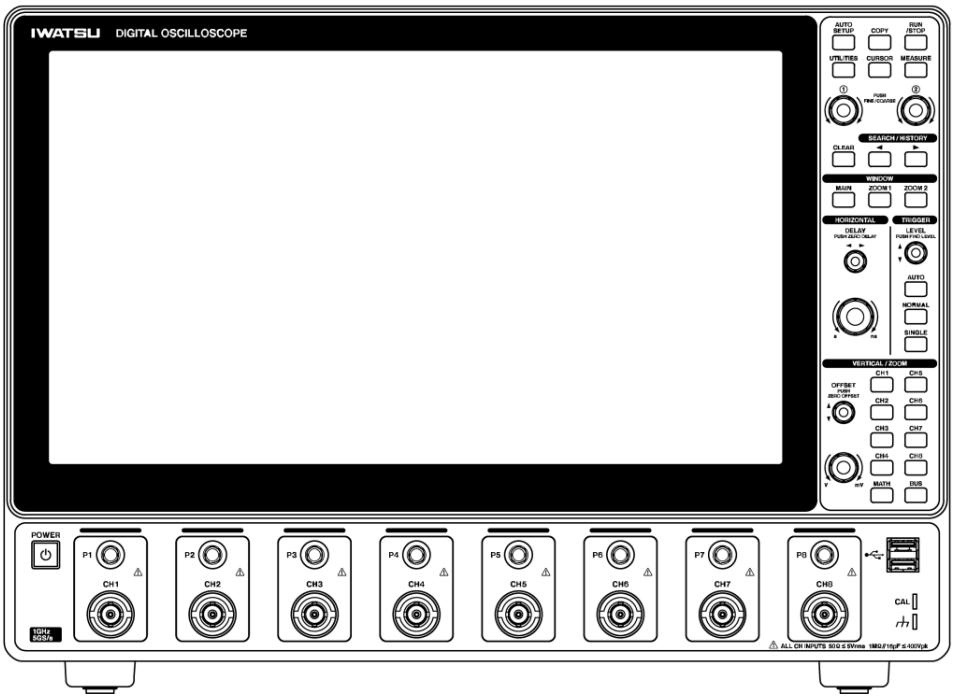
Digital Oscilloscope

DS-8000 Series

Instruction Manual

To view the Remote Control Manual, see the PDF files on the Manual CD.



IWATSU

Preface

- ◇ Thank you for purchasing the Digital Oscilloscope DS-8000 Series. We sincerely hope to continue using our instruments for a long time.
- ◇ Before using this instrument, thoroughly read this Instruction Manual to fully understand its contents. After reading the Instruction Manual, keep it in a safe place for future reference.
- ◇ This Instruction Manual describes cautions on handling, operating procedures, operation examples, and specifications of the instrument in detail. See the Remote Control Manual in the Manual CD for description of remote controls that use USB or LAN Interface.
- ◇ In the content of the Instruction Manual, it explains based on 8CH model. When it is necessary to explain the obvious difference between 4CH model and 8CH model, this manual explains in each part.

Important Safety Precautions

To ensure safe operation of the instrument and to prevent injury to the user or damage to property, read and carefully observe ⚠ WARNING and ⚠ CAUTION in the following sections.

Definition of WARNING and CAUTION as used in the Instruction Manual

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

Explanation of the symbol on the panel

⚠ **General CAUTION**	This symbol warns you to carefully read relevant descriptions of the instruction manual before operating a part with this symbol put in order to protect the operator from injury and the instrument from damage.

Notices

- ◇ Some of the contents of the Instruction Manual may be modified without notice for improvements in specifications and function.
- ◇ Reproduction or reprinting of the contents of the Instruction Manual without prior permission from IWATSU is prohibited.
- ◇ If any question arises about the instrument, contact IWATSU or our sales distributors.
- ◇ The Instruction Manual is compatible with Software Version 6.08.
- ◇ Follow local ordinances or regulations when disposing the instrument.
- ◇ All product names and brand names included in the Instruction Manual are listed for identification purposes. Each is a registered trademark held by the relevant individual or corporate body. The TM and ®marks of each company in the text.

Revision History

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Carefully read the following safety information. Read also the following pages.

⚠ WARNING

- **Do not use the instrument in an environment where any explosive gas exists.**
  Doing so may cause an explosion.

- **If any smoke, odor, or unusual noise is found, immediately turn OFF the power and disconnect the power plug from the power outlet completely.**
  If the instrument is used continuously without taking of any corrective actions, this may cause an electric shock or a fire. After the POWER button has been put in the standby mode and the power plug has been disconnected from the power outlet, contact IWATSU or our sales distributors for repair. Never attempt to repair the instrument by the customer. Failure to do so may cause a serious accident.

- **Pay special attention so that any water does not enter the instrument or the instrument does not get wet.**
  If the wet instrument is operated, this may cause an electric shock, a fire or a malfunction. If water enters, put the POWER button in the standby mode and disconnect the power plug from the power outlet, and then contact IWATSU or our sales distributors for repair.

- **Do not touch the plug of the power cord by wet hand.**
  Doing so may cause an electric shock.

- **Do not place the instrument on an unstable place, such as a shaky stand or an inclined place.**
  If the instrument is placed on an unstable place, it may be fallen down or laid down, causing an electric shock, a personal injury, or a fire. If the instrument is fallen down or the cover is damaged, put the POWER button in the standby mode and disconnect the power plug from the power outlet, and then contact IWATSU or our sales distributors for repair.

- **Do not remove any cover or panel.**
  High-voltage parts exist inside the instrument. If you touch such part, this may cause an electric shock. If the inspection, calibration, or repair is required, contact IWATSU or our sales distributors for such work.

- **Great care should be taken when measuring a high-voltage.**
  If you touch a high-voltage part during measurement, this may cause an electric shock.

- **Always use a 3-prong power cord specified by IWATSU, that suits power supply voltage and current for this instrument.**
  Please use the power cord included with this instrument. Using another cord that is incompatible with the power voltage and current may result in electric shock, fire and/or malfunction. Additionally, using a 2-prong power cord may result in electric shock.
  - Unless otherwise specified purchase, a 100 V (90 V to 120 V) power cord is supplied with the instrument. If operating the instrument at 200 V (180 V to 250 V), always use the 3-prong power cord (optional) for 200 V systems.
  - If the power cord is lost or damaged, contact IWATSU or our sales distributors for the cable purchase again.
  - When the power is supplied from a 2-prong power outlet to the instrument through the 3-prong to 2-prong conversion adaptor, ground the grounding terminal of the 3-prong to 2-prong conversion adaptor.
  - When the 3-prong power cord supplied with the instrument is used to supply the power from a 3-prong power outlet, ground the grounding line of the power cord.

⚠ WARNING(Continued)

- **Always use the instrument in a specified power voltage range.**
  If the instrument is operated in a voltage range other than that specified, this may cause an electric shock, a fire, or a malfunction. Table 1 shows the allowable power voltage and frequency ranges.

Table 1 Power Source Specifications

Frequency Range	Voltage Range
50/60 Hz	AC 100 to 240 V ±10%

- **Insert the power plug into the power outlet after checking that any dust is not sticking to the power plug. Additionally, disconnect the power plug or power adaptor from the power outlet once every six months to one year, and inspect and/or clean the power plug.**
  If the power plug is contaminated, this may cause an electric shock, a fire, or a malfunction.

- **The Probe Power Connector on the front panel is a dedicated connector that supplies power to Recommended Active Probe.**
  It cannot be used for any other purpose. It may cause damage to the instrument.

- **When handling the power cord, strictly observe the following cautions.**
  Failure to do so may cause an electric shock, a fire or a malfunction. If the power cord is damaged, contact IWATSU or our sales distributors for repair.
  - Do not modify the power cord.
  - Do not bend the power cord forcibly.
  - Do not twist the power cord.
  - Do not bundle the power cord.
  - Do not pull the power cord.
  - Do not heat the power cord.
  - Do not let the power cord get wet.
  - Do not place a heavy object on the power cord.

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

- **If a lightning occurs near the instrument operation place, immediately put the POWER button in the standby mode and disconnect the power plug from the power outlet.**
  A lightning may cause an electric shock, a fire, or a malfunction.

- **Do not allow metal objects, etc., to touch the metal blades of the power plug.**
  Contact with a metal object, etc., may cause an electric shock, a fire or a malfunction.

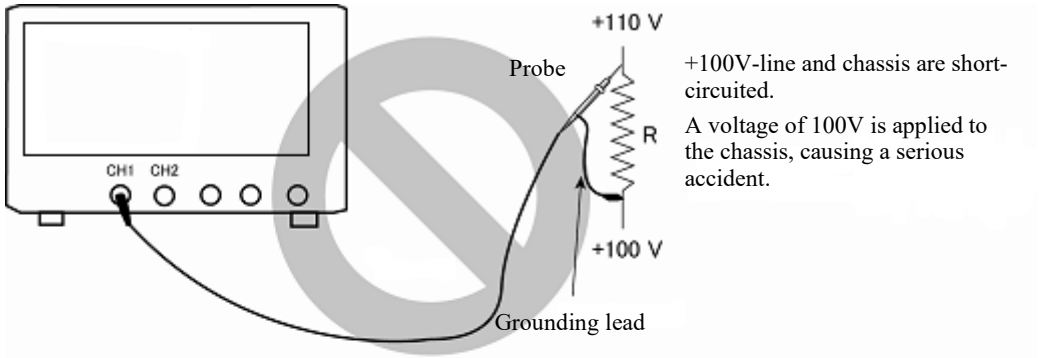
- **Do not use multiple-connection power outlets.**
  Power strips and other multiple-connection outlets may cause a fire or overheating.

⚠WARNING(Continued)

- **Connect the grounding lines of the probe and input connector to the grounding potential (grounding line) of an object to be measured.**

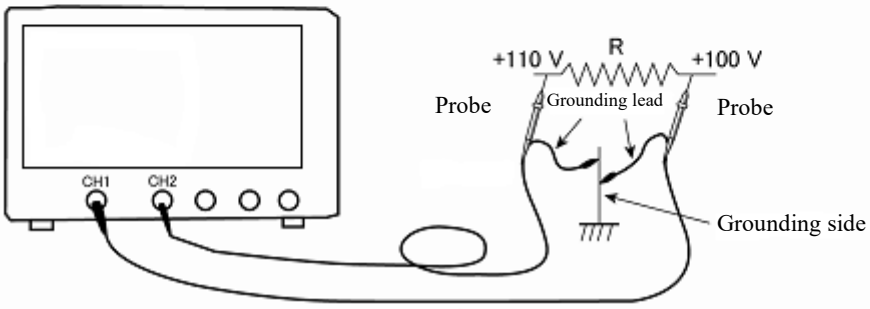
  If the grounding line of the instrument is connected to an electric potential other than the grounding potential of an object to be measured, this may cause an electric shock or an accident (object to be measured, the instrument, or other connected unit is broken). (See the following Fig. [Example of improper connection].)

[Example of improper connection]



When measuring a floating potential, it is recommended to perform the measurement by means of the differential method (example shown in the Fig. below shows the subtraction (CH1 - CH2)). (See the following Fig. [Example of proper connection].)

[Example of proper connection]



- **Do not put any metallic or flammable foreign object through the ventilation openings.**

  If any metallic or flammable foreign object is put through the ventilation openings, this may cause a fire, an electric shock, or a malfunction. If a foreign object has entered, set the POWER button to standby, then remove the plug from the outlet, and then contact the IWATSU or our sales distributors for repair.

⚠ WARNING(Continued)

- **Do not place containers of water or chemicals, small metal objects, etc. near the instrument.**

  If the contents are spilled and enter the instrument, it may cause an electric shock, a fire or a malfunction. If water, chemicals, or metal objects enter the instrument, set the POWER button to standby, remove the plug from the outlet, and then contact IWATSU or our sales distributors for repair.

- **Do not use the instrument if it is not functioning correctly.**

  Using a malfunctioning instrument (due to dropping, etc.) may cause an electric shock or a fire. If the instrument is not functioning correctly, set the POWER button to standby, remove the plug from the outlet, and then contact IWATSU or our sales distributors for repair.

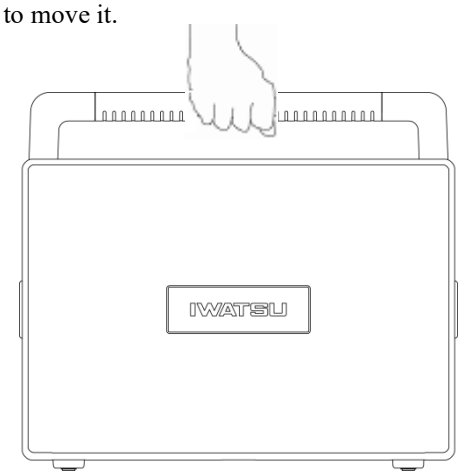
- **Do not place the instrument in an area where frequent vibrations or impacts occur.**

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

- **If the instrument is dropped, it may result in a physical injury or property damage. Always hold the center of the handle firmly so that the instrument does not drop. When moving, attach the panel cover to protect the LCD screen.**

  When moving the instrument, hold the center of the handle to move it.

(1) Disconnect the cables.
  a) Disconnect the power cord.
    (Wind the power cord to bundle it.)
  b) Turn the probe connector counterclockwise to disconnect it.
(2) Hold the handle.
  a) Raise the handle.
  b) Hold the center of the handle.



Carefully read the following safety information. Read also the following pages.

⚠ CAUTION

Installation place

- **Always use the instrument in a specified operating environment.**
  If the instrument is operated in an operating environment other than that specified, this may cause a malfunction.
  Use the instrument only indoors.
  Specification guarantee temperature and humidity ranges:
  +10 °C to +35 °C, below the moisture amount of 80% RH (No dew condensation allowed.)
  Operation guarantee temperature and humidity ranges: 0 °C to +40 °C,
  the moisture amount of 5 to 80% RH or less (30 °C or less, no dew condensation allowed)
  Upper limit: the moisture amount of 5 to 55% RH (40 °C, no dew condensation allowed)
- **Keep an appropriate space at the rear and on both sides of the instrument.**
  If the instrument is put inside the rack mount or on other measuring instrument, carefully check the temperature rise. If the temperature rises excessively, this may cause an operation fault or a specification fault.
- **Do not place any object close to the ventilation openings or fan of the instrument.**
  If any object is placed close to the ventilation openings or fan of the instrument, the air ventilation is blocked and the internal temperature increases, causing a fire or malfunction
- **Do not use or store the instrument in a location that is humid (bathroom, etc.) or dusty.**
  Placing it in a humid or dusty location may cause an electric shock, a fire or a malfunction.
- **Do not place the instrument in a location next to a worktable or humidifier, where it may be exposed to oily smoke or steam.**
  Doing so may cause an electric shock, a fire or a malfunction.
- **Do not place the instrument in the location where direct sunshine strikes and the location where humidity is high.**
  Doing so may cause the going up of internal temperature or a fire.

When measuring

- **Do not apply a voltage other than that specified to an input terminal (CH1, CH2, CH3, CH4, CH5 Note 2, CH6 Note 2, CH7 Note 2, CH8 Note 2).**
  Doing so may cause a malfunction. The following shows the maximum voltage levels that can be input.
  1 MΩ: 400 Vpeak
  50 Ω: 5 Vrms Note 1
  Note 1: The maximum voltage that can be input may decrease depending on the frequency or high-voltage pulse of the input signal.
  Note 2: Description of CH5, CH6, CH7 and CH8 is for 8CH model only.
- **When connecting the probe or measurement cable, care should be taken so that you do not pull such cable. If such cable is pulled, this may cause the instrument to be laid down.**
  If the instrument is laid down, this may cause an electric shock, a personal injury, a fire, or a malfunction.

⚠ CAUTION (Continued)

Power supply

- **The POWER button located at the lower left portion of the front panel is intended to control the operation status of the instrument.**
  This instrument provides two basic modes, "ON" and "STANDBY". In the ON mode, the power is supplied to all parts of the instrument and the instrument is ready for operation. In the STANDBY mode, the power is turned OFF except for specific standby circuit.
  When the power cord is connected to the power outlet even though the POWER button is set to standby, the standby circuit slightly consumes the electric power as shown below. Unplug the power cord to fully shut off the power.
  • Standby power: 9 Wmax

- **Connect or disconnect the power cord after the POWER button has been turned to stand-by completely.**
  If the power cord is connected or disconnected with the power supplied, this may cause an electric shock or a malfunction.

- **When disconnecting the power cord from the power outlet, always hold the power plug firmly.**
  If the power cord is pulled, the cord is damaged, causing an electric shock or a fire.

- **Do not use the power cord provided with product for other products.**
  In accordance with electrical safety regulations, the power cord provided with the instrument is not to be used with other electrical equipment.

- **Use the power cord that meets the safety standards or regulation of your country and region as a power cord is a safety component.**

- **Make sure that the power plug is plugged into the power outlet.**

Handling

- **Do not use a damaged power cord, cable or probe.**
  Doing so may cause an electric shock, a fire or a malfunction.

- **Keep the power cord away from heating appliances.**
  The coating of the power cord may melt and cause a fire or electric shock.

- **Do not place any object on the instrument.**

- **If the instrument is not used for an extended period of time, always disconnect the power plug from the power outlet to ensure the safety.**
  If the power plug is not disconnected, this may cause an electric shock or a fire.

- **The liquid crystal display is a touch screen method. In the sharp one such as the pointed one and pen points (Silicon rubber is excluded), never do the touch operation. Do the touch operation with the finger or the resin pen (silicon rubber).**
  The liquid crystal screen might be damaged when the liquid crystal screen is touched and operated by the sharp one, and it causes the breakdown.

- **Do not give an excessive impact to the LCD screen.**
  The screen may crack and the glass may scatter, which may result in injury.

⚠ CAUTION (Continued)

Transportation

- **When transporting the instrument, remove the power cord, cables, probes, etc. and use the original packing materials at time of purchase, or similar materials.**
  If a large vibration or shock is applied to the instrument during transportation, the instrument may malfunction, causing a fire. If appropriate packing and cushioning materials are not available, contact IWATSU or our sales distributors. When having the unit transported by a shipping company, write "Precision Instrument - Handle With Care" on each side of the packing box.

Other

- **Do not short-circuit the probe power connectors (P1 to P8) and output terminals (USB, AUX OUT, DVI-D) with metal or a damaged cord.**
  It may cause a fire or malfunction.

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

- **Do not use for a prolonged period without cleaning the inside.**
  If you use the instrument for a prolonged period without cleaning dust inside, fire or malfunction may result.
  We recommend to order IWATSU or our sales distributors for inside cleaning together with periodical inspection and calibration once a year or so.

- **Please note that the USB memory that can be used by connecting to the USB terminals on the front and side panels of this instrument has the following restrictions and conditions.**
  • Do not connect any device other than a USB memory, USB keyboard and USB mouse.
  • Use a USB memory formatted with FAT, FAT32 or exFAT. (exFAT does not support the read-only attribute.)
  • Do not connect multiple USB memory sticks.

  If you do not observe the above restrictions and conditions, the operation of this instrument and USB memory cannot be guaranteed.
  It may also cause a malfunction.

- **The life of the backup battery of the instrument is about 7 years. The battery cannot be replaced by the user.**
  Please replace it in about 7 years. Contact IWATSU or our sales distributors for replacement.

- **Do not use this instrument by method of no regulations with this instruction manual.**
  If not, the protection equipped in this instrument might not function.

Verify Packed Items

When you receive the instrument, check that the following items are included correctly while referring to the list of components and the component diagram shown below. If any item is missing or damaged during transportation, immediately contact IWATSU or our sales distributors.

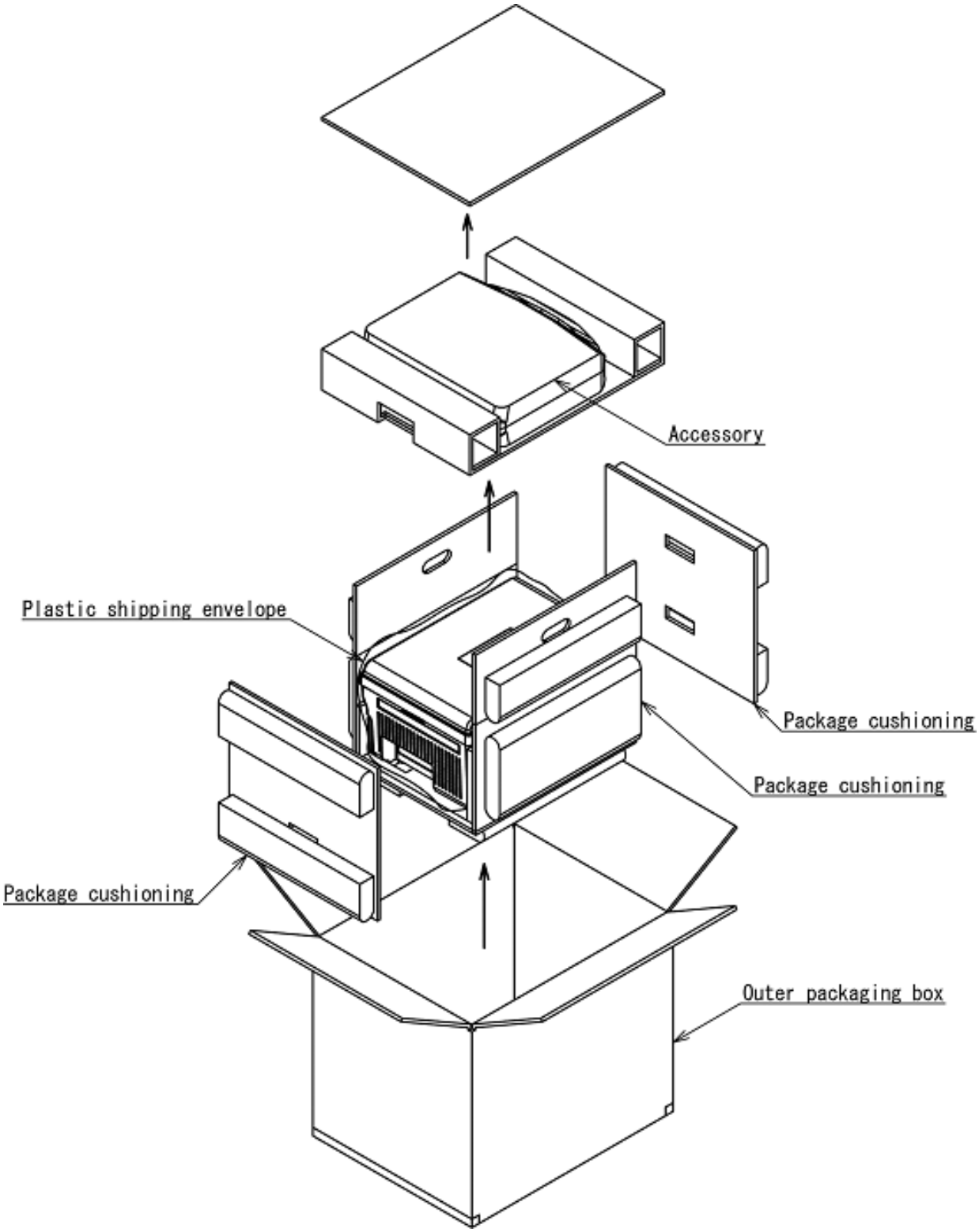
Items

○DS-8000 Series Oscilloscope ・・・・・・・・・・1
○Accessories (See accessory list below)

Accessory list

Item	Quantity
Probe (PML711i-R0)	4
Power cord (3 prong)	1
Manual CD	1
User's Guide (Booklet)	1
Front panel cover	1
Cord strap	1
Accessory storage case	1

Unpacking Drawing (Oscilloscope and Accessory)



Software Version Upgrade

Please check with our sales staff or our website as the software version upgrade is applicable to each instrument.
URL: https://www.iti.iwatsu.co.jp/index_e.html

Remote Control from PC

Please see the Remote Control Manual on the Manual CD.

How to Care

a) Cleaning

Before cleaning, pull out the power cord to avoid electric shock. To clean the housings, wipe it gently with a soft cloth moistened with water or a small amount of diluted neutral detergent. Do not use solvents or detergents, which may cause discoloration or unexpected damage. Select the solvent and detergent as follows.

- Solvents or detergents that can be used: water, neutral detergent (diluted)
- Unusable solvents or detergents: alcohol, gasoline, acetone, lacquer, detergent containing ether, thinner and ketone

b) Dirty screen

Remove dirt by the following method.

- Wipe off ordinary dirt with a soft cloth.
- Wipe off particularly severe stains with a cloth dampened with a neutral detergent.

Calibration

When used continuously, we recommend regular calibration about 2,000 hours or about every year. Please ask IWATSU for calibration.

Returning the Instrument for Repair

If the instrument malfunctions, contact IWATSU or our sales distributors and send it back to IWATSU. If the instrument malfunctions within the warranty period, IWATSU will repair it free of charge.
When sending back the instrument for repair, clarify the instrument name, serial Number (Please see 2.14.1 About Window), contents of fault, name of person in charge, company name or department name, and phone number.

How to Disposal

When disposing of the instrument, it is absolutely necessary to correctly recycle or dispose of the instrument according to the laws and regulations defined in the region. To dispose of the instrument, ask an appropriate recycle company according to the laws and regulations defined in the region.

Contents

Chapter 1 DS-8000 Series Overview

This chapter provides an overview of the DS-8000 series, installation method and user interface.

1.1 Features

- 8CH/4CH, 2.5 GS/s, 5 GS/s Sampling (interleaving), 12-bit High Resolution, 1 GHz/500 MHz/350 MHz Bandwidth
- 15.6 inch, Full-HD 1920 x 1080 with Capacitive Touchscreen
- Touchscreen User Interface
- Probe Power Connector per Each Channel

1.2 Key Performance of DS-8000 Series

Table 1.1 shows the key performance of the DS-8000 series. See Chapter 3, Performance for more detailed specifications.

Table 1.1 Key Performances of the DS-8000 Series

	DS-8108	**DS-8058**	**DS-8038**	**DS-8104**	**DS-8054**	**DS-8034**
Number of Channels	8			4		
Bandwidth	1 GHz	500 MHz	350 MHz	1 GHz	500 MHz	350 MHz
Bandwidth Limit	20 MHz/100 MHz/500 MHz	20 MHz/100 MHz		20 MHz/100 MHz/500 MHz	20 MHz/100 MHz	
Max., Sampling Rate Equivalent sampling Rate	5 GS/s: 12-bit (Interleaving [Note 1]) 2.5 GS/s: 12-bit (All Channels) 200 GS/s					
Time base Range	200 ps/div to 50 s/div	500 ps/div to 50 s/div		200 ps/div to 50 s/div	500 ps/div to 50 s/div	
Input Coupling	AC 1 MΩ, GND, DC 1 MΩ and DC 50 Ω.					
Vertical Sensitivity	1 mV/div to 10 V/div (1 MΩ) 1 mV/div to 1 V/div (50 Ω)					
Max. Input Voltage	1 MΩ: 400 Vpeak 50 Ω: 5 Vrms					

Note 1: Achieved by using multiple AD converters into one channel.

With the 4 CH model (DS-8104 / 8054 / 8034), up to 2 channels can be observed simultaneously at 5 GS/s.

With the 8 CH model (DS-8108 / 8058 / 8038), up to 4 channels can be observed simultaneously at 5 GS/s.

The combination of 2 channels is CH1 and CH2, CH3 and CH4, CH5 and CH6, CH7 and CH8.

1.3 Installation

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

1.3.1 Installation Conditions

■ Flat and horizontal place

Install it in a stable place, keeping it horizontal on the left, right, front and rear. If you use it in an unstable place, it may fall or fall, resulting in injury or malfunction.

■ Well-ventilated place

There are ventilation openings (right, rear and left when facing the front) on both sides and the rear of this instrument. To prevent the temperature inside the instrument from rising, leave a space of 15 cm or more around it so that these ventilation openings are not blocked.

■ Performance guarantee temperature, operating temperature, and humidity range

Performance Guarantee temperature range: +10 °C to +35 °C

> Operating temperature range, humidity range: 0 °C to +40 °C,
> 5% to 80% RH (30 °C or less, no condensation)
> 5% to 55% RH (40 °C or less, no condensation)
> Note: Condensation may occur if the temperature or humidity moves from a low temperature environment to a high temperature environment or if there is a sudden temperature change. In such a case, acclimatize to the ambient temperature so that the temperature gradually rises before use.

■ Power OFF

To turn off the power, you need to unplug the power cable from the rear panel or unplug the power cable from the power outlet. Please secure a space for that.

1.3.2 Installation

Install this instrument horizontally or at an angle using a stand.

Of the four legs on the bottom, the two legs on the front can be used as a stand and opened forward as shown in Figure 1.1 to give an inclination (about 10 °) for easier viewing.

The two front legs normally fold and open when tilted to act as a stand.

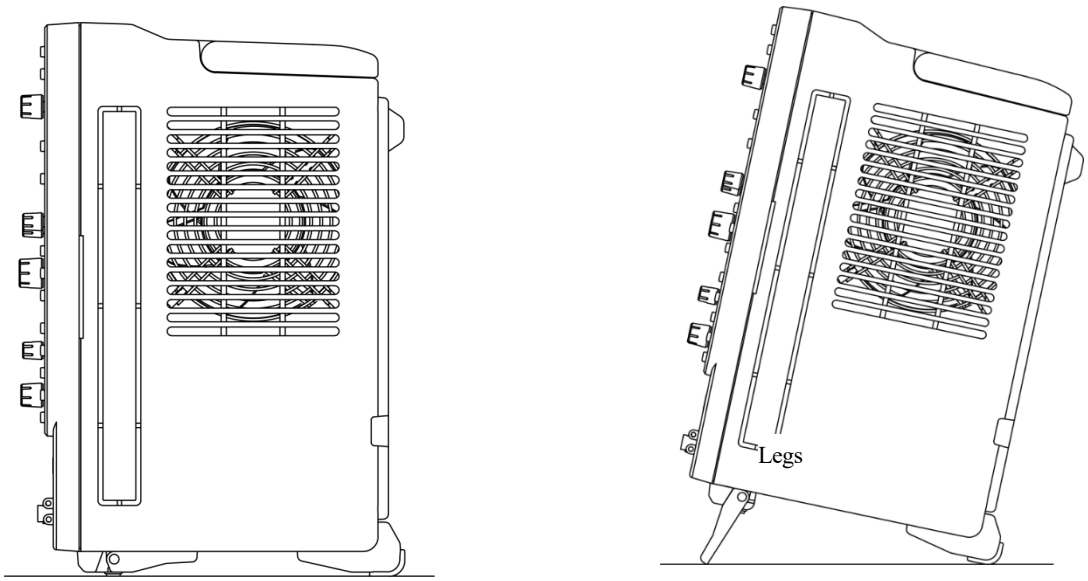


Figure 1.1 Horizontal and Tilted Installation

1.4 Power Connection, Power On / Standby

As for the power connection and power cable are explained in the warnings and cautions on pages ii to viii at the beginning of this manual. Be sure to follow the warnings and precautions when connecting to the power supply.

The following describes how to connect the power supply and how to turn on / stand by the power supply of this oscilloscope.

1.4.1 Power Cord Connection

Operating procedure

1. Connect the supplied power plug into the AC line input (~ LINE) on the Rear panel (see Figure 1.2).
2. Connect the other plug of the power cable to a power outlet (see Figure 1.2)

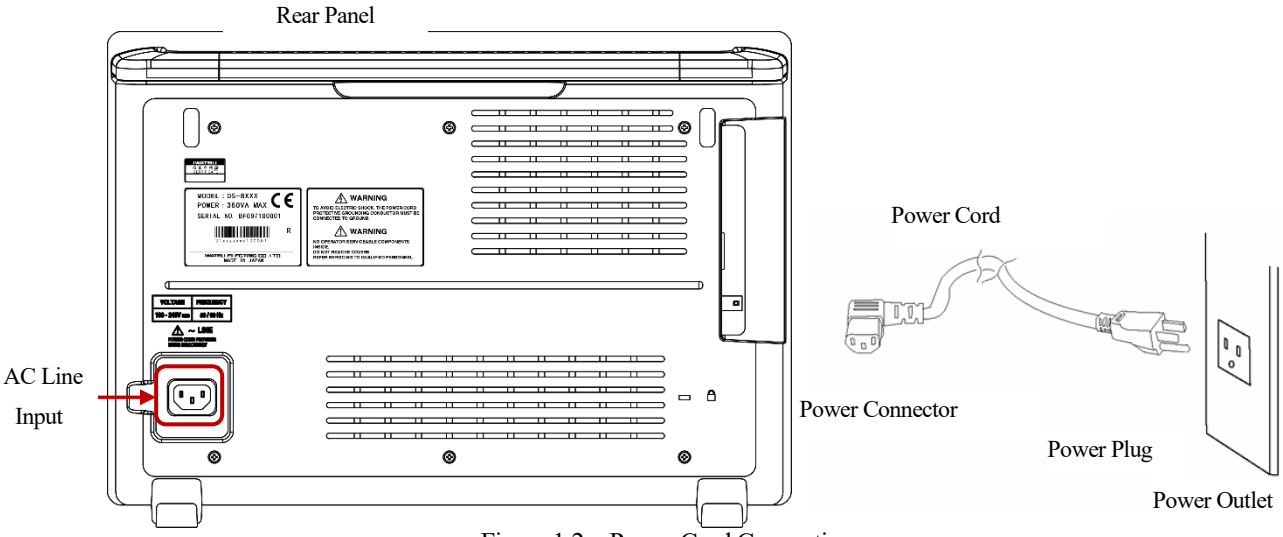


Figure 1.2 Power Cord Connection

1.4.2 Power On / Standby

The POWER button is located at the bottom left of the front panel in Figure 1.3. If you press and hold the POWER button for 0.5 seconds or longer, the LED will light up and the power will turn on. To put the power supply on standby, press and hold the POWER button for 1 second or longer to turn off the LED and put the power supply on standby.

To turn off the power, you need to unplug the power.

Operating procedure

1. Press and hold the POWER button for 0.5 seconds or longer.
2. The LED lights up and the power turns on.

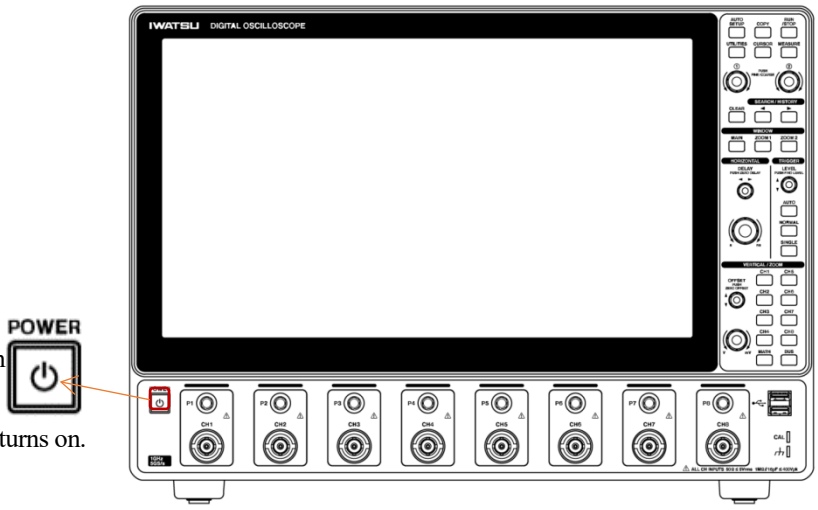


Figure 1.3 Power On / Standby

- The status when the power is turned on

  When the power is turned on, it starts up in about 30 seconds and enters the waveform standby state. However, until the waveform is captured, the state will be "No waveform data", nothing will be displayed in the waveform display area.

Note: For accurate measurement, warm up for at least 20 minutes after turning on the power.

- Behavior during power standby

  When the power is set to standby (even if the power cable is unplugged), the previous setting is stored. The next time you turn on, the stored setting conditions will be recalled automatically.
- If you turn the power off and then turn it on later, leave it at least 10 seconds
- To turn off the power, unplug the power cable from the Rear panel. Alternatively, unplug the power cable from the power outlet.

1.5 Controls and Functions

1.5.1 Front Panel

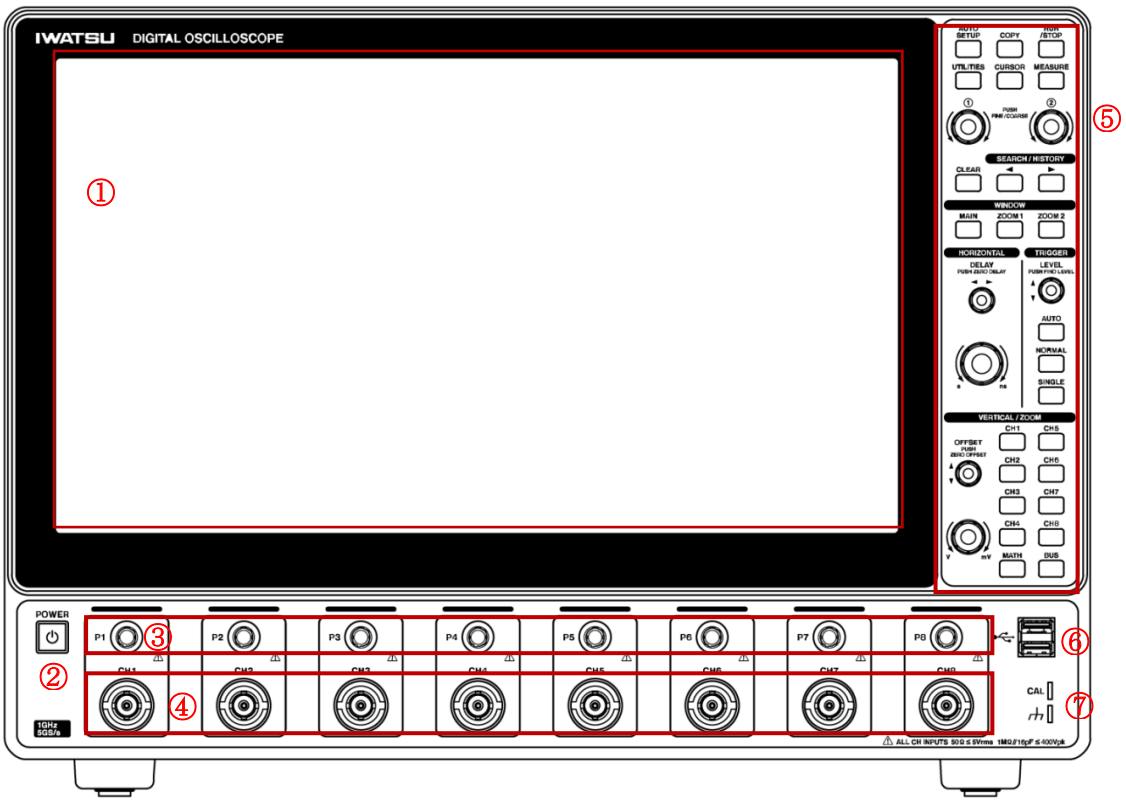


Figure 1.4 Front Panel

Table 1.2 The functions of the control on the front panel

No.	Name	Description
①	Display	15.6-inch, Full-HD 1920 x 1080, capacitive touch screen, 16,777,216 or more colors, waveforms and CH information are displayed in different colors.
②	POWER Button	Power button. By pressing, the power supply transitions (toggle change) from the standby state to the on state and from the on state to the standby state.
③	Probe Power Connectors	Connectors that supply power to the active probes of P1, P2, P3, P4, P5, P6, P7, and P8 (P5, P6, P7, P8 are 8CH models only) from the front left side. See 1.13 Probe Power Connectors.
④	INPUT Connectors	Signal input (BNC) connectors for CH1, CH2, CH3, CH4, CH5, CH6, CH7, and CH8 (CH5, CH6, CH7, CH8 are 8CH models only). Input specifications are listed at the bottom of the panel.
⑤	Operation Panel	It can be operated with the buttons or Knobs on the Operation Panel.
⑥	USB Ports	A USB port for inputting and/or outputting data from a USB memory and connecting a USB keyboard and USB mouse. ・Input function: Used when upgrading the main unit software or changing data or setting. ・Output function: Outputs screen data and set up to a USB memory.
⑦	CAL Terminals	Outputs the calibration signal. The top is the CAL signal output terminal and the bottom is the GND terminal. Mainly used for probe calibration. The output signal is a square wave of 4.0 V ± 3% and 1 kHz ± 0.5%.

