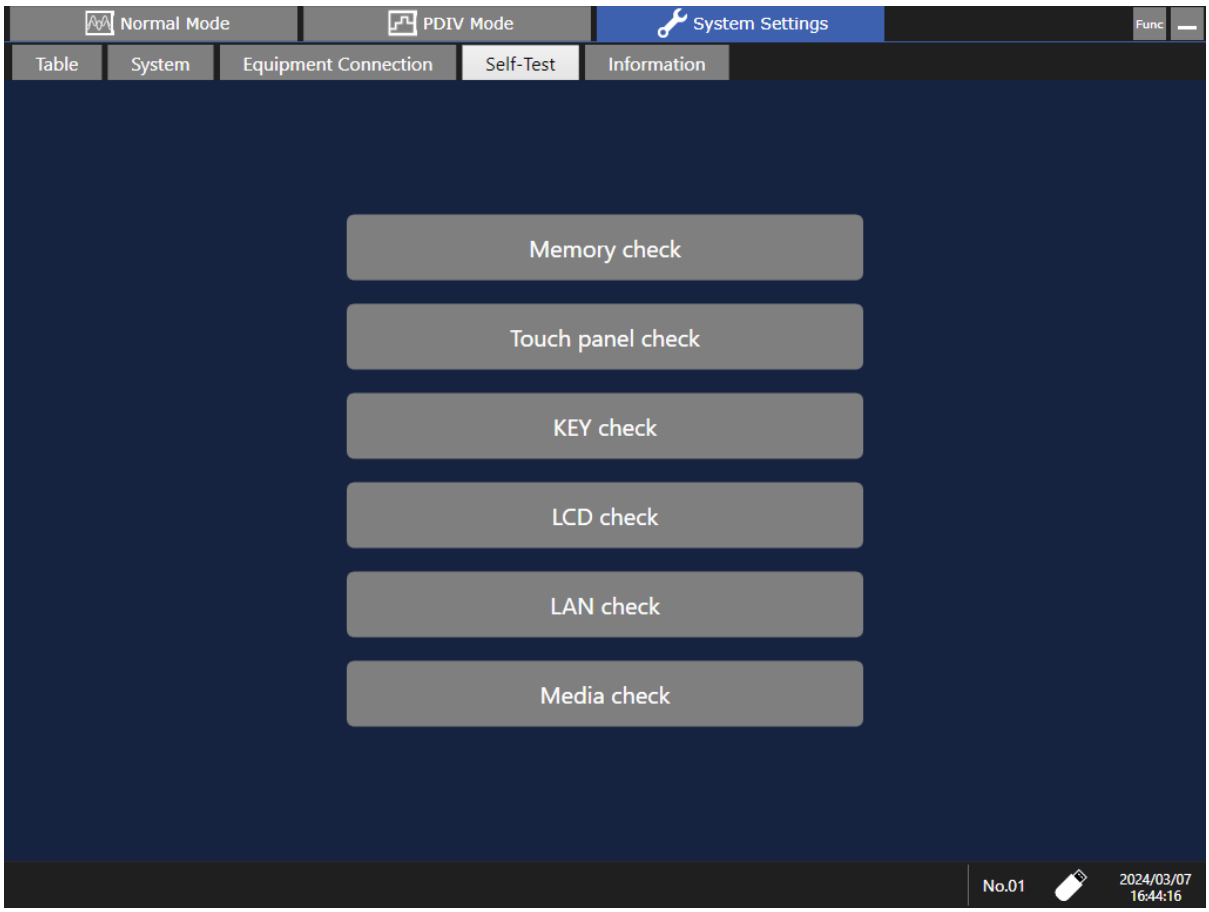
The characteristics of some of the parts used in the instrument may deteriorate with extended use.
To ensure the instrument can be used over the long term, it is recommended to replace these parts on a periodic basis.
When replacing batteries, please contact your authorized Hioki distributor or reseller.
The service life of parts varies with the operating environment and frequency of use. These parts are not guaranteed to operate throughout the recommended replacement cycle.

Part name	Recommended replacement cycle	Remarks/conditions
Fan motor	Approx. 5 years	-
LCD (Backlight) (Half-life of brightness)	Approx. 80,000 hours	At an ambient temperature of 25°C The service life varies significantly depending on the ambient environment. In particular, the service life reduces in an environment containing sulfur and halogen, and high temperature environment.
SSD Unit U8332	Approx. 1400 hours (If written to repeatedly)	At an ambient temperature of 25°C TBW (Total Byte Written): Approx. 300 TB Data retention period: About one year (When the instrument is turned off) Data backup at regular intervals is recommended.
Electrolytic capacitors	Approx. 10 years	Printed circuit boards that include this component must be replaced. Deteriorates in approx. 10 years when the instrument is used in a severe environment (at an ambient temperature of 40°C (104°F)).
Lithium battery	Approx. 10 years	The instrument contains built-in backup lithium batteries, which offer a service life of about 10 years. If the date and time deviate substantially at power-on, it is the time to replace that battery. Contact your authorized Hioki distributor or reseller.

The fuse is housed in the power unit of the instrument. If the instrument is not powered on, the fuse may be blown. Customers cannot replace or repair this themselves. Contact your authorized Hioki distributor or reseller.

8.2 Self-check

Executing the self-check function checks the instrument for malfunctions.
Tap **[System Settings]** > **[Self-Test]**.



The self-check consists of the following checks:

Memory check

This function checks the storage memory and backup memory (SRAM memory).

IMPORTANT

- Save measurement data in a storage device before performing the memory check. Any measurement data will be deleted after the memory check.
- Do not turn off the instrument during the memory check.

1 **Tap [Memory check].**

2 **Tap [Execute].**

The memory check starts.

Tips

To stop the memory check, press the STOP key to interrupt the memory check. Pressing the operation keys other than the **STOP** key is ignored.

The judgment results are displayed once the memory check has been complete.

Results display	Result description
PASS	The instrument has passed the check.
FAIL	The instrument has failed the check. Request repairs.
Abort	One of the checks was aborted.

Touch panel check

This check tests the touch panel for proper operation.

1 **Tap [Touch panel check].**

The sides to be checked go white.

2 **Place your finger on a mark on the edge of a side and drag the side to the other mark on the side. When the mark on the other side changes to [✓], release your finger.**

The screen displays the judgment result after all of the marks have changed to a check mark.

Results display	Result description
PASS	The instrument has passed the check.
FAIL	The instrument has failed the check. Request repairs.

Key check

This check tests the keys and rotary knobs for proper operation.

1 **Tap [KEY check].**

2 **Press each operation key one or more times.**

The corresponding key is highlighted.

3 **Turn the rotary knob clockwise and counterclockwise one or more times each.**

Operating all of the keys completes the check.

Tips

To cancel the key check:
Tapping [Close] redisplays the previous screen.

LCD check

This check tests the display for proper operation.

1 **Tap [LCD check].**

The screen becomes uniformly red.

2 **Tap the screen or press any key to check the display state.**

Every operation changes the screen in the following order, eventually redisplay the original screen.
Red → green → blue → black → white

LAN check

This check tests the LAN cable for malfunction such as disconnection.

1 **Tap [LAN check].**

2 **Set an IP address used for connecting to the LAN in the [Address] box.**

3 **Tap [Start].**

4 **Check the transmission/reception result on the screen.**

5 **Tap [Close].**

Media check

This check tests the storage devices for malfunction.

1 **Tap [Media check].**

2 **Tap the [Media] box and select a storage device from the list.**

The screen displays the information of the selected storage device.

3 **Tap [Read/Write check].**

The read/write check starts.

4 **Check the transmission/reception result on the screen.**

5 **Tap [Close].**

8.3 Cleaning the Instrument

⚠ CAUTION

- To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketone, thinners or gasoline. Doing so could deform and discolor the instrument.
- Clean the air vents periodically to avoid blockage. When the vents get clogged, the instrument's internal cooling effect is hampered, and this can lead to damage to the instrument.