1.5.2 Rear Panel and Side Panel

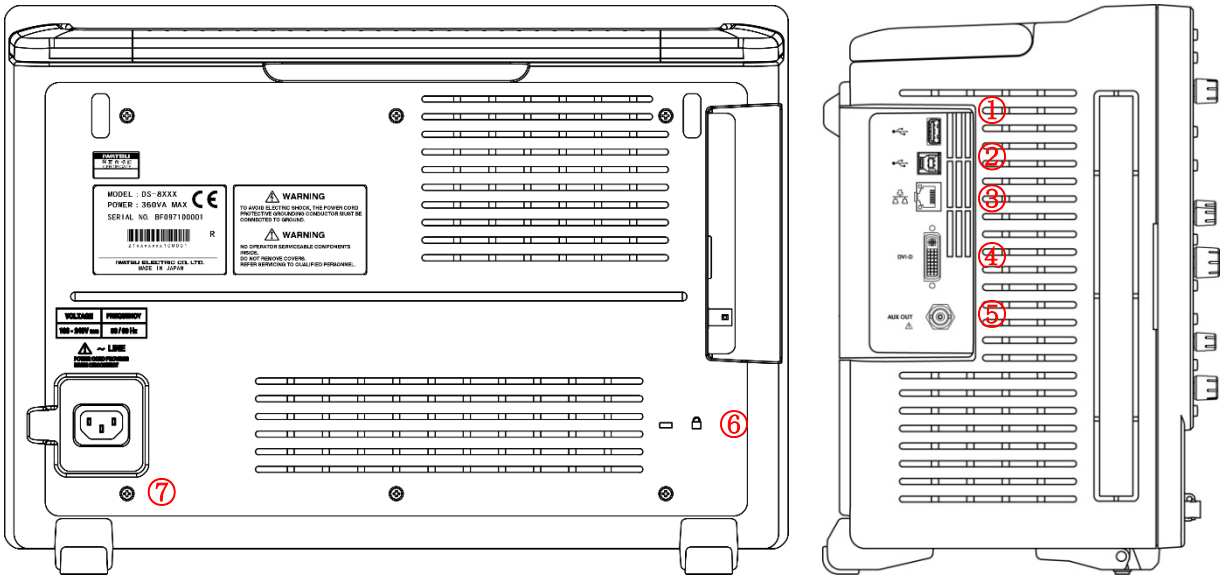


Figure 1.5 Rear and Side Panel

Table 1.3 Rear panel and side panel

№	Name	Description
①	USB Port	Connector for inputting / outputting data of USB memory, USB keyboard, and USB mouse. ・Input function: Used when upgrading the firmware or changing data or setting conditions. ・Output function: Outputs screen data and setting conditions to a USB memory.
②	USB Port	USB Device Port. Remote control is possible using the USB Port.
③	LAN Port	LAN port. It can be connected to a PC for remote control. For the remote control commands, see the "DS-8000 Remote Control Manual" included in the Manual CD.
④	DVI-D Connector	Full HD (1920 x 1080) fixed output. When you can connect to an external monitor to view the oscilloscope screen, connect to the external monitor with the power of the oscilloscope turned off and start the oscilloscope.
⑤	AUX OUT Connector	AUX OUT: Outputs H level TRIG output (square wave signal) when trigger occurs. (Caution: It is an output terminal and will be damaged if voltage is input). The maximum output voltage is 3.3 Vmax.
	TRIG IN Connector	TRIG IN: External trigger input if this instrument implements DS-601(DS8K EXT-TRIG-IN) factory option.
⑥	Kensington Lock Hole	Pass the handle part such as Kensington lock through the upper hole.
⑦	AC Line Input	AC power connector. The AC power specifications are listed above.

1.6 Display Screen Configuration

The display screen consists of a Waveform Display Area, Readouts, Lists, MENU button and Windows.

Table 1.4 Display screen configuration

Item	Description
Waveform Display Area	The YT waveforms are displayed (Maximum 1800 x 960 pixels). When the zoom display, up to two areas of the waveform can be zoomed in. Up to 18 screens can be displayed in split display. The 4CH model can display up to 14 screens.
XY Waveform Display Area	The XY waveforms are displayed alone or side by side on the left side of the waveform display area.
Readouts	The setting value and acquisition results are displayed as a character string.
List	Measure and the Bus decoding result are displayed in a list format. It can be displayed vertically stacked with the waveform display area.
MENU Button	Tap the MENU button at the top right of the screen to display the MENU. Each Settings Window is displayed from the item of this MENU.
Window	The setting screen for each item is displayed in window format.

1.6.1 Screen Layout

- The waveform display area that displays the YT waveform can be zoomed and split. The Readout that displays the setting value and acquisition result of each item as a character string is displayed at the bottom and right of the screen, and the list is displayed at the bottom of the waveform display area.

1.6.1.1 XY Waveform Display Area and Waveform Display Area Layout

The XY Waveform Display Area is displayed on the left side of the screen, and the Waveform Display Area is displayed on the right side of the screen.

Note: When the Sample mode is set to Roll, the XY Waveform Display Area cannot be displayed in Roll mode, so the message "Unable to display XY screen when Roll is selected." is displayed and the XY Waveform Display Area is closed.

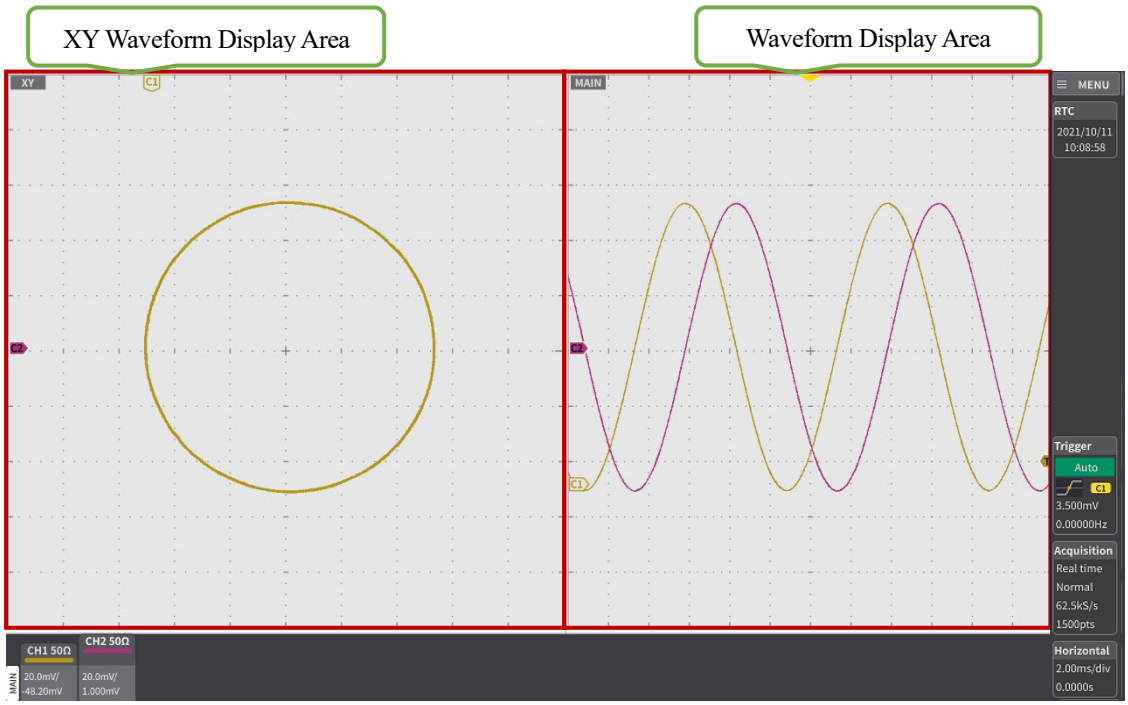


Figure 1.6 Screen layout (XY waveform and YT waveform)

1.6.1.2 Waveform Display Area, MENU button and Readout layout

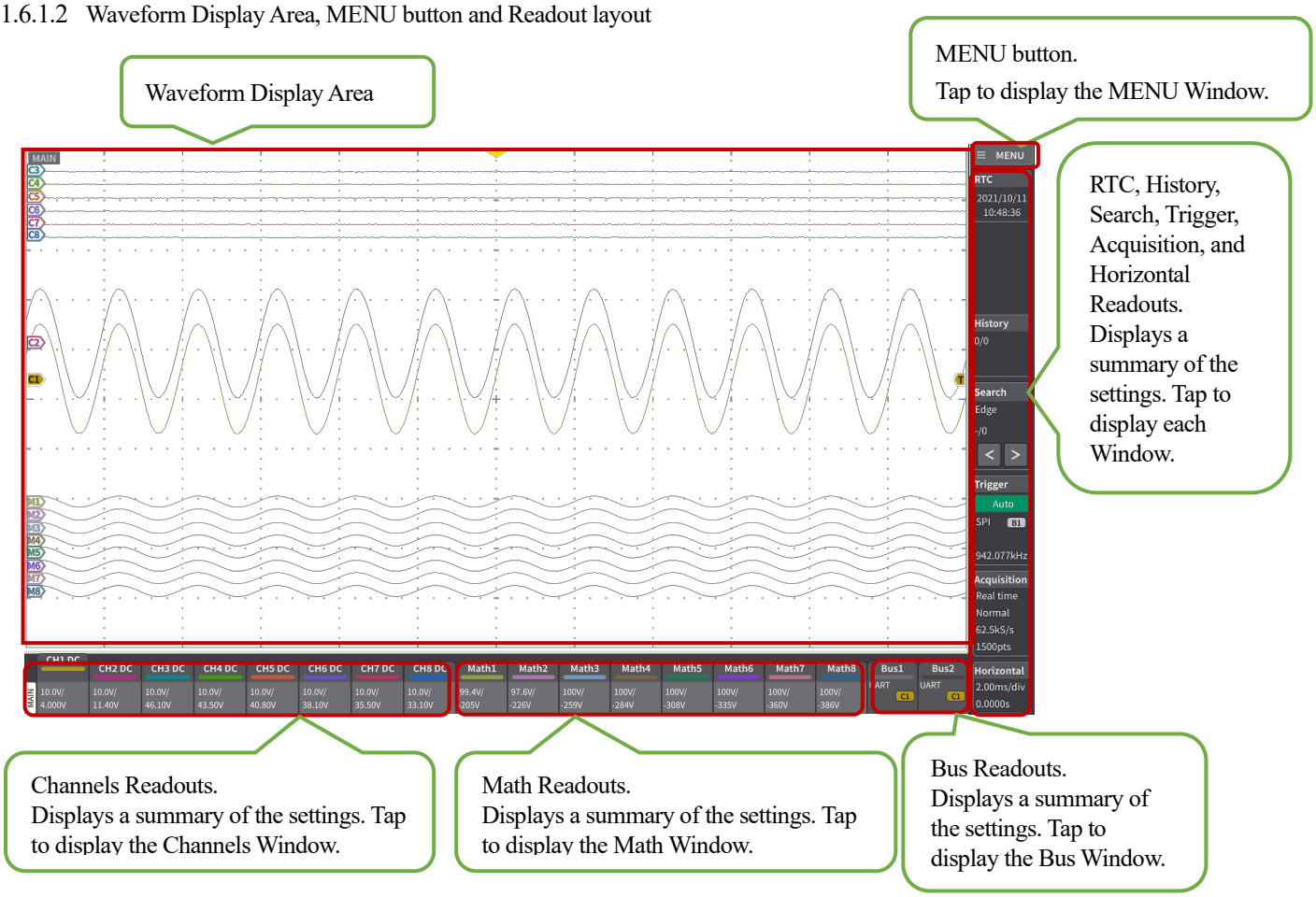


Figure 1.7 Screen (YT waveform, MENU button and Readout)

Note: The screen color scheme is set to Color scheme 2 suitable for hard copy.

1.6.1.3 List Layout

Displays Measure, Search and Bus decoding results in list format. The list is displayed vertically stacked with the waveform display area.

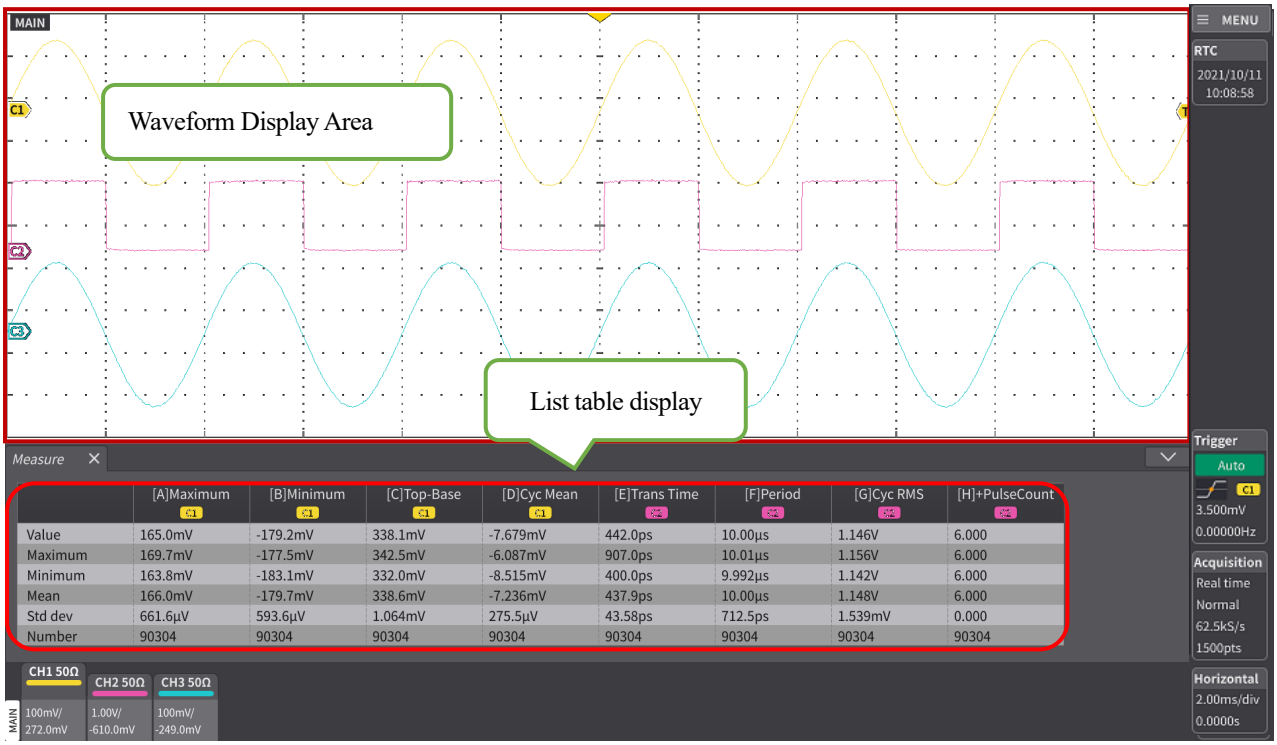


Figure 1.8 Screen (YT Waveform and List table)

The decoding result and list are displayed vertically stacked with the waveform display area.

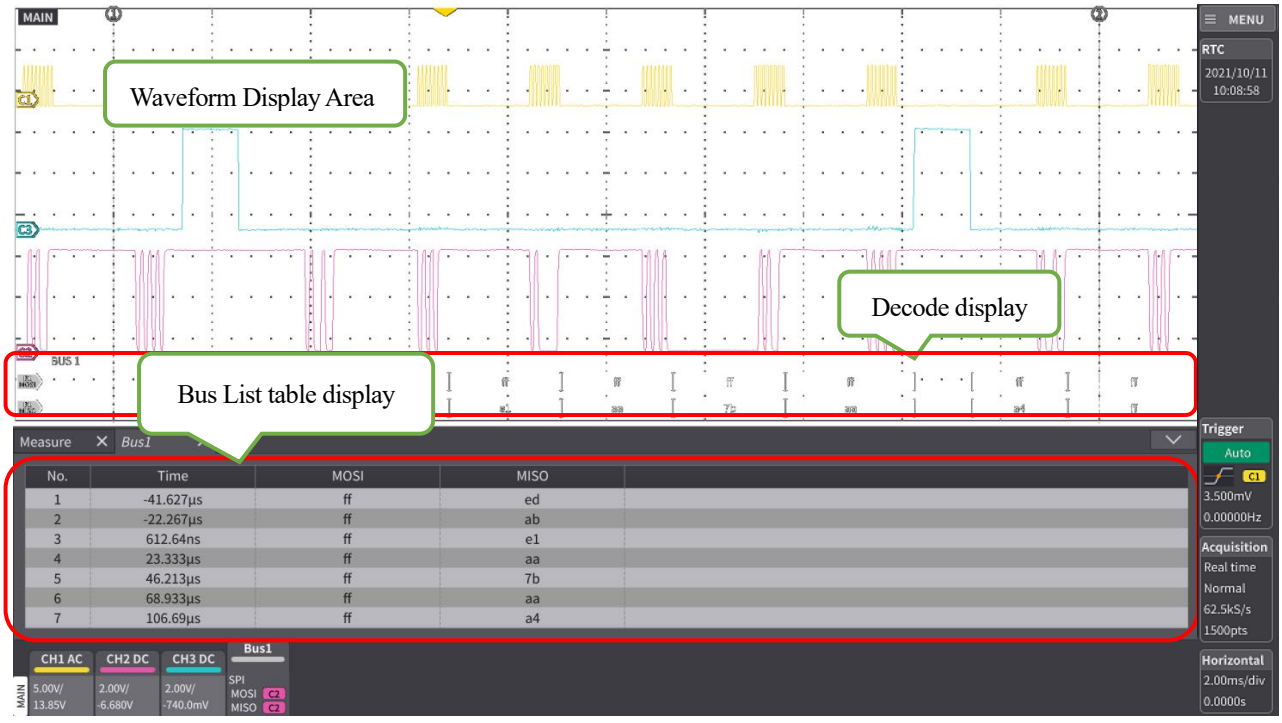


Figure 1.9 Screen (Bus Waveform SPI, Bus List table and Decoding Result

1.6.1.4 MENU Button

- By tapping the MENU button on the upper right of the screen, the MENU Window shown in Figure 1.10 and Table 1.5 is displayed.
- Tap an item on this MENU Window to display the selected Settings Window.
- When you select a MENU item, the Settings Window is displayed and the MENU Window is closed.
- You can also close the displayed MENU Window by tapping the "Close" button.

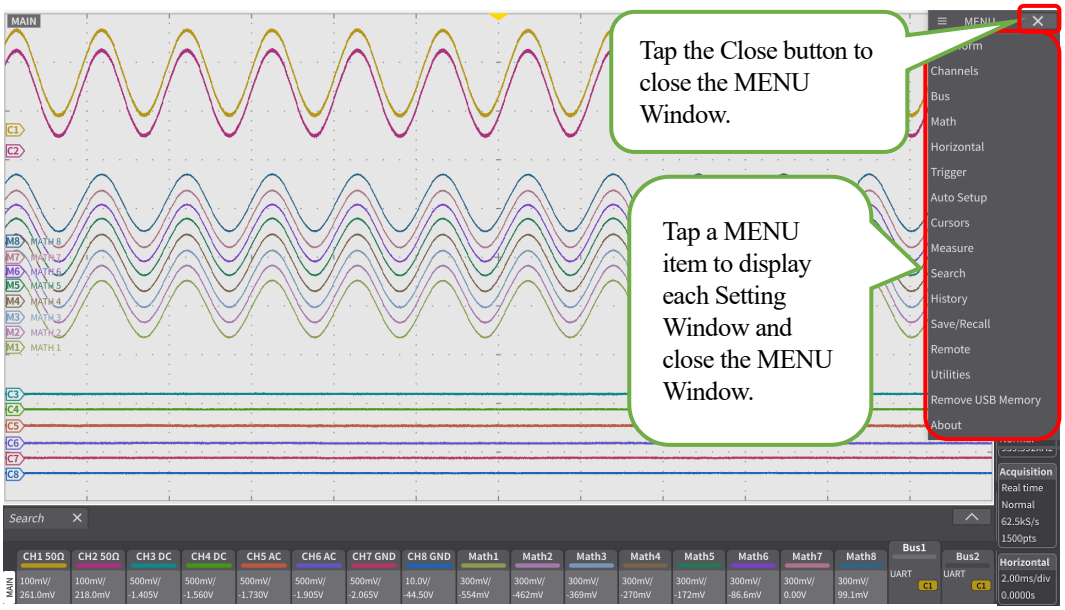


Figure 1.10 Screen (MENU button and MENU Window)

Table 1.5 MENU Window

Item	Action
× (Close button)	Close the MENU Window.
Waveform	Display Waveform Window.
Channels	Display Channels Window.
Bus	Display Bus Window.
Math	Display Math Window.
Horizontal	Display Horizontal Window.
Trigger	Display Trigger Window.
Auto Setup	Display Auto Setup Window.
Cursors	Display Cursors Window.
Measure	Display Measure Window.
Pass/Fail	Display Pass/Fail Window.
Search	Display Search Window.
History	Display History Window.
Save/Recall	Display Save/Recall Window.
Remote	Display Remote Window.
Utilities	Display Utilities Window.
Remove USB Memory	The USB memory can be safely removed by executing the MENU.
About	Display About Window.

1.6.1.5 Window

- Tapping the item on the MENU Window, each Settings Window is displayed in Window format.
- You can perform setting operations from the window-style Settings Window.

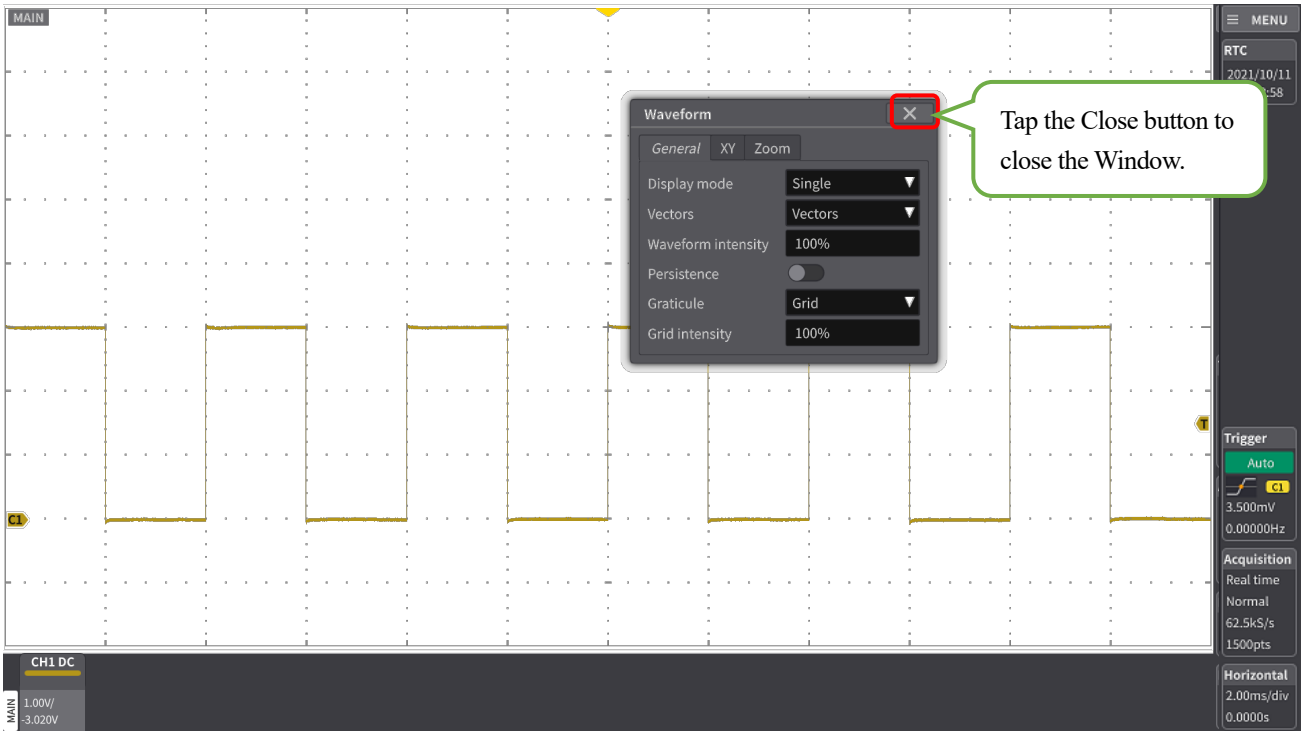


Figure 1.11 Screen example (Waveform Window)

1.6.1.6 Screen Transition (Screen Operation)

Tap (operate) the MENU button, MENU Window, or readout to display the Settings Window as shown in Figure 1.12.

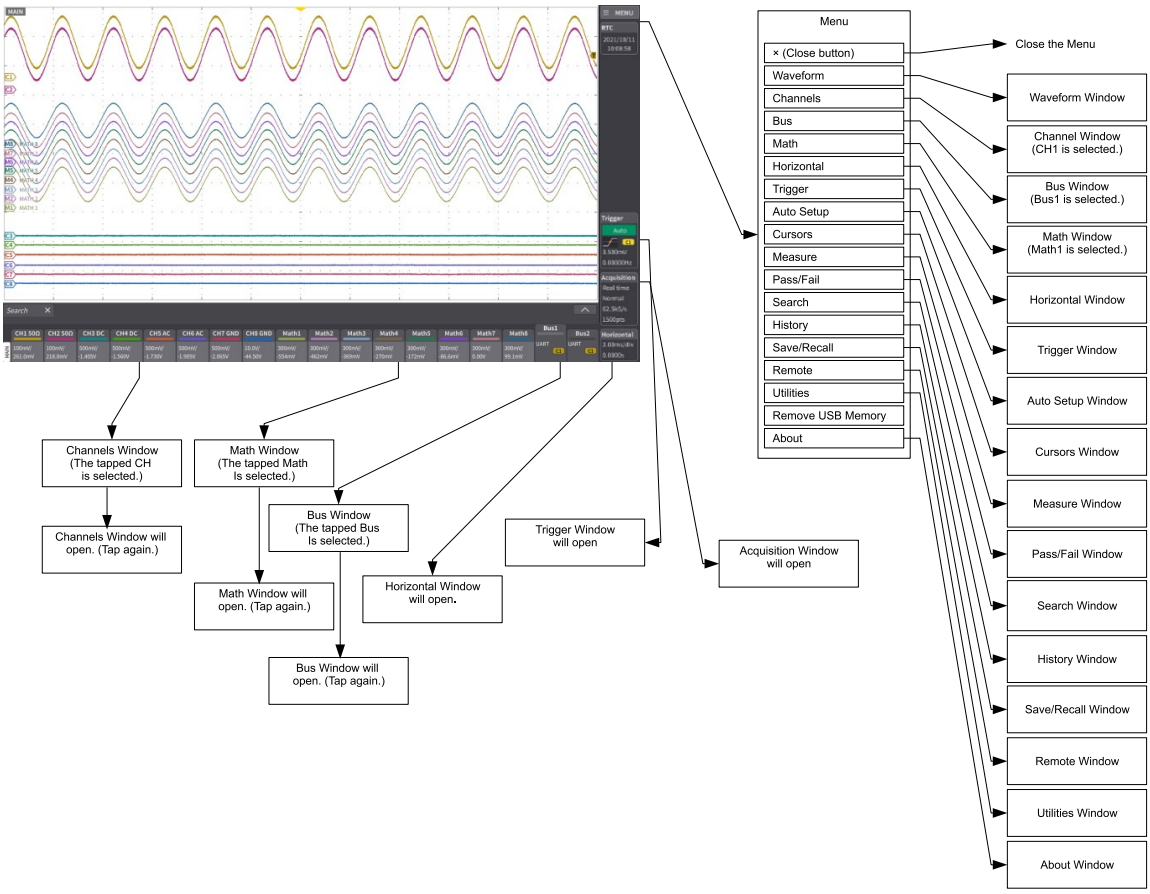


Figure 1.12 Displayed Window transition during readout and MENU operation.

1.6.2 Readout

- The setting value and acquisition result are displayed as a character string.
- When you tap a Readout, the Readout Settings Window is displayed.

- Channels Readout

The Channels Readout displays a configuration summary of the settings for each channel at the bottom of the screen.
The Readout of the main waveform is displayed as C-1 to C-6, and the Readout of the Zoom waveform is displayed as C-4 and C-6.

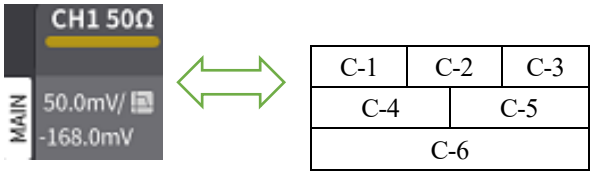


Figure 1.13 Channels Readout Layout

Table 1.6 Channels Readout Configuration

	Item	Description
C-1	Title	CH + (Number of Channel)
C-2	Input Coupling	AC
		GND
		DC
		50 Ω
C-3	Invert	Blank (No Invert)
		↕ (Invert is ON)
C-4	MAIN (Vertical Range)	Value + Unit + /
C-5	Bandwidth Control Icons	When bandwidth is limited, the characteristics of bandwidth limitation are displayed as icons.
C-6	MAIN Offset Voltage	Value + Unit

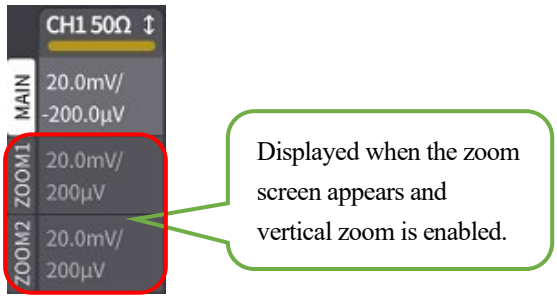


Figure 1.14 Channels ZOOMs Waveform Readout Layout

■ Bus Readout

Bus Readout displays a summary of the settings for each Bus at the bottom of the screen. Nothing is displayed in the Zoom waveform Readout.

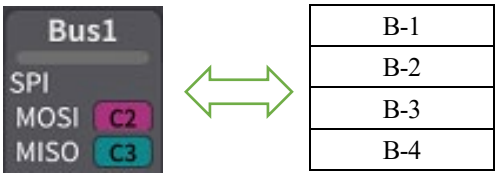


Figure 1.15 Bus Readout Layout

Table 1.7 Bus Readout Configuration

	Item	Description
B-1	Bus Number	Bus + Number (Example: Bus1)
B-2	Bus type	When the Bus type is UART
		When the Bus type is SPI
		When the Bus type is I2C
B-3	Data input CHx	For UART (Example: CH1)
		For SPI (Example: MOSI CH1)
		For I2C (Example: SDA CH1)
B-4	Data input CHx or Source	For UART and I2C
		For SPI (Example: MISO CH1)

■ Horizontal Readout

The Horizontal Readout displays a summary of the Horizontal axis settings on the right side of the screen.

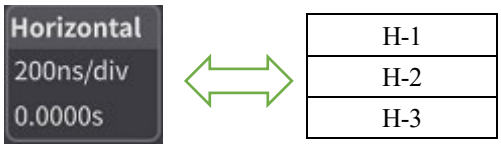


Figure 1.16 Horizontal Setting Readout Layout

Table 1.8 Horizontal Setting Readout Configuration

	Item	Description
H-1	Title	Character string “Horizontal”
H-2	Timebase Range	Value + s/div
H-3	Delay Time	Value + s

■ Trigger Readout

The Trigger Readout displays a summary of the trigger settings on the right side of the screen.

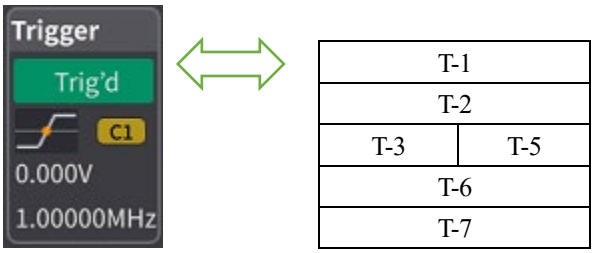


Figure 1.17 Trigger Readout Layout

Table 1.9 Trigger Readout Configuration

	Item	Display Content		Description
T-1	Title	Character string “Trigger”		If trigger jitter reduction works, * will be displayed.
T-2	Trigger Status	Stop	Stop Trigger	Stopping
		Endless	Endless Trigger	Displayed when the trigger mode is Auto in Roll.
		Auto	Auto Trigger	When the trigger is auto
		Inhibit	During Inhibit	During the inhibit period
		Ready	Trigger Ready Status	Waiting for trigger
		Trig’d	Triggered	Trigger detected
T-3	Trigger Type Icons			Edge (Positive / Negative)
				Edge ALT
				Edge OR
				Pulse Count
				Pulse Width (Positive / Negative)
				Period (Positive / Negative)
				Dropout (Positive / Negative)
				OR
				NOR
				AND
				NAND
		UART (Character string)		UART
		SPI (Character string)		SPI
		I2C (Character string)		I2C
				Sequence
				Transition Time (Rise / Fall)
T-5	Source Icons	 to  ,  , 		Trigger source CH1 to CH8, Bus 1, Bus 2, Line (Edge only). Not displayed for Edge OR and logic trigger. If the Bus source is None, it will not be displayed.

T-6	Trigger Level	Value + Unit Low/Mid/Up (Transition Time only)	The trigger level (voltage value) of the last selected trigger source. Not displayed for Edge OR, logic trigger, and serial trigger. For Transition Time, it indicates whether the waveform is at the bottom (Low), inside (Mid), or top (Up) in the area between Level(High) and Level(Low).
T-7	Frequency Counter	Value + Hz	Shows the frequency of the trigger.

■ Acquisition Readout

The Acquisition Readout displays a summary of waveform acquisition settings on the right side of the screen.
Tap the Acquisition Readout to display the Horizontal Window.

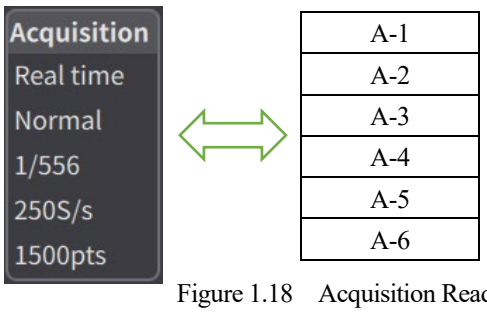


Figure 1.18 Acquisition Readout Layout

Table 1.10 Acquisition Readout Configuration

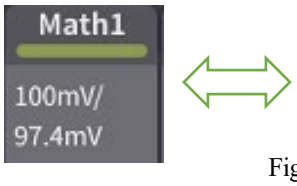
	Item	Description	
A-1	Title	Character string “Acquisition”	
A-2	Sample Mode	Normal	Real time
		Equivalent	Equ
		Roll	Roll
A-3	Acquisition Mode	Normal	Normal
		Peak Detect	Peak
		Average	Avg + Number of times
		Hi Res	HR + Number of Bit
		Advance Hi Res	A-HR + Number of Bit
		Sine Interpolation	Sin(x)/x
A-4	Number of Pages	[Current # of Pages] / [Total Pages]	
A-5	Sampling Rate	Value + S/s	
A-6	Number of Points	Value + pts	

■ Math Readout

The Math Readout provides a summary of each Math's settings at the bottom of the screen.

Tap the Math Readout to display the Math window.

The Readout of the main waveform is displayed as M-1 to M-5, and the Readout of the Zoom waveform is displayed as M-4 to M-5.



M-1
M-3
M-5 or M-4

Figure 1.19 Math Readout Layout

Table 1.11 Math Readout Configuration

	Item	Description
M-1	Number of Math	Math+(Number of Math)
M-3	Vertical Range[Note 1]	Value + Unit + /
M-4	Frequency Range (FFT only) [Note 1]	Value + Hz/
M-5	Position [Note 1]	Value + Unit

Note 1: Since the Zoom waveform is not displayed in FFT operation, the contents of the readout are displayed in blank.

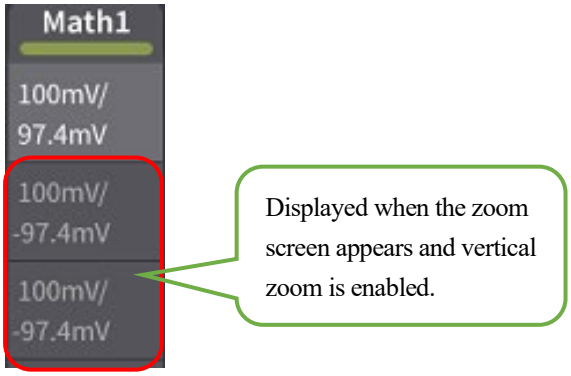


Figure 1.20 Math Readout ZOOMs Waveform Layout

■ RTC / ACQ Readout

The RTC / ACQ Readout displays the current time or waveform acquisition time on the right side of the screen. Tap the RTC / ACQ Readout to display it with the Date & time tab selected in the Utilities Window. When the Acquisition timestamp is set in 2.6.3.1 Display, the time when the waveform was acquired is displayed by the ACQ Readout shown in Figure 1.22.

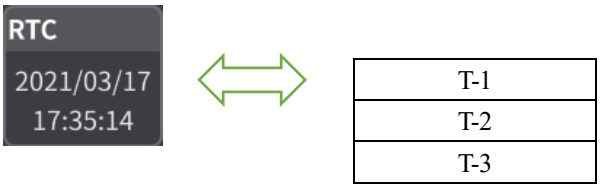


Figure 1.21 RTC Readout Layout

Table 1.12 RTC Readout Configuration

	Item	Description
T-1	Title	Character string “RTC”
T-2	Date	Year/Month/day
T-3	Current Time	Current Time

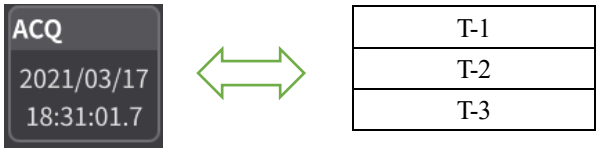


Figure 1.22 ACQ Readout Layout

Table 1.13 ACQ Readout Configuration

	Item	Description
T-1	Title	Character string “ACQ”
T-2	Date	Year/Month/day
T-3	Time Stamp	Time when the waveform was acquired

■ Cursor Readout

The Cursor Readout displays Channel, Math, and Horizontal cursor settings and measurement results. For Channel and Math, it is displayed below the MAIN, ZOOM1, and ZOOM2 Readouts on the screen. When it is Horizontal, it will be displayed at the bottom of the Horizontal Readout. Tap the Cursor Readout to display the Cursors Window. Cursor Readouts are not displayed when Cursors is OFF.

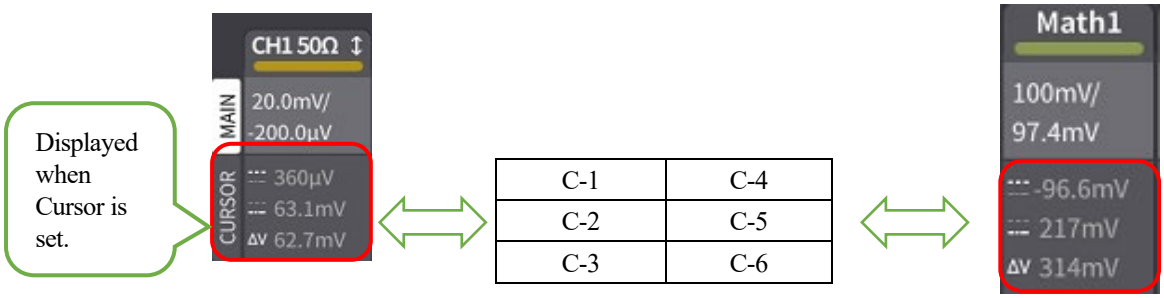


Figure 1.23 Cursor Readout Layout for CH and Math

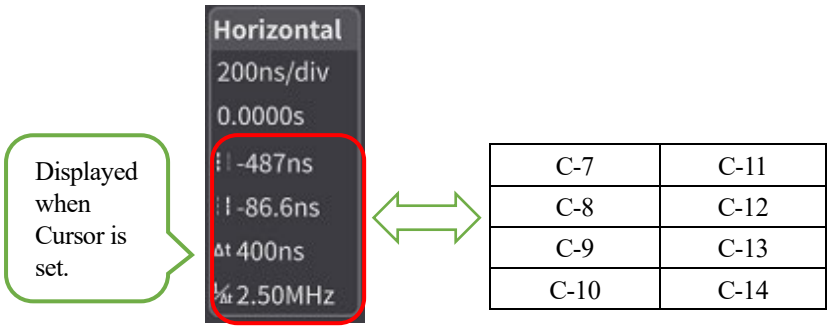


Figure 1.24 Cursor Readout Layout for Horizontal

Table 1.14 Cursor Readout Configuration

	Item	Description
C-1	Vertical axis cursor1 Icon	Cursor1 line type
C-2	Vertical axis cursor2 Icon	Cursor2 line type
C-3	ΔV Icon	voltage difference
C-4	Cursor1 voltage value	Value + unit
C-5	Cursor2 voltage value	Value + unit
C-6	Voltage difference value	Value + unit
C-7	Horizontal axis cursor1 Icon	Cursor1 line type
C-8	Horizontal axis cursor2 Icon	Cursor2 line type
C-9	Δt Icon	Time difference
C-10	1/Δt	Frequency difference
C-11	Cursor1 time	Value + unit
C-12	Cursor2 time	Value + unit
C-13	Δt	Δt: Value + s
C-14	1/Δt	1/Δt: Value + Hz

Table 1.15 shows the relationship between the Cursor type setting and the Readout to be displayed. If all items are unselected, their Readout will not be displayed.

Table 1.15 Cursor type and Cursor Readout to display (○: Show, ×: Hide)

Cursor type	CH1 to CH8, Math1 to Math8 Cursor Readout			Horizontal Cursor Readout			
	Cursor1 C-1, C-4	Cursor2 C-2, C-5	ΔV C-3, C-6	Cursor1 C-7, C-11	Cursor2 C-8, C-12	Δt C-9, C-13	1/Δt C-10, C-14
Time	×	×	×	○	○	○	○
Amplitude	○	○	○	×	×	×	×
Time & Amplitude	○	○	○	○	○	○	○
Value at cursor	○	○	×	○	○	○	○

■ Search Readout

Search Readout displays a summary of Search settings and Previous Button and Next Button on the right side of the screen. When tap other than the Previous Button and Next Button of Search Readout, the Search window will be displayed. Table 1.17 shows the operation when the Previous Button and Next Button are tapped. Search Readout is displayed only when Search is enabled.

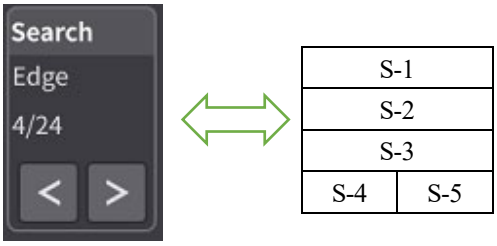


Figure 1.25 Search Readout Layout

Table 1.16 Search Readout Configuration

	Item	Description
S-1	Character string “Search”	
S-2	Search target	Edge
		Cyc RMS
		Cyc Mean
		Trans Time
		Frequency
		Period
		Pulse Width
		Duty Cycle
S-3	Current search result	[The number oh Currently displayed search result] / [Total number of search results]
S-4	Previous Button	Prev –S Icon
S-5	Next Button	Next –S Icon

Table 1.17 Previous Button and Next Button operation

Button to Tap	Operation
Previous Button	Return to the previous search result.
Next Button	Proceed to the next search result.

■ History Readout

History Readout displays a summary of History settings and the Previous Button and Next Button on the right side of the screen. Tap any button other than Previous Button and Next Button in History Readout to display the History window. Table 1.19 shows the operation when the Previous Button and Next Button are tapped. History Readout is displayed only when History is enabled.

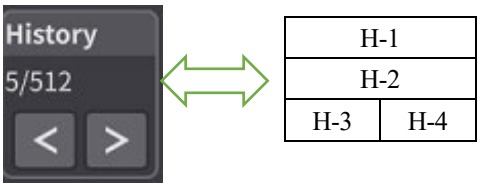


Figure 1.26 History Readout Layout

Table 1.18 History Readout Configuration

	Item	Description
H-1	Character string “History”	
H-2	Current history	[Currently displayed history number] / [Total number of history]
H-3	Previous Button	Prev –S Icon
H-4	Next Button	Next –S Icon

Table 1.19 Previous Button and Next Button operation

Button to Tap	Operation
Previous Button	Return to the previous history result.
Next Button	Proceed to the next history result.

1.6.2.1 Readout Show / Hide

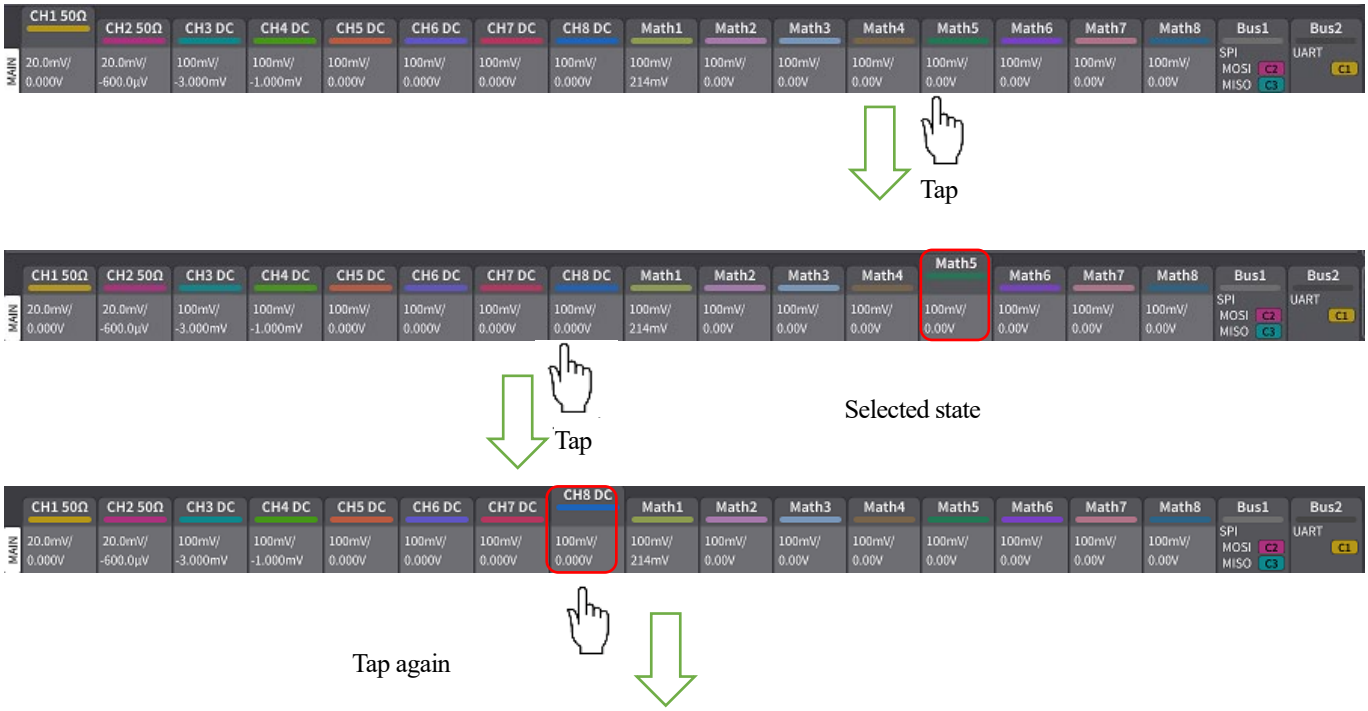
The setting OFF / ON of each item determines Show / Hide of Readout.

Table 1.20 The setting OFF / ON of each item vs Show / Hide of Readout

Item	OFF/ON	Readout (○: Show, ×: Hide, —: Depends on other items)								
		Channel		Bus	Math		Horizontal Trigger Acquisition Time	Cursor	Search	History
		Main	Zoom		Main	Zoom				
Channel	OFF	×	×	—	—	—	— (Always shown)	—	—	—
	ON (Zoom: OFF)	○	×	—	—	—		—	—	—
	ON (Zoom: ON, Vertical zoom: ON)	○	○	—	—	—		—	—	—
	ON (Zoom: ON, Vertical zoom: OFF)	○	×	—	—	—		—	—	—
Bus	OFF	—	—	×	—	—		—	—	—
	ON (Zoom: OFF)	—	—	○	—	—		—	—	—
	ON (Zoom: ON)	—	—	○	—	—		—	—	—
Math	OFF	—	—	—	×	×		—	—	—
	ON (Zoom: OFF)	—	—	—	○	×		—	—	—
	ON (Zoom: ON, Vertical zoom: ON)	—	—	—	○	○		—	—	—
	ON (Zoom: ON, Vertical zoom: OFF)	—	—	—	○	×		—	—	—
Cursors	OFF	—	—	—	—	—		×	—	—
	ON	—	—	—	—	—		○	—	—
Search	OFF	—	—	—	—	—		—	×	—
	ON	—	—	—	—	—		—	○	—
History	OFF	—	—	—	—	—		—	—	×
	ON	—	—	—	—	—		—	—	○

1.6.2.2 Readout selection status and display of Settings Window

When you tap Channels, Bus, or Math Readout, that Readout will be selected.



When you tap the selected Readout, the Channels Window is displayed.

Figure 1.27 Select Readout and display Settings Window

1.6.2.3 Displaying the Settings Window from Readout

Channel Readout displays the Settings Window (Channels Window) when tapping Channel Readout [CH8].

Figure 1.28 Display of Channels Window by tapping Channels Readout

1.6.3 List Table

The list Table shows Bus decode results and Measurement results. It is a switchable tab-type, and each cannot be displayed at the same time. Whether or not to display the list table is determined by the setting of the Show List toggle switch in each Settings Window.

At the right end of the list title bar, you'll see a fold button when opened and an open button when folded. You can fold or open the list by tapping this button.

Touch the title bar of each list to display its contents in the list table. You can also hide the list by touching the close button on the list title bar. At this time, the status of the Show List toggle switch in each Settings Window is also linked.

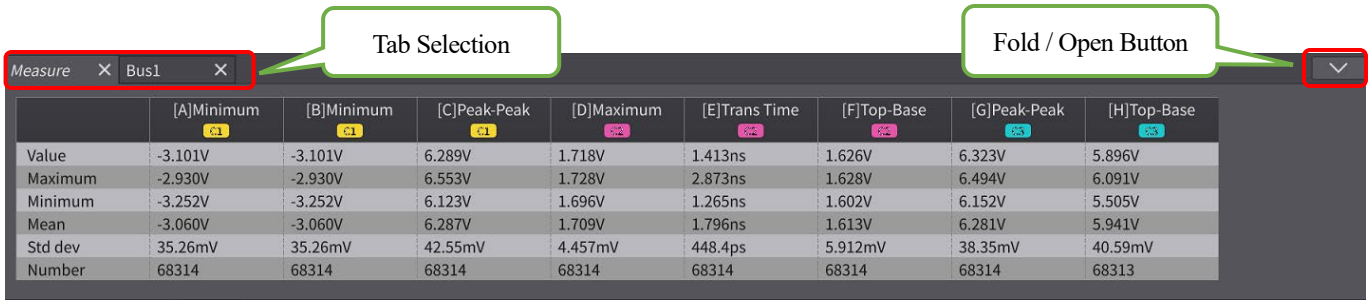


Figure 1.29 List Table display example (when the Measure list is opened in the selected state)

■ Bus List Table

The columns displayed in the Bus list are shown in Table 1.21, Table 1.22 and Table 1.23. It can be selected for each line, and when a line is selected, a marker is displayed in the corresponding part of the waveform.

Table 1.21 Columns displayed in the Bus list (UART)

Column Header	Column Content	Display Format	Example
No.	The number of decode result	The decode result at the beginning of the waveform is 1.	1
Time	Timestamp	The time when the trigger point is 0s.	1.8228ms
Data	Decode Result	Completed successfully: 2 Hex digits.	78
		Not completed successfully: Unknown	Unknown
Parity	Parity Error	No Parity: None	None
		No Parity Error: OK	OK
		When Parity Error Occurred: Error	Error

Table 1.22 Columns displayed in the Bus list (SPI)

Column Header	Column Content	Display Format	Example
No.	The number of decode result	Integer value. The decode result at the beginning of the screen is 1.	1
Time	Timestamp	The time when the trigger point is 0s.	1.8228ms
MOSI	MOSI Decode Result	1 to 4 Hex digits. Depending on the Word Size, 1 digit for 4 bits, 2 digits for 4-8 bits, 3 digits for 9-12 bits, and 4 digits for 13-16 bits.	8F
MISO	MISO Decode Result	1 to 4 Hex digits. Depending on the Word Size, 1 digit for 4 bits, 2 digits for 4-8 bits, 3 digits for 9-12 bits, and 4 digits for 13-16 bits.	9E

Table 1.23 Columns displayed in the Bus list (I2C)

Column Header	Column Content	Display Format	Example
No.	The number of decode result	Integer value. The decode result at the beginning of the screen is 1.	1
Time	Timestamp	The time when the trigger point is 0s.	1.8228 ms
Condition / Address / Data	Condition, address or decode result	Start	Start
		Stop	Stop
		Restart	Restart
		7-bit Address: "A:" + 2-digit Hex addresses + "R" or "W"	A:53R
		10-bit Address: "A:" + 3-digit Hex addresses + "R" or "W"	A:3F4W
		Data: 2-digit Hex	80
		Not completed successfully: Unknown	Unknown
ACK	ACK	ACK	ACK
		No ACK	No ACK

■ Measure List Table

There are two display formats for the Measure list: statistical display enabled and statistical display disabled. The displayed contents are shown in Table 1.24 to Table 1.26.

See 2.8.1.3 Statistics for enabling / disabling statistical display.

Table 1.24 Measure List table display columns

Column Heading	Contents displayed in the Column	Display Format
[A] to [H]	Displays the Measure number, abbreviated measurement type, source CH or Math icon (CH1 to CH8, Math1 to Math8). If Enabled in the Measure window is OFF, the measurement type and source will be hidden.	Example with one source: [A] Maximum (CH1) Example with two sources: [A] Skew(Level) (CH1) (CH2)
Pass/Fail	Displays pass/fail results, number of times passed, number of pass/fail judgements, etc. when Pass/Fail is enabled. The contents displayed will differ depending on whether the statistical display is disabled or enabled.	Statistical display is disabled: ✓ Number of passes / Number of pass/fail judgments ✓ or × Pass / Fail results Statistical display is enabled: ✓ or × Pass / Fail results ✓ number of passes ×number of failures Total: Number of pass/fail judgments

There are two types of display formats for the Measure list table: statistical display enabled and statistical display disabled. An example of the displayed contents is shown in Figure 1.30, Figure 1.31, Figure 1.32, and Figure 1.33. The evaluation results in Table 1.25 and Table 1.26 are marked with ✓ if the measurement result satisfies the condition and × if it does not, as shown

in Figure 1.31 and Figure 1.33 when the pass/fail judgment is valid. If the pass/fail judgment is invalid or no condition is set for the measurement result, nothing is displayed.

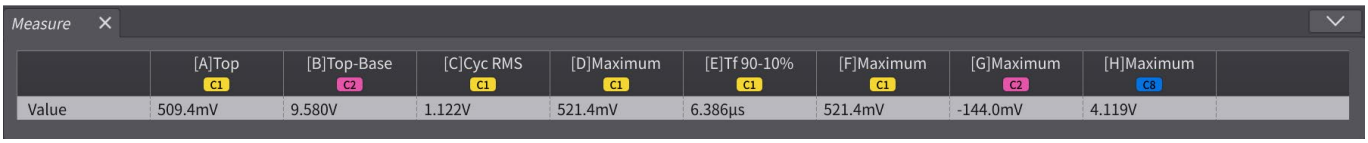


Figure 1.30 Measure List table display example (statistical display disabled, pass/fail judgment disabled)

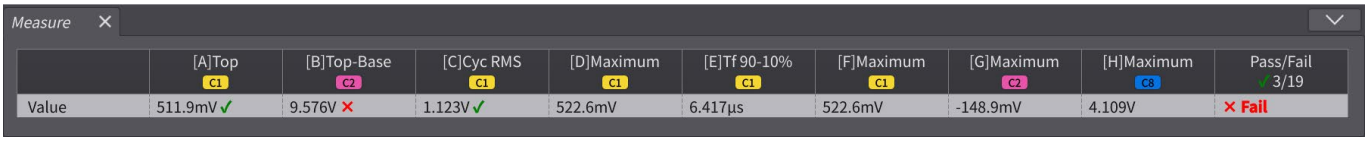


Figure 1.31 Measure List table display example (statistical display disabled, pass/fail judgment enabled)

Table 1.25 Rows displayed in the Measure list when statistics display is disabled

Row heading	Content shows in the Row	Notation Format
Value	Latest measurement result	4 significant digits + SI Prefix + Unit Evaluation result

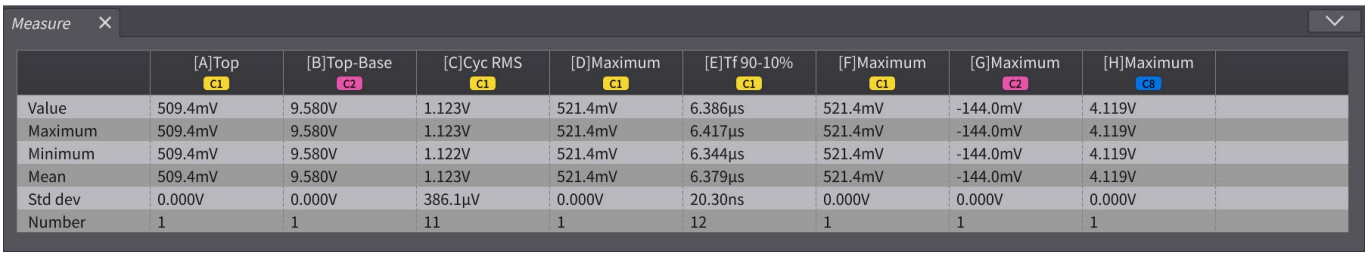


Figure 1.32 Measure List table display example (statistical display enabled, pass/fail judgment disabled)

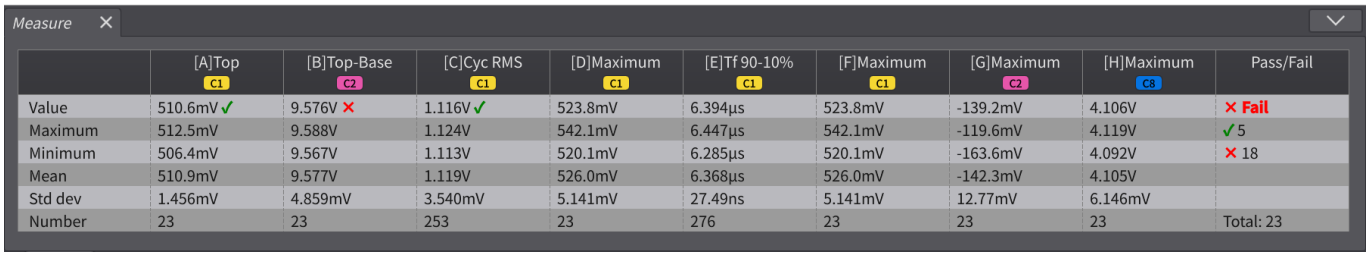


Figure 1.33 Measure List table display example (statistical display enabled, pass/fail judgment enabled)

Table 1.26 Rows displayed in the Measure list when statistics display is abled

Row heading	Content shows in the Row	Notation Format
Value	Latest measurement result	4 significant digits + SI Prefix + Unit Evaluation result
Maximum	Maximum value of measurement result	4 significant digits + SI Prefix + Unit
Minimum	Minimum value of measurement result	4 significant digits + SI Prefix + Unit
Mean	Average value of measurement result	4 significant digits + SI Prefix + Unit
Std dev	Standard deviation of measurement result	4 significant digits + SI Prefix + Unit
Number	Number of measurement result	Integer

Measure measurement type, abbreviation and number of sources are shown in Table 1.27.

Table 1.27 Measure measurement type, abbreviation and number of sources

Measure measurement type	Abbreviation	Number of source	Measure measurement type	Abbreviation	Number of source
Maximum	Maximum	1	Frequency	Frequency	1
Minimum	Minimum	1	Period	Period	1
Peak-Peak	Peak-Peak	1	+Pulse Count	+PulseCount	1
Top	Top	1	-Pulse Count	-PulseCount	1
Base	Base	1	+Pulse Width	+PulseWidth	1
Top-Base	Top-Base	1	-Pulse Width	-PulseWidth	1
RMS	RMS	1	Duty Cycle	Duty Cycle	1
Cyclic RMS	Cyc RMS	1	dV/dt	dV/dt	1
Mean	Mean	1	Integral	Integral	1
Cyclic Mean	Cyc Mean	1	Integral (Absolute)	IntegralAbs	1
+Overshoot	+Overshoot	1	Integral (Positive)	+Integral	1
-Overshoot	-Overshoot	1	Integral (Negative)	-Integral	1
Transition Time	Trans Time	1	Skew (%)	Skew (%)	2
Tr 20-80%	Tr 20-80%	1	Skew (Level)	Skew (Level)	2
Tf 80-20%	Tf 80-20%	1	Phase (%)	Phase (%)	2
Tr 10-90%	Tr 10-90%	1	Phase (Level)	Phase (Level)	2
Tf 90-10%	Tf 90-10%	1			
Tr (Level)	Tr (Level)	1			
Tf (Level)	Tf (Level)	1			

■ Search List Table

The list table to display in the Search list table is shown in Figure 1.34. The column descriptions are shown in Table 1.28. The list can be selected row by row, and when a line is selected, the zoom screen displays the relevant part of the selected waveform in the center of the screen.

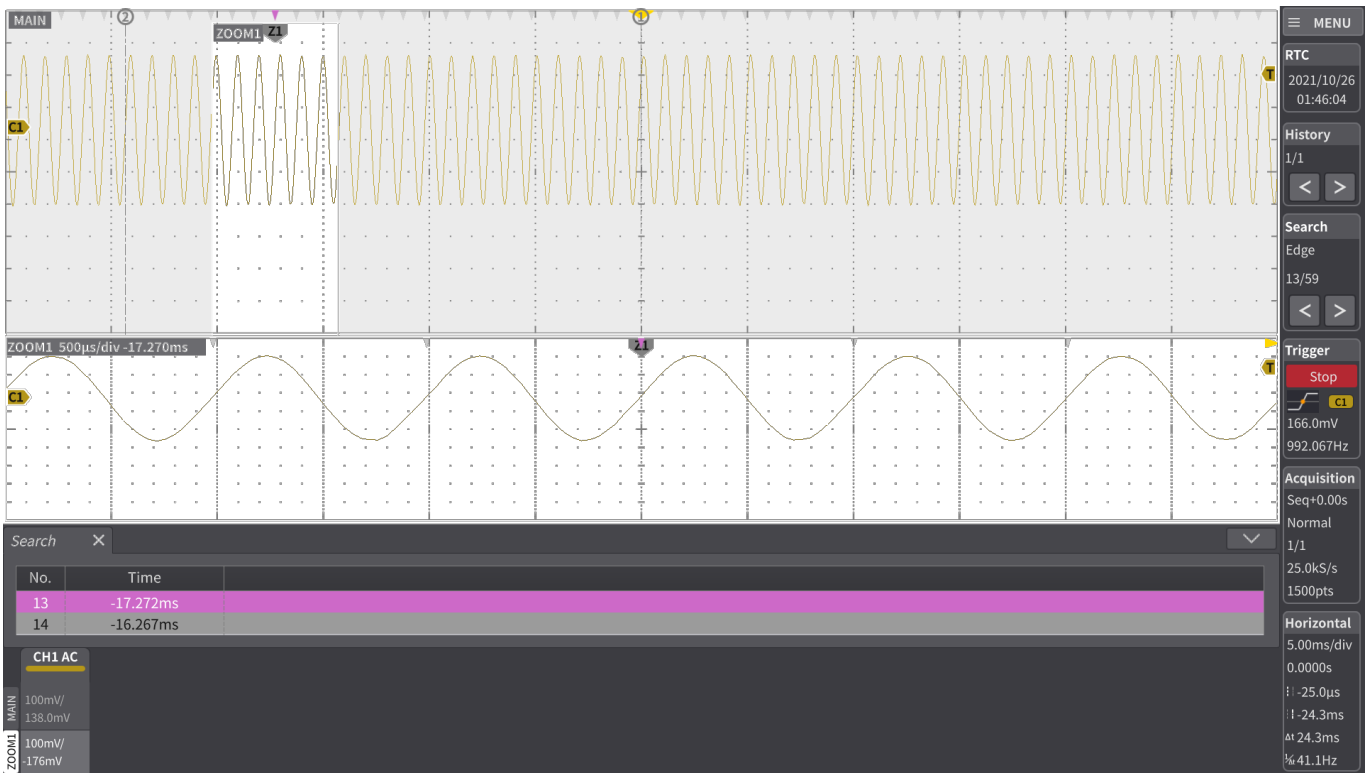


Figure 1.34 Search List Table example

Table 1.28 Columns displayed in the Search list

Column heading	Content shows in the column	Notation Format
No.	Search result number	Indicates the inspection result number from the beginning of the waveform.
Time	Timestamp of search result position	Displays the time when the trigger point is 0s.
Value	Search result value	See Table 1.29.

Table 1.29 Search type and list Notation format

Type	Notation Format
Edge	Blank
Cyclic RMS	4 significant digits + SI Prefix + Unit
Cyclic Mean	4 significant digits + SI Prefix + Unit
Transition Time	4 significant digits + SI Prefix + Unit
Frequency	4 significant digits + SI Prefix + Unit
Period	4 significant digits + SI Prefix + Unit
Pulse Width	4 significant digits + SI Prefix + Unit
Duty Cycle	4 significant digits + SI Prefix + Unit

1.7 Waveform Display Area Information

■ Screen configuration / information

The screen configuration / information shown in Table 1.30 are displayed in the waveform display area.

Table 1.30 Display configuration / information of waveform display area

Display configuration / information	Description
Grid line	The frame and grid line of each screen are displayed.
Main Screen	Display the waveform. There are Single and Split display modes. Single mode displays all waveforms in one screen, and Split mode displays waveforms on different screens.
Zoom Screen	Zoom in and display a part of the main screen. You can set up to two zoom areas.
Screen Label	The screen name and timebase information are displayed on the screen label at the upper left corner of the screen and zoom screen.
Trace Label	The Label character string set in Channels and Math is displayed on the right side of the offset marker. This string can be moved with the touch screen or mouse.
Marker	The GND position, trigger position, trigger level, zoom area, and decode result position of the waveform are displayed.
Cursor	Cursors will be displayed when measuring.
Gate	Displays the measurement area.

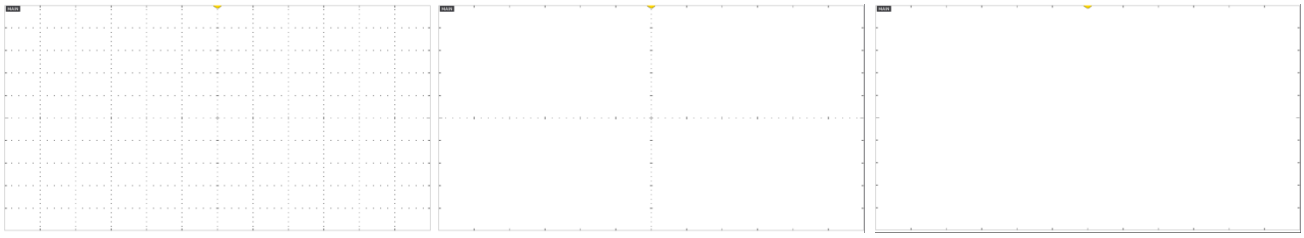
1.7.1 Grid Line

The grid line can be selected from Grid, Axis, and Frame.

The screen image is shown in Figure 1.35.

Operating procedure

See 2.1.2.5 Graticule



Grid Axis Frame

Figure 1.35 Screen image of grid lines

1.7.2 Main Screen

Display the waveform. There are Single and Split display modes. Single display mode shows waveforms in one screen, and Split display mode shows waveforms on different screens.

Operating procedure

See 2.1.2.1 Display mode.

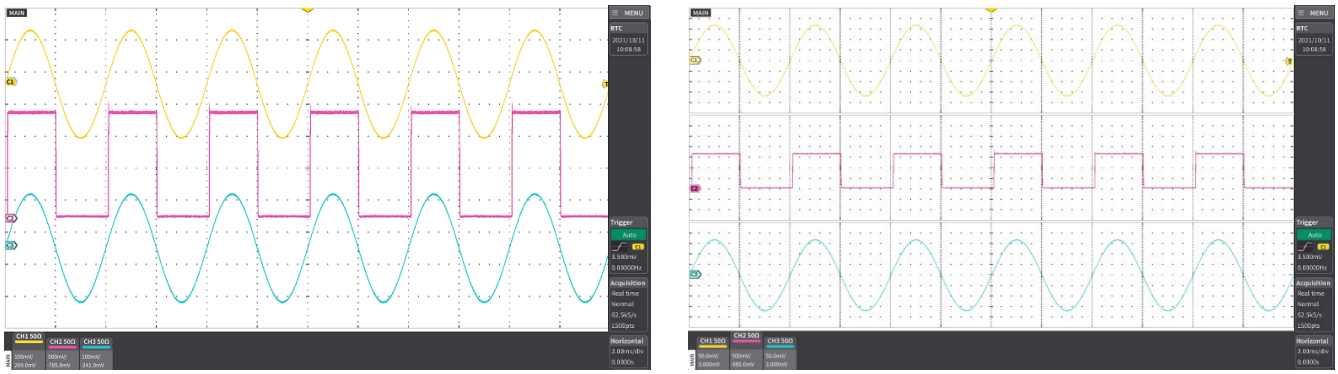


Figure 1.36 Single display mode and Split display mode

1.7.3 Zoom Screen

Zoom in and display a part of the (Main) waveform. The zoom area can be set up to 2 areas (Zoom1, Zoom2). During the zoom display, a zoom frame showing the zoomed area is displayed on the main screen.

Operating procedure

From the operation panel, see 1.8.1 Operation Panel. Press the ZOOM1 and ZOOM2 buttons of WINDOW. The corresponding zoom screen is displayed.

From Setting Window

How to set the waveform to Zoom, See 2.1.5 Waveform_Zoom1

How to set the sensitivity of the waveform, See 2.2.4 Channels_Zoom

How to set the sensitivity of the waveform, See 2.3.3 Horizontal_Zoom

1.7.4 Screen Labels

The screen name and timebase information are displayed on the screen label at the upper left corner of the screen and zoom area frame. The displayed contents are shown in Table 1.31.

Table 1.31 Screen label contents

Screen / Frame	Name	Timebase Information
Main Screen	MAIN	No Information
Zoom1/Zoom2 Area Frame	ZOOM1 or ZOOM2	No Information
Zoom1/Zoom2 Screen	ZOOM1 or ZOOM2	Zoomed timebase range, Time of the center of the screen.

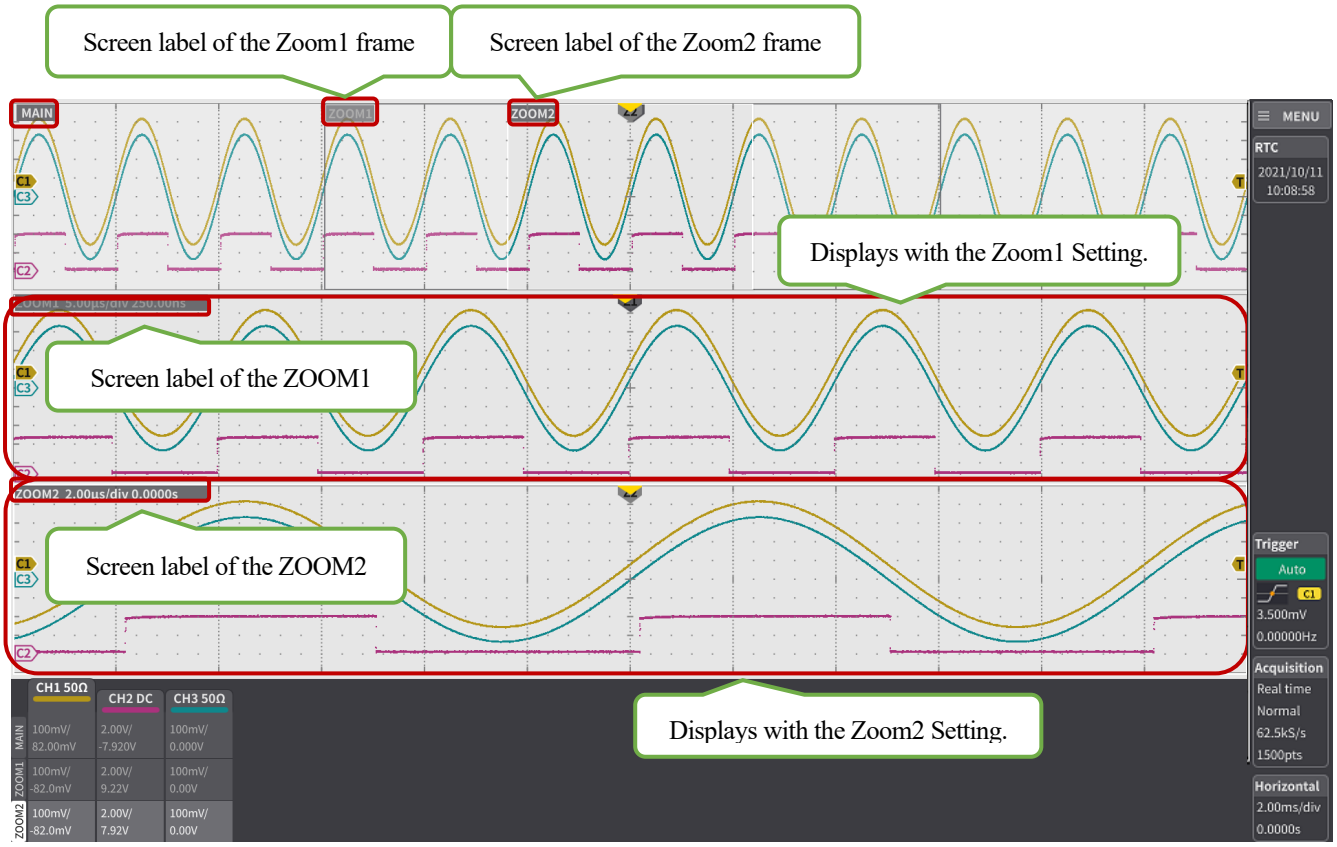


Figure 1.37 Zoom screens and screen labels

1.7.5 Trace Label

The Label character string in the Channels Window and Math Window is displayed on the right side of the offset marker. This character string can be moved with the touch screen or mouse.

Operating procedure

See 2.2.3.2 Label
See 2.10.1.4 Label

1.7.6 Markers

The GND position, trigger position, trigger level, zoom position, and decode result position of the waveform are displayed graphically. Table 1.32 shows the contents represented by the shape.

Table 1.32 Marker types

Name	Color	Position	Drag Operation	Description
Channels, Math offset marker	Same color with the waveform	Left edge of screen	Yes	Displays the 0V position of Channels and Math. CH1: C1, Math1: M1
Bus marker	Bus display color	Left edge of screen	No	Displays the position of the Bus decode result.
Trigger marker	Same color with trigger source	Top edge of screen	Yes	Displays the trigger position.
Trigger level marker	Same color with trigger source	Right edge of screen	Yes	Displays the trigger voltage.
Zoom marker	White	Top edge of screen	Yes (Main screen only)	Displays the center of the zoom range on the main waveform. Zoom1: Z1, Zoom2: Z2 You can move the zoom area by dragging the zoom marker even if the zoom area displayed on the main screen is narrow and displayed in a straight line.
Search / Decode marker	White	Top edge of screen	No	Displays the search position or decode position.