Wipe the LCD gently with a soft, dry cloth.

8.4 Troubleshooting

See "Before Requesting Repairs" if you think there is a problem. If this does not help you resolve your problem, contact your authorized Hioki distributor or reseller.

Before requesting repairs

If the power or operating keys does not operate properly

Condition	Cause	Solution	Reference
Nothing appears on the screen even if you turn on the power.	• The power cord is disconnected. • The power cord is not connected properly.	Connect the power cord properly.	Supplying Power to the Instrument
The instrument does not operate even if you press the keys.	Some key is being held down.	Check if a key is stuck.	-
The instrument does not operate even if you press the keys.	The key lock is engaged.	Disengage the key lock.	Key lock

If the instrument cannot save any data

Condition	Cause	Solution	Reference
The instrument cannot save any data on a storage device including an SD card.	You are not using Hioki's optional SD memory card.	Use Hioki's optional SD card.	Options (Sold separately)
The instrument cannot save any data on a storage device including an SD card.	The storage device does not have sufficient free space.	Initialize or replace the storage device.	-
The instrument cannot save any data on a storage device including an SD card.	The storage device is not properly inserted.	Properly insert the storage device.	-
The instrument cannot save any data on a storage device including an SD card.	The storage device has not been formatted.	Format the storage device before initial use.	-
The instrument cannot save any data on a storage device including an SD card.	The number of files in the folder has reached 5,000.	Up to 5000 files can be saved in a folder. If you would like to create more files, adjust the quantity.	-

If measurement is not possible

Condition	Cause	Solution	Reference
AC PD measurement is not possible.	• The measurement cable is not connected. • The measurement cable is not connected properly.	Connect the power cord properly.	Connecting Connection Cables
AC PD measurement is not possible.	The AC PD sensor (ST9200) has failed.	Inspect the AC PD sensor (ST9200).	Inspecting the AC PD Sensor

It is presumed that normal mode AC PD measurement has been normal so far.
The AC PD sensor or the AC VOLTAGE sensor part of the AC partial discharge sensor (ST9200) may be malfunctioning.

Perform the following inspections.
AC PD sensor inspection:

1 **Tap [AC PD] > [Calibration].**

The Calibration screen will be displayed.

2 **Check [Calibration Rate].**

3 **Execute calibration again for the same object under measurement.**

See: Calibration

4 **Check the [Calibration Rate].**

Compare the **[Calibration Rate]** in step 2 with the **[Calibration Rate]** in step 4.

5 **Check that the [Calibration Rate] fluctuation width is 10% or less than the previous time.**

If 10% or less, there will be no issues with the AC PD sensor part of the AC PD sensor.
If not, contact your authorized Hioki distributor or reseller.

6 **Tap [Close].**

Review and address any warning messages, and then tap **OK**. The calibration screen closes.

AC VOLTAGE sensor inspection:

1 **Tap [AC PD] > Setting key > [Operation Settings].**

Set the applied voltage (U) setting to 200 V.

2 **Press the START key.**

3 **Check whether the sine wave for the indicated value of around 200 V is displayed on the real-time waveform screen of the ST4200 AC PD.**

If the sine wave for the indicated value of around 200 V is displayed, there will be no issues with the AC PD sensor AC VOLTAGE sensor part.
If not, contact your authorized Hioki distributor or reseller.

If the cause cannot be revealed

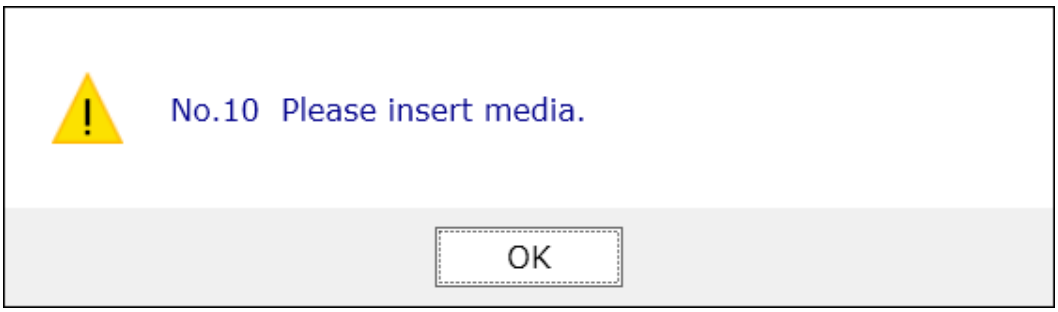
Initialize the instrument. Settings will be restored to the factory default.
See: Initializing the Instrument

8.5 Message

If any problem is found, the screen will display an error message or a warning message. It also displays an informational message with advice for usage.

Action that should be taken after a message

If a message remains



If an error message, warning message, or information message remains, check the details and tap **[OK]**.

To inform of a message with a beep sound

Tap **[System Settings]** > **[System]**.
See: System

Error messages

The list of error messages is as follows. Check the solution.
If an error is displayed on the screen, the instrument must be repaired. Contact your authorized Hioki distributor or reseller.

No.	Message	Solution	Reference
176	Internal temperature is abnormal. Please turn the power off.	Check the operating temperature environment and fan rotation before requesting instrument repair.	-

No.	Message	Solution	Reference
195	Fan malfunction detected. Power off immediately.	High internal temperature may damage the instrument. Immediately turn off the instrument and request instrument repair.	-
639	Hardware error	A hardware error was detected. Immediately turn off the instrument and request instrument repair.	-
645	Hardware error	A hardware error was detected. Immediately turn off the instrument and request instrument repair.	-
646	Hardware error	A hardware error was detected. Immediately turn off the instrument and request instrument repair.	-
647	Hardware error	A hardware error was detected. Immediately turn off the instrument and request instrument repair.	-
648	Hardware error	A hardware error was detected. Immediately turn off the instrument and request instrument repair.	-
649	Hardware error	A hardware error was detected. Immediately turn off the instrument and request instrument repair.	-
651	Hardware error	A hardware error was detected. Immediately turn off the instrument and request instrument repair.	-
652	Hardware error	A hardware error was detected. Immediately turn off the instrument and request instrument repair.	-
653	Processing could not be successfully completed.	An error occurred during an internal process of the instrument. Press the power key and tap **[Shutdown]** to turn off the instrument. Then, turn on the instrument again. You can continue the measurement by tapping **[Continue]**; however, you should turn off the instrument once.	-

Warning messages

The list of warning messages is as follows. Check the solution.

No.	Message	Solution	Reference
10	Please insert media.	Insert an SD card or a USB flash drive.	-

No.	Message	Solution	Reference
11	Manual save setting for Realtime Waveform is not checked. Manual save setting for Data Series is not checked. Manual save setting for the Q=f(U) Graph is not checked. Manual save setting for SBS Graph is not checked.	On the Save Data Settings screen, check the box of the item for manual saving.	-
13	Disk full.	The instrument cannot save any files because of insufficient free space on the storage device. Delete unnecessary files to free up enough space or use a new storage device.	-
14	Cannot load this file.	The selected file cannot be loaded in the following cases: • The file is a CSV file to which a Q=f(U) graph was saved. • The file was saved when the **[Region]** settings were different than the current settings. • The file contents are corrupted.	-
15	Unable to access file.	Check that the storage device is properly inserted. When the storage device is write protected, cancel write protect.	-
22	No waveform data to save.	Perform a measurement.	-
23	No data series data to save.	Perform another measurement or load a file.	-
25	This device cannot be removed.	The instrument is accessing the device. Remove the device after the **SAVE** key turns off.	Name and Function of Each Part
26	Folder is full.	Delete files in the folder or change the saving destination folder.	-
72	Zero adjustment failed.	-	-
112	Aborted.	-	-
209	LAN disconnected.	Check the network environment.	-
210	LAN timed out.	Check the network environment.	-

No.	Message	Solution	Reference
226	Network error.	A network error occurred during communication. Check the network environment.	-
232	File processing could not be successfully completed.	An unexpected error occurred while a file is being processed in the SD memory card or USB flash drive. Replace the storage device with another or cycle the instrument.	-
241	File processing error.	An unexpected error occurred while a file is being processed in the SD memory card or USB flash drive. Replace the storage device with another or cycle the instrument.	-
401	The current exceeds the measurable range. Please change the "Qsen" setting so that it does not exceed the range.	-	-
402	The current exceeds the measurable range. Please change the "Range" setting so that it does not exceed the range.	-	-

8.6 Initializing the Instrument (System Reset)

Choose settings configured on the instrument to restore them to the factory default settings (basic measurement settings).

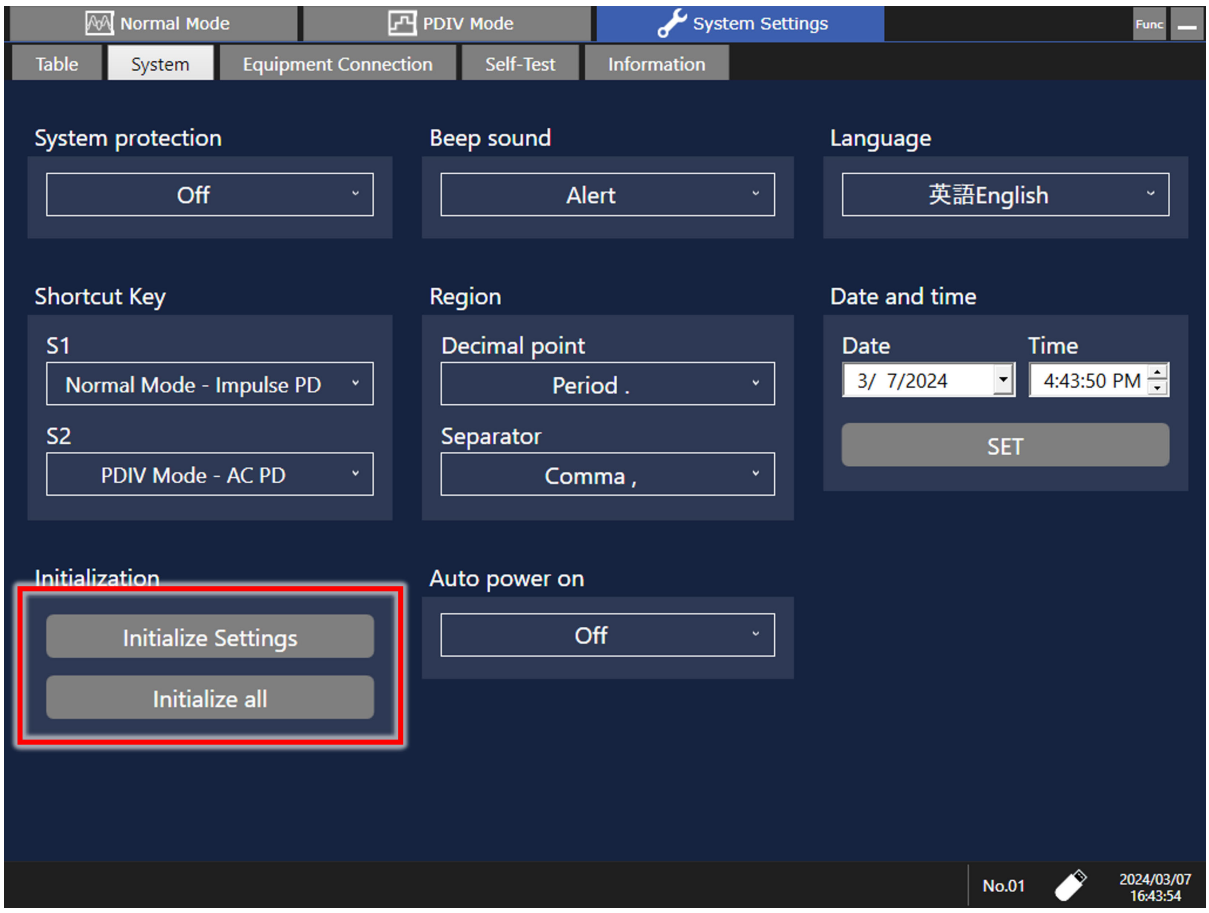
1 **Disconnect the measurement sample.**

2 **Tap [System Settings] > [System].**

The System screen is displayed.

3 **Tap [Initialize Settings] or [Initialize all].**

The instrument will be initialized.



Tips

It is also possible to conduct a system reset with the ***RST** communications command.

List of initial settings

Types of Measurement Modes

Setting item	Default setting	Initialize Settings	Initialize all	*RST
Measurement mode	Normal	✓	✓	✓
Type of PD to be Measured	AC	✓	✓	✓

AC PD Measurement Operation Settings

Symbol	Setting item	Default setting	Initialize Settings	Initialize all	*RST
U	Applied voltage	200 V	✓	✓	✓
Ulimit	Voltage Upper Limit	5000 V	✓	✓	✓
Ilimit	Voltage Current Limit	0.2 mA	✓	✓	✓
f	Voltage Frequency	50 Hz	✓	✓	✓
Tref	Sampling Time Width	100 ms	✓	✓	✓
Sc	PD Axis Scale	300 pC	✓	✓	✓
Qsen	Measurement Sensitivity	x40	✓	✓	✓
Qth	AC PD Threshold Value	10.00 pC	✓	✓	✓
Er	Qmax Evaluation Rate	50 pps	✓	✓	✓
fH	High Cutoff Frequency	1000 kHz	✓	✓	✓

Symbol	Setting item	Default setting	Initialize Settings	Initialize all	*RST
fL	Low Cutoff Frequency	30 kHz	✓	✓	✓
Us	Starting Voltage	10%	✓	✓	✓
Umax	Maximum Test Voltage Value	1000 V	✓	✓	✓
Tru	Ramp Up Time	5.0 s	✓	✓	✓
Trk	Maximum Voltage Holding Time	1.0 s	✓	✓	✓
Trd	Ramp Down Time	5.0 s	✓	✓	✓
-	Trigger Mode	Single	✓	✓	✓

AC PD Measurement Judgment Settings

Symbol	Setting item	Default setting	Default setting	Initialize Settings	Initialize all	*RST
Qmax	Repeatedly occurring maximum PD intensity	OFF	0.00 pC	✓	✓	✓
m	ACPD Pulse Repetition Rate	OFF	0 pcs	✓	✓	✓
n	ACPD Pulse Repetition Rate	OFF	0 pps	✓	✓	✓
m+	Positive Pole ACPD Pulse Count	OFF	0 pcs	✓	✓	✓
m-	Negative Pole ACPD Pulse Count	OFF	0 pcs	✓	✓	✓
P	Discharge Power	OFF	0.00000E+00 W	✓	✓	✓
D	Quadratic Rate	OFF	0.00000E+00 C^2/s	✓	✓	✓
I	Average Discharge Current	OFF	0.00000E+00 A	✓	✓	✓
Ui	PD Inception Voltage	OFF	0 V	✓	✓	✓

Symbol	Setting item	Default setting	Default setting	Initialize Settings	Initialize all	*RST
Ue	PD Extinction Voltage	OFF	0 V	✓	✓	✓

Normal Mode AC PD Measurement Display Configuration

Setting item	Default setting	Initialize Settings	Initialize all	*RST
Display 1	Judgment Result	✓	✓	✓
Display 2	Realtime Value	✓	✓	✓
Display 3	Realtime Waveform	✓	✓	✓
Display 4	Settings View	✓	✓	✓
Judgment Result Item 1	None	✓	✓	✓
Judgment Result Item 2	None	✓	✓	✓
Realtime Value Item 1	Urms	✓	✓	✓
Realtime Value Item 2	Up+	✓	✓	✓
Realtime Value Item 3	Up-	✓	✓	✓
Realtime Value Item 4	None	✓	✓	✓
Realtime Value Item 5	None	✓	✓	✓
Realtime Value Item 6	Qmax	✓	✓	✓
Realtime Value Item 7	Qth	✓	✓	✓
Realtime Value Item 8	m	✓	✓	✓
Realtime Value Item 9	n	✓	✓	✓
Realtime Value Item 10	None	✓	✓	✓
Settings View Item 1	U	✓	✓	✓
Settings View Item 2	f	✓	✓	✓
Settings View Item 3	Tref	✓	✓	✓
Settings View Item 4	Qsen	✓	✓	✓