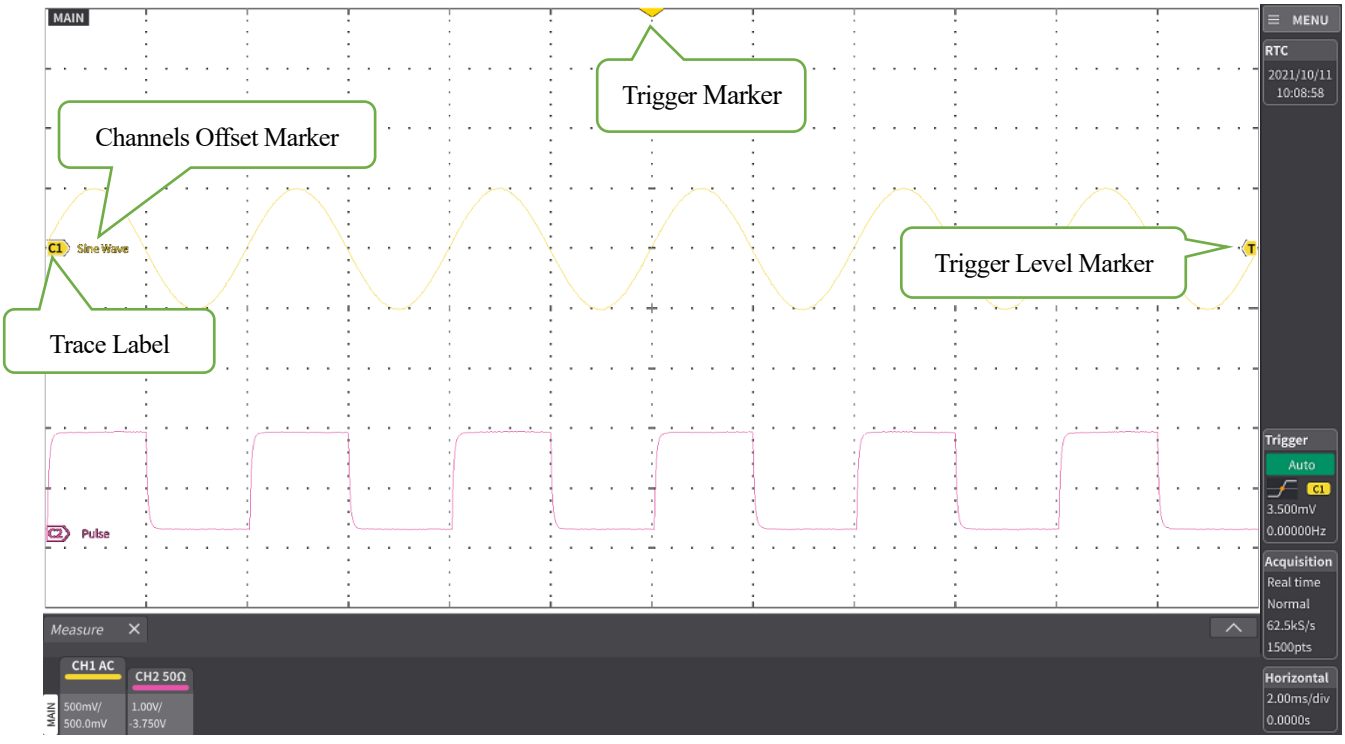


Figure 1.38 The positions of Trace Label and Marker

■ Channels marker icon and position (in case of CH1 waveform)

Table 1.33 Marker icon and position

Status \ Offset or Position	Inside screen $-5 \leq pos \leq 5$	Outside screen (Lower) $pos < -5$	Outside screen (Upper) $5 < pos$
X Axis [div]	Left edge of screen	Left edge of screen	Left edge of screen
Y Axis [div]	pos	Bottom edge of screen	Top edge of screen
Selected			
Not Selected			

Table 1.34 Waveform state and marker icon (example if Offset or Position is in the screen)

Status \ Waveform	Normal	Underflow exists	Overflow exists	Underflow and overflow exist
Selected				
Not selected				

■ Trigger marker icon and position

Table 1.35 Trigger marker icon and position

Icon	Delay (0s Waveform Position) [div] $pos = \frac{\text{Delay}}{\text{TDiv}}$	X Axis [div]	Y Axis [div]
	Inside screen $-6 \leq pos \leq 6$	pos	Top edge of screen
	Outside screen (Left) $pos < -6$	Left edge of screen	Top edge of screen
	Outside screen (Right) $6 < pos$	Right edge of screen	Top edge of screen

■ Trigger level marker icon and position

Table 1.36 Trigger level marker icon and position

Icon	Trigger Level Position [div] $pos = \frac{\text{Level} + \text{Offset}}{\text{V/Div}}$	X Axis [div]	Y Axis [div]
	Inside screen $-5 \leq pos \leq 5$	Right edge of screen	pos
	Outside screen (Upper) $5 < pos$	Right edge of screen	Top edge of screen
	Outside screen (Lower) $pos < -5$	Right edge of screen	Top edge of screen

■ Search / Decode Marker shape and drawing position

Table 1.37 Search / Decode Marker shape and drawing position

Icon	Start position of the search result or the decoding result selected in the Bus list [div] $pos = \frac{\text{Start} + \text{Delay}}{\text{TDiv}}$	X Axis [div]	Y Axis [div]
	$-6 \leq pos \leq 6$	pos	Top edge of screen
Hide	$pos < -6$ or $6 < pos$	-	-

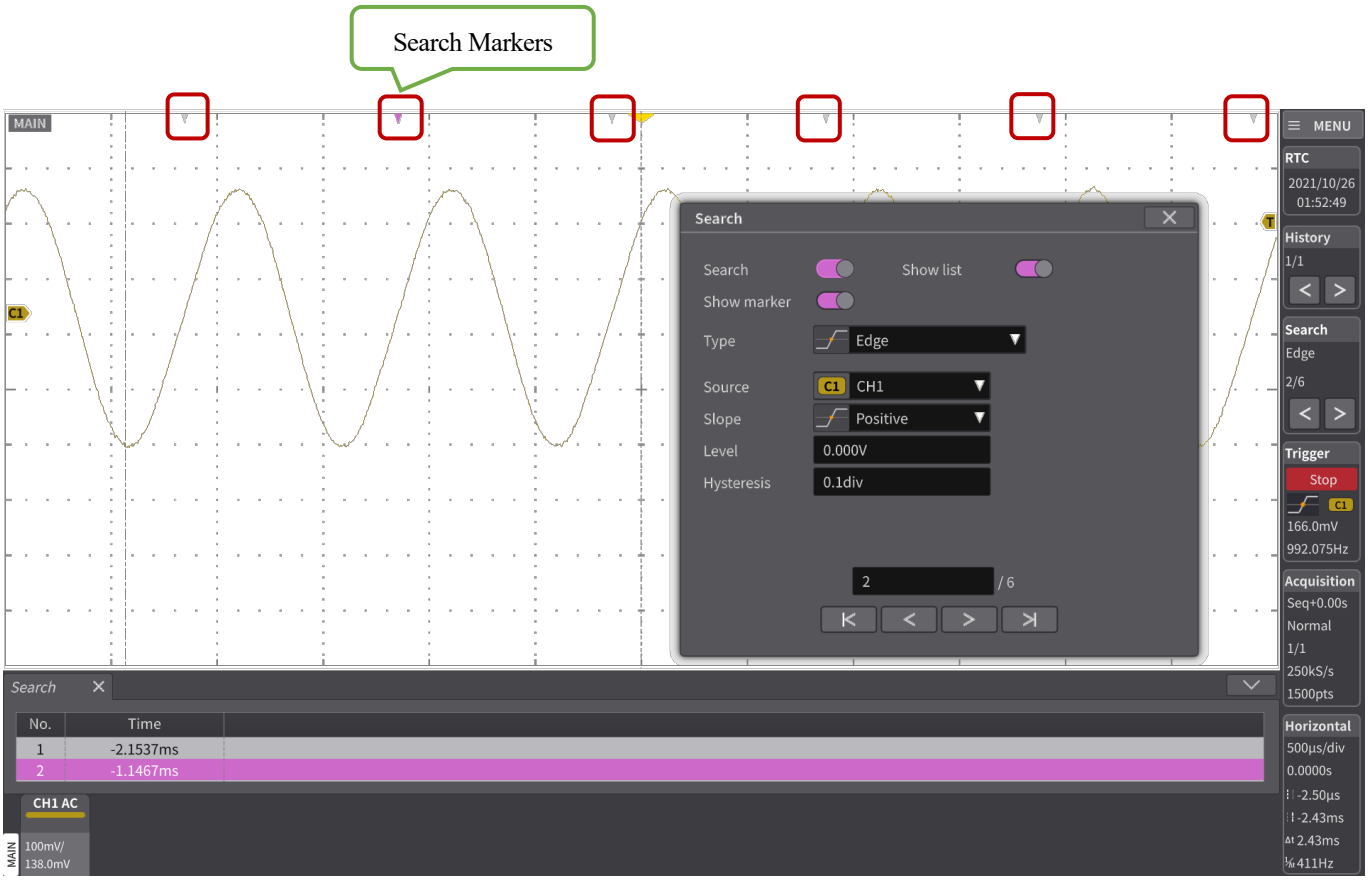


Figure 1.39 Search Marker positions

1.7.7 Cursors

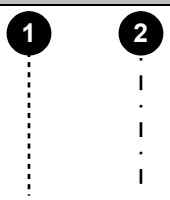
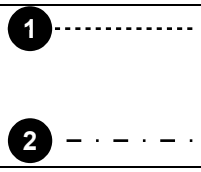
Display four types of cursors to measure time and voltage. The cursor is set in the Cursors window. For operation, if the Knob1 and Knob2 icons are displayed, use the (1) and (2) Knobs on the Operation Panel. Alternatively, you can set it by dragging the cursor on the touch screen. You can also set it from the Cursors window with the (1) Knob on the Operation Panel. See 2.7.1 Cursors Window.

- While the time-voltage cursor is displayed, the measurement results are displayed in the Horizontal readout and Channels readout.
- If you want to show the gate while the time cursor is displayed, hide the time cursor. When the gate is hidden, the time cursor reappears. See 1.7.8 Gate.
- If the Measure window is displayed, the cursor will not be displayed.
- When the Cursors window is displayed, the Knob1 and Knob2 icons are not displayed, and you cannot operate with the (1) and (2) Knobs on the Operation Panel. Also, the cursor does not support drag operations on the touch screen.
- If the time cursor and voltage cursor are displayed at the same time, touch the cursor and select which cursor to be operated with the (1) and (2) Knobs.

Operating procedure

See 2.7.1 Cursors Window.

Table 1.38 Cursor Icon

Cursor Type	Icon	Description
Time Cursors		If the (1) and (2) Knobs are the target of operation, the Knob1 and Knob2 icons will be displayed. These icons are not displayed when they are not the operation target.
Voltage Cursors		If the (1) and (2) Knobs are the target of operation, the Knob1 and Knob2 icons will be displayed. These icons are not displayed when they are not the operation target.

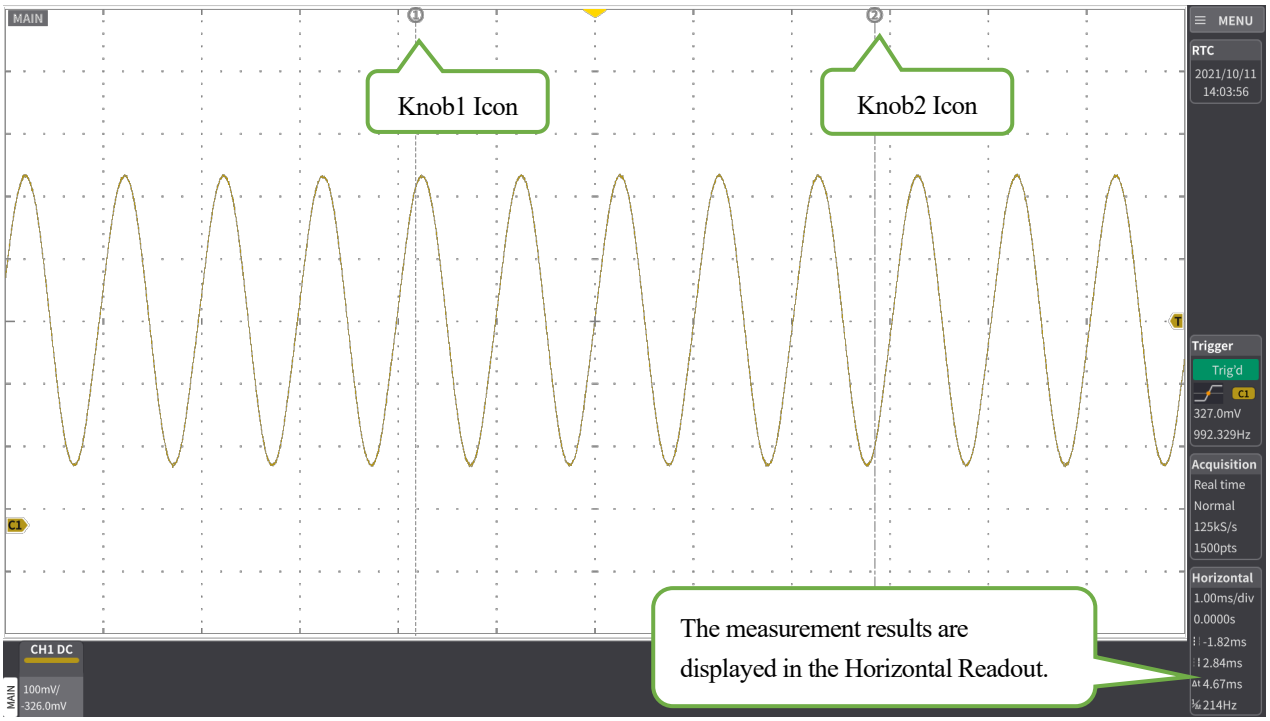


Figure 1.40 Example of Knob1 and Knob2 icons for the time cursors

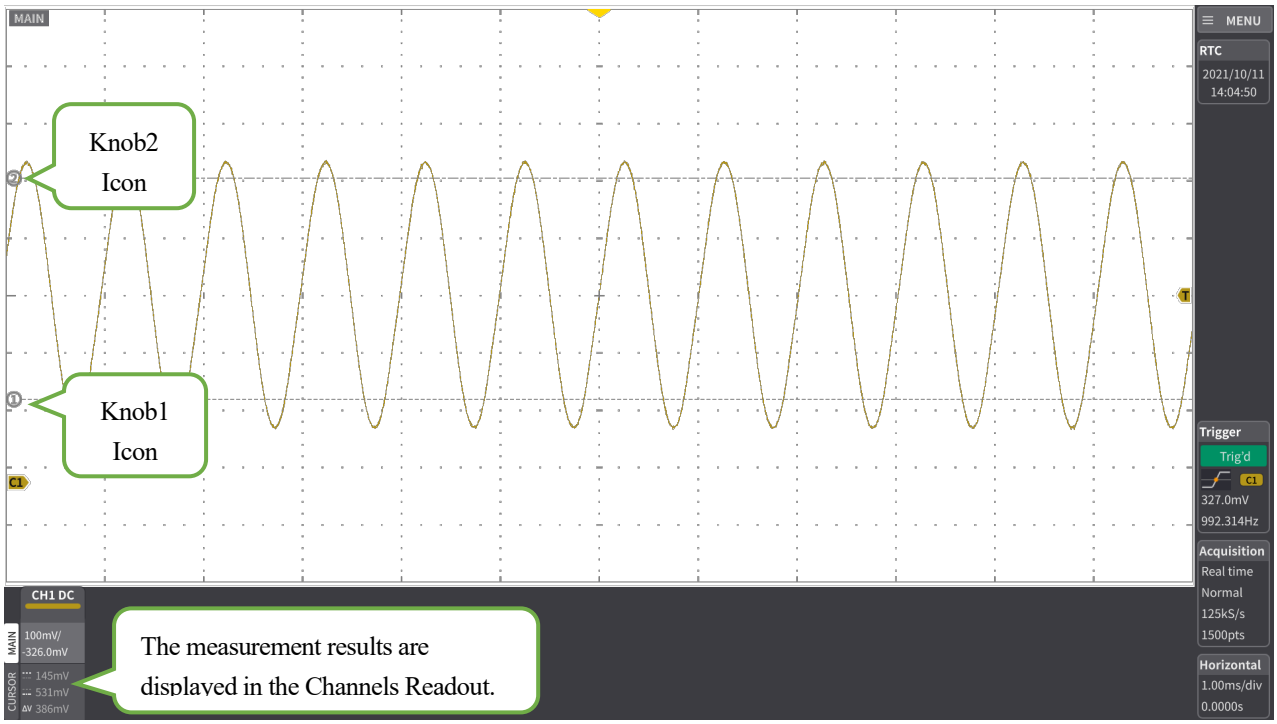


Figure 1.41 Example of Knob1 and Knob2 icons for the voltage cursors

■ Cursor in XY display

In the case of XY display, there is no time information, so the time cursor is not displayed.

As shown in Figure 1.42, the Cursor display of the channel amplitude set in X source and the measurement result are displayed in the Readout.

As shown in Figure 1.43, the Cursor display of the channel amplitude set in Y source and the measurement result are displayed in the Readout.

See 2.1.3 Waveform_XY.

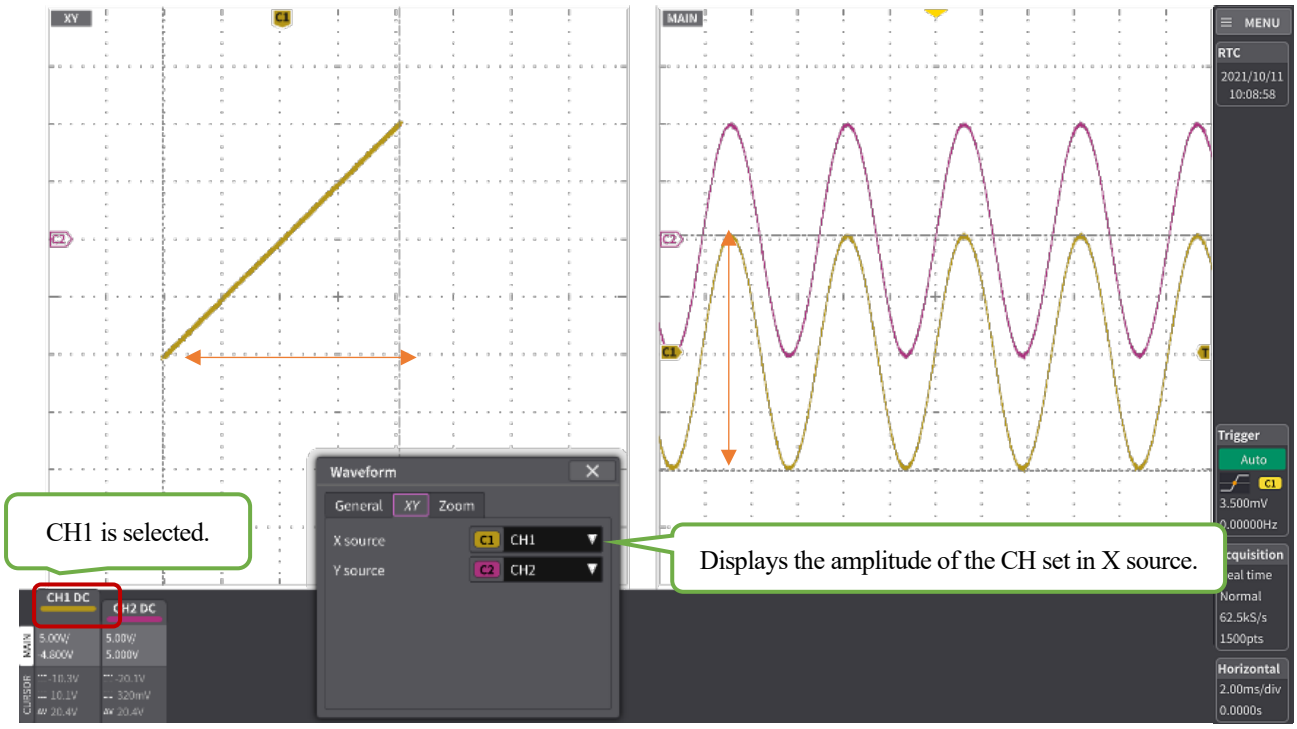


Figure 1.42 Cursor (X source is CH1) example when displaying XY

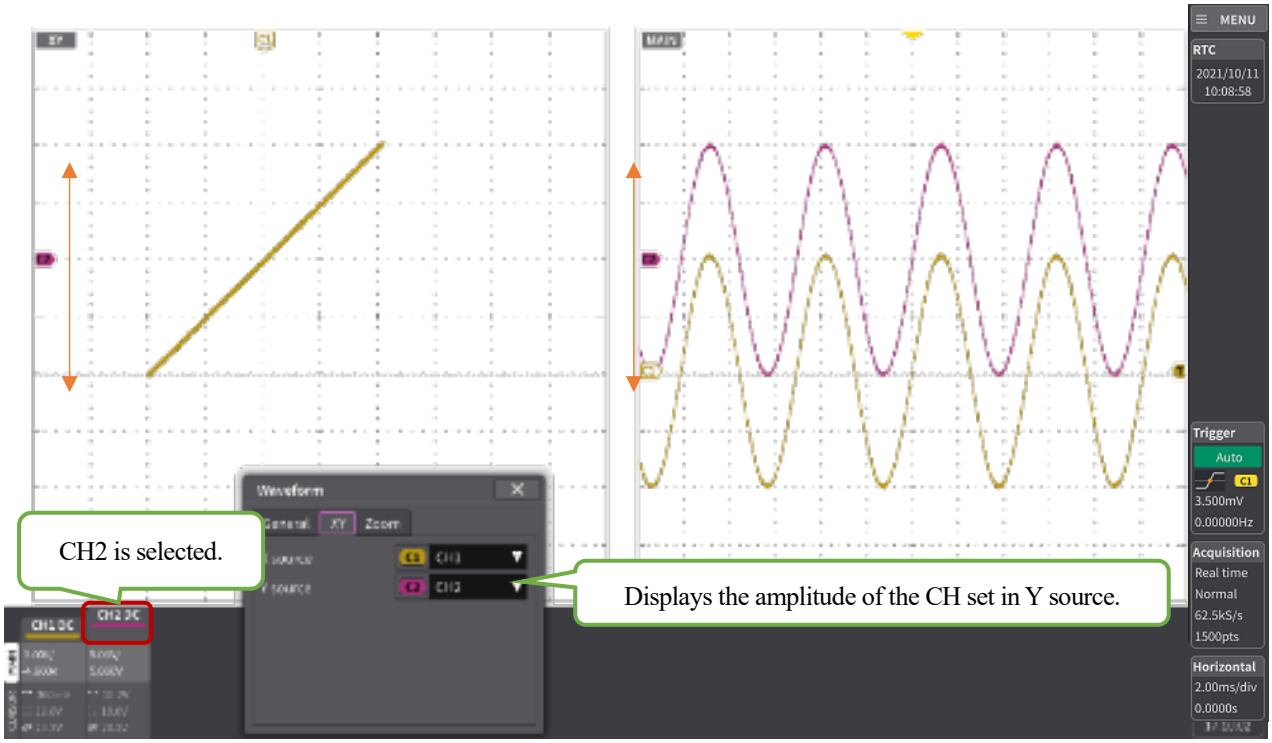


Figure 1.43 Cursor (Y source is CH2) example when displaying XY

1.7.8 Gate

Gate is displayed when you specify the measurement range in the Measurement window settings. Gate is displayed only when the Measure window is active and disappears when the Measure window is closed. Also, gates are displayed only for Measure items selected in the Measure window. Measure items are [A] to [H].

Operating procedure

See 2.8.1.9 Gate

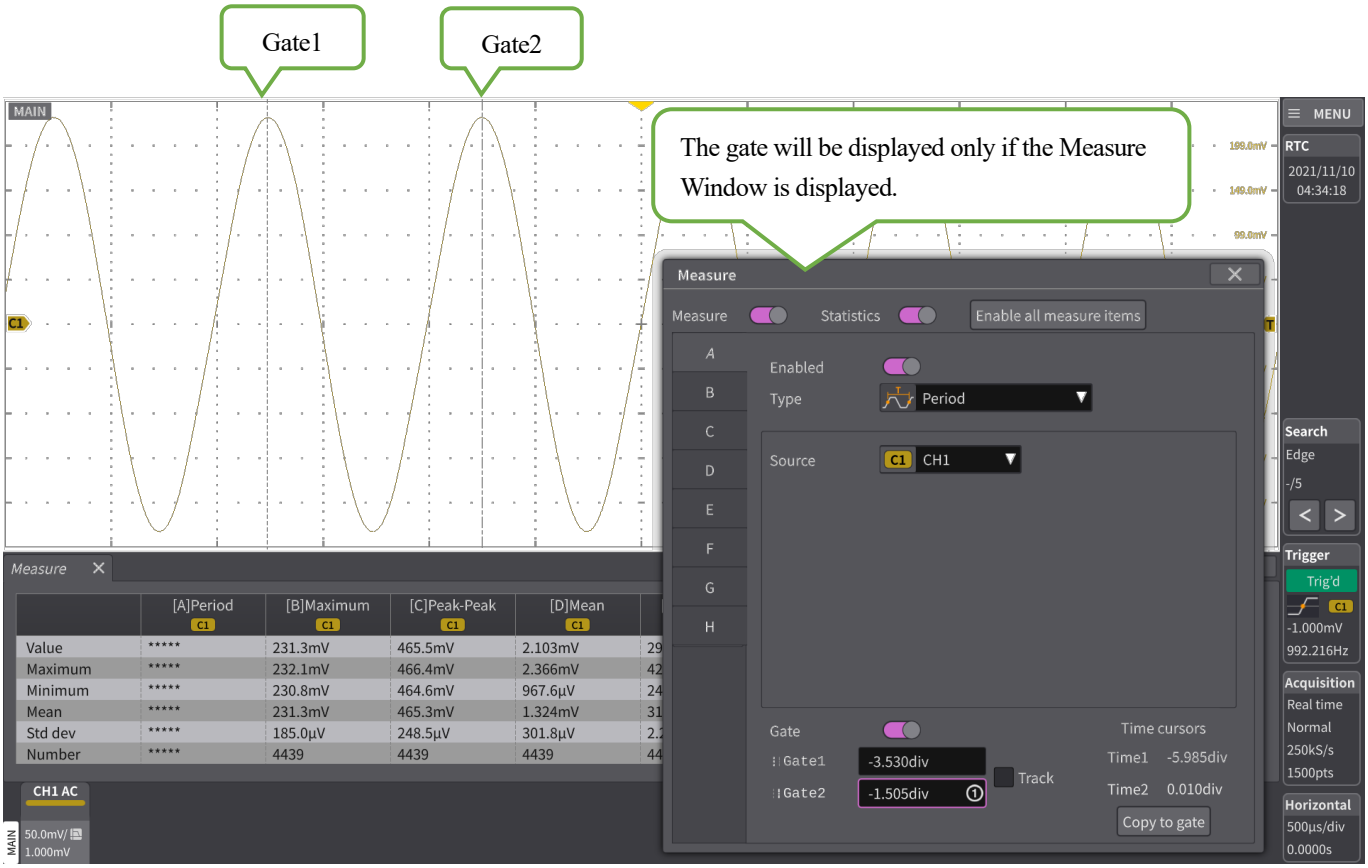


Figure 1.44 Gate and Measurement Window

1.8 Operation

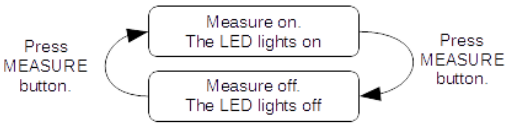
Table 1.39 shows the types of operations of this instrument

Table 1.39 Types of operations

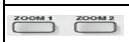
Types of operation	Operation
Operation Panel	Buttons or Knob operation
Touch Screen	Operation by touch screen on the LCD display
Mouse	Operation with a mouse connected to the USB port
Keyboard	Operation with a keyboard connected to the USB port
Remote	Operation via remote interface

1.8.1 Operation Panel

Table 1.40 Operation Panel controls and functions

Control	Name	LED	Function
AUTO SETUP	AUTO SETUP button	-	Run the Auto Setup.
COPY	COPY button	-	Save either a hard copy, a waveform, or both. For details on how to assign functions, see 2.6.4.4 Priority function to assign to button COPY.
RUN /STOP	RUN/STOP button	Run: Green Stop: Red	Start or stop acquisition. Lights in green during waveform acquisition operation. Lights in red while waveform acquisition is stopped.
UTILITIES	UTILITIES button		Displays the Utilities window.
CURSOR	CURSOR button	Display: Green Hide: OFF	Switches the cursor display, non-display, etc. For details on how to assign functions, See 2.6.4.5 Priority function to assign to button CURSOR.
MEASURE	MEASURE button	Measure ON: Green Measure OFF: OFF	If Measure is OFF, turns Measure ON. Turns Measure OFF if Measure is on. 
①	(1) Knob	-	The item displayed as (1) can be operated on the cursor or window. When the cursor is displayed without a window, you can control the cursors. Press this Knob to switch between fine and coarse.
②	(2) Knob	-	The item displayed as (2) can be operated on the cursor or window. When the cursor is displayed without a window, you can control the cursors. Press this Knob to switch between fine and coarse.
CLEAR	CLEAR button	-	・Waveform display and waveform data ・Number of average ・Persistence display ・Initialize the page and auto measurement results.
◄ ►	Previous button Next button	-	Moves to previous or next items in the SEARCH/HISTORY. 2.6.4.6 Priority function to assign to button ◄►. Assign to the SEARCH function or HISTORY function in advance.

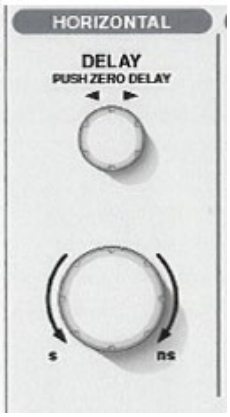
■ WINDOW

Controls	Name	LED	Function
	MAIN button	ON: Green Zoomed Out: OFF	When in the zoom display, you can switch the control object to the main waveform.
	ZOOM 1 button ZOOM 2 button	ON: Green No display: OFF	If it is not in zoom display, switch to zoom display. As for in zoom display, you can switch the control object to zoom1 and zoom2 waveforms.

■ TRIGGER

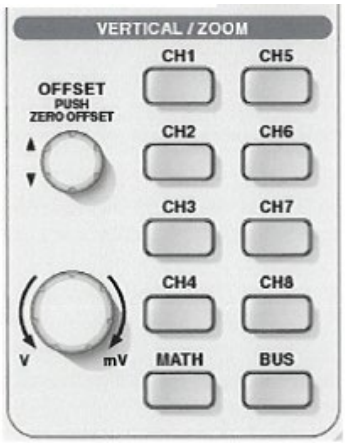
Controls	Name	LED	Function
	LEVEL Knob	-	Turns to adjust the trigger level. Pushes to detect the trigger level. In the case of Transition Time trigger, when pushes, switches the operation target to Level(High) or Level(Low) at the time of the LEVEL knob rotation.
	AUTO button	AUTO: Green NORMAL, SINGLE: OFF	Changes the trigger mode to AUTO.
	NORMAL button	NORMAL: Green AUTO, SINGLE: OFF	Changes the trigger mode to NORMAL.
	SINGLE button	SINGLE: Green AUTO, NORMAL: OFF	Change the trigger mode to SINGLE. When the trigger mode is SINGLE and the trigger is waiting, it executes a manual trigger.

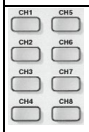
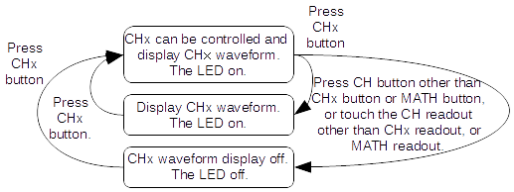
■ HORIZONTAL



	DELAY Knob	-	Turns to adjust the delay time. Pushes to set the delay time to 0 s.
	TIME Knob	-	Turn to adjust the timebase setting. Pushes to return the timebase range and delay time to when the waveform was acquired.

■ VERTICAL



Controls	Name	LED	Function
	OFFSET Knob	-	Turns to adjust the offset of the trace selected with the CH button and Math button. Pushes to set the offset voltage to 0 V.
	VOLTS Knob	-	Turns to set the vertical voltage range of the trace selected with the CH button and Math button. Pushes to return the voltage range when the waveform acquired.
	CHx button	CHx ON: Color of CHx CHx OFF: OFF	When the LED is OFF, pushes the button for that channel to turn on the LED. When the LED is lit, you can control object. When you press it again while the channel is on, the channel display turns OFF and the LED turns OFF. 
	MATH button	When Math is selected (displayed): Lights up. All Maths are not displayed OFF	Press to control Math. Press it to MATH 1 ON. Press it again to MATH 1 OFF. If multiple MATHs are on, Press MATH button to control the next MATH. LED turns OFF when all Maths are OFF.
	BUS button	When Bus is selected (displayed): Lights up. All Bus are not displayed OFF	Press to control Bus. Press it to Bus1 ON. Press it again to Bus1 OFF. If multiple Bus are ON, Press BUS button to control the next BUS. LED turns OFF when all Bus are OFF.

1.8.2 Touch Screen Operation

Touch screen operations are assigned to the mouse operation shown below. All operations are available only with the touch screen. Use the On-Screen Keyboard to enter strings.

When touch operation is performed on the main screen or zoom screen, the process shown in Table 1.42 is executed. When pinching the waveform, turn on Fine for Time and Position for time axis zoom for smooth operation.

Table 1.41 Touch screen operation and corresponding mouse operation

Touch screen operation	Mouse operation
Tap	Left Click

Table 1.42 Touch operation of the main screen and zoom screen and the process to be executed

Touch Screen Operation		Main Screen	Zoom screen
Pinch operation of waveform		When CH or Math (other than FFT) is selected, change Time/div and Delay. When Math (FFT) is selected, zoom in/out in the direction of frequency axis.	Zoom in/out in the horizontal axis direction of the waveform.
Drag operation	Zoom frame	Change zoom position	None
	Channel marker	Change offset.	When vertical zoom is enabled, change the Zoom position. When vertical zoom is disabled, change the offset.
	Math marker	Change the Math position.	When vertical zoom is enabled, change the Zoom position. When vertical zoom is disabled, change the Math position.
	Trigger marker	Change delay.	Change Zoom Position.
	Trigger Level Marker	Change trigger level.	None

1.8.3 Operation with Mouse and Keyboard Connected to USB Port

It can also be operated by connecting a USB mouse or USB keyboard to the USB port. However, it does not support Japanese characters. Only single-byte alphanumeric characters can be entered.

1.8.4 Remote Operation via Remote Interface

See 2.13 Remote Control Operations and Settings.

1.9 Touch Interface

The settings of the Settings Window can be operated using the touch interface shown in Table 1.43. It can be operated mainly with the touch interface, but there are also some settings that can be operated with the Knobs on the Operation Panel and setting items that can be entered from the USB keyboard.

Table 1.43 Touch Interface Types and Functions

Touch Interface	Function
Combo Box	Selects an item from the list.
Button	Tap to execute the process.
Radio Button	Select from multiple selections.
Toggle Switch	Select ON or OFF (mainly used when the selection operation dynamically changes the display).
Check box	Select ON or OFF.
String Input Box	Enter the string from the On-Screen Keyboard (you can also enter it from the USB keyboard).
Numeric Input Box	Enter the value from the On-Screen Keyboard or from the (1) Knob on the Operation Panel.
Horizontal Tab	If you select one from the multiple tabs, the contents displayed on the screen will also change.
Vertical Tab	If you select one of the tabs on the left, the contents displayed on the screen will also change.
List View	You can view a list with column headings, row headings, or both, and select items row by row.
Binary Editor	Edit the binary or hexadecimal value.

1.9.1 Combo Box

Select an item from the list displayed by tapping. When you touch an item other than the list while the list is displayed, the list will be closed.

Operating procedure

1. Tap the combo box.
2. Select from the displayed list.

■ Combo Box

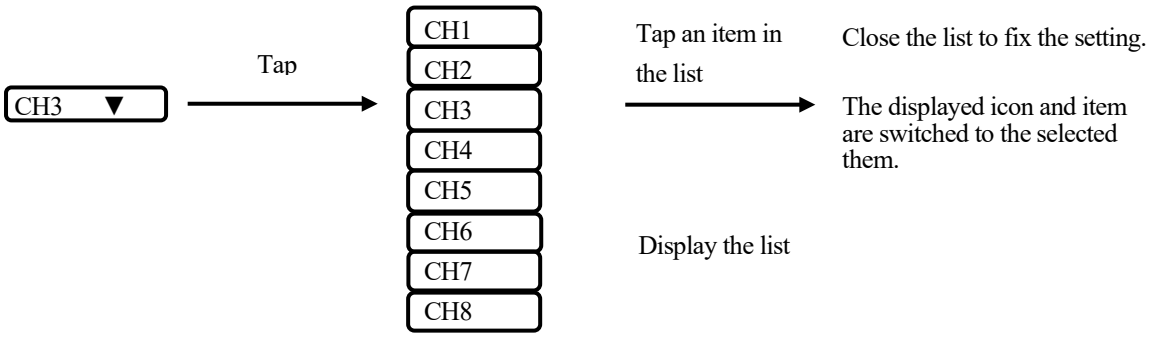


Figure 1.45 Operation image of combo box

1.9.2 Combo Box with Icon

A combo box that displays an icon next to the item name. Select an item from the list. When you touch an item other than the list while the list is displayed, the list will be closed.

Operating procedure

1. Tap the combo box with the icon.
2. Select from the list with the displayed icon.

■ Combo Box with icon

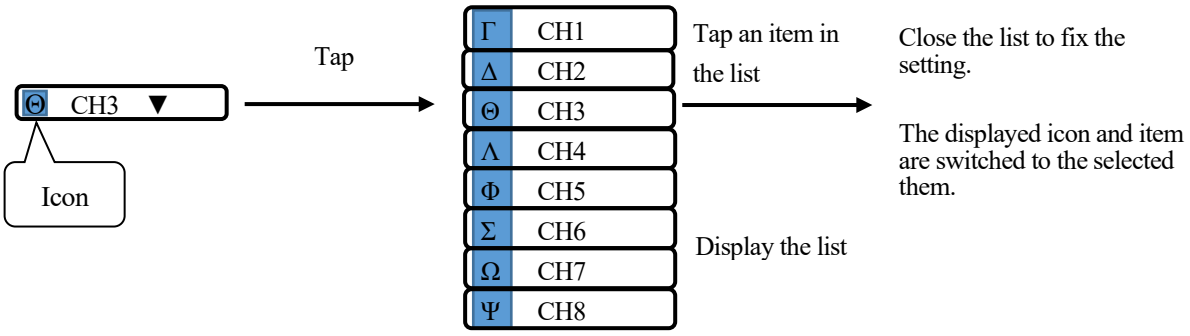


Figure 1.46 Operation image of combo box with icon

1.9.3 Button

Tap to execute the process.

Operating procedure

1. Tap the button to execute the process.

■ Button

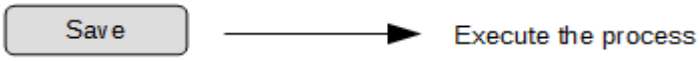


Figure 1.47 Button operation image

1.9.4 Radio Button

Select from multiple selection items by tapping the radio button you want to select.

Operating procedure

1. Tap the radio button to select from multiple selections.

■ Radio Button

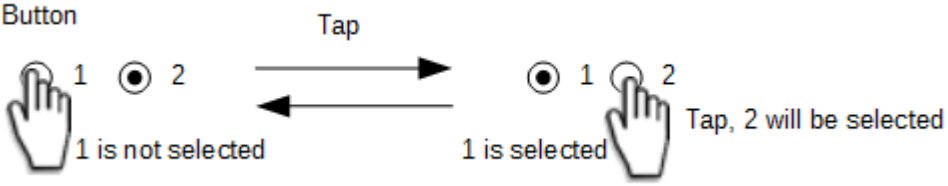


Figure 1.48 Radio button operation image

1.9.5 Toggle Switch

You can select ON or OFF by tapping the toggle switch. It is used when the display is dynamically changed by the selection operation.

Operating procedure

1. Tap the toggle switch to select ON and OFF.

■ Toggle Switch

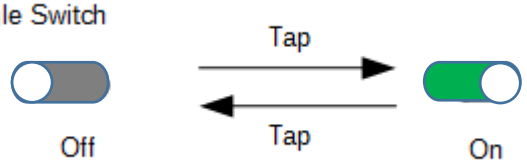


Figure 1.49 Toggle switch operation image

1.9.6 Check Box

You can select ON or OFF by tapping the check box.

Operating procedure

1. Tap the checkbox to switch ON and OFF.

■ Checkbox

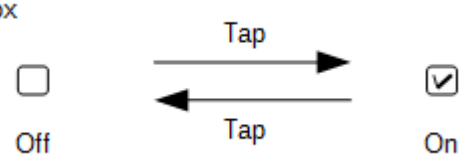


Figure 1.50 Operation image of checkbox

1.9.7 Character String Input Box

Enter the character string from the On-Screen Keyboard. You can also input from a USB keyboard.

Operating procedure

1. When the character string input box has no focus, touch the character string input box. ->Focus (select).
2. Tap the string input box. ->The On-Screen Keyboard is displayed. (See 1.9.14 On-Screen Keyboard).
3. Enter a character string from the On-Screen Keyboard.
4. Close the On-Screen Keyboard.

■ String Input Box

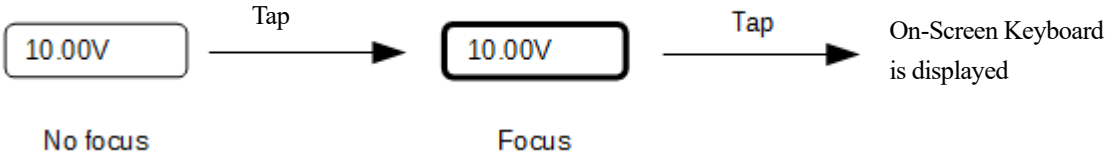


Figure 1.51 Operation image of the Character String Input Box

1.9.8 Numeric Input Box

Enter the numbers on the On-Screen Keyboard. Alternatively, use the (1) Knob on the Operation Panel to set the value.

Operating procedure

1. When the Numeric Input Box has no focus, touch the number input box. Focus (select).
2. Tap the numeric input box. -> The On-Screen Keyboard is displayed. (See 1.9.14 On-Screen Keyboard)
   Alternatively, you can change the value with the (1) Knob on the Operation Panel.
3. Enter a number from the On-Screen Keyboard.
4. Close the On-Screen Keyboard.

■ Numeric Input Box

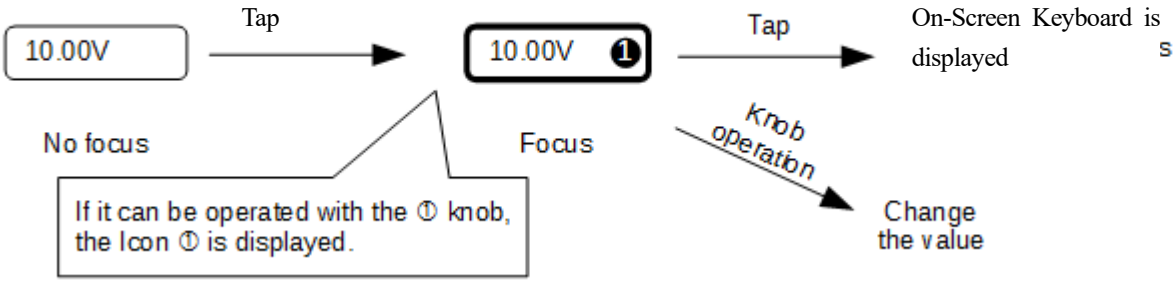
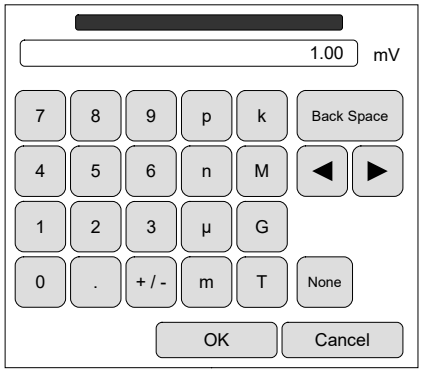


Figure 1.52 Operation image of the numeric input box



On-Screen Keyboard

(1) Knob on the Operation Panel

Figure 1.53 Numeric Input Box on the On-Screen Keyboard and (1) Knob on the Operation Panel

1.9.9 Numeric Input Box (with Up / Down Button)

Enter a value from the On-Screen Keyboard (Up button, Down button), or set with the (1) Knob on the Operation Panel.

Operating procedure

1. When the numeric input box (with Up / Down button) has no focus, touch the numeric input box (with Up / Down button). -> Focus (select).
2. Tap the Up / Down button to change the value.

Tap the numeric input box. The screen keyboard is displayed. (See 1.9.14 Screen Keyboard.) Enter numbers from the On-Screen Keyboard.
When the (1) icon is displayed, you can also change the value by turning the (1) Knob on the Operation Panel.

■ Numeric Input Box (with Up / Down Button)

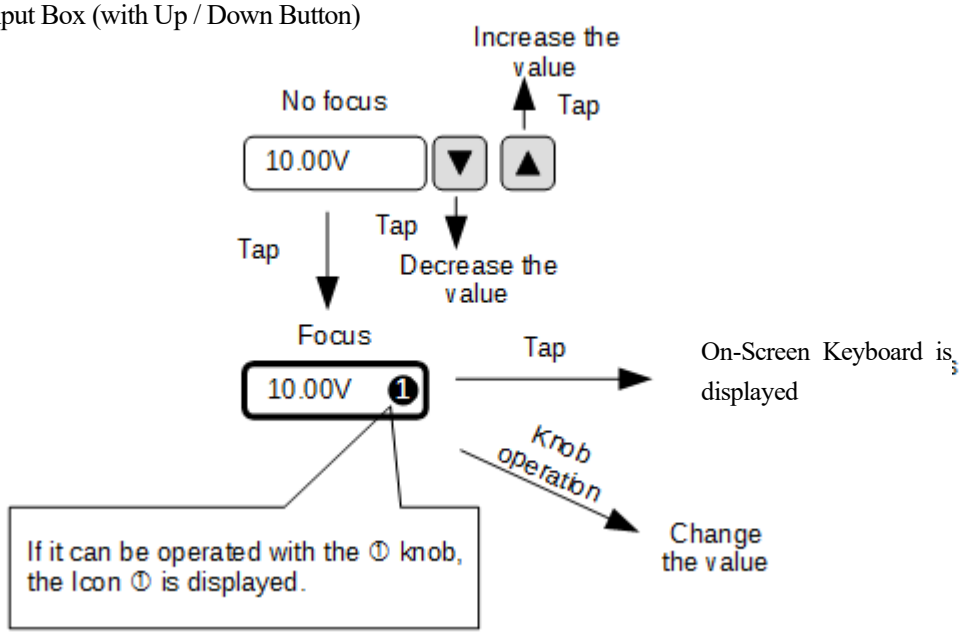
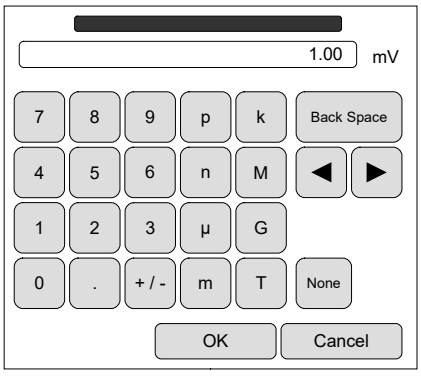


Figure 1.54 Operation image of the Numeric Input Box (with Up / Down buttons)



On-Screen Keyboard

(1) Knob on the Operation Panel

Figure 1.55 On-Screen keyboard and Operation Panel (1) Knob

1.9.10 Horizontal Tab

When you select one from multiple tabs arranged side by side, the display contents of the Settings Window will change.

Operating procedure

1. Tap the Horizontal tab you want to select. The tapped Horizontal tab is focused (selected).

■ Horizontal Tab

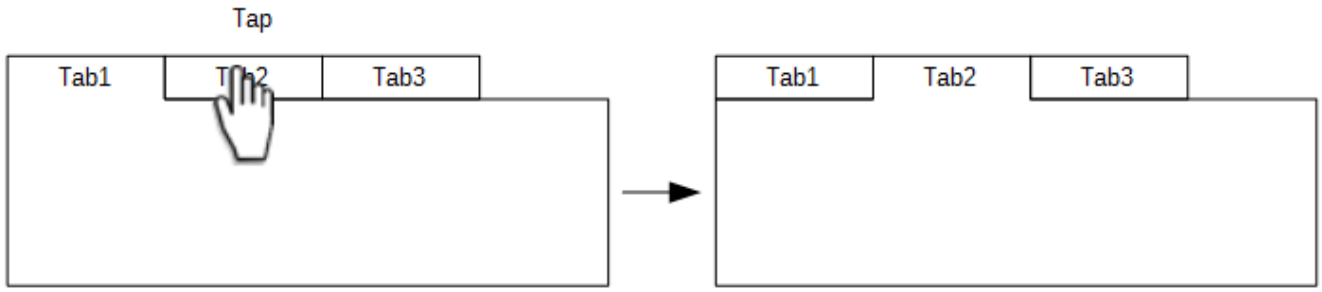


Figure 1.56 Horizontal tab operation image

1.9.11 Vertical Tab

Select one from multiple tabs arranged vertically on the left to change what is displayed on the screen.

Operating procedure

1. Tap the vertical tab you want to select. The tapped vertical tab is focused (selected).

■ Vertical Tab

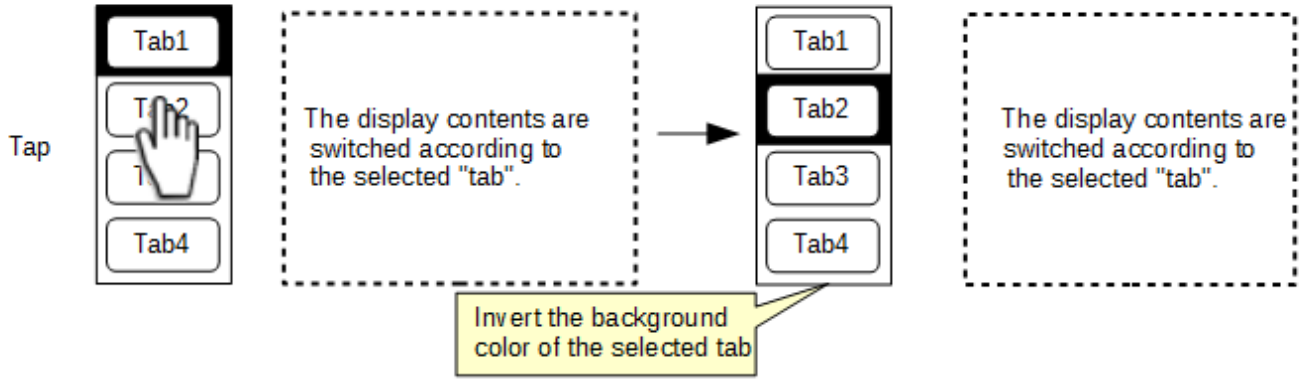


Figure 1.57 Vertical tab operation image

1.9.12 List View

You can view a list with column headings, row headings, or both, and select items row by row

Operating procedure

1. Tap the list you want to select. The tapped list is focused (selected).

■ List View

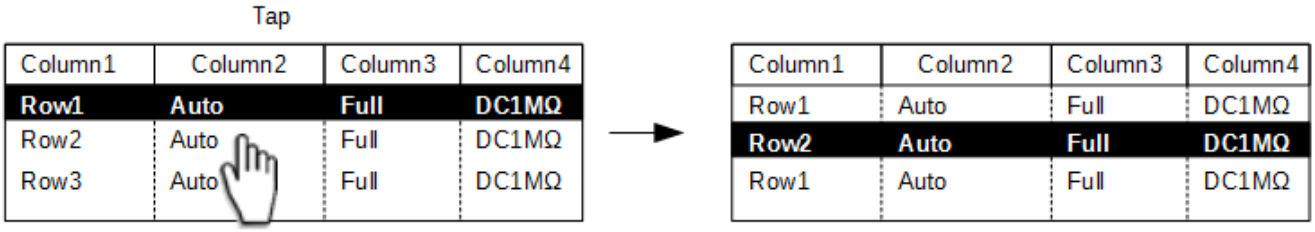


Figure 1.58 List view operation image

1.9.13 Binary Editor

Edits the binary or hexadecimal value.

Operating procedure

1. Tap the cell you want to select. The tapped cell is focused (selected).
2. Tap the focused cell. The On-Screen Keyboard is displayed.
3. Enter from the On-Screen Keyboard.

■ Binary Editor

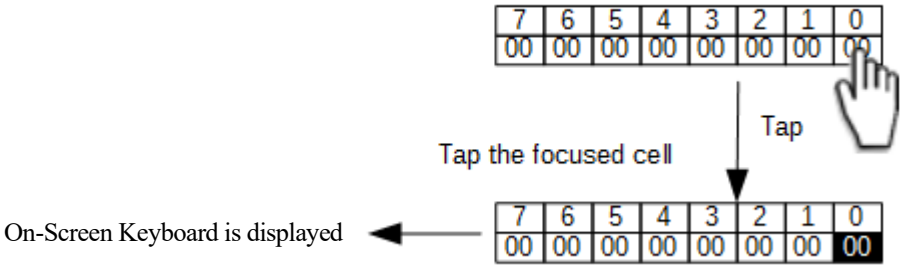


Figure 1.59 Image of binary editor

1.9.14 On-Screen Keyboard

When entering numbers or strings from the touch screen, the screen keyboard shown in Figure 1.60 is displayed.

Table 1.44 On-Screen Keyboard types

Screen keyboard types	Description
Numeric input	Enter the decimal number from the touch screen.
Binary / Hex input	Enter the binary or hexadecimal number from the touch screen.
Input-restricted hexadecimal input	Enter a maximum of 4 hexadecimal numbers with input restrictions from the touch screen.
Character string input	Enter the character string of alphanumeric symbols from the touch screen.

■ On-Screen Keyboard for numeric input

Press the OK button and it will be reflected in the settings. The maximum, minimum, and resolution checks of the values are performed after pressing the OK button.

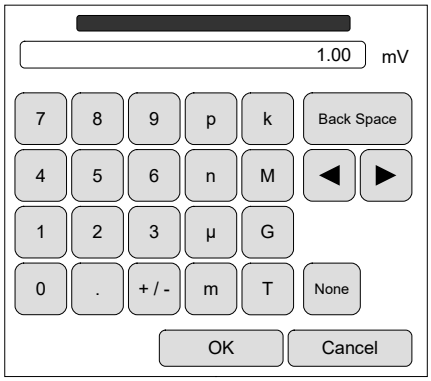


Figure 1.60 On-Screen Keyboard for numeric input

■ On-Screen Keyboard for Binary / Hex input

Press the OK button and it will be reflected in the settings. The maximum, minimum, and resolution checks of the values are performed after pressing the OK button.

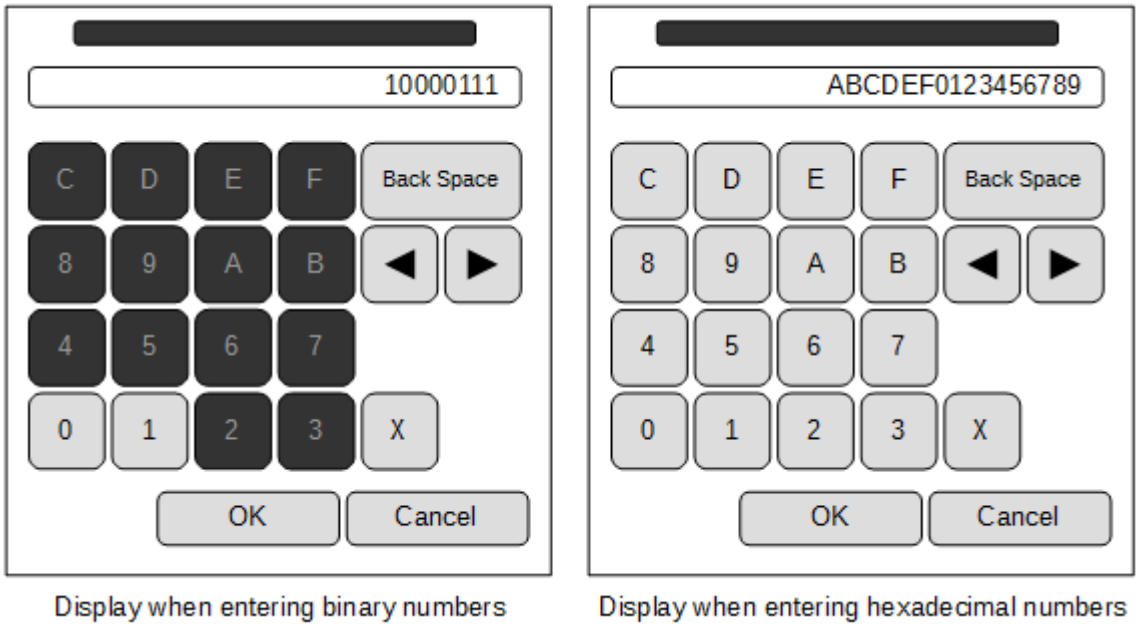


Figure 1.61 On-Screen Keyboard for binary / hex value input

■ On-Screen Keyboard for character string input

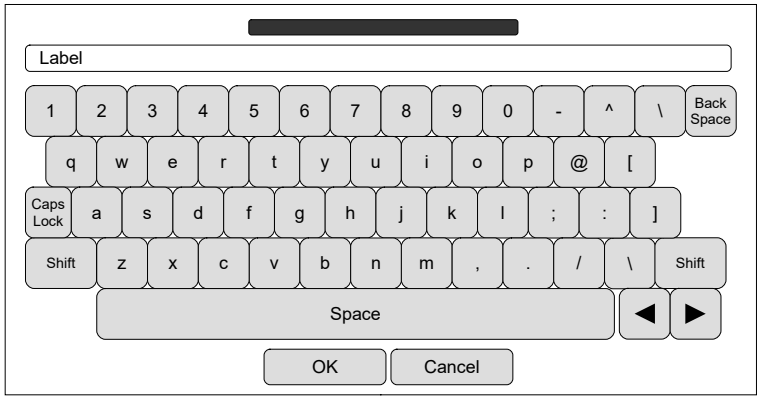


Figure 1.62 On-Screen Keyboard for string input

1.10 Color Scheme

Table 1.45 shows the waveform, grid line, cursor, and background color assignments. The color scheme can be selected from color schemes 1 to 3. See 2.6.2.2 Color scheme for color scheme settings.

Table 1.45 Applications for color schemes 1 to 3

Color Scheme	Application
Color scheme 1	Normal display
Color scheme 2	Select when printing a hard copy
Color scheme 3	User specific use. Customizable. The initial value is the same as color scheme 1.

The waveforms, grid lines, cursors, and background colors are assigned in Table 1.46, but you can edit them. See 2.6.2.3 Edit.

Table 1.46 Display colors and color schemes

	Color scheme 1		Color scheme 2		Color scheme 3	
	Color	RGB Value	Color	RGB Value	Color	RGB Value
CH1 Waveform		F5D732		B49619		F5D732
CH2 Waveform		E655AA		AA327D		E655AA
CH3 Waveform		1EC8CD		0F878C		1EC8CD
CH4 Waveform		78D732		469619		78D732
CH5 Waveform		FF8C73		B95A41		FF8C73
CH6 Waveform		7D69FF		5F55C3		7D69FF
CH7 Waveform		EB3278		B4375F		EB3278
CH8 Waveform		0573E1		1E64B9		0573E1
MATH1 Waveform		CDDC87		8C9B50		CDDC87
MATH2 Waveform		EBB4EB		A578AA		EBB4EB
MATH3 Waveform		B4DCFF		7896B9		B4DCFF
MATH4 Waveform		B9A082		78644B		B9A082
MATH5 Waveform		46B991		237855		46B991
MATH6 Waveform		A550FF		7841C3		A550FF
MATH7 Waveform		DC7DA0		AF7387		DC7DA0
MATH8 Waveform		2D87B9		2D6487		2D87B9
Bus1		C3C3C3		6E6E6E		C3C3C3
Bus2		828282		464646		828282
Grid Line		808080		808080		808080
Cursors		808080		808080		808080
Decode Markers		C8C8C8		C8C8C8		C8C8C8
Background		000000		E6E6E6		000000

1.11 Icon

This instrument uses the icons in Table 1.47.

Table 1.47 Icon classification

Classification	Icon	Description
Channels		It matches the design of the CH button on the Operation Panel.
Channels		
Channels		
Channels		
Channels		
Channels		
Channels		
Channels		
Channels		Waveform Inverted
Channels		Bandwidth Control [Note] is the Low pass characteristic.
Channels		Bandwidth Control [Note] is the Bandpass characteristic.
Channels		Bandwidth Control [Note] is the High pass characteristic.
Waveform		Display mode: Single
Waveform		Display mode: Split
Waveform		Display mode: XY
Waveform		Display mode: XY Single
Waveform		Display mode: XY Split
Math		It matches the design of the Math button on the Operation Panel.
Math		
Math		
Math		
Math		
Math		
Math		
Math		
Bus		It matches the design of the Bus button on the Operation Panel.
Bus		
Trigger		Edge trigger (specify rising edge)
Trigger		Edge trigger (specify falling edge)
Trigger		Edge ALT trigger (alternate rising and falling edges)
Trigger		Edge OR trigger
Trigger		Pulse number trigger. Specify the number of positive pulses.

Trigger		Pulse number trigger. Specify the number of negative pulses.
Trigger		Pulse width trigger. Specify the width of the positive pulse.
Trigger		Pulse width trigger. Specify the width of the negative pulse.
Trigger		Periodic trigger. Specify the period of the positive pulse.
Trigger		Periodic trigger. Specify the period of the negative pulse.
Trigger		Missing trigger. When there is no rise within the specified time after detecting the rising edge.
Trigger		Missing trigger. When there is no falling edge within the specified time after detecting the falling edge.
Trigger		OR trigger
Trigger		Negative OR trigger
Trigger		AND trigger
Trigger		Negative AND trigger
Trigger		UART trigger
Trigger		SPI trigger
Trigger		I2C trigger
Trigger		Sequence trigger
Trigger		Transition Time trigger
Cursor		Vertical cursor1
Cursor		Vertical cursor2
Cursor		Horizontal cursor1
Cursor		Horizontal cursor2
Cursor		The Voltage between cursors
Cursor		The time between cursors
Cursor		The frequency between cursors
Search/ History		Prev-S Icon, Return to previous search / history result
Search/ History		Next-S Icon, Proceed to the next search / history result

Note: The bandwidth control, which is determined by the Bandwidth setting and the Digital Filter setting, is displayed as an icon.

1.12 Probe Phase Adjustment

■ Probe phase adjustment

The probe waveform adjustment adjusts the capacitance of the variable capacitor inside the probe so that the gain with respect to frequency is constant when the oscilloscope and probe are combined. If this adjustment is not done properly, correct measurement will not be performed. When using the probe for the first time, adjust the waveform of the probe.

Since the input capacitance may be slightly different between the same type of oscilloscope and channels in the same oscilloscope, even if the waveform is adjusted once, if the combination with the oscilloscope is changed or the connected channel is changed, the waveform needs to be adjusted again. Waveform adjustment is performed by connecting the attached probe to the CAL signal output terminal.

The specifications of the CAL signal of this instrument are as follows.

- Waveform Type: Sinewave
- Output Voltage: 4.0 V ±3%
- Frequency: 1 kHz ±0.5%

Note: Do not apply voltage to the CAL signal output terminal from the outside.
The internal circuit may be damaged.

Follow the steps below to adjust the probe waveform.

Operating procedure

1. Connect the probe to the input connector (CH1 to CH8).
2. Connect the probe tip to the CAL output terminal and the ground lead to GND terminal.
3. In the Auto Setup window of the MENU button, tap the Auto Setup button. Alternatively, press the AUTO SETUP button on the Operation Panel.
4. While looking at the displayed square wave (Figure 1.63 (a), (b)), insert the attached adjustment driver into the waveform adjustment hole of the probe and turn it (see Figure 1.64), and adjust the square wave into the ideal waveform (Figure 1.63) as close as possible to (c).

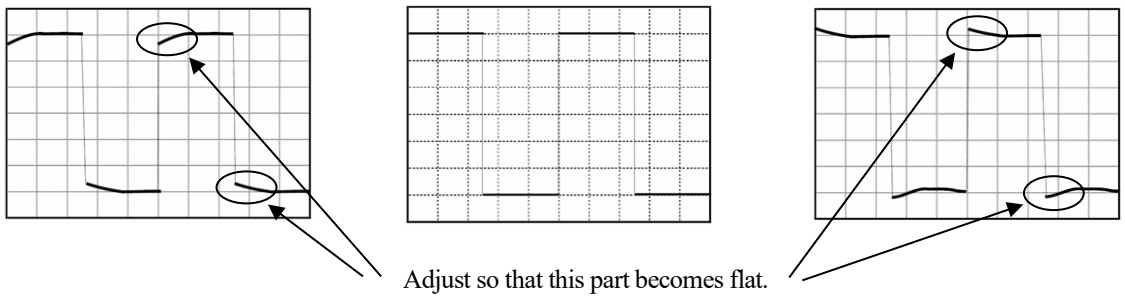


Figure 1.63 (a) Insufficient compensation (c) Ideal compensation (b) Over compensation

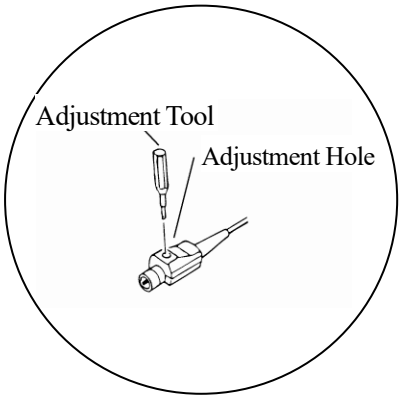


Figure 1.64 Waveform adjustment

1.13 Probe Power Connector

Dedicated probe power connectors for supplying power to FET probes, current probes, and differential probes that support the probe power connectors. The total current of the probe power connectors is about 1.0 A in the combination of P1 and P2, P3 and P4, P5 and P6, and P7 and P8. For the 4CH model (8104/8054/8034), it is a combination of P1 and P2 and P3 and P4. A warning will be displayed on the screen when the supply current exceeds 1.0 A. In this case, the overcurrent protection of this instrument may cause the probe power output to become unstable, so do not use it in that combination. For the current consumption of each probe, see the instruction manual of each probe.
Figure 1.66 shows a warning when an overcurrent is detected at the probe power connector P1:CH1/P2:CH2.

Operating procedure

1. Connect the probe to the input connector (CH1 to CH8).
2. Connect the probe power cable to the probe power output connectors on P1 through P8 (probe power cables that do not support probe power connectors cannot be connected (fitted), see Table 1.48).
3. Refers to 2.2.7 Channels_Probe Setup to set the probe to use.
   The attenuation ratio, unit (V/A), etc. are set according to the probe.

> Note: You can also set the probe by selecting the Channels window from the menu button. See the 2.2.7 Channels_Probe Setup.

When using a current probe, the total current of the probe power connector changes depending on the measured total current. If a warning is displayed using CH1 and CH2, change the probe power connector to the probe power connector of another CH so that you may be able to use a current probe.

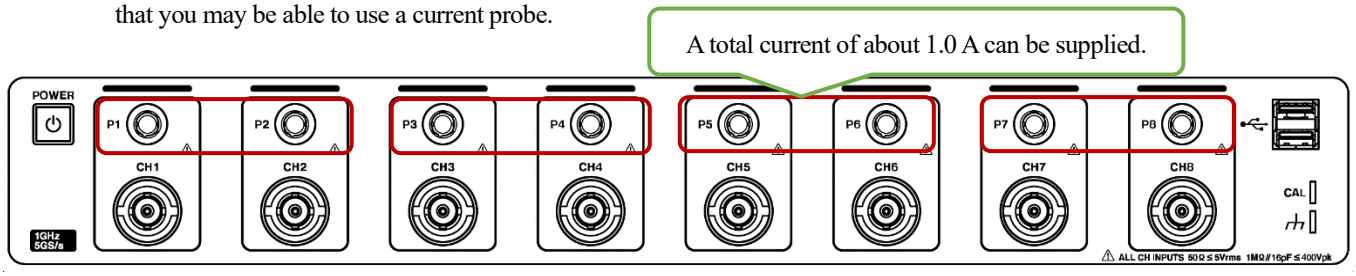


Figure 1.65 Probe Power Connector

Table 1.48 List of compatible probes

Probe Type	Model
FET Probe	SFP-4A/5A
High Voltage Differential Probe	SS-320
Current Probe	SS-240A SS-250 SS-260 SS-270

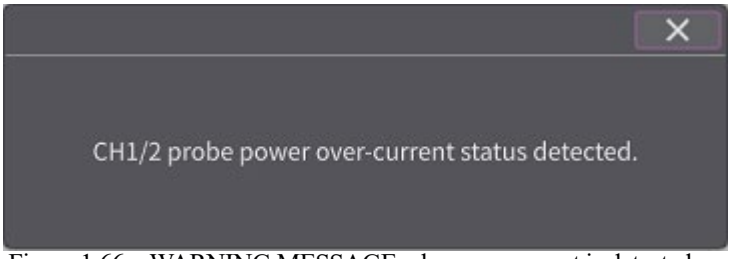


Figure 1.66 WARNING MESSAGE when overcurrent is detected.

> Memo:
> The combination of probe power connector and INPUT connector is not relevant. There is no problem connecting the probe to the INPUT connector on CH1 and using the probe power supply on other channels.

> Note:
> The probe power connector is a dedicated connector that supplies power to the probes listed in Table 1.48 Compatible Probes. It cannot be used for any other purpose. It may cause damage to the instrument.

Chapter 2 Basic Operation and Function

This chapter provides an overview of the basic operations and settings using the user interface (see 1.8 Operation and 1.9 Touch Interface). The operation and settings of this instrument are mainly performed from each Settings Window.

2.1 Screen Display Settings and Changes

- Select Waveform from the MENU Window and set it in the Waveform Window.
- The Settings Window consists of setting items and widgets corresponding to the setting items.
- Depending on the selection of the setting item, there are newly displayed setting items and widgets corresponding to the setting items.

2.1.1 Waveform Window

Select the Horizontal tab to the relevant label name and set from the settings window.
When you turn on the toggle switch of Persistence, the setting items of Time and Color gradation are displayed.

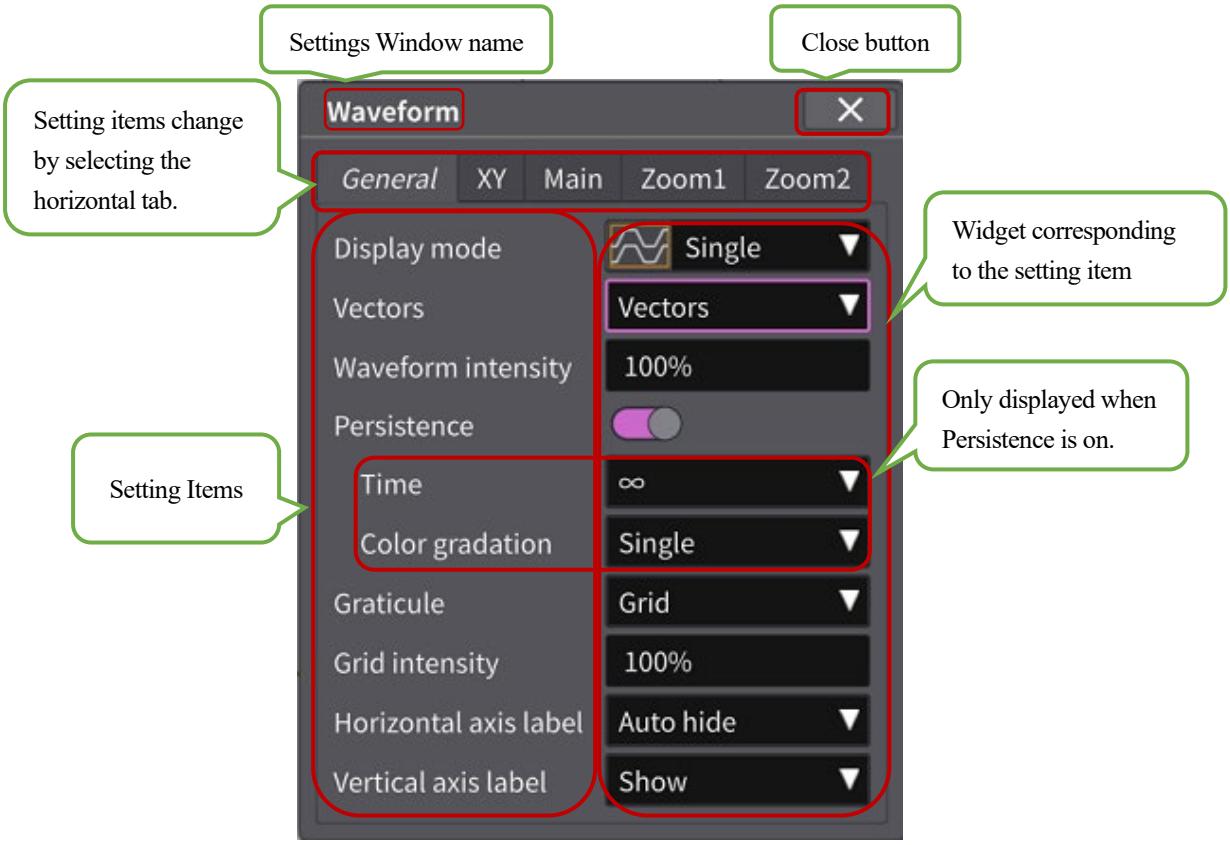


Figure 2.1 Waveform Window

2.1.2 Waveform_General

Select Zoom on the General tab to display the General-related Settings Window.
Input method: Horizontal Tab
Select the Horizontal tab from General / XY / Zoom.
The following is an explanation in the Settings Window in Figure 2.1 when General is selected on the Horizontal tab.

2.1.2.1 Display mode

Choose whether to display the waveform on a single screen or on separate screens.
Input method: Combo box
List: Select from Single / Split / XY / XY Single / XY Split / Off
See 1.7.2 Main Screen

Note: When Sample mode is Roll Sample
List: Select from Single / Split / Off.
See 2.3.2.4 Sample mode.

2.1.2.2 Vectors

Select whether to interpolate between waveform data (vector display) or display as dots.
Input method: Combo box
List: Select from Vectors / Dots.

2.1.2.3 Waveform intensity

Set the brightness of the waveform with the numerical setting (%).
Input method: Numeric input box

2.1.2.4 Persistence

Set the time to leave the waveform data on the screen. When Persistence is turned on, Time and Color gradation are displayed.
Input method: Toggle switch

■ **Time**

In the persistence mode, the waveform remains on the screen for the specified amount of time.
Input method: Combo box
List: Select from 100ms / 200ms / 500ms / 1s / 2s / 5s / 10s / ∞.

■ **Color gradation**

The display color of persistence is a single color.
Input method: Combo box
List: Single

2.1.2.5 Graticule

Select the grid lines. An image of the grid lines is shown in Figure 2.2.
Input method: Combo box
List: Select from Grid / Axis / Frame.

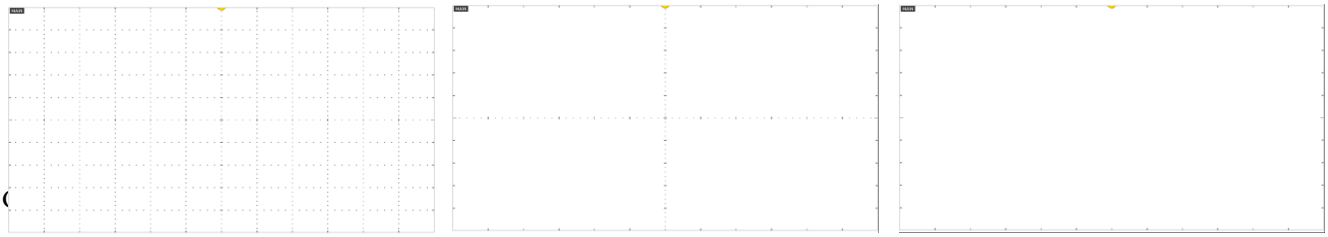


Figure 2.2 Grid line

2.1.2.6 Grid intensity

Adjusts the intensity of the grid lines.
Input method: Numeric Input Box and (1) Knob on the Operation Panel
For the input method, see 1.9.8 Numeric input box.