Setting item	Default setting	Initialize Settings	Initialize all	*RST
Settings View Item 5	Qth	✓	✓	✓
Settings View Item 6	fL	✓	✓	✓
Settings View Item 7	X	✓	✓	✓
Settings View Item 8	Cr	✓	✓	✓
Settings View Item 9	None	✓	✓	✓
Settings View Item 10	None	✓	✓	✓

PDIV Mode AC PD Measurement Display Configuration

Setting item	Default setting	Initialize Settings	Initialize all	*RST
Display 1	Judgment Result	✓	✓	✓
Display 2	Realtime Value	✓	✓	✓
Display 3	Realtime Waveform	✓	✓	✓
Display 4	Settings View	✓	✓	✓
Judgment Result Item 1	None	✓	✓	✓
Judgment Result Item 2	None	✓	✓	✓
Realtime Value Item 1	Urms	✓	✓	✓
Realtime Value Item 2	Up+	✓	✓	✓
Realtime Value Item 3	Up-	✓	✓	✓
Realtime Value Item 4	Ui	✓	✓	✓
Realtime Value Item 5	Ue	✓	✓	✓
Realtime Value Item 6	Qmax	✓	✓	✓
Realtime Value Item 7	Qth	✓	✓	✓
Realtime Value Item 8	m	✓	✓	✓
Realtime Value Item 9	n	✓	✓	✓
Realtime Value Item 10	None	✓	✓	✓

Setting item	Default setting	Initialize Settings	Initialize all	*RST
Settings View Item 1	Umax	✓	✓	✓
Settings View Item 2	Tru	✓	✓	✓
Settings View Item 3	f	✓	✓	✓
Settings View Item 4	Tref	✓	✓	✓
Settings View Item 5	Qsen	✓	✓	✓
Settings View Item 6	Er	✓	✓	✓
Settings View Item 7	Qth	✓	✓	✓
Settings View Item 8	X	✓	✓	✓
Settings View Item 9	Cr	✓	✓	✓
Settings View Item 10	None	✓	✓	✓

Table

Setting item	Initialize Settings	Initialize all*1	*RST
Current Table	✓	✓	✓
Table Other Than Current Table	-	Delete	-

*1: After Initialize all, the current table becomes No.1.

System

Setting item	Default setting	Initialize Settings	Initialize all	*RST
Beep sound	Alert	-	✓	-
Decimal Point	. (period)	-	✓	-
Separator	, (comma)	-	✓	-
Header	OFF	-	✓	-

Device	Setting item	Default setting	Initialize Settings	Initialize all	*RST
Controller	Port	8802	-	✓	-
AC Power	Model	3153	-	✓	-
AC Power	Interface	NONE	-	✓	-
High Voltage Multiplexer	Interface	NONE	-	✓	-

8.7 Disposal (Removing the lithium battery)

The instrument contains a lithium battery for memory backup. When disposing of this instrument, remove the lithium battery and dispose of the battery and instrument in accordance with local regulations.

⚠ WARNING

Do not short-circuit, recharge, disassemble or dispose of them in fire. The battery may explode if mistreated.

- To avoid an electric shock, turn off the instrument and disconnect any power cords and connection cables from the instrument before removing the lithium battery.
- Keep batteries away from children to prevent accidental swallowing.

Dispose of the battery in accordance with local regulations.

CALIFORNIA, USA ONLY
Perchlorate Material - special handling may apply.
See https://dtsc.ca.gov/perchlorate/

Removing the lithium battery

Required items

Flat-head screwdriver (No.2), Torx screwdriver (T10), hex wrench (2.5), and nippers (one each)

1 **Turn off the instrument and remove any cables and storage media.**

2 **Remove the rear and left panels.**

Pushing the left panel downward enables easy removal from the body.

3 **Remove the right panel.**

Pushing the right panel downward enables easy removal from the body.

4 **Remove the handle.**

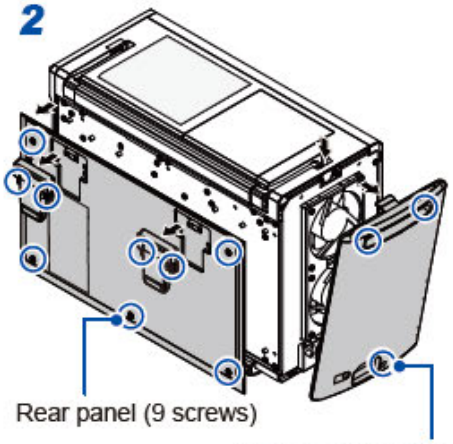
5 **Remove the cover of the media box.**

6 **Remove the upper panel.**

7 **Use nippers to remove the lithium battery from the printed circuit board.**

Pull the lithium battery up from the circuit board, and cut the positive and negative leads with the nippers.

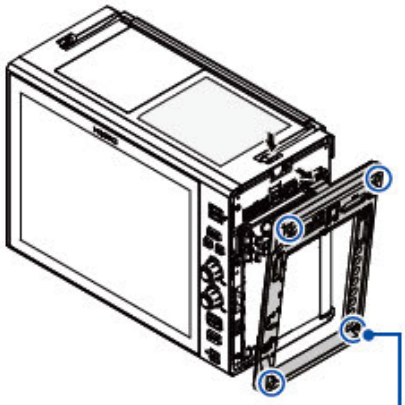
2



Rear panel (9 screws)

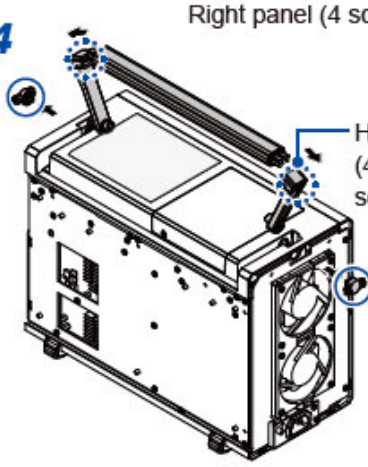
Left panel (3 screws)

3



Right panel (4 screws)

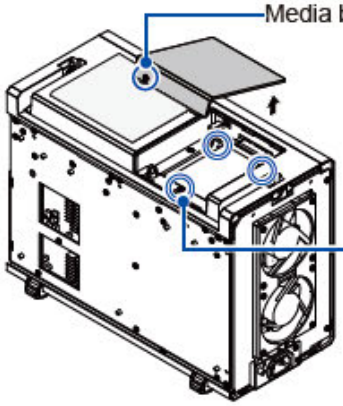
4



Handle
(4 socket head screws)

Fastener (4 screws)

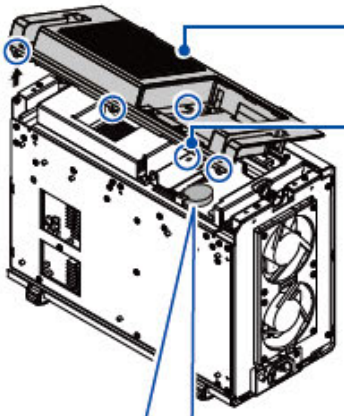
5



Media box cover (1 screw)

If SSD unit or HD unit is installed (3 Torx screws)

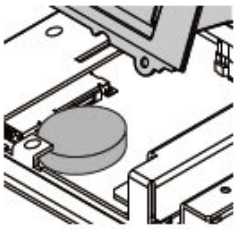
6



Upper panel (4 screws)

Media box (1 screw)

7 Lithium battery



Do not connect the positive and negative (positive and chassis) with each other.