2.1.2.7 Horizontal axis label

Select the numerical display method on the horizontal axis of the selected Source (Hide / Show / Hide after the operation is completed).
Input method: Combo box
List: Select from Hide / Show / Auto hide

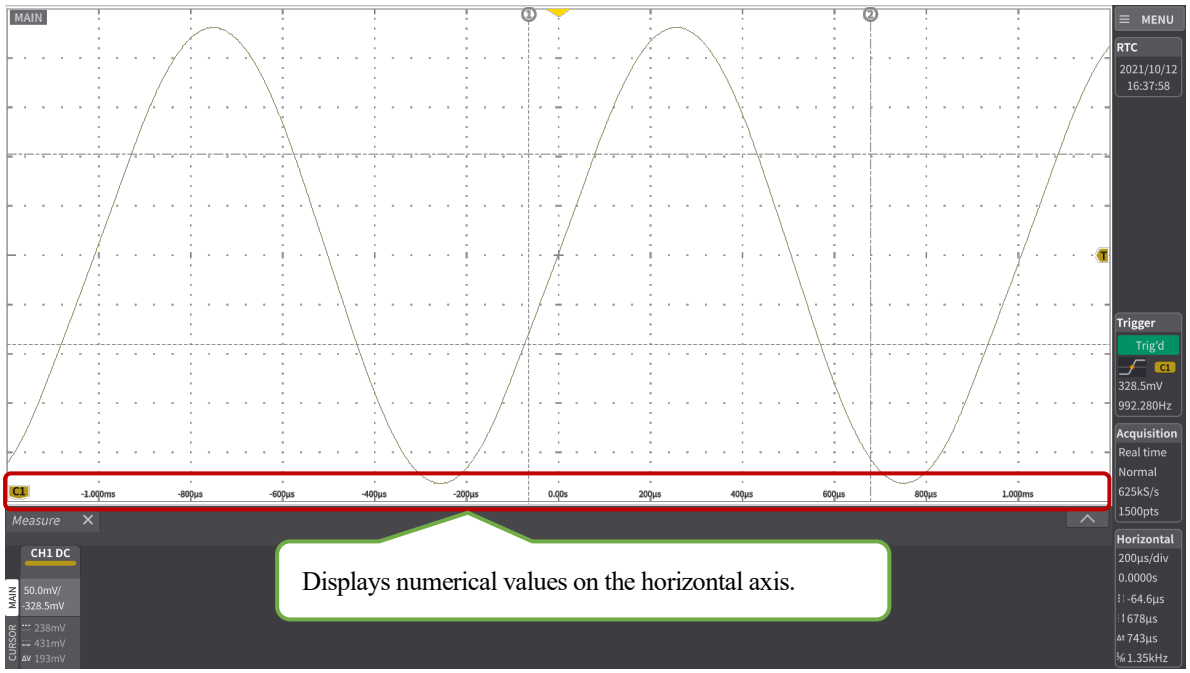


Figure 2.3 CH / Math horizontal axis numerical display example

2.1.2.8 Vertical axis label

Select the numerical display method on the vertical axis of the selected Source (hide / show / hide after the operation is completed).
Input method: Combo box
List: Select from Hide / Show / Auto hide

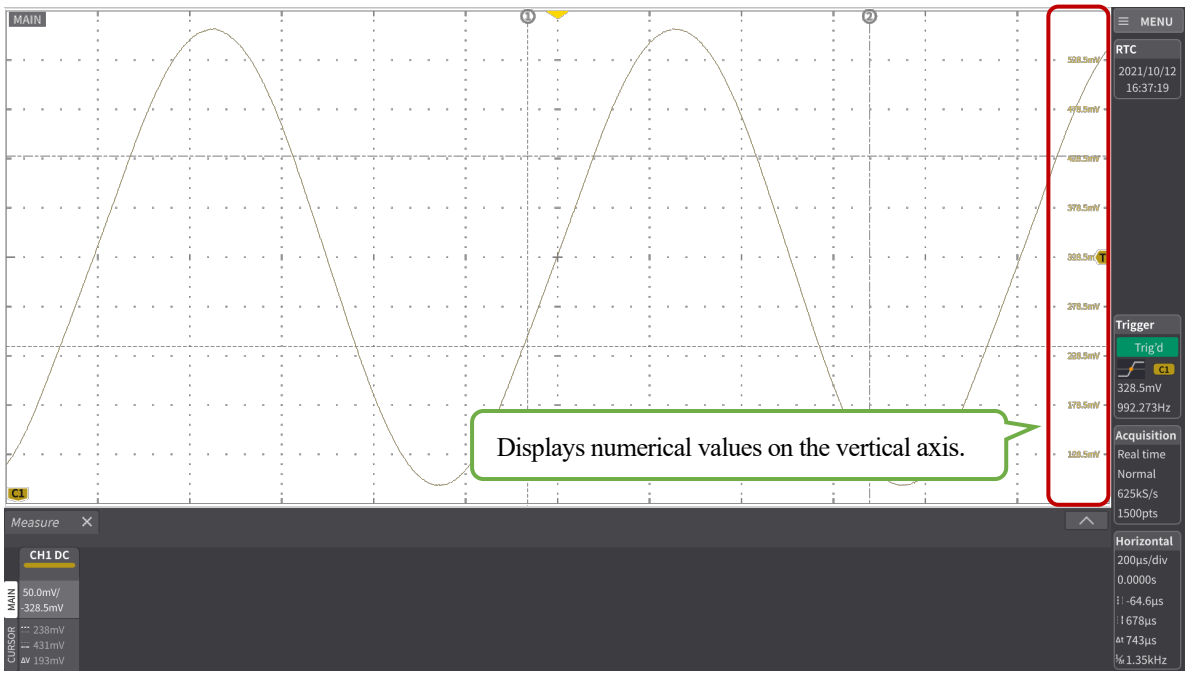


Figure 2.4 CH / Math vertical axis numerical display example

2.1.3 Waveform_XY

Select XY on the Horizontal tab to display the XY-related Settings Window.

Input method: Horizontal Tab
Select the Horizontal tab from General / XY / Zoom1 / Zoom2.
The following is an explanation in the Settings Window in Figure 2.5 when XY is selected on the Horizontal tab.

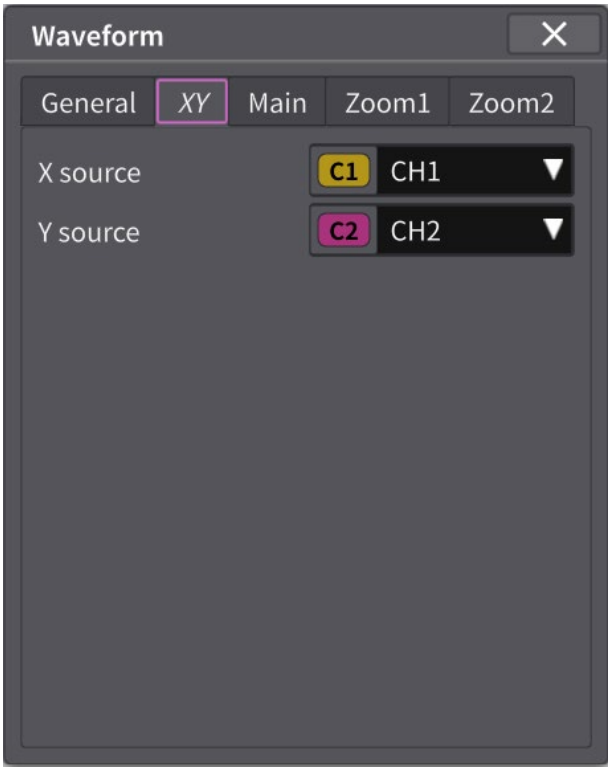


Figure 2.5 Waveform_XY Settings Window

2.1.3.1 X Source

Select the channel source to display on the X axis of the XY display.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.1.3.2 Y Source

Select the channel source to display on the Y axis of the XY display.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.1.4 Waveform_Main

Choose from multiple side-by-side tabs displayed at the top.
Input method: Horizontal tab

Select the horizontal tab from General / XY / Main / Zoom1 / Zoom2.
The following is explained in Figure 2.6 when Main is selected on the horizontal tab.
Set the channel waveform to be displayed and the calculation result waveform.

Select the channel waveform and calculation result waveform to be displayed with the check boxes, but you can display them all at once or hide them all at once.
Input method: Check box

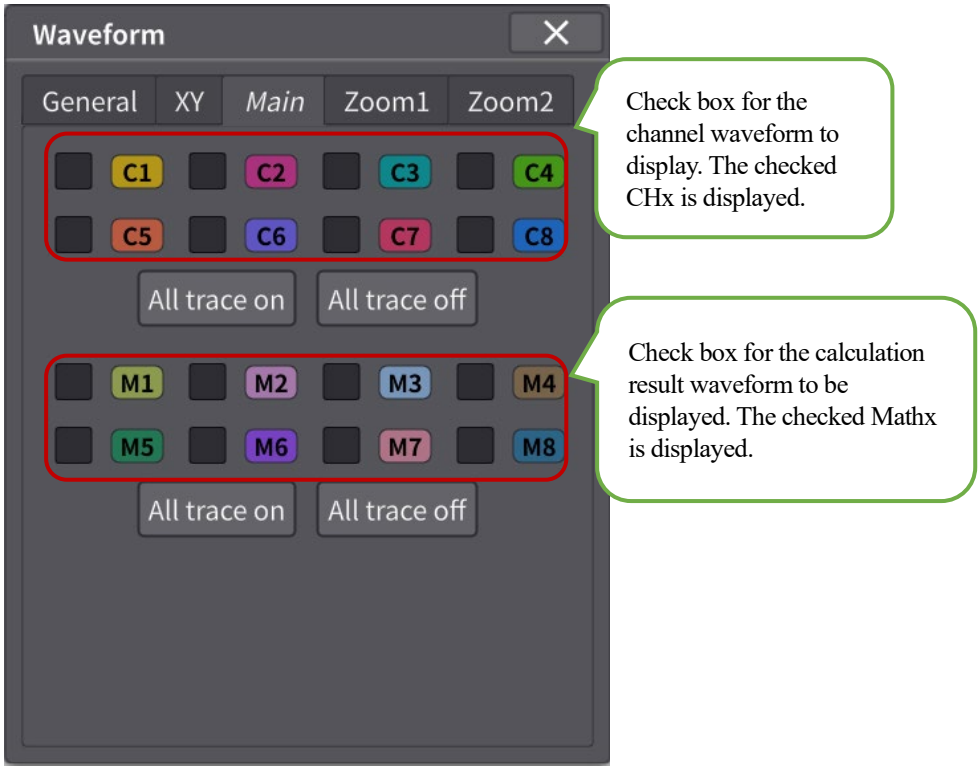


Figure 2.6 Waveform_Main Settings Window

2.1.4.1 All trace on

All channel waveforms to be displayed are set and displayed at once.
Input method: Button

2.1.4.2 All trace off

Hides all channel waveforms to be displayed.
Input method: Button

2.1.4.3 All trace on

The calculation result waveforms to be displayed are collectively set and displayed.
Input method: Button

2.1.4.4 All trace off

Hides the operation result waveforms to be displayed at once.
Input method: Button

2.1.5 Waveform_Zoom1

Choose from multiple side-by-side tabs displayed at the top.
Input method: Horizontal tab

Select the horizontal tab from General / XY / Main / Zoom1 / Zoom2.
Below, explain with Figure 2.7 when Zoom1 is selected on the horizontal tab.
Set the channel waveform to be displayed and the calculation result waveform.
Select the channel waveform and calculation result waveform to be displayed with the check boxes, but you can display them all at once or hide them all at once.
Input method: Check box

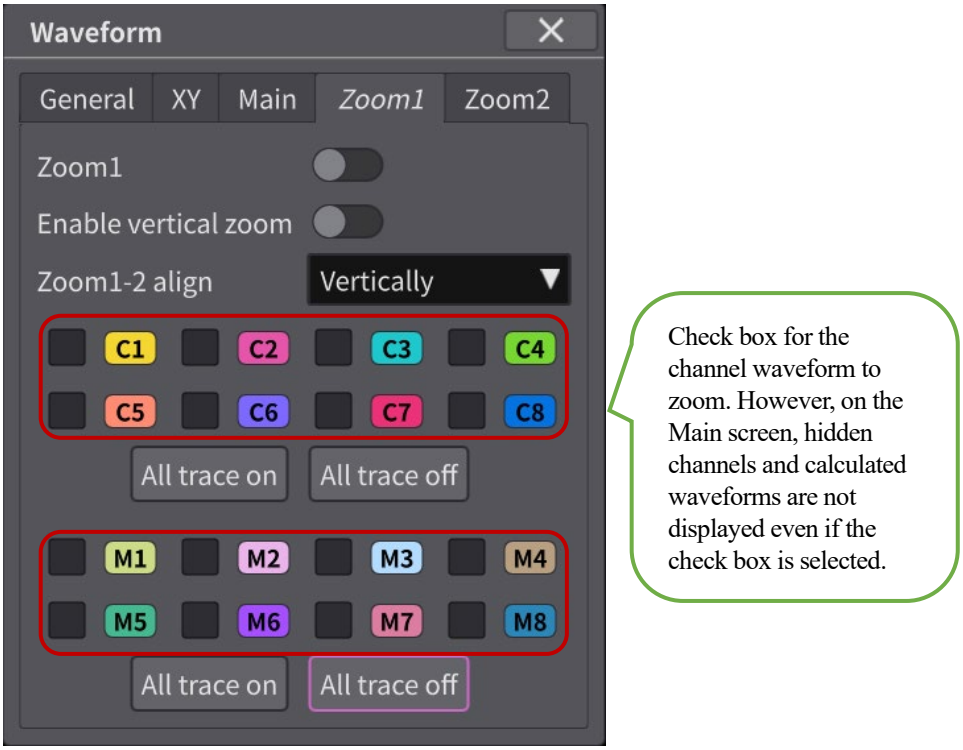


Figure 2.7 Waveform_Zoom1 Settings Window

2.1.5.1 Zoom1

Choose to show / hide the Zoom1 screen.
Input method: Toggle switch
See 1.7.3 Zoom screen.

2.1.5.2 Enable vertical zoom

Enables/disables vertical zoom of waveforms displayed on the Zoom1 screen. If vertical zoom is disabled, the vertical axis of the waveform on the Zoom1 screen will be at the same scale as the Main screen.
Input method: Toggle switch

2.1.5.3 Zoom1-2 align

Selects the direction in which the Zoom1 and Zoom2 screens will be aligned; Figure 2.8 shows the alignment when set to Vertically, and Figure 2.9 shows the alignment when set to Horizontally.
Input method: combo box
List: Vertically / Horizontally

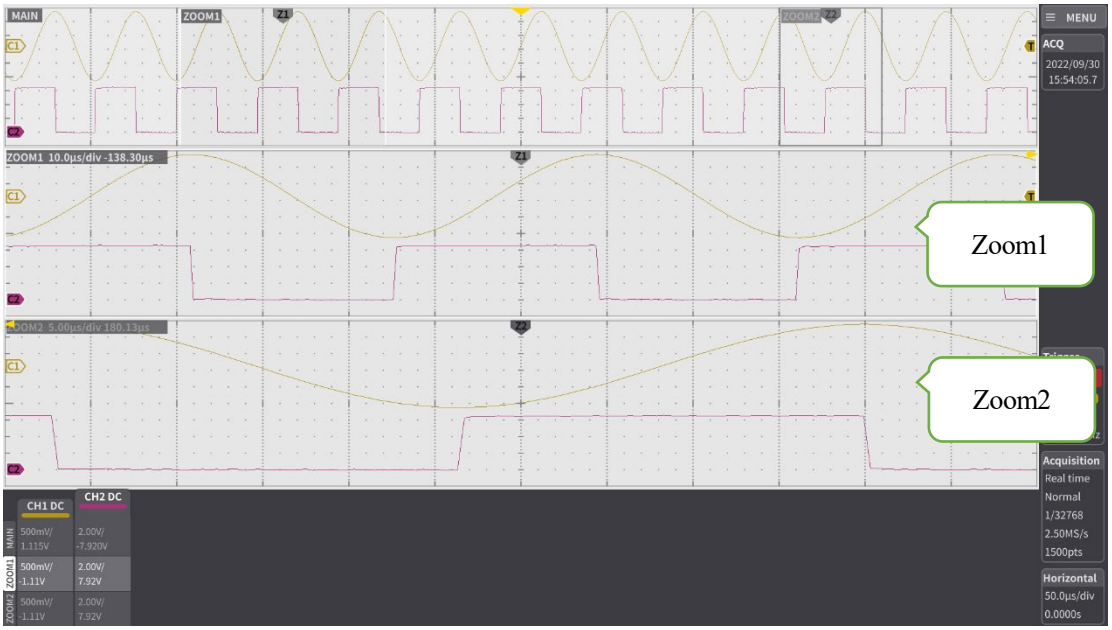


Figure 2.8 Zoom1-2 align set to Vertically

Figure 2.9 Zoom1-2 align set to Horizontally

2.1.5.4 All trace on

The channel waveforms to be displayed are displayed in a batch.

Input method: Button

2.1.5.5 All trace off

Shows all channel waveforms to be displayed.

Input method: Button

2.1.5.6 All trace on

The calculation result waveforms to be displayed are displayed in a batch.

Input method: Button

2.1.5.7 All trace off

The calculation result waveforms to be displayed are hidden at once.

Input method: Button

2.1.6 Waveform_Zoom2

Choose from multiple side-by-side tabs displayed at the top.
Input method: Horizontal tab

Select the horizontal tab from General / XY / Main / Zoom1 / Zoom2.
Below, explain with Figure 2.10 when Zoom2 is selected on the horizontal tab.
Set the channel waveform to be displayed and the calculation result waveform.
Select the channel waveform and calculation result waveform to be displayed with the check boxes, but you can display them all at once or hide them all at once.
Input method: Check box

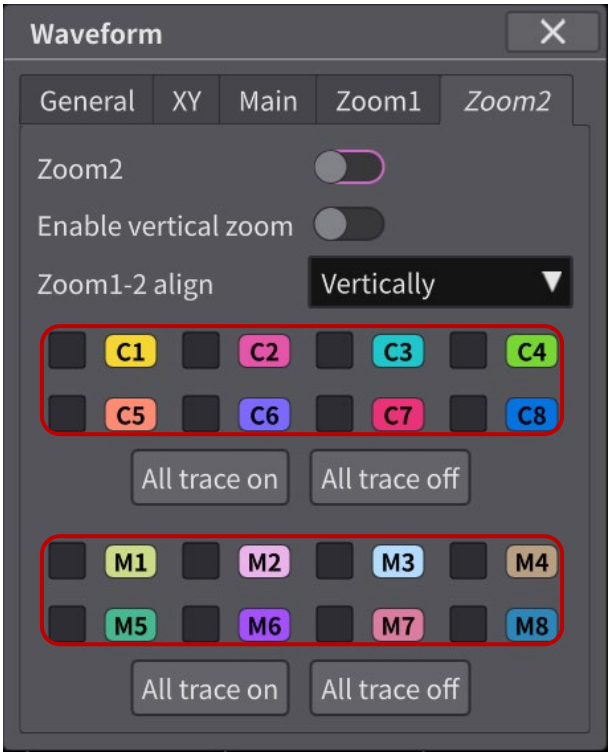


Figure 2.10 Waveform_Zoom2 Settings Window

2.1.6.1 Zoom2

Choose to show / hide the Zoom2 screen.
Input method: Toggle switch
See 1.7.3 Zoom Screen.

2.1.6.2 Enable vertical zoom

Enables/disables vertical zoom of waveforms displayed on the Zoom2 screen. If vertical zoom is disabled, the vertical axis of the waveform on the Zoom2 screen will be at the same scale as the Main screen.
Input method: Toggle switch

2.1.6.3 Zoom1-2 align

Selects the direction in which the Zoom1 and Zoom2 screens will be aligned; Figure 2.8 shows the alignment when set to Vertically, and Figure 2.9 shows the alignment when set to Horizontally.
Input method: combo box
List: Vertically / Horizontally

2.1.6.4 All trace on

The channel waveforms to be displayed are displayed in a batch.
Input method: Button

2.1.6.5 All trace off

Shows all channel waveforms to be displayed.

Input method: Button

2.1.6.6 All trace on

The calculation result waveforms to be displayed are displayed in a batch.

Input method: Button

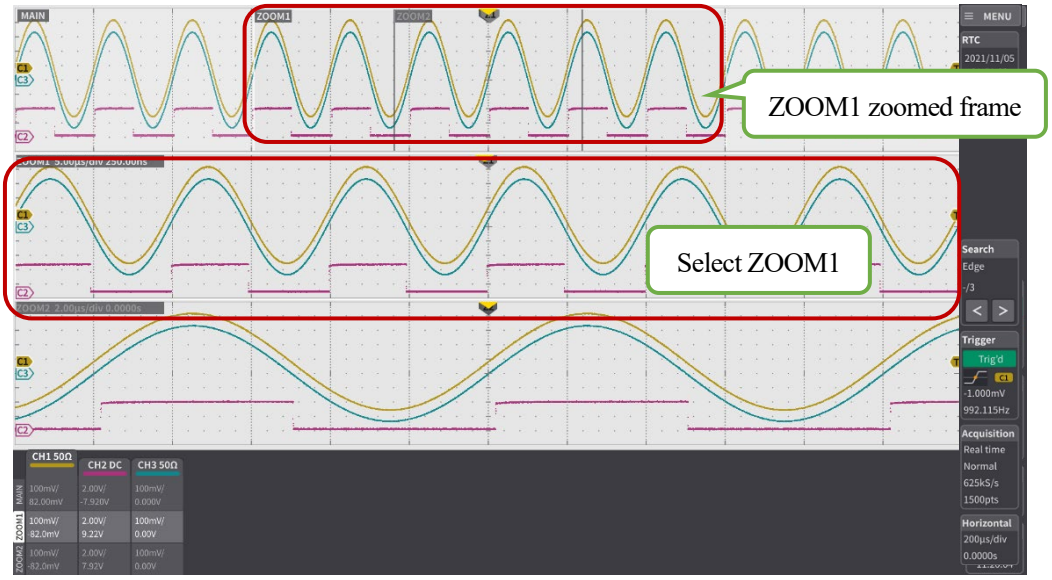
2.1.6.7 All trace off

The calculation result waveforms to be displayed are hidden at once.

Input method: Button

■ When ZOOM1 is selected in the display of ZOOM1 and ZOOM2, the enlarged part of MAIN corresponding to ZOOM1 is focused.

ZOOM1 Focused >



■ When ZOOM2 is selected in the display of ZOOM1 and ZOOM2, the enlarged part of MAIN corresponding to ZOOM2 is focused

ZOOM2 Focused >

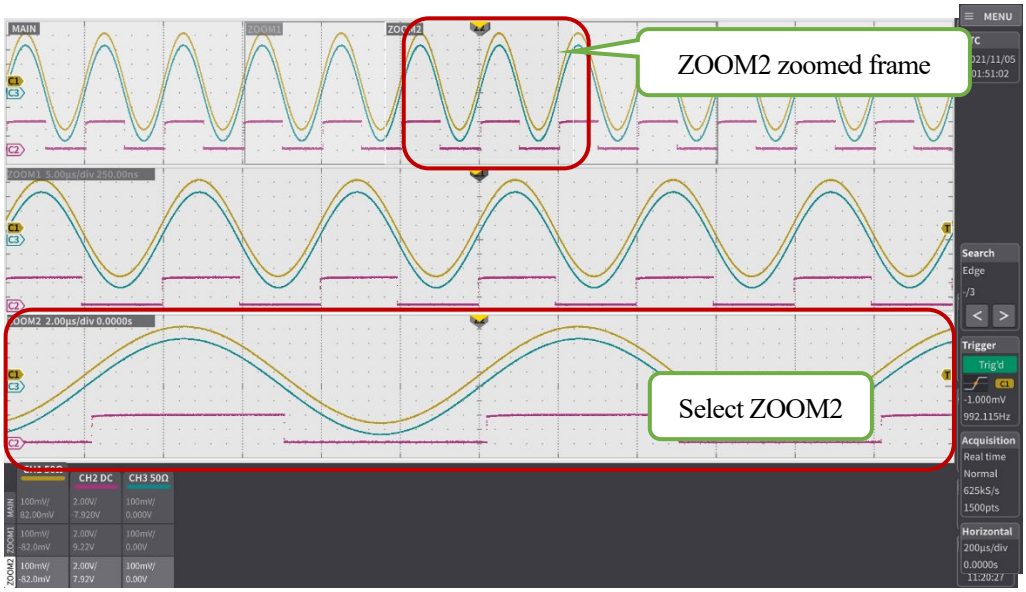


Figure 2.11 Display of ZOOM1 and ZOOM2 screens

■ Adjusting the display area of the Main Screen and the Zoom Screen

With the Main screen selected, you can adjust the height of the Main screen by dragging the touch screen.

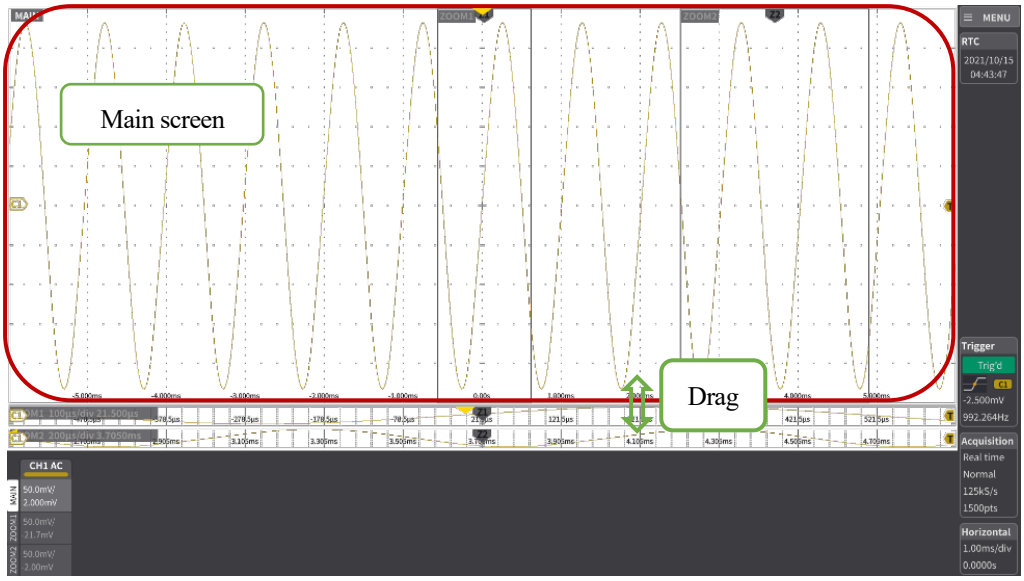


Figure 2.12 Main screen is maximum

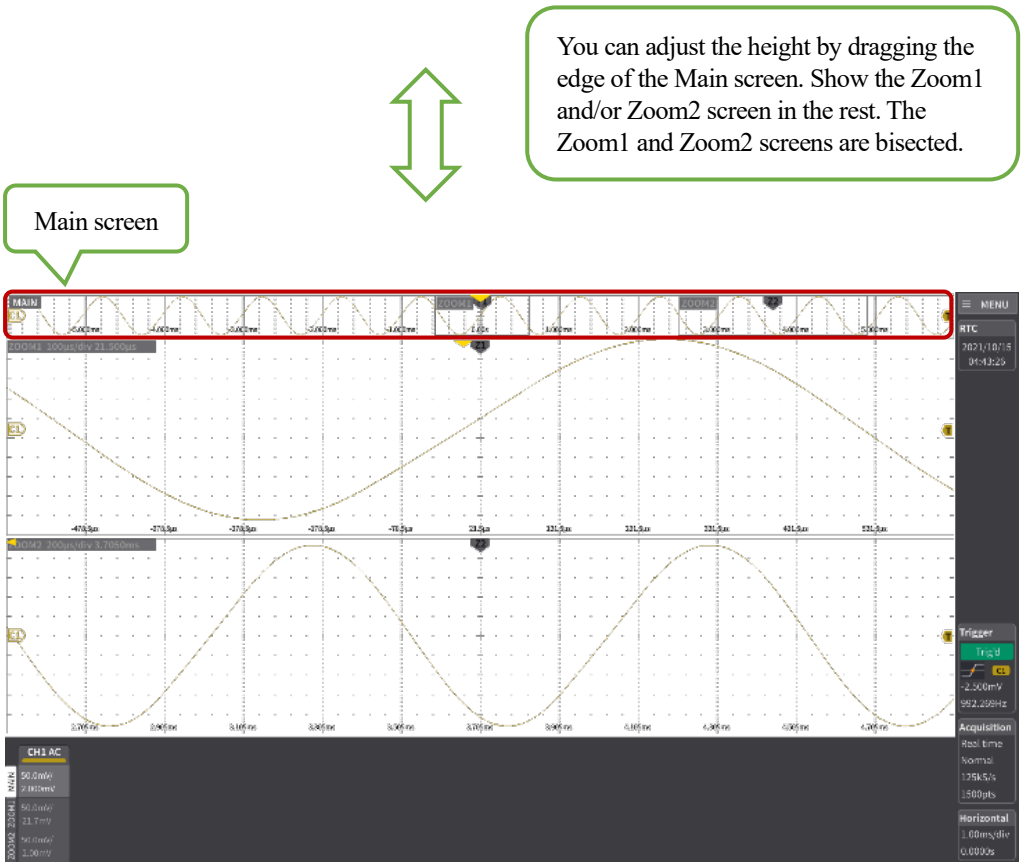


Figure 2.13 Main screen is minimum

2.2 Vertical Related Operations and Settings

- Select Channels from the MENU Window and set from the Channels Window.
- When you select CH on the Vertical tab, the Horizontal tab displays the contents of the Settings Window related to the label name of the Horizontal tab.
- Use the buttons or Knobs on the control panel to set the measurement parameter values.
- Tap the Channels Readout to display the Channels Window

■ Operation from the Operation Panel

1. Use the CHx button to turn the waveform ON/OFF.
2. Adjusts the OFFSET of the selected CH.
3. Change the V/div of the selected CH.

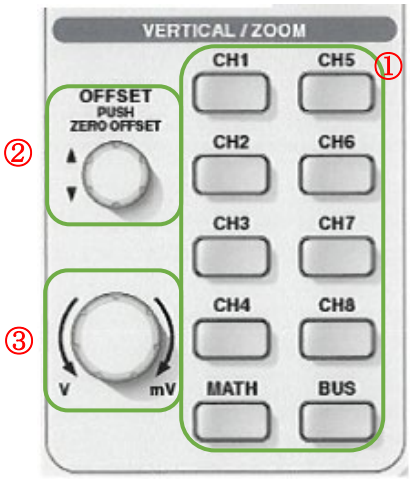


Figure 2.14 Operation from the Operation Panel

■ Operation from Readout

Tap the CHx Readout you want to change to display the associated Channels Window, where you can change it.

Operating procedure

1. If the CHx Readout you want to change is not focused (selected), touch it to focus (select) it.
2. Tap the focused (selected) CHx Readout.
3. The Channels Window of the tapped CHx is displayed, and you can change the settings.

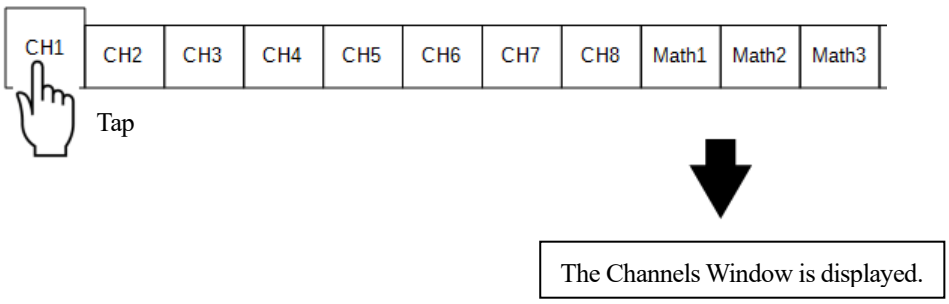


Figure 2.15 Operation image from Readout

2.2.1 Channels Window

Select a channel on the vertical tab, then select the Horizontal tab for the associated label name, and set it in the settings screen window.

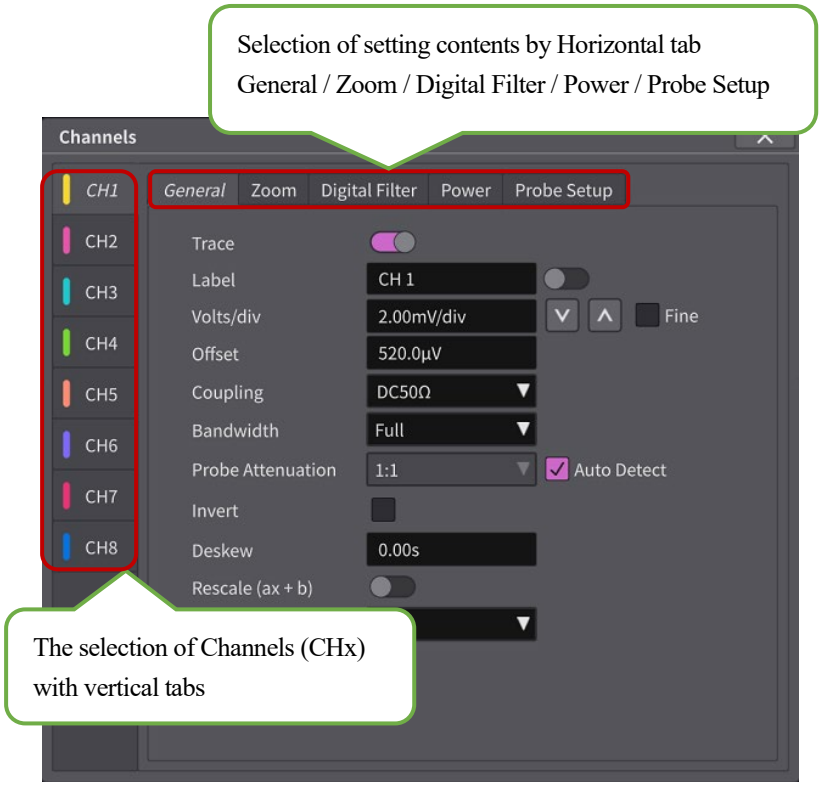


Figure 2.16 Channels Window

2.2.2 Channels Waveform Setting Change

Select the CHx you want to change on the vertical tab.
Input method: Vertical tab
For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.2.3 Channels_General

Select from the Horizontal tab at the top and change the content in the settings screen window.
Input method: Horizontal tab
Horizontal tabs can be selected from General / Zoom / Power / Probe Setup.
Describes the Settings Window when General is selected on the Horizontal tab (Figure 2.16).

2.2.3.1 Trace

Select ON/OFF of CHx waveform.
Input method: Toggle Switch

2.2.3.2 Label

By entering the label name and tapping the toggle switch, the label name can be displayed next to the offset marker of the waveform.
Input method: Character String Input Box
Input method: Toggle Switch.
See 1.7.5 Trace Label.

2.2.3.3 Volts/div

Set the voltage per division.
Input method: Numeric Input Box (with Up / Down buttons) / On-Screen Keyboard / (1) Knob on operation panel
For the input method, see 1.9.9 Numeric Input Box (with Up / Down button).

2.2.3.4 Fine (adjustment)

Set whether to fine-adjustment Volts/div.
Input method: Check box

2.2.3.5 Offset

Set the offset value of the waveform.
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.2.3.6 Coupling

Select the input coupling of the input waveform.
Input method: Combo box
The list is shown in Table 2.1.

Table 2.1 Input coupling settings

List	Description
AC 1 MΩ	A capacitor is connected to the input to block the DC component. It is used when measuring only the AC component.
GND	Disconnect the signal from the input connector and connect it to ground. It is used to check the ground level.
DC 1 MΩ	With an input resistance of 1 MΩ, all DC and AC components can be measured.
DC 50 Ω	With an input resistance of 50 Ω, all DC and AC components can be measured.

2.2.3.7 Bandwidth

Set the bandwidth limit.
Input method: Combo box
List: Select from 20 MHz / 100 MHz / 500 MHz / Full (DS-8108 / 8104).
List: Select from 20 MHz / 100 MHz / Full (DS-8058 / 8054 / 8038 / 8034).

2.2.3.8 Probe Attenuation

Set the probe attenuation ratio. It cannot be set when Auto Detect is On.
Input method: Combo box
List: Select from 0.1:1 / 1:1 / 2:1 / 5:1 / 10:1 / 20:1 / 50:1 / 100:1 / 200:1 / 250:1 / 500:1 / 1000:1 / 2000:1 / 5000:1 / 10000:1.

2.2.3.9 Auto Detect

When the box is checked, the probe attenuation ratio will be set automatically.
Input method: Check box

2.2.3.10 Invert

Set the inversion of the waveform.
Input method: Check box

2.2.3.11 Deskew

Set the deskew value.
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

■ Deskew

For measurements where there is a Skew (time difference) between channels, Deskew can be used to compensate the skew. Figure 2.17 shows an example when CH2 Deskew is set to Δt. By setting the Deskew of CH2 to Δt, the time lag with CH1 can be compensated.

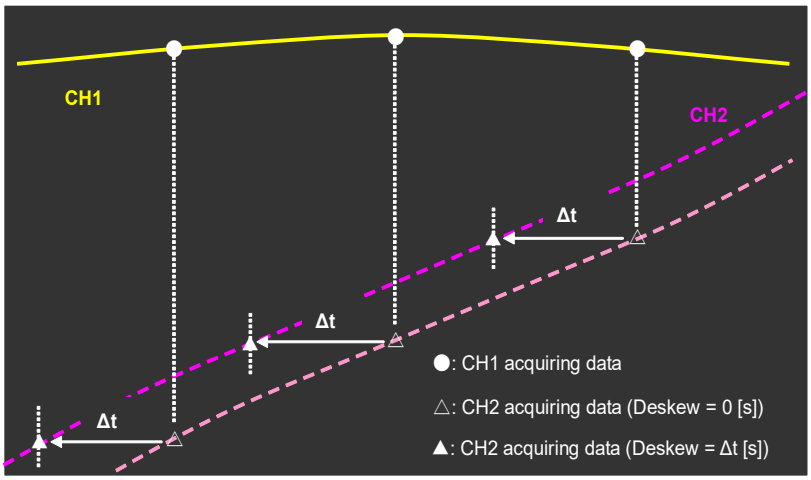


Figure 2.17 Example of CH2 Deskew set to Δt

■ Deskew settings

Table 2.2 shows the settable range and minimum resolution of deskew. Table 2.3 shows when the number of waveform points exceeds 150k points. Note that there is an upper limit for each sampling rate.

Table 2.2 Deskew range and minimum resolution (within 150k points)

Timebase [s/div]	Range [s]	Minimum Resolution [s]	Timebase [s/div]	Range [s]	Minimum Resolution [s]
200 p	-10.0μ - 10.0 μ	5.00 p	200 μ	-200μ – 200 μ	1.00 μ
500 p	-10.0μ- 10.0 μ	5.00 p	500 μ	-500 μ– 500 μ	2.50 μ
1.00 n	-10.0μ- 10.0 μ	5.00 p	1.00 m	-1.00m - 1.00 m	5.00 μ
2.00 n	-10.0μ- 10.0 μ	10.0 p	2.00 m	-2.00m - 2.00 m	10.0 μ
5.00 n	-10.0μ- 10.0 μ	25.0 p	5.00 m	-5.00m - 5.00 m	25.0 μ
10.0 n	-10.0μ- 10.0 μ	50.0 p	10.0 m	-10.0m - 10.0 m	50.0 μ
20.0 n	-10.0μ- 10.0 μ	100 p	20.0 m	-20.0m - 20.0 m	100 μ
50.0 n	-10.0μ- 10.0 μ	250 p	50.0 m	-50.0m - 50.0 m	250 μ
100 n	-10.0μ- 10.0 μ	500 p	100 m	-100m – 100 m	500 μ
200 n	-10.0μ- 10.0 μ	1.00 n	200 m	-200m – 200 m	1.00 m
500 n	-10.0μ- 10.0 μ	2.50 n	500 m	-500m – 500 m	2.50 m
1.00 μ	-10.0μ- 10.0 μ	5.00 n	1.00	-1.00 - 1.00	5.00 m
2.00 μ	-10.0μ- 10.0 μ	10.0 n	2.00	-2.00 - 2.00	10.0 m
5.00 μ	-10.0μ- 10.0 μ	25.0 n	5.00	-5.00 - 5.00	25.0 m
10.0 μ	-10.0μ- 10.0 μ	50.0 n	10.0	-10.0 - 10.0	50.0 m
20.0 μ	-20.0μ- 20.0 μ	100 n	20.0	-20.0 - 20.0	100 m
50.0 μ	-50.0μ- 50.0 μ	250 n	50.0	-50.0 - 50.0	250 m
100 μ	-100μ – 100 μ	500 n			

Table 2.3 Sampling rate and deskew range, and minimum resolution (150k points or higher)

Sampling Rate	Range [s]	Minimum Resolution [s]	Sampling Rate	Range [s]	Minimum Resolution [s]
5.0 GS/s	-10.0µ - 10.0 µ	5.00 p	2.5 MS/s	-5.00m - 5.00 m	5.00 p
2.5 GS/s	-10.0µ- 10.0 µ	5.00 p	1.25 MS/s	-10.0m - 10.0 m	5.00 p
1.25 GS/s	-10.0µ- 10.0 µ	5.00 p	625 kS/s	-20.0m - 20.0 m	5.00 p
625 MS/s	-20.0µ- 20.0 µ	5.00 p	500 kS/s	-20.0m - 20.0 m	5.00 p
500 MS/s	-20.0µ- 20.0 µ	5.00 p	250 kS/s	-50.0m - 50.0 m	5.00 p
250 MS/s	-50.0µ- 50.0 µ	5.00 p	125 kS/s	-100m - 100 m	5.00 p
125 MS/s	-100µ- 100 µ	5.00 p	62.5 kS/s	-200m - 200 m	5.00 p
62.5 MS/s	-200µ- 200 µ	5.00 p	50 kS/s	-200m - 200 m	5.00 p
50 MS/s	-200µ- 200 µ	5.00 p	25 kS/s	-500m - 500 m	5.00 p
25 MS/s	-500µ- 500 µ	5.00 p	12.5 kS/s	-1.00 - 1.00	5.00 p
12.5 MS/s	-1.00m - 1.00 m	5.00 p	6.25 kS/s	-2.00 - 2.00	5.00 p
6.25 MS/s	-2.00m - 2.00 m	5.00 p	5 kS/s	-2.00 - 2.00	5.00 p
5 MS/s	-2.00m - 2.00 m	5.00 p	2.5 kS/s	-5.00 – 5.00	5.00 p

2.2.3.12 Rescale (ax+b)

Set Rescale OFF/ON.

Input method: Toggle switch

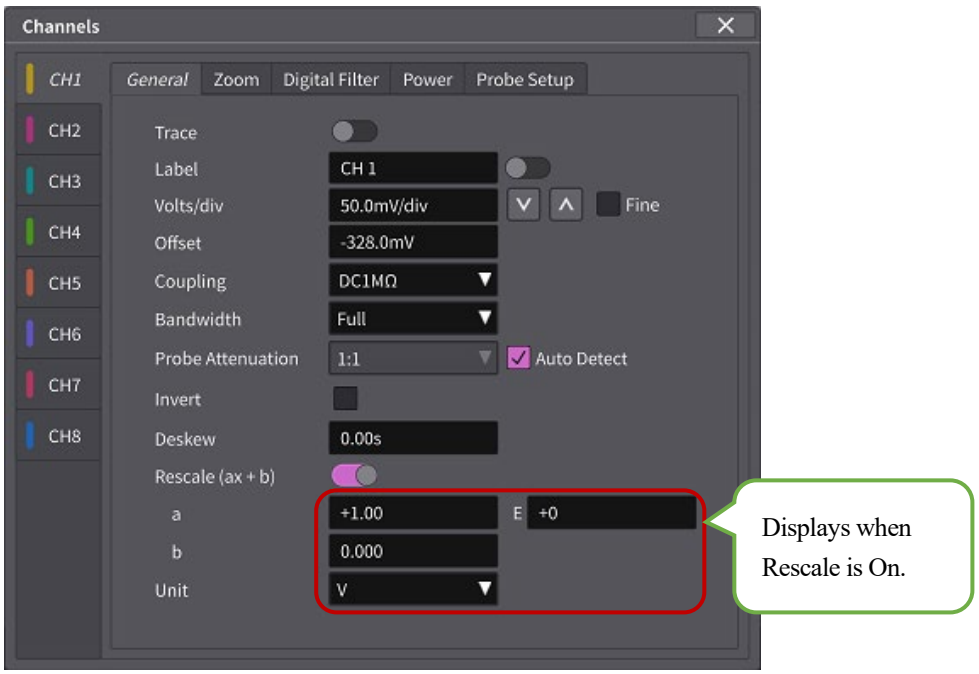


Figure 2.18 Settings Window when Rescale is on

The conversion formula is

$$(a \times 10^{E}) \times X + b$$

When Rescale is turned on, the following is displayed and ready to input.

■ a (mantissa)

Set the mantissa part of the coefficient a. (0.01 to 1.00)

Input method: Numeric Input Box

■ E (index part)

Set the exponent part of the coefficient a. (-6 to +3)

Input method: Numeric Input Box

■ b (constant part)

Set the constant b.

Input method: Numeric Input Box

■ Unit

Set the unit of the voltage axis.

Input method: Combo box

List: Select from V / A / W / °C / Ω / No Unit.

2.2.4 Channels_Zoom

Select Zoom on the Horizontal tab to display the Zoom-related Settings Window.

Input method: Tap Zoom on the Horizontal tab.

The Settings Window when Zoom is selected on the Horizontal tab is explained below (Figure 2.19).

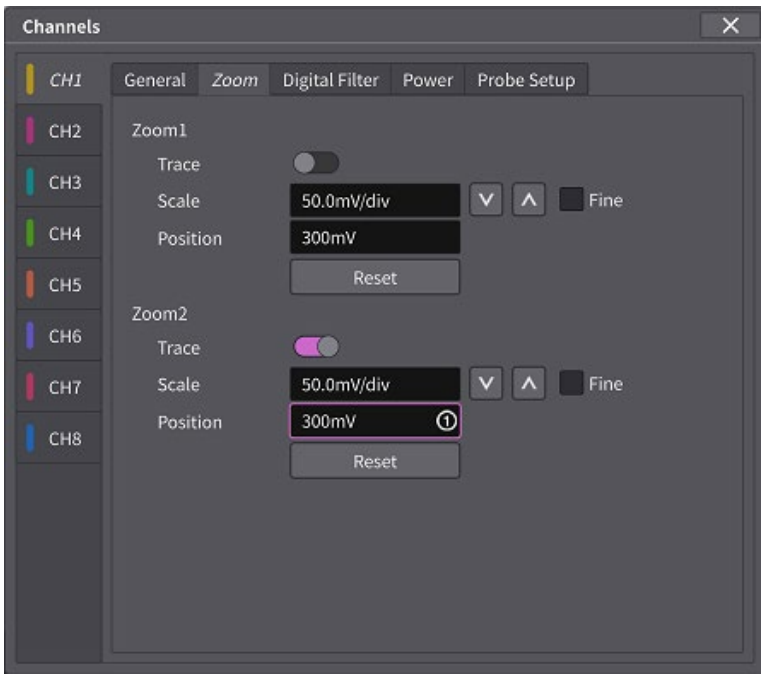


Figure 2.19 Settings Window when Zoom is selected on the Horizontal tab

2.2.4.1 Zoom1 / Zoom2_Trace

Set ON / OFF of Zoom1 / Zoom2.

Input method: Toggle switch

2.2.4.2 Zoom1 / Zoom2_Scale

Set each scale of Zoom1 / Zoom2.

Input method: Numeric Input Box (with Up / Down buttons) / Screen keyboard / (1) Knob on Operation Panel

For the input method, see 1.9.9 Numeric Input Box (with Up / Down button).

Scale cannot be changed if 2.1.5.2 or 2.1.6.2 Enable vertical zoom is disabled.

2.2.4.3 Zoom1 / Zoom2_Fine

Set whether to fine-tune the zoom vertical setting of Zoom1 / Zoom2.

Input method: Check box

Fine cannot be changed if 2.1.5.2 or 2.1.6.2 Enable vertical zoom is disabled.

2.2.4.4 Zoom1 / Zoom2_Position

Set the Zoom1 / Zoom2 position.

Input method: Numeric Input Box

Position cannot be changed if 2.1.5.2 or 2.1.6.2 Enable vertical zoom is disabled.

2.2.4.5 Zoom1 / Zoom2_Reset

Set Scale and Position to Volts/div and Offset values when acquiring waveforms.

Input method: Button

Reset cannot be executed if 2.1.5.2 or 2.1.6.2 Enable vertical zoom is disabled.

2.2.5 Channels_Digital Filter

By selecting Digital Filter on the horizontal tab, the display contents of the setting window related to Digital Filter will be changed.
Input method: Horizontal tab Tap Digital Filter on the horizontal tab.
Below, when Digital Filter is selected on the horizontal tab, it is explained in Figure 2.20.

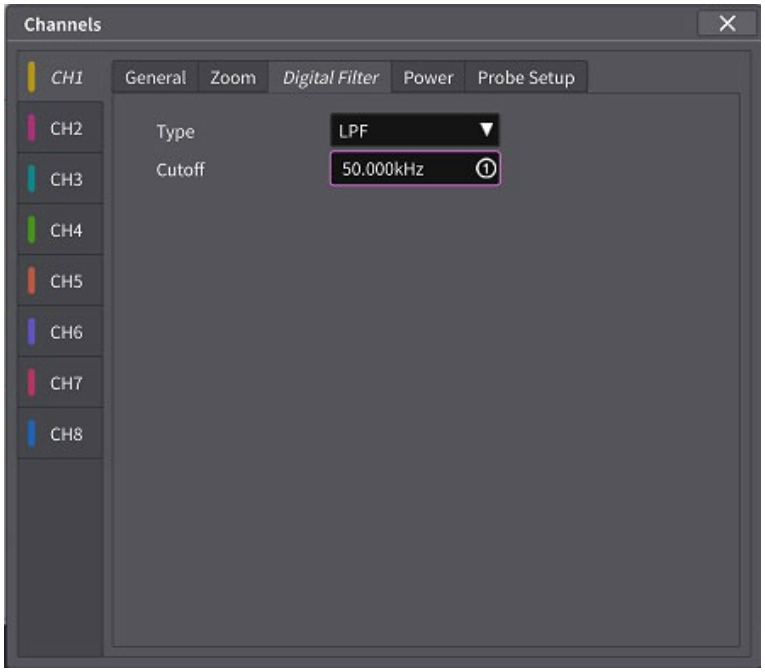


Figure 2.20 Channels_Digital Filter Settings Window

2.2.5.1 Type

Sets the type of target FIR digital filter.
Input method: Combo box
List: select from Off / LPF / HPS / SMA.
Note: SMA stands for simple moving average.

Table 2.4 Digital Filter setting

Item	Description
Off	Does not use the digital filter.
LPF	The cutoff frequency can be set in 421 steps of sampling frequency x (0.040 to 0.460) [Hz].
HPF	The cutoff frequency can be set in 421 steps of sampling frequency x (0.040 to 0.460) [Hz].
SMA	The width of the SMA can be set from ± 1 to ± 25 points.

Note: The digital filter is turned off when Sample mode is Roll operation and Acquisition mode is Peak Detect peak detection. Type cannot be set with this setting.

2.2.5.2 Type_LPF_Cutoff

Sets the cutoff frequency of the low pass filter.
Input method: Numeric input box
Setting range: Sampling frequency x (0.040 to 0.460) [Hz]

2.2.5.3 Type_HPF

Select HPF from the list of Types. This is explained in the settings window in Figure 2.21.

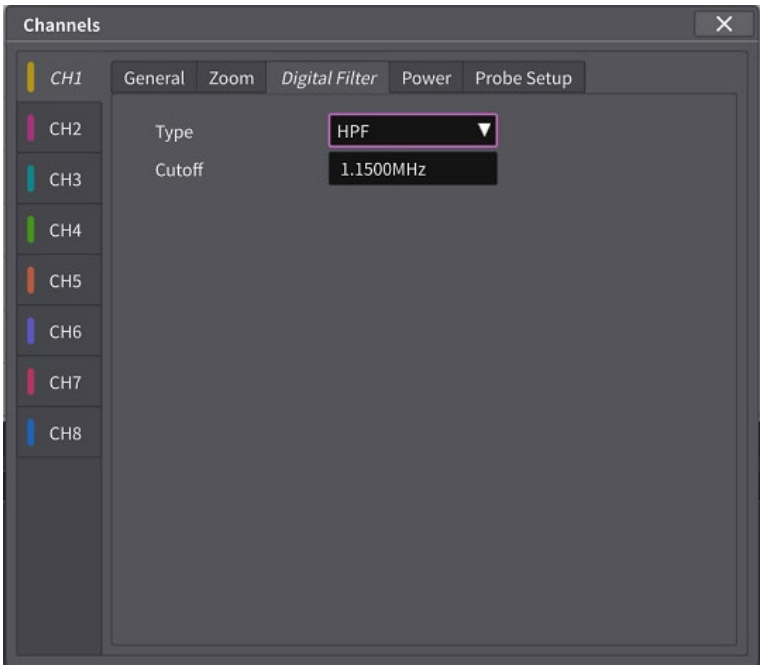


Figure 2.21 Type_HPF Settings Window

2.2.5.4 Type_HPF _Cutoff

Sets the cutoff frequency of the high pass filter.

Input method: Numeric input box

Setting range: Sampling frequency x (0.040 to 0.460) [Hz]

2.2.5.5 Type_SMA

Select SMA in the list from the list of Types. This is explained in the settings window in Figure 2.22.

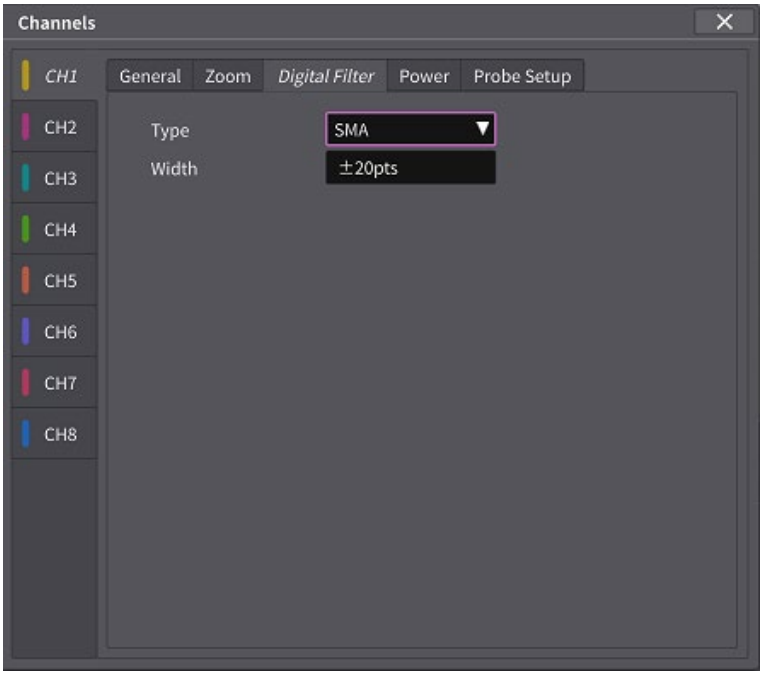


Figure 2.22 Type_SMA Settings Window

2.2.5.6 Type_SMA_width

Set the number of points for the simple moving average.
Input method: Numeric input box
Setting range: ± 1 to ± 25 points

2.2.6 Channels_Power

Select Power on the Horizontal tab to display the Power-related Settings Window.
Input method: Tap Power on the Horizontal tab.
The settings Window when Power is selected is explained below (Figure 2.23).

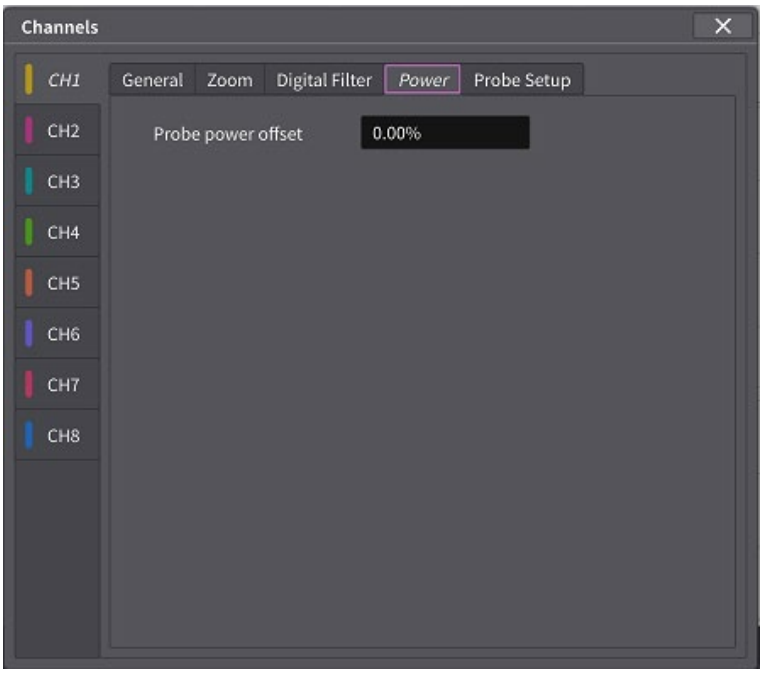


Figure 2.23 Settings Window when Power is selected on the Horizontal tab

2.2.6.1 Probe power offset

Set the offset amount (%) of the active probe connected to the CH selected on the vertical tab.
Since the offset amount is controlled from the probe power connector Px, connect the power cord of the active probe to the probe power connector Px corresponding to the CHx selected on the vertical tab. See the specifications of the active probe to use for more information on offsets.
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.2.7 Channels_Probe Setup

Select Probe Setup on the Horizontal tab to display the Probe Setup-related Settings Window.

Input method: Tap Probe setup on the Horizontal tab.

The Settings Window when Probe setup is selected is explained below (Figure 2.24).

Select the probe to use from the Model list. Items that can be set are Unit, Atten, Bandwidth and Coupling.

When the attached voltage probe has a 10: 1 attenuation, select Standard for Model.

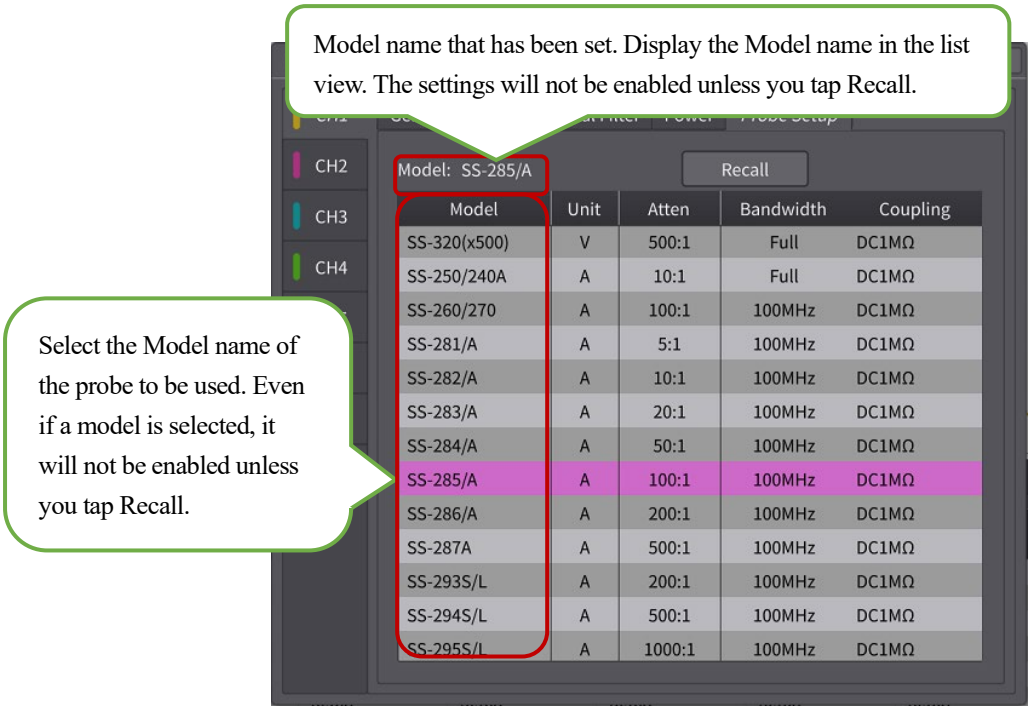


Figure 2.24 Settings Window when Power Setup on the Horizontal tab is selected

2.2.7.1 Recall

Set the Model selected from the list view.

Input method: Button

2.3 Horizontal Axis Related Operations and Settings

- Select Horizontal from the MENU Window and set from the Horizontal Window.
- Uses the buttons or Knobs on the Operation Panel to change the values of the measurement parameters.
- Also display the Horizontal Window by tapping the Horizontal Readout and Acquisition Readout.

- Operation Panel Operation

Operating procedure

1. Changes the Time/div of the selected waveform.
2. Changes the DELAY of the selected waveform.

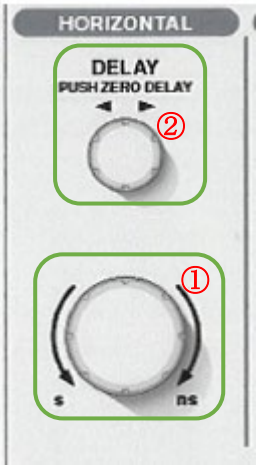


Figure 2.25 Operation from the Operation Panel

- Operation from Horizontal Readouts and Acquisition Readouts

Operating procedure

1. Tap Horizontal Readout or Acquisition Readout.
2. Set in the Horizontal Window.

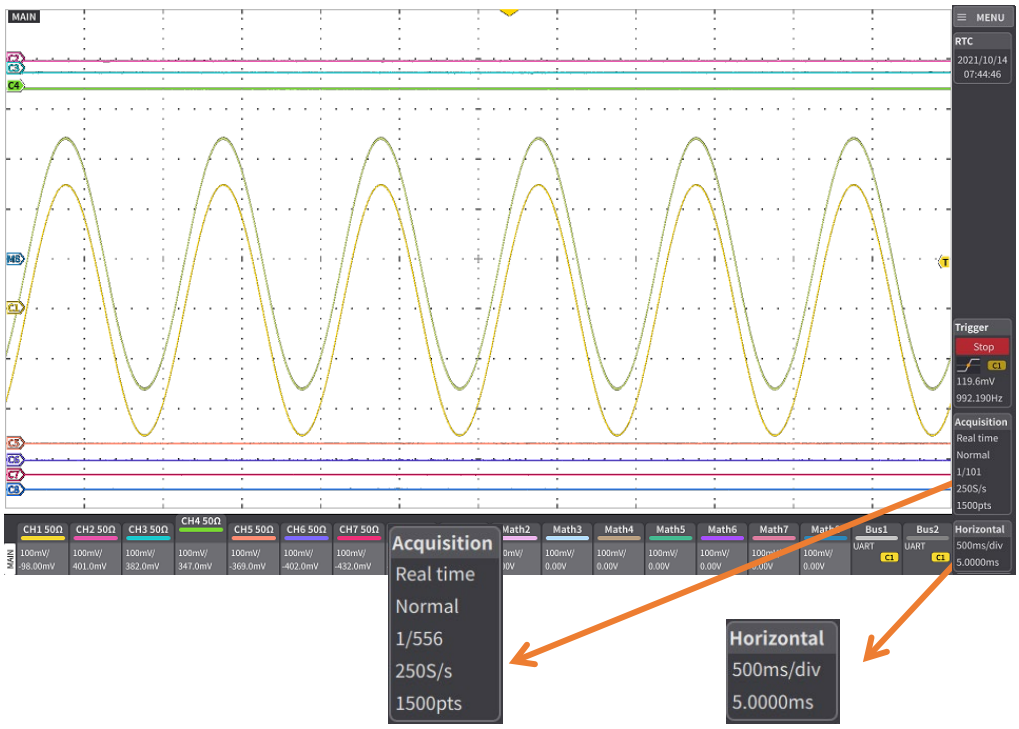


Figure 2.26 Horizontal Readout and Acquisition Readout

2.3.1 Horizontal Window

Select from General / Zoom on the Horizontal tab.

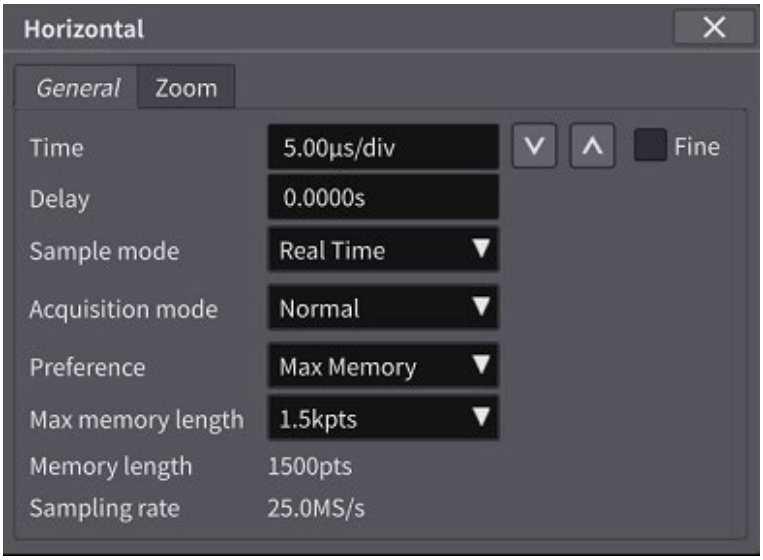


Figure 2.27 Settings Window when General is selected on the Horizontal tab

2.3.2 Horizontal_General

Select General on the Horizontal tab to display the General-related Settings Window.
Input method: The Horizontal tab.
Settings Window when General is selected in the Horizontal tab is explained in (Figure 2.27).

2.3.2.1 Time

Set Time/div.
Input method: Numeric Input Box (with Up / Down buttons) / On-Screen Keyboard / (1) Knob on the Operation Panel
For the input method, see 1.9.9 Numeric Input Box (with Up / Down button).

2.3.2.2 Fine

Set whether to fine adjust for the sweep time range.
Input method: Check box

2.3.2.3 Delay

Set the delay time.
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.3.2.4 Sample mode

Select the sample mode to convert the input waveform (analog signal) to a digital signal.
Waveform processing is restricted by the conversion (Sample) mode that converts analog signals to digital signals.

- There is a sample mode that is automatically determined from the relationship between the Horizontal axis and the memory length, so even if you set it, the sample mode may be changed automatically. The current sample mode is displayed in the Acquisition Readout, so check it if necessary.
- In the case of Roll (Sample mode), there are restrictions such as XY display and Average cannot be set in Acquisition mode.

Input method: Combo box
List: Real time / Sequence / Equivalent / Roll

- Real time Sample

Real-time sample samples the input signal at constant intervals to digitalize it. Waveform data can be captured and displayed with a single trigger. In addition, the input signal is captured at the sampling rate according to the maximum memory length and Horizontal axis sensitivity.

■ Sequence Sample

By storing the data in the divided memory blocks (segments) each time the sampling data acquisition operation is started, the dead time such as the acquisition data read time can be reduced, and high-speed waveform acquisition can be realized.

Table 2.5 Acquisition mode that can be set Sequence Sample

Acquisition mode	Peak Detect
	High Resolution,
	Advanced High Resolution
	Sin(x)/x Interpol

Note: When the Trigger mode (Sweep) is Auto / Normal, it is a repetitive operation that captures and draws waveforms for the number of segments. When it is Single, the waveform is not drawn in the Run state, but the waveform is drawn after the transition to the Stop state. All waveforms acquired in the sequence sample are overwritten (persistence is not supported).

■ Equivalent Sample

When the signal you want to measure is a repetitive signal, you can increase the apparent sampling speed by using the principle of equivalent sampling. The principle of equivalent sampling is shown in Figure 2.28. The data captured t1, t2, and t3 hours after the trigger generation time T is indicated by △, ○, and ×. By measuring this tn (n = 1,2,3 ...) time and overwriting the waveform data in consideration of the relative time relationship, an apparently very high sampling speed can be realized.

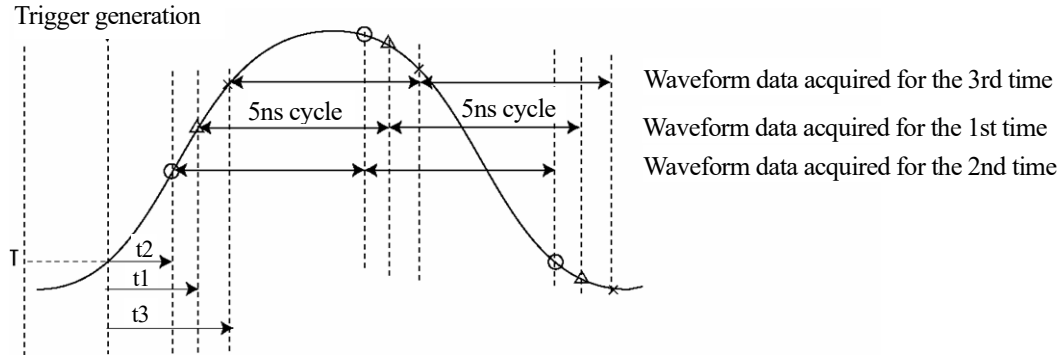


Figure 2.28 Equivalent sampling principle

This instrument achieves a maximum of 200 GS/s equivalently by performing the above tn time measurement resolution at 5 ps.

■ Roll Sample

Roll acquires and displays waveform data in real time, scrolling consecutive waveform points from right to left. The timebase can be set at ≧ 100ms/div.

The trigger modes for Roll are shown in Table 2.6 compared to Real time.

Table 2.6 The trigger modes for Roll

Trigger mode when Real Time	Trigger mode when Roll
Auto	Endless
Normal	Repeat Trig'd
Single	Trig'd

Table 2.7 shows the Horizontal axis range of the trigger mode for Roll.

Table 2.7 Horizontal axis range corresponding to Roll

Maximum memory length [points]	Maximum number of points in 1div [points]	Sampling cycle [s]	Operating range [s/div]
120 M	10 M	800 n to 80.0 u	5.00 to 50.0
60 M	5 M	1.60 u to 16.0 u	5.00 to 50.0
30 M	2.5 M	800 n to 20.0 u	2.00 to 50.0
15 M	1.25 M	800 n to 40.0 u	1.00 to 50.0
1.5 M	125 k	800 n to 400 u	100 m to 50.0
150 k	12.5 k	8.00 u to 4.00 m	100 m to 50.0
15 k	1.25 k	80.0 u to 40.0 m	100 m to 50.0
1.5 k	125	800 u to 400 m	100 m to 50.0

Table 2.8 shows the Horizontal axis range of Roll when the Sampling rate is fixed.

Table 2.8 Horizontal axis range corresponding to Roll (fixed sampling rate)

Sampling rate [S/s]	Sampling cycle [s]	Operating range [s/div]
1.25 M	800 n	100 m to 5.00
500 k, 250 k	2.00 u to 4.00 u	100 m to 20.0
125 k to 2.5	8.00 u to 400 m	100 m to 50.0

Table 2.9 shows the operating status of the waveform in Roll and the operating status of each function.

Table 2.9 Roll operating status and operation of each function

Operation / function	Auto Roll in operation	Normal Roll in operation	Normal 300ms from waveform acquisition	Single Roll in operation	Stop state
Main	Roll waveform display	Roll waveform display	Same as normal waveform	Roll waveform display	Same as normal waveform
Zoom	Waveform hidden	Waveform hidden	Same as normal waveform	Waveform hidden	Same as normal waveform
Math	Roll waveform display only for basic Math[Note 1].	Roll waveform display only for basic Math.	Same as normal waveform	Roll waveform display only for basic Math.	Same as normal waveform
Measure	Measurement result invalid	Last measurement result	Same as normal waveform	Last measurement result	Same as normal waveform
Cursor(Value)	Measurement result invalid	Last measurement result	Same as normal waveform	Last measurement result	Same as normal waveform

Note 1: Roll is a real-time display, so only basic operations excluding integral, dV/dt, FFT and SMA.

2.3.2.5 Number of segment

Figure 2.29 shows the settings window when Sample mode is selected as Sequence. By storing data in divided memory blocks (segments), dead time such as read time of acquired data can be reduced, and high-speed waveform acquisition can be realized. Sets the size of this segment.

Input method: Numeric input box / operation panel (1) Knob Range: 1 to 32768

Note: The maximum value that can be set differs depending on the combination of memory length and deskew settings.

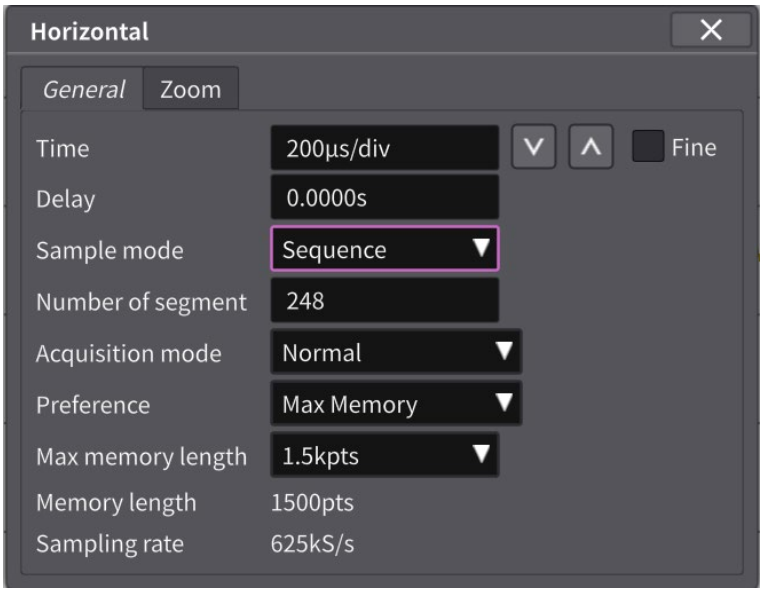


Figure 2.29 Setting window when Sample mode is selected as Sequence

2.3.2.6 Acquisition mode

Acquisition mode is a processing mode in which an analog signal is sampled, converted into digital data, and then combined into a waveform record. The created waveform record is stored in the acquisition memory and displayed.

There are various modes for the processing method of collecting waveform records.

The waveform display is determined by the combination of sample mode and waveform acquisition mode. Set the combination of sample mode and waveform acquisition mode according to the measurement conditions and measurement purpose.

In addition, there are some settings that cannot be combined with the sample mode and the waveform acquisition mode. If necessary, check the acquisition readout to see the actual sample mode and waveform acquisition mode.

Input method: Combo box

List: Normal / Peak Detect / Average / High Resolution / Advanced High Res / Sin(x)/x Interpol

■ Normal mode

In Normal mode, the input signal is acquired at the sampling rate according to the maximum memory length and Horizontal axis sensitivity.

■ Peak Detect mode

The maximum / minimum values that occur in the interval twice the sampling period are detected, and the results are recorded in the memory in chronological order. When set to Peak Detect, the maximum / minimum values that occur in the interval twice the sampling cycle without Peak Detect are detected, and the results are recorded alternately in the memory.

The minimum detectable time for the maximum / minimum value is 400ps (2.5GS / s). Figure 2.30 shows an example comparing with and without Peak Detect. When the memory length and sweep time are selected appropriately, the waveform data point A in the figure may not be detected unless Peak Detect is set. When Peak Detect is set as in the case of the lower side, it captures at 400ps cycle regardless of the sampling cycle, so it is possible to reliably catch the phenomenon that occurred within the sampling cycle.

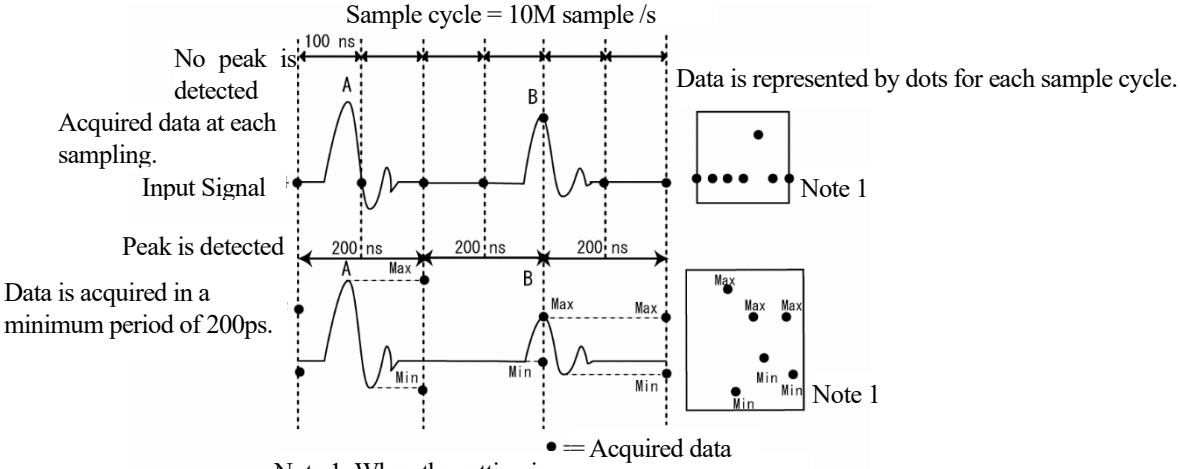


Figure 2.30 Comparison example when Peak Detect is set

Memo: Limitations when measuring Peak Detect

Even when set to Peak Detect, it will not work at sampling rates above 2.5 GS/s.

When the Peak Detect function is operating, “Peak” is displayed in the Readout display area on the screen. Also, the sampling rate is displayed in the Readout. If the sampling rate is large, adjust it with the [Time/div] adjustment Knob, or change the Max Memory setting in the Horizontal Window.

■ Average mode

When Average is set, each time an input signal is acquired, it is averaged with the previously acquired data and displayed as a waveform. The averaging process can attenuate the random noise of the input signal. The average number of times is 2 to 65,536 times. The larger the number of averaging, the less noise on the signal can be observed. In SINGLE mode, the measurement is repeated and displayed until the data is acquired for the set average number of times, and then the measurement ends.
Therefore, the Average process may take some time. By pressing the CLEAR button during Run operation (AUTO, NORMAL, SINGLE button is lit), the averaging process is initialized. During the averaging operation, the Acquisition Readout shows the current number of averaging (see Table 1.10).
The formula for calculating the weighted average in the averaging process of this Instrument is as follows.

$$A_n = A_{n-1} + \frac{(D_n - A_{n-1})}{n} \quad (n \leqq N)$$

$$A_n = A_{n-1} + \frac{(D_n - A_{n-1})}{N} \quad (n > N)$$

Where n is Current number of averaging,
N is Average times set by Average times,
A_n is nth average value and
D_n is nth measured value.

In the SINGLE mode, the measurement ends when N times are taken in, so the above formula is not applicable.
Since n is displayed as a value processed inside the Instrument, it cannot be set by the user.

Memo: Limitations when setting Average
- There is no limit to the maximum memory length setting even if Average is set.
- Even if Average is selected while Roll is on, averaging is not performed.

■ High Resolution mode

When the sample rate is set lower than the maximum sampling, the data captured by the maximum sampling is averaged and displayed with high resolution.

High Resolution mode is a mode in which the data captured by the highest sampling is averaged and displayed when the sample rate is set lower than the highest sampling. Random noise can be attenuated and the vertical axis resolution can be effectively increased, so waveform traces can be observed smoothly. High Resolution mode is effective for both single-shot and repetitive signals.

The number of bits to which the vertical axis resolution is added depends on the sampling rate (time/div setting (sweep speed)) of this Instrument. The lower the sampling rate (time/div setting), the more samples will be averaged for each display point. For example, for every doubling of the number of averaging, the vertical axis resolution increases by 0.5 bits. Table 2.10 shows the relationship between the sampling rate and the vertical axis resolution (effective number of bits).