Tools used

- ◯ : Phillips-head screwdriver (No.2)
- ◎ : Torx screwdriver (T10)
- : Hex wrench (2.5)

8.8 Open-source Software

This instrument includes software to which GNU General Public License and other licenses are applied. You have the right to obtain, modify, and redistribute the source code of the software under these licenses.
For details, visit the following website:
https://www.hioki.com/global/support/oss
Hioki would prefer you not to direct any inquiries on the content of the source code.

8.9 Rack Mounting

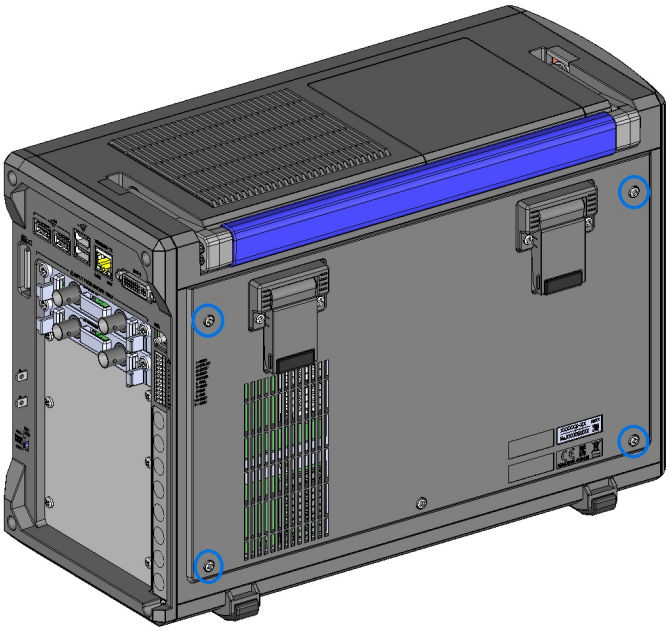
⚠ WARNING

Use screws with the specified lengths to prevent damage to the instrument and electric shock. When you remove the rack mount and restore the instrument to its original condition, use the screws (M3 × 3 mm) that were installed at the factory.
If you have lost a screw or find that the screw is damaged, contact your authorized Hioki distributor or reseller.

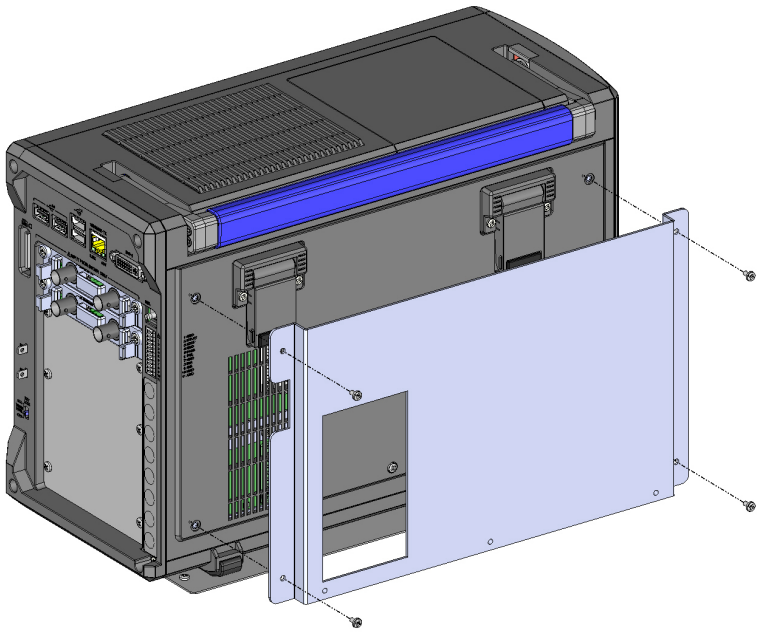
⚠ CAUTION

When mounting the instrument in a rack, place it on the shelf plate and support brackets specified by the manufacturer of the rack. The rack mount may be damaged if mounted to the rack with only screws.

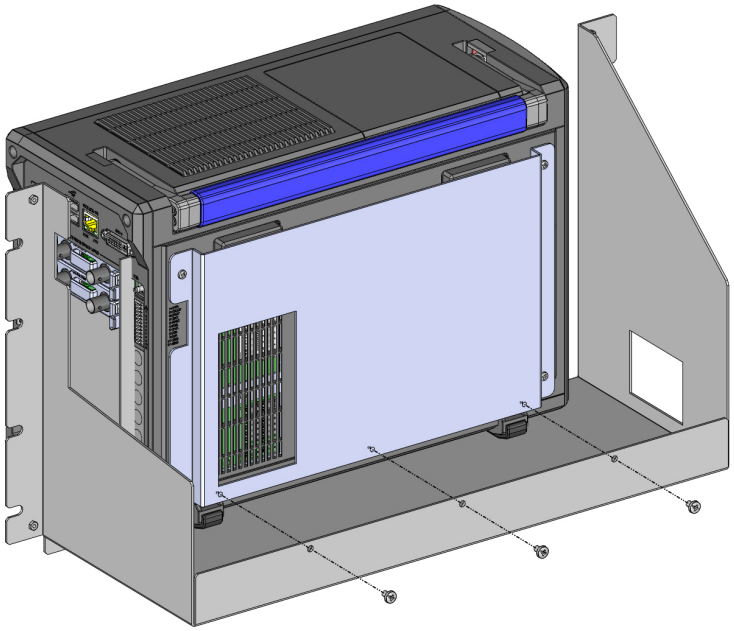
1 **Unscrew the screws (M3 × 3 mm) in four locations on the back of the instrument.**



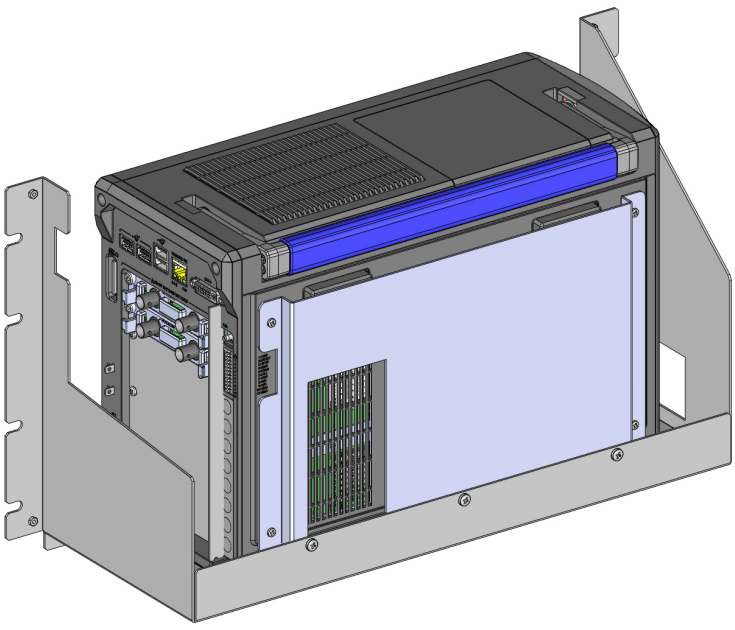
2 **Fix the back plate to the instrument with the included screws (M3 × 5 mm) in four locations.**



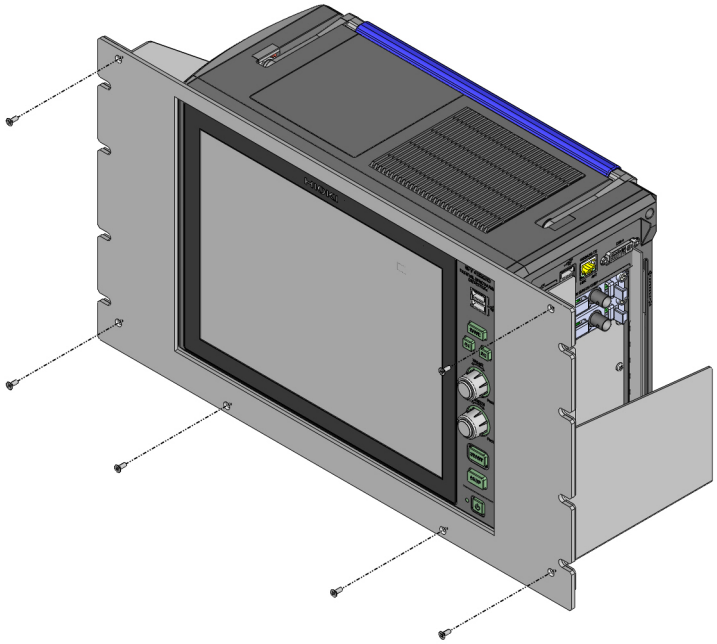
3 **Place the instrument in the rack mounting adapter and fix it with the included screws (M4 × 6 mm) in three locations.**



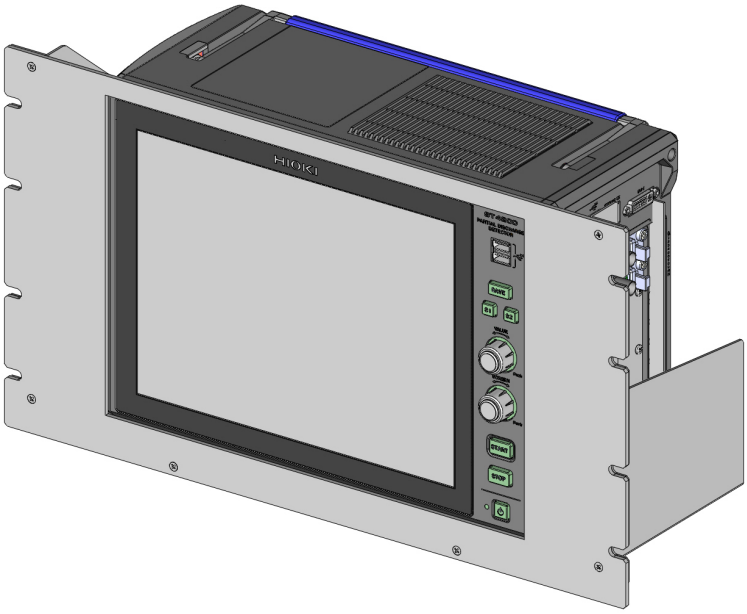
After the instrument is fixed in the adapter



4 **Fix the adapter to the front panel with the included screws (M3 × 8 mm, countersunk head screw) in six locations.**



Completed image



9 Specifications

9.1 General Specifications

Item	Description
Operating environment	Indoor use, pollution degree 2, altitude up to 2000 m (6562 ft.)
Operating temperature and humidity range	0°C to 40°C (32°F to 104°F), 80% RH or less (non-condensing)
Storage temperature and humidity range	-10°C to 50°C (–14°F to 122°F), 80% RH or less (non-condensing)
Standards	• Safety EN 61010 • EMC EN 61326 Class A
Power supply	• Commercial power Rated supply voltage: 100 V to 240 V AC (Assuming voltage fluctuation of ±10%.) Rated power-supply frequency: 50 Hz/60 Hz Anticipated transient overvoltage: 2500 V Maximum rated power: 300 VA Normal consumption power (reference value): 70 W (AC PD measurement)
Dimensions	Approx. 353W × 235H × 154.8D mm (13.9″W × 9.3″H × 6.1″D) (excluding protrusions)
Weight	Approx. 7.1 kg (15.7 lbs) (with the U8332 removed) Approx. 7.3 kg (16.1 lbs) (with the U8332 installed)
Product warranty duration	3 years
Included accessories	Included accessories
Options	Options

9.2 Measurement Specifications

Basic specifications

AC PD

Item	Description
Measurement mode	• Normal Mode Applies a constant voltage and conducts single or consecutive measurements • PDIV Mode Changes applied voltage in conformance with standards while measuring
Input channels	• AC VOLTAGE: Voltage monitor signal (BNC terminal) • AC PD: AC PD current sensor signal (BNC terminal)
Detection method	Discharge measurement method using detection impedance and band pass filter based on IEC 60270 and IEC 60034-27-1 See: AC PD Detection Principle
Sampling speed	100 MS/s
Measurement items	• Normal Mode Repeatedly occurring maximum PD intensity (Qmax), number of PD pulses generated (m, m+, m-), rate of PD pulse generation (n), voltage RMS value (Urms), voltage peak value (Up+, Up-), voltage peak-to-peak (Upp), average discharge current (I), discharge power (P), quadratic rate (D), PD pulse apparent charge (q), PD pulse phase angle (ø) • PDIV Mode Repeatedly occurring maximum PD intensity (Qmax), number of PD pulses generated (m, m+, m-), rate of PD pulse generation (n), voltage RMS value (Urms), voltage peak value (Up+, Up-), voltage peak-to-peak (Upp), average discharge current (I), discharge power (P), quadratic rate (D), PD pulse apparent charge (q), PD pulse phase angle (ø), PD inception voltage (Ui), PD extinction voltage (Ue)
Sampling window time width (Tref)	100 ms to 1000 ms
Measured value display update interval	100 ms to 1000 ms (linked to the value set for the sampling window time width)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Test frequency range (applied voltage)</td><td>45 Hz to 1.1 kHz</td></tr>
<tr><td>Frequency characteristics (AC PD)</td><td>30 kHz to 1 MHz (-6 dB)</td></tr>
<tr><td>Charge measurable range</td><td><table><tr><th>Tested object capacitance C</th><th>Charge measurable range Q</th></tr><tr><td>200 pF ≤ C < 2 nF</td><td>10 pC ≤ Q ≤ 500 pC</td></tr><tr><td>2 nF ≤ C ≤ 10 nF</td><td>10 pC ≤ Q ≤ 2500 pC</td></tr></table></td></tr>
<tr><td>PD pulse time resolution</td><td>10 μs</td></tr>
</table>

Accuracy specifications

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>PD pulse phase angle measurement accuracy (reference value)</td><td>
<table>
<tr><th>Voltage input frequency</th><th>PD pulse phase angle error (°)</th></tr>
<tr><td>45 Hz ≤ f ≤ 100 Hz</td><td>±0.4</td></tr>
<tr><td>100 Hz < f ≤ 400 Hz</td><td>±1.0</td></tr>
<tr><td>400 Hz < f ≤ 1 kHz</td><td>±2.5</td></tr>
</table>
</td></tr>
<tr><td>Effect of radiated radio-frequency electromagnetic field</td><td>50 pC or less (at 10 V/m)</td></tr>
<tr><td>Effect of conducted radio-frequency electromagnetic field</td><td>50 pC or less (at 10 V)</td></tr>
<tr><td>Effect of superimposed pulse noise on the power supply</td><td>50 pC or less (with 1 kV and superimposed pulse noise of pulse width 50 ns)</td></tr>
</table>

Display specifications

Display Equipment

Item	Description
Display	12.1-inch XGA TFT color LCD (1024 × 768 dots) With capacitive touch panel

Graph Displayed Items

Item	Description
AC PD	• Voltage waveform, PD pulse monitor X axis: Time Y axis: Voltage, PD pulse (each on a different scale) • Voltage to discharged quantity characteristics (Q=f(U) Graph) X axis: Voltage RMS value Y axis: Maximum PD magnitude occurring repeatedly • Generic graph X axis: Arbitrary measurement item Y axis: Arbitrary measurement item • PD pulse phase angle to apparent charge to PD pulse number (PRPD characteristic) X axis: PD pulse phase angle Y axis: apparent charge Z axis (color chart display): PD pulse number or rate of PD pulse generation

9.3 Specifications of Functions

Judgment functions

Item	Description
Judgment description	The judgment is FAIL when the measurement result is equal to or more than the judgment value and PASS when less than the judgment value. However, when the judgment value is a negative value, the judgment is FAIL when the measurement result is equal to or less than the judgment value and PASS when more than the judgment value. For PD generation and extinction voltage during a PDIV measurement, a FAIL judgment at less than the judgment value can be set as the FAIL condition.

Measurement items that can be judged	• AC PD
	  • Normal mode
	  Repeatedly occurring maximum PD intensity (Qmax), PD pulse count (m, m+, m-), PD pulse generation rate (n), Average discharge current (I), Discharge power (P), Secondary rate (D)
	  • PDIV mode
	  Repeatedly occurring maximum PD intensity (Qmax), PD pulse count (m, m+, m-), PD pulse generation rate (n), Average discharge current (I), Discharge power (P), Secondary rate (D), PD start voltage (Ui), PD extinction voltage (Ue)

Linked control function

Item	Description

High voltage generator	• Control description
	Linked control of withstand voltage tester as a partial discharge test high voltage generator
	• Compatible devices
	  • Hioki
	  3153 Automatic Insulation/Withstanding HiTester
	  • Kikusui Electronics Corporation
	  TOS5200 Series, TOS5300 Series, TOS9300 Series
	  Withstanding Voltage/Insulation Resistance Tester

Partial discharge detector	• Control description Only connect the partial discharge detector to the test circuit during AC PD testing. • Compatible devices High Voltage Multiplexer SW2001-04, SW2001-08, SW2001-16, SW2001-24 (Specification with PD Sensor ST9200 [for AC partial discharge])
Control authority conflict with host device	When the ST4200 controls the above devices, the ST4200 has exclusive control. At other times, the host device can execute command control via ST4200.

Save function

Item	Description
Saving destination	• SD Memory Card Z4001 (2 GB), Z4003 (8 GB) • USB Drive Z4006 (16 GB) • SSD U8332 SSD Unit (256 GB)
File system	FAT32, NTFS, exFAT
File name	Alphanumeric, Japanese, and Chinese input
Handling when a file name same as an exiting file is specified	A sequence number is added to the end of the file name to be saved.
Saving type	In normal mode and PDIV mode, select the save type on each of the Save setting screens for AC PD. Common save settings • Automatic saving The following are automatically saved after measurements. • Data Series • Q=f(U) graph image • Manual saving The following are saved by pressing the SAVE key. • Data Series • AC PD Realtime waveform image • Q=f(U) graph image • Graph images of AC PD analysis functions
Saving format	• Tables .TBL, .TB1 • Displayed graph image .BMP, .PNG, .JPEG • Measurement data .CSV Saves in the fixed format for each mode
File designation	New file or existing file Before starting a measurement, choose whether a new file is created or data is appended to the existing file
SAVE key operation	The SAVE key is used to save data based on a pre-defined destination, file name, and saving setting.

Data loading function

Item	Description
Drive data is loaded from	• SD Memory Card Z4001 (2 GB), Z4003 (8 GB) • USB Drive Z4006 (16 GB) • SSD U8332 SSD Unit (256 GB)
Loadable data formats	Measurement data (.CSV) Tables (.TBL, .TB1)

AC PD Data Storage

Normal mode

Model name, mode	ST4200 (Model name)	AC (Type)	Normal (mode)	V2.00 (Version)									
Measuring conditions	CONF												
Measurement Condition Heading	Tref (Meas. time)	fL (BPF lower)	fH (BPF upper)	CalRate	VoltRate	PdRate	Vernier						
Unit	"ms".	"kHz".	"kHz".										
Value	integer	integer	integer	index	index	index	index						
Data	DATA												
Data Heading	Time (Apparent charge time)	q (Apparent charge)	u (Instantaneous voltage)	Phase (Voltage Phase)	Date	Urms (Voltage RMS)	Upk+ (voltage peak positive)	Upk− (voltage peak negative)	Freq.	Qmax:60 (PD charge : Evaluation rate)	Judge_Qmax	Qth (PD threshold)	Qpk (PD peak)
Unit or Judgment level	"us"	"pC"	"V"	"deg."	"yyyy/mm/dd hh:mm:ss.000"	"Vrms"	"V"	"V"	"Hz"	"pC"	decimal or blank	"pC"	"pC"
Measurement 1 PD1	decimal	decimal	integer	integer	(Example) 2024/01/23 09:32:02.517	integer	integer	integer	decimal	decimal	PASS/FAIL/OVER/none	decimal	decimal
PD2	decimal	decimal	integer	integer									
	|	|	|	|									
PDm	decimal	decimal	integer	integer									
Measurement 2 PD1	decimal	decimal	integer	integer	(Example) 2024/01/23 09:32:03.517	integer	integer	integer	decimal	decimal	PASS/FAIL/OVER/none	decimal	decimal
PD2	decimal	decimal	integer	integer									
	|	|	|	|									
PDm	decimal	decimal	integer	integer									
	|												
Measurement Last PD1	decimal	decimal	integer	integer	(Example) 2024/01/23 09:32:04.517	integer	integer	integer	decimal	decimal	PASS/FAIL/OVER/none	decimal	decimal
PD2	decimal	decimal	integer	integer									
	|	|	|	|									
PDm	decimal	decimal	integer	integer									

PDIV mode

The first half is saved for each measurement as in Normal mode, and PDIV results are added at the end.

	See Normal mode				
	new line				
Heading for PDIV	Ui (PD Inception voltage)	Judge Ui	Ue (PD Extinction voltage)	Judge Ue	Judge All
Unit or Judgment level	"V"	integer or blank	"V"	integer or blank	blank
Value	decimal	PASS/FAIL/OVER/none	decimal	PASS/FAIL/OVER/none	PASS/FAIL/OVER/none

AC PD Normal mode Continued

m (Number of PD)	Judge_m	m+ (Number of positive PD)	Judge_m+	m− (Number of negative PD)	Judge_m−	n (PD Repetition Rate)	Judge_n	I (Average discharge current)	Judge_I	P (Discharge power)	Judge_P	D (Quadratic rate)	Judge_D	Judge_All
""	integer or blank	""	integer or blank	""	integer or blank	""	index or blank	"A"	index or blank	"W"	index or blank	"C^2/s"	index or blank	blank
integer	PASS/FAIL/OVER/none	integer	PASS/FAIL/OVER/none	integer	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	PASS/FAIL/OVER/none
integer	PASS/FAIL/OVER/none	integer	PASS/FAIL/OVER/none	integer	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	PASS/FAIL/OVER/none
integer	PASS/FAIL/OVER/none	integer	PASS/FAIL/OVER/none	integer	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	index	PASS/FAIL/OVER/none	PASS/FAIL/OVER/none

Specifications of interfaces

Item	Description
USB	• No. of Ports USB 3.0 compatible × 2, USB 2.0 compatible × 4 • Connector Series-A receptacle • Peripheral devices Keyboard, mouse, USB flash drive, USB serial conversion cable • Maximum cable length 1 m
RS-232C (USB serial conversion cable)	• Connectible device Slave measuring instruments of the instrument • Connector D-sub 9 pins, male • Transmission method Synchronous step, full duplex • Transmission speed 9600 bps, 19200 bps • Data bit length 8 • Stop bits 1 • Parity check None • Delimiter Transmission: CR+LF, Receiving: LF or CR+LF • Flow control None • Protocol Non-procedural • Communication details Command communication for cooperation control • Default setting Transmission speed: 9600 bps

Item	Description
LAN	• Standards IEEE802.3 • Transmission system 100BASE-TX Full duplex • Protocol TCP/IP • Connector RJ-45 • Communication contents Set and query using communication commands • Settings IP address, Subnet mask, Default gateway Port numbers for communication commands: 1002 to 49002 • Delimiter Transmission: CR+LF, Receiving: LF, CR+LF • Maximum cable length 3 m

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>EXT. I/O</td><td>

Terminal block
Push-button type
Input

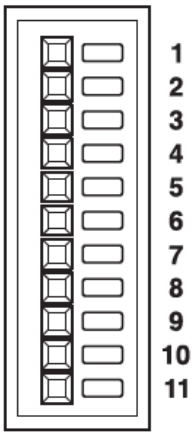
Maximum input voltage
10 V DC
Input voltage
High level 2.5 V to 10 V,
Low level 0 V to 0.8 V
Responsible pulse width
High period: 50 ms or more, Low period: 50 ms or more
Pulse intervals
200 ms or more

Output

Output type
Open-drain output(with 5 V output equipped, active-low)
Output voltage
High level: 4.0 V to 5.0 V,
Low level: 0 V to 0.5 V
Maximum input voltage
50 V DC, 50 mA, 200 mW

Pin assignment

<table>
<tr><th>Pin No.</th><th>Signal name</th><th>I/O</th><th>Description</th><th>Detection</th></tr>
<tr><td>1</td><td>GND</td><td>-</td><td>Ground potential</td><td>-</td></tr>
<tr><td>2</td><td>START</td><td>IN</td><td>Measurement start</td><td>Edge</td></tr>
<tr><td>3</td><td>STOP</td><td>IN</td><td>Measurement stop</td><td>Edge</td></tr>
<tr><td>4</td><td>GND</td><td>-</td><td>Ground potential</td><td>-</td></tr>
<tr><td>5</td><td>PASS</td><td>OUT</td><td>Overall judgement: PASS</td><td>-</td></tr>
<tr><td>6</td><td>FAIL</td><td>OUT</td><td>Overall judgement: FAIL</td><td>-</td></tr>
<tr><td>7</td><td>GND</td><td>-</td><td>Ground potential</td><td>-</td></tr>
<tr><td>8</td><td>N/A</td><td>-</td><td>Unassigned</td><td>-</td></tr>
<tr><td>9</td><td>N/A</td><td>-</td><td>Unassigned</td><td>-</td></tr>
<tr><td>10</td><td>GND</td><td>-</td><td>Ground potential</td><td>-</td></tr>
</table>
</td></tr>
</table>

Item	Description
	<table><tr><th>Pin No.</th><th>Signal name</th><th>I/O</th><th>Description</th><th>Detection</th></tr><tr><td>11</td><td>GND</td><td>-</td><td>Ground potential</td><td>-</td></tr></table> 

9.4 Specifications of the Options

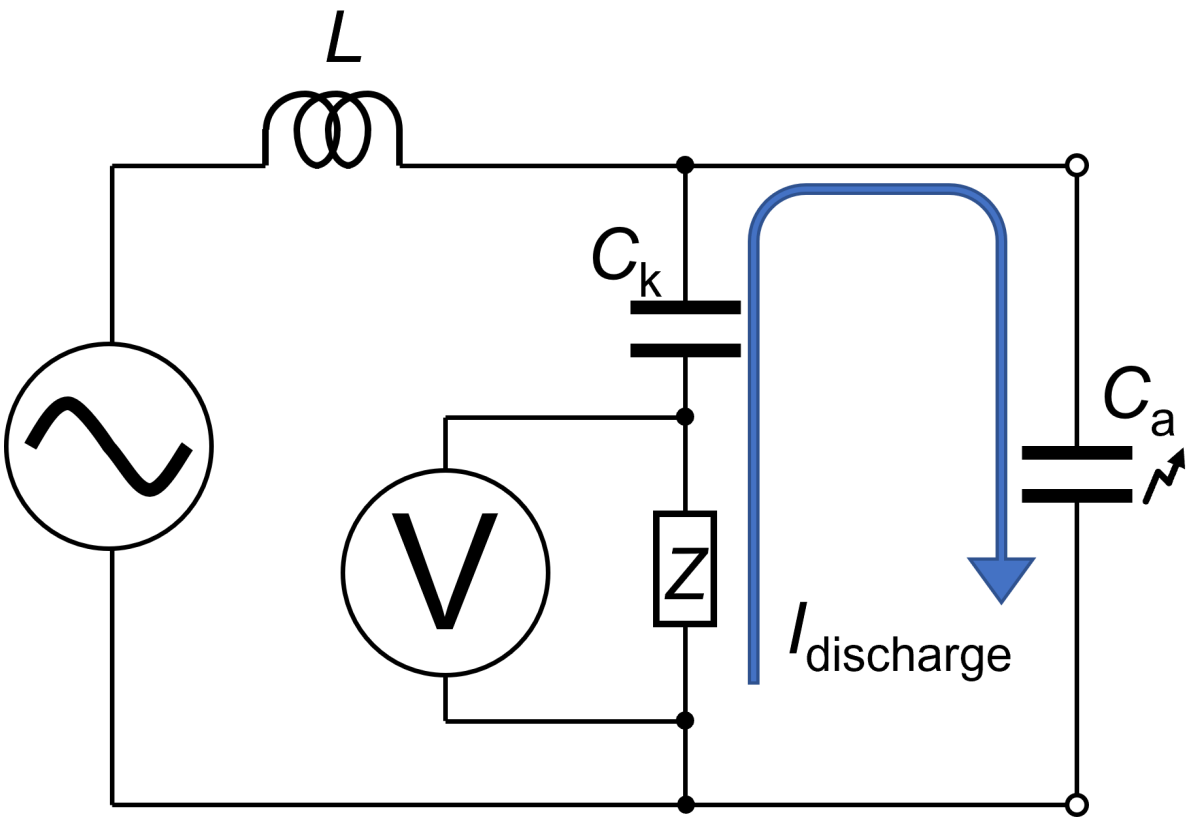
U8332 SSD Unit

Item	Description
Recording capacity	256 GB (MLC)
Supported interface standard	Serial ATA Revision 3.0 compatible (2.5-inch)
Operating temperature and humidity range	Consistent with the specifications of a PD Detector in which the U8332 is installed.
Storage temperature and humidity range	Consistent with the specifications of a PD Detector in which the U8332 is installed.

10 Detection Principle

10.1 AC PD Detection Principle

With this instrument, high AC voltage is applied to the insulating part of the object under measurement (winding wire) in order to detect AC PD. The figure shows an equivalent circuit during AC PD detection. During AC PD detection, the insulating part is often thought to be pure capacitance C_a.
The figure shows an example of applying high AC voltage to C_a using high AC voltage and a circuit. If partial discharge occurs at points where the insulation fails in C_a, the current I, discharge flows in the direction of the arrow shown in the figure. At this time, because the current causing the discharge contains high-frequency components, the current causing the discharge does not flow to the source of high AC voltage application serially connected to the blocking coil L. The current causing the discharge flows in a circuit created by the coupling condenser C_k and detection impedance Z. Potential difference occurs at both ends of Z according to the current causing the discharge. The instrument records the waveform of this potential difference and finds the charge quantity q through integration processing.



Calculation methods for AC PD measurement items

Calculation methods for AC PD measurement items are based on expressions defined in Section 3.3 of IEC 60270.

- Average Discharge Current I

This indicates the value obtained by dividing the sum of the absolute value for the magnitude of the individual apparent charge q_i *during the selected reference time interval* T_{ref} by the derived quantity.
The unit is $\mathrm{C/s}$, i.e., A.

$$I = \frac{1}{T_{ref}} \times (|q_1| + |q_2| + \cdots |q_i|)$$

- Discharge Power P

The value of the derived quantity that is the average pulse power fed into the terminals of the object under measurement due to apparent charge magnitude q_i *during selected reference time interval* T_{ref}.
The unit is W.

$$P = \frac{1}{T_{ref}} \times (q_1 u_1 + q_2 u_2 + \cdots q_i u_i)$$

Here, u_1, $u_2 \cdots u_i$ are instantaneous values of the test voltage at the instant of occurrence q_i of the individual apparent charge magnitude q_i.

- Quadratic Rate D

This indicates the value obtained by dividing the sum of the squares of individual apparent charge magnitude qi during the selected reference time interval $Tref$ by the time interval.
The unit is $\mathrm{C^2/s}$.

$$D = \frac{1}{T_{ref}} \times ({q_1}^2 + {q_2}^2 + \cdots {q_i}^2)$$

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Edited and published by HIOKI E.E. CORPORATION Printed in Japan

Europe only

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