Table 2.10 Sampling rate vs Vertical axis resolution (bit)

Sampling rate (S/s)	Vertical axis resolution (bit)
1.25 GS/s＜Sampling rate	12
625 MS/s＜Sampling rate≦1.25 GS/s	12.5
250 MS/s＜Sampling rate≦625 MS/s	13.0
125 MS/s＜Sampling rate≦250 MS/s	13.5
62.5 MS/s＜Sampling rate≦125 MS/s	14.0
25 MS/s＜Sampling rate≦62.5 MS/s	14.5
12.5 MS/s＜Sampling rate≦25 MS/s	15.0
6.25 MS/s＜Sampling rate≦12.5 MS/s	15.5
Sampling rate≦6.25 MS/s	16.0

■ Advanced High Res mode

Advanced High Resolution is digitally processed and has higher resolution than High Resolution.

The relationship between the sampling rate and the vertical axis resolution (effective number of bits) is shown in Table 2.11.

Table 2.11 Sampling rate vs Vertical axis resolution (bit)

Sampling rate (S/s)	Vertical axis resolution (bit)
1.25GS/s＜Sampling rate	12
625MS/s＜Sampling rate≦1.25GS/s	13.5
250MS/s＜Sampling rate≦625MS/s	14.0
125MS/s＜Sampling rate≦250MS/s	15.0
62.5MS/s＜Sampling rate≦125MS/s	15.5
25MS/s＜Sampling rate≦62.5MS/s	16.0
12.5MS/s＜Sampling rate≦25MS/s	16.0
6.25MS/s＜Sampling rate≦12.5MS/s	16.0
Sampling rate≦6.25MS/s	16.0

■ Sin(x)/x Interpol mode

Sin (x)/x interpolation uses curve fit (Sin (x)/x function) to create interpolated data between the actual values acquired. By creating interpolated data, the apparent sampling speed can be increased for measurement. Unlike the equivalent sample, the interpolated data is created from a single waveform, so it is also effective for single-shot signals.

This instrument achieves an equivalent maximum of 200 GS/s by performing interpolation resolution at 5 ps.

2.3.2.7 Preference

Set the priority when selecting memory length and the sampling rate. See Table 2.12.
Input method: Combo box
List: Select from Max memory / Sampling Rate.

Settings Window when Max Memory is selected (Figure 2.29) is explained below.
When selecting Sampling Rate, see 2.3.2.11 Preference and Figure 2.31.

Table 2.12 Preference Selection

Preference	Description
Max memory	The sampling rate is automatically set so that the memory length is as long as possible below the maximum memory length selected in Max memory length.
Sampling Rate	It is fixed to the value selected by Sampling Rate and the memory length is set automatically. The range of the time base range that can be set may be limited.

2.3.2.8 Max memory length

Displayed when Preference is Max memory. Select the maximum memory length.
Input method: Combo box
List: Select from 1.5k points / 15k points / 150k points / 1.5M points / 15M points / 30M points / 60M points / 120M points.

2.3.2.9 Memory length

Shows the memory length.
Display the value by label.

2.3.2.10 Sampling rate

Shows the sampling rate.
Display the value by label.

2.3.2.11 Preference

Settings Window when Sampling Rate is selected in Preference (Figure 2.31) is explained below.

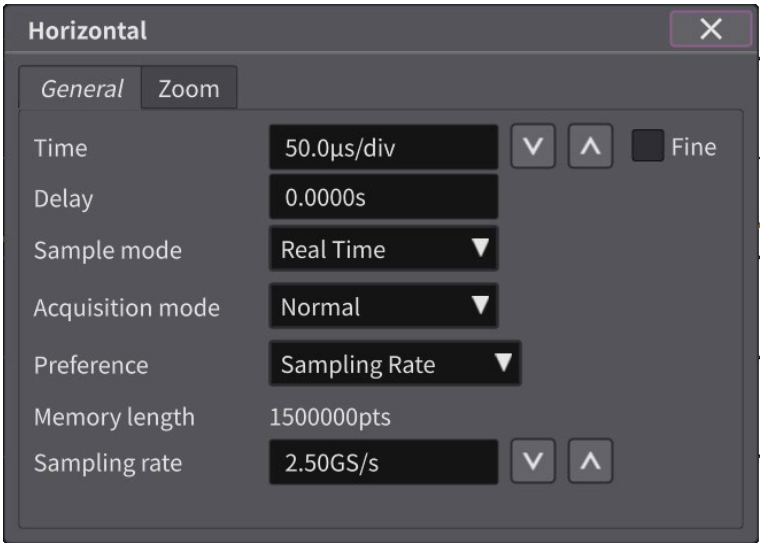


Figure 2.31 Settings Window when Sampling Rate is selected in Preference

2.3.2.12 Memory length

Shows the memory length.
Display the value by label.

2.3.2.13 Sampling rate

Set the sampling rate (5 GS/s can be set when Interleaving).
Input method: Numeric Input Box (with Up / Down buttons) / On-Screen Keyboard / (1) Knob on the Operation Panel
For the input method, see 1.9.9 Numeric Input Box (with Up / Down button).

2.3.3 Horizontal_Zoom

Select Zoom on the Horizontal tab to display the Zoom-related Settings Window.
Input method: Horizontal tab

Settings Window when Zoom is selected in the Horizontal tab (Figure 2.32) is explained below.

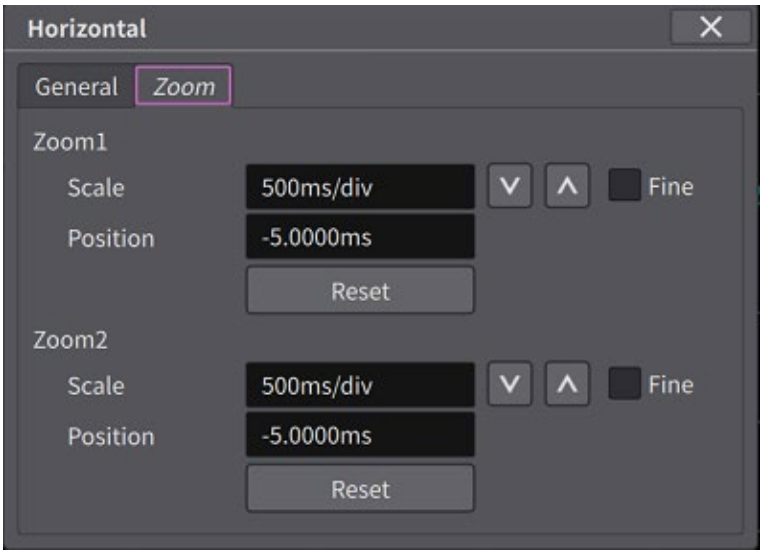


Figure 2.32 Settings Window when Zoom is selected on the Horizontal tab

2.3.3.1 Zoom1 / Zoom2_Scale

Set the time axis of Zoom1 / Zoom2.
Input method: Numeric Input Box (with Up / Down buttons) / On-Screen Keyboard / (1) Knob on the Operation Panel
For the input method, refer to 1.9.9 Numeric Input Box (with Up / Down button).

2.3.3.2 Zoom1 / Zoom2_Fine

Set whether to fine adjustment for the timebase setting of Zoom1 / Zoom2.
Input method: Check box

2.3.3.3 Zoom1 / Zoom2_Position

Set the delay time of Zoom1 / Zoom2.
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box

2.3.3.4 Zoom1 / Zoom2_Reset

Set Scale and Position to Volts/div and Offset values when acquiring waveforms.
Input method: Button

2.4 Trigger Related Operations and Settings

- Select Trigger from the MENU Window and set from the Trigger Window.
- Uses the buttons or Knobs on the Operation Panel to change the measurement parameter values.
- Also display the Trigger Window by tapping the Trigger Readout.

2.4.1 Trigger Window

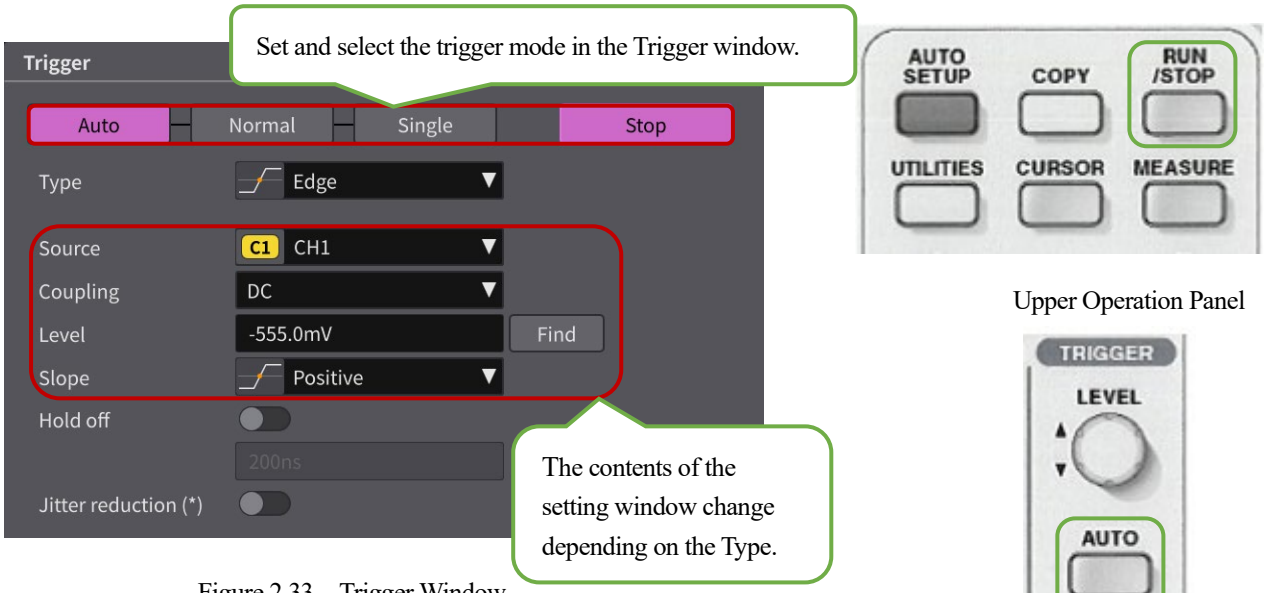


Figure 2.33 Trigger Window

Figure 2.34 Operation Panel related TRIGGER mode

2.4.2 Trigger Mode Selection

Set and select the trigger mode.
Input method: Button or Operation Panel.

Table 2.13 Trigger mode

Trigger mode	Input Method	Operation Panel	Selection Item / Execution Process, etc.	Description
Auto	Button	AUTO Button NORMAL Button SINGLE Button	Only one of the AUTO, NORMAL, and SINGLE will be selected. Selected: Red background Unselected: Gray background	Change the trigger mode to Auto / Normal / Single.
Normal				
Single				
Run/Stop	Button	RUN/STOP Button	Waveform acquisition: Red background Waveform acquisition stopped: Background is gray	In the above trigger mode, start or stop waveform acquisition.

■ AUTO mode

Even if the trigger condition is not met, the trigger signal is automatically generated and the waveform is updated.

■ NORMAL mode

The waveform is updated every time the trigger condition is met, and the system waits for the next trigger. Stable observation is available even with low frequency signals of several tens of Hz. When the trigger condition is not met, set to auto mode.

■ SINGLE mode

When the trigger condition is met, the waveform is updated only once and stops.
When waiting for a trigger (Ready) in the SINGLE mode, press the SINGLE button to forcibly trigger once and becomes Stop state

2.4.2.1 Type

The contents of the Settings Window change depending on the type of trigger.
Input method: Combo box with icon
List: Select from Edge / Edge ALT / Edge OR / Pulse count / Pulse width / Period / Dropout / OR / NOR / AND / NAND / UART / SPI / I2C / Sequence / Transition Time.

The contents of the Settings Window change depending on the type of trigger. Common setting items are omitted below.

2.4.3 Type_Edge

Select Edge from the list.
Trigger at the edge of the trigger source

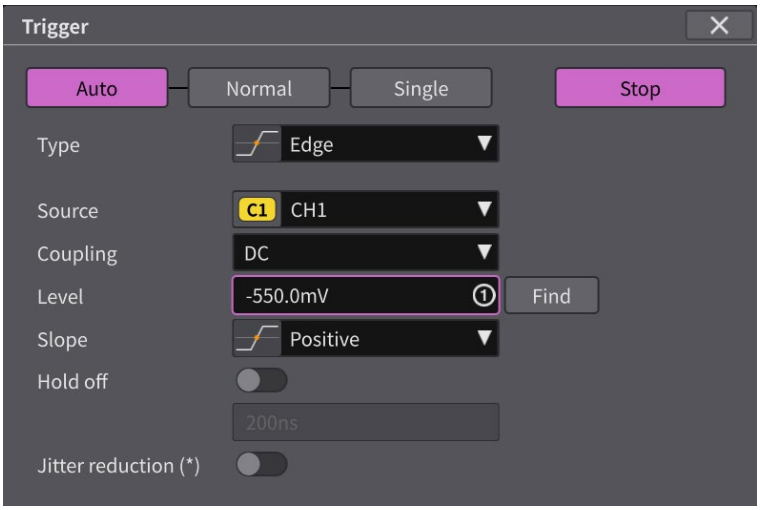


Figure 2.35 Settings Window when Trigger type is selected as the Edge

2.4.3.1 Source

Select the input channel for the trigger.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8 / Line(*).
For the 4CH model, select from CH1 / CH2 / CH3 / CH4 / Line(*).
(*) You can select "Ext 0.5V" and "Ext 1.2V" instead of "Line" if this instrument implements DS-601(DS8K EXT-TRIG-IN) factory option. The selection items mean as follows.

Table 2.14 External trigger selection

Source	Description
Ext 0.5V	The trigger source is external input with threshold level at 0.5V.
Ext 1.2V	The trigger source is external input with threshold level at 1.2V.

2.4.3.2 Coupling

Set the coupling of the trigger input.
Input method: Combo box
List: Select from AC / DC / HF Reject / LF Reject / DC Noise reject.

Table 2.15 Coupling selection

Coupling	Description
AC	Only the AC component of the trigger signal passes through.
DC	All frequency components of the trigger signal pass through.
HF Reject	Attenuates trigger signals of 10 kHz or higher.
LF Reject	Attenuates trigger signals of 10 kHz or less.
DC Noise Reject	By not detecting signals with an amplitude of 1 div or less as trigger, false trigger due to noise are reduced and the accuracy of edge trigger is improved.

2.4.3.3 Level

Set the trigger level.
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box

2.4.3.4 Find

Detect the trigger level.
Input method: Press the button or LEVEL Knob.

2.4.3.5 Slope

Specify the slope of the trigger.
Input method: Combo box with icon
List: Select from Positive / Negative.

2.4.3.6 Hold off

Set whether to enable holdoff. Set the holdoff time.
Input method: Toggle switch
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.4.3.7 Jitter reduction (*)

Enables/disables trigger jitter reduction. If trigger jitter reduction is enabled, a * appears in the Trigger readout during RUN operation. The conditions under which trigger jitter reduction works are shown in Table 2.16.
Input Method: Toggle Switch

Table 2.16 Conditions for trigger jitter reduction works

Items	Conditions
Sampling rate	2.5GS/s or 5GS/s (interleaved)
Sample mode	Real time, Sequence, Equivalent
Acquisition mode	Normal, Average, Sin(x)/x Interpol
Delay	Real time: -25ms to +6div Sequence: -6div to +6div Equivalent: -1ms to +6div
Trigger type	Edge, Pulse Count, Pulse Width, Period, Sequence (B trigger is only Edge, Pulse Count, or Period)
Trigger coupling	DC, DC Noise Reject
Trigger source	CH1 to CH8 (8CH model) CH1 to CH4 (4CH model) *CH trace of trigger source must be on

When trigger jitter reduction is set to enable, the waveform approaches a jitter-free waveform by interpolating between samplings to increase the time resolution (Figure 2.36). This allows a finer waveform trace to be displayed. However, trigger jitter reduction may not work when the waveform condition meets the following conditions.

- The waveform near the trigger level is outside the screen.
- The waveform near the trigger level has a slow slope.
- The trigger level is not set near the center of the waveform amplitude.

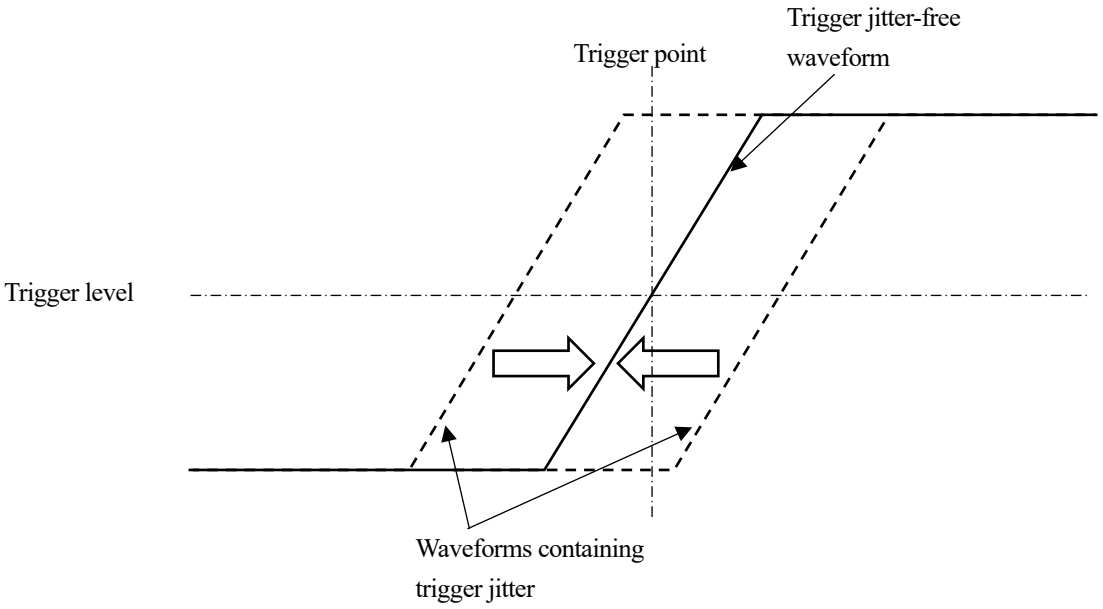


Figure 2.36 Conceptual diagram of trigger jitter reduction

2.4.4 Type_Edge ALT

Select Edge ALT from the list.

Trigger alternately at the rising and falling edges of the Trigger source.

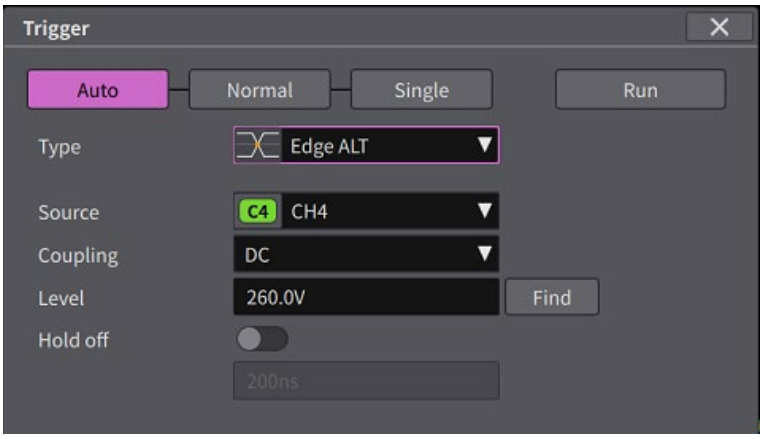


Figure 2.37 Settings Window when the Edge ALT is selected as the Trigger type

2.4.5 Type_Edge OR

Select Edge OR from the list.
Set Coupling, Level, and Slope for single to multiple CHs.
When there is even one edge specified, it will be triggered.

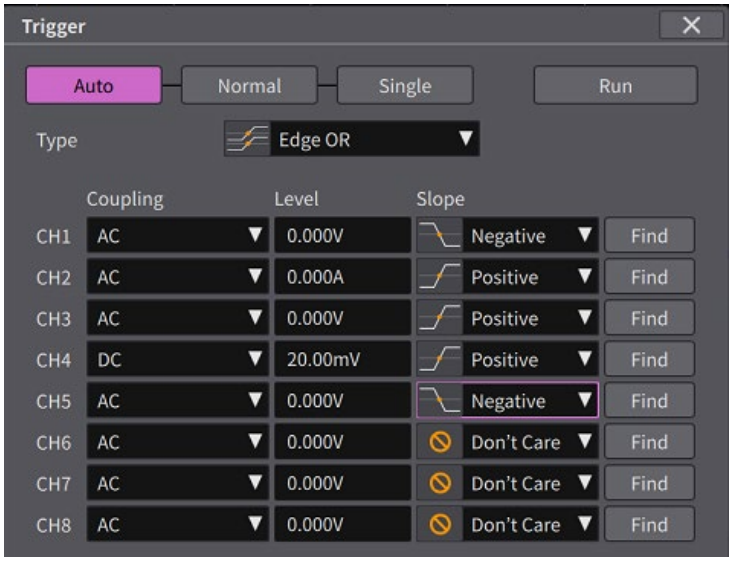


Figure 2.38 Settings Window when the Edge OR is selected as the Trigger type

2.4.5.1 Slope

Specify the slope of the trigger.
Input method: Combo box with icon
List: Select from Positive / Negative / Don`t Care.

Table 2.17 Selection of Slope

Slope	Description
Positive	Set the trigger to occur at the rising edge of the waveform.
Negative	Set the trigger to occur at the falling edge of the waveform.
Don`t Care	Remove the specified CH from the trigger operation.

2.4.6 Type_Pulse Count

Select Pulse Count from the list.
Trigger when the specified number is detected at the specified edge.

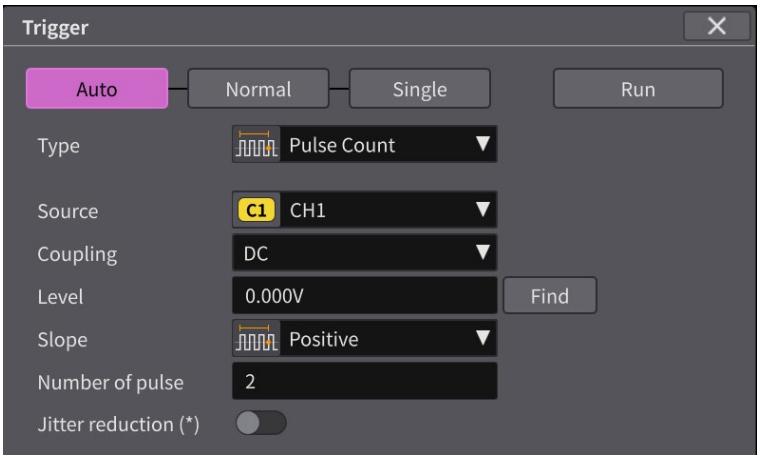


Figure 2.39 Settings Window when the Pulse Count is selected as the Trigger type

2.4.6.1 Slope

Specify the slope.
Input method: Combo box with icon
List: Select from Positive / Negative.

2.4.6.2 Number of pulse

Set the number of pulse for pulse count rigger.
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box

2.4.7 Type_Pulse Width

Select Pulse Width from the list.
Trigger with the specified polarity and the specified pulse width.

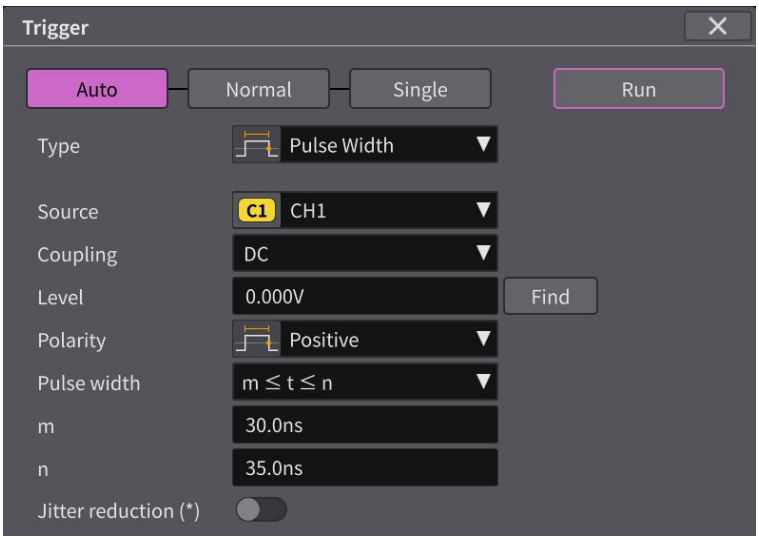


Figure 2.40 Settings Window when the Pulse Width is selected as the Trigger type

2.4.7.1 Polarity

Specify the polarity of the pulse.
Input method: Combo box with icon
List: Select from Positive / Negative.

2.4.7.2 Pulse width

Select the pulse width condition.
Input method: Combo box
List: Choose from m ≤ t / t ≤ m / m ≤ t ≤ n / t ≤ m, n ≤ t.

2.4.7.3 m

Set the pulse width value m. However, it is necessary required to be m ≤ n. Setting range 30.0 ns - 50.0 s
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.4.7.4 n

Set the pulse width value n. However, it is necessary that m ≤ n. Setting range 30.0 ns - 50.0 s
Displayed only when Pulse width is m ≤ t ≤ n / t ≤ m, n ≤ t.
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.4.8 Type_Period

Select Period from the list.

Trigger when the time between the specified Slope and the edge (Slope) is less than or wider than the specified time.

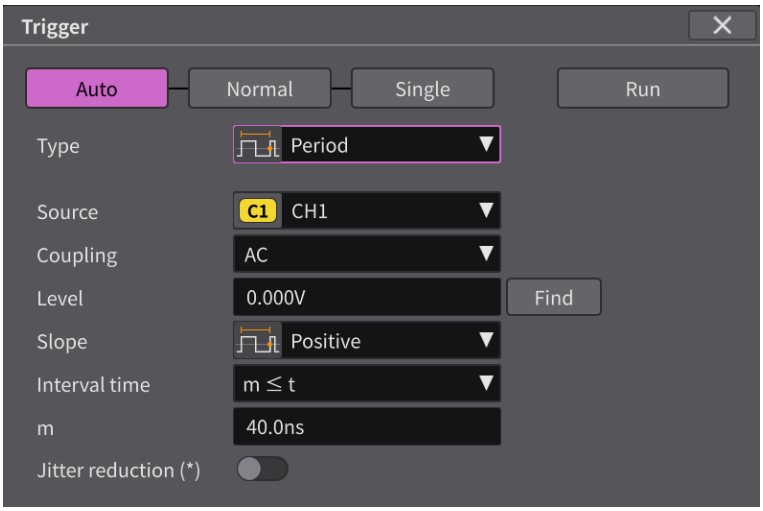


Figure 2.41 Settings Window when the Period is selected as the Trigger type

2.4.8.1 Interval time

Select the trigger cycle condition.
Input method: Combo box
List: Select from m ≤ t / t ≤ m.

2.4.9 Type_Dropout

Select Dropout from the list.

Trigger when there is no specified edge between the specified rising edge (Slope) or falling edge (Slope) during the specified Dropout time.

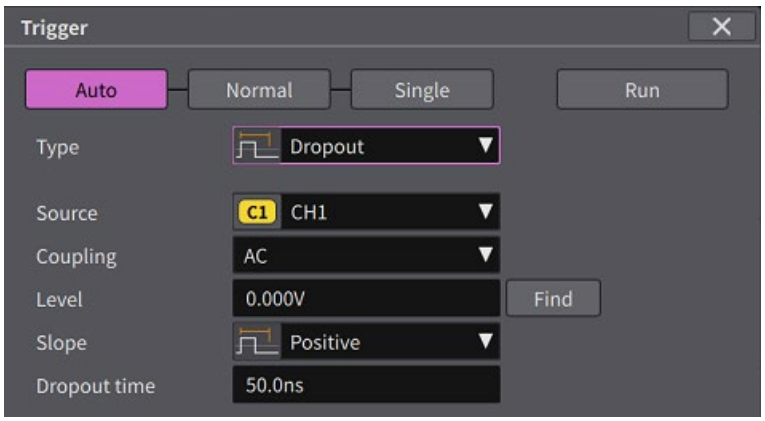


Figure 2.42 Settings Window when the Dropout is selected as the Trigger type

2.4.9.1 Dropout time

Set the Dropout time. Setting range 50.0 ns to 50.0 s
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.4.10 Type_OR / NOR / AND / NAND

Selects one from OR / NOR / AND / NAND in the list.

Set the High / Low level from one CH to multiple CHs, and calculate the trigger source based on the Boolean operator selected from four types. Detect and trigger a change from False to True.

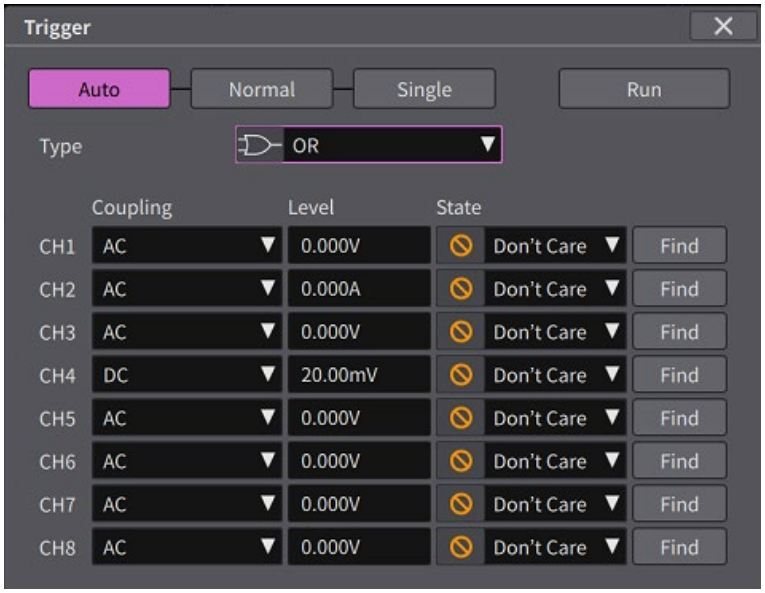


Figure 2.43 Settings Window when the OR / NOR / AND / NAND is selected as the Trigger type

2.4.11 Type_UART / SPI / I2C

Select one from UART / SPI / I2C in the list.

Table 2.18 shows the Source to be displayed in the Trigger window depending on the Bus settings. When Source is None, only Type can be operated in the Trigger window of serial trigger.

Table 2.18 Bus Type Settings and Trigger Window Status

(Yes: Available, No: Unavailable)

Bus1 Type	Bus2 Type	UART Trigger		SPI Trigger		I2C Trigger	
		Operation	Source	Operation	Source	Operation	Source
UART	UART	Yes	Bus1 / Bus2	No	None	No	None
UART	SPI	Yes	Bus1	Yes	Bus2	No	None
UART	I2C	Yes	Bus1	No	None	Yes	Bus2
SPI	UART	Yes	Bus2	Yes	Bus1	No	None
SPI	SPI	No	None	Yes	Bus1 / Bus2	No	None
SPI	I2C	No	None	Yes	Bus1	Yes	Bus2
I2C	UART	Yes	Bus2	No	None	Yes	Bus1
I2C	SPI	No	None	Yes	Bus2	Yes	Bus1
I2C	I2C	No	None	No	None	Yes	Bus1 / Bus2

Note: It is possible to set multiple Thresholds for the same channel in the Source Bus1 / Bus2 settings, but in that case only the highest priority Threshold will be used for trigger detection, as shown in Table 2.19

.

Table 2.19 Trigger detection

Type	Threshold priority (higher to the left)
UART	Source
SPI	Clock > MOSI > MISO > Chip Select
I2C	SCL > SDA

2.4.11.1 Type_UART

Select UART from the list.
It is one of the serial triggers and is used to trigger the UART signal under the specified conditions.
For UART, see 2.14 BUS (Serial Bus Signal).

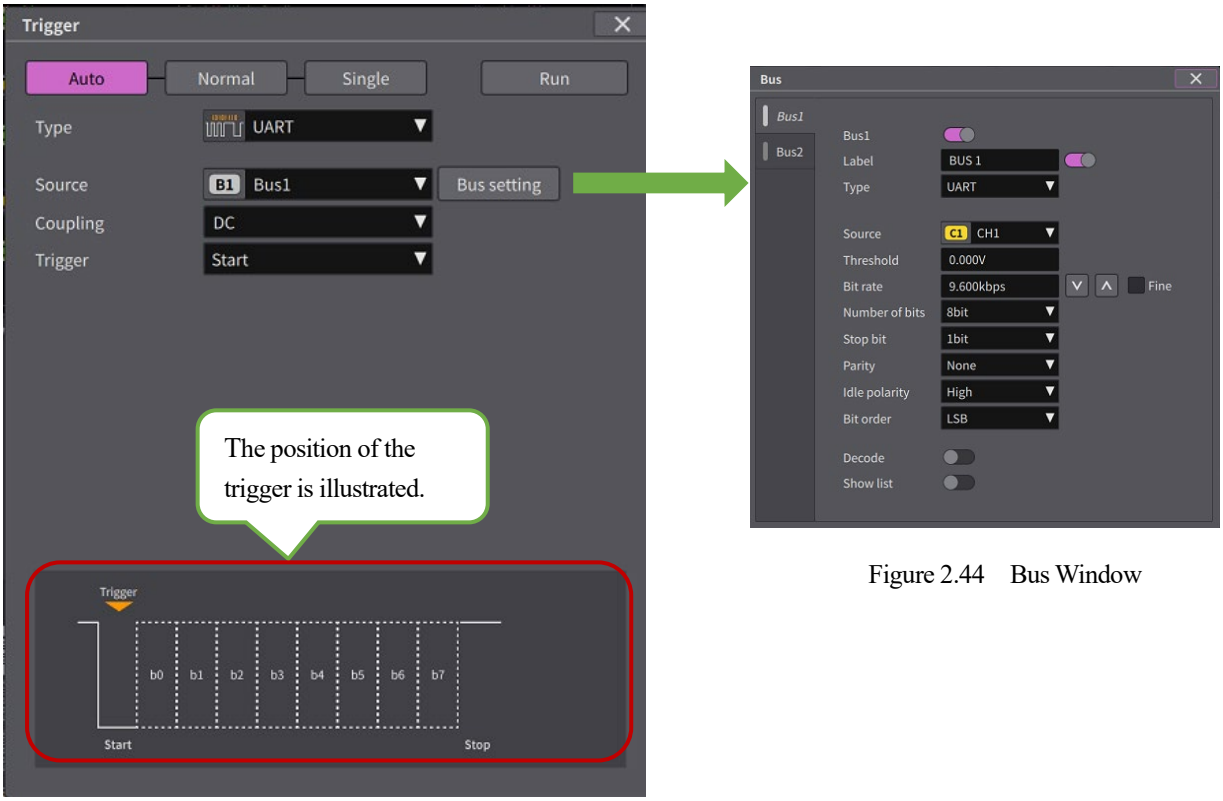


Figure 2.44 Bus Window

Figure 2.45 Settings Window when the UART is selected as the Trigger type

2.4.11.2 Source

Specify the input channel for the trigger
Input method: Combo box with icon
List: Select from Bus1 / Bus2.

2.4.11.3 Bus setting

Displays the Bus Window with the Bus tab selected in Source selected. However, when Source is None, the Bus1 tab is selected.
Change the conditions in the Bus Window as required.
Input method: Button

2.4.11.4 Coupling

Set the coupling of the trigger input.
Input method: Combo box
List: Select from DC / HF Reject / DC Noise Reject.

2.4.11.5 Trigger

Select the event to trigger.
Input method: Combo box
List: Select from Start / Stop / Data / Parity error.

Table 2.20 UART Trigger types

List	Description
Start	Trigger when a start bit is detected.
Stop	Trigger when a stop bit is detected.
Data	Trigger when a specified data pattern is detected.
Parity Error	Trigger when a parity error is detected.

If the list selection is Start / Stop / Parity error and Data, the Settings Window is change.
Figure 2.45 shows the Settings Window when the list selection is Start / Stop / Parity error.
Figure 2.46 shows the Settings Window when the list selection is Data.

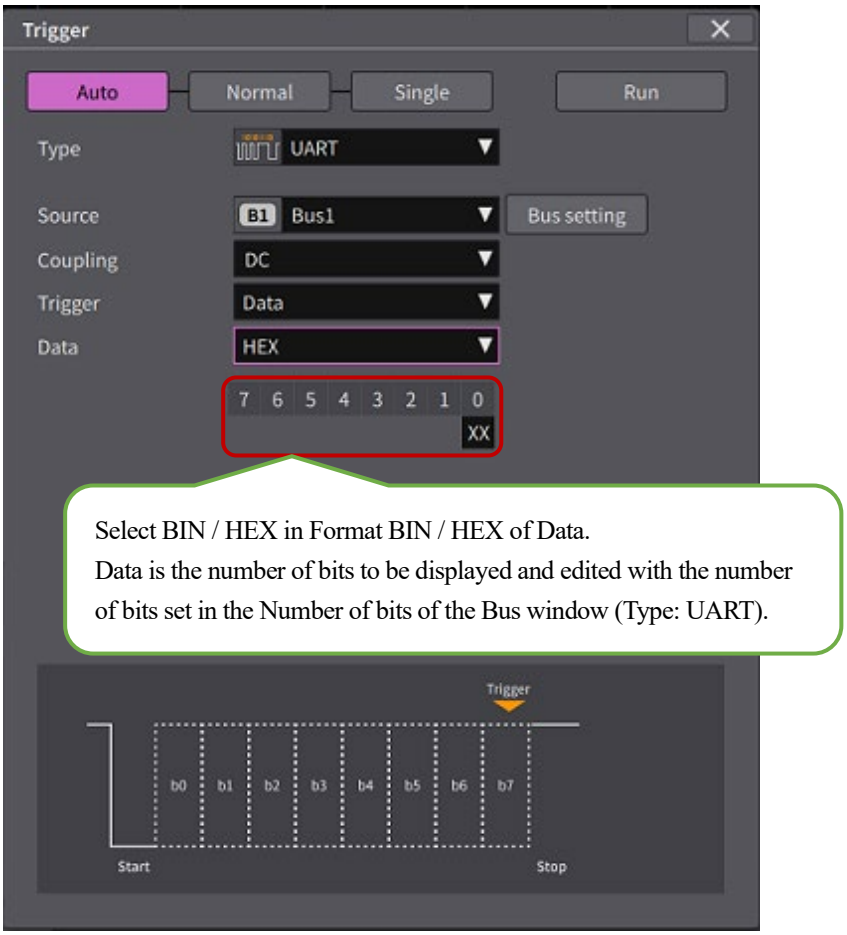


Figure 2.46 Settings Window when the Data is selected as the Trigger type.

2.4.11.6 Data

Specify the bit string of the data pattern as a numerical value. Trigger when the specified data pattern is detected.

■ Format

Select the data format.

Input method: Combo box

List: Select from BIN / HEX.

■ Data

Input method: Binary editor

Specify X for each digit from Hexadecimal: 00 to FF, Binary: 0 to 1.

The number of bits set in Number of bits in the Bus Window shown in Figure 2.44 is the number of bits to display and edit.

2.4.11.7 Type_SPI

Select SPI from the list. It is one of the serial triggers and is used to trigger the SPI signal under the specified conditions.
For SPI, see 2.14 BUS (Serial Bus Signal).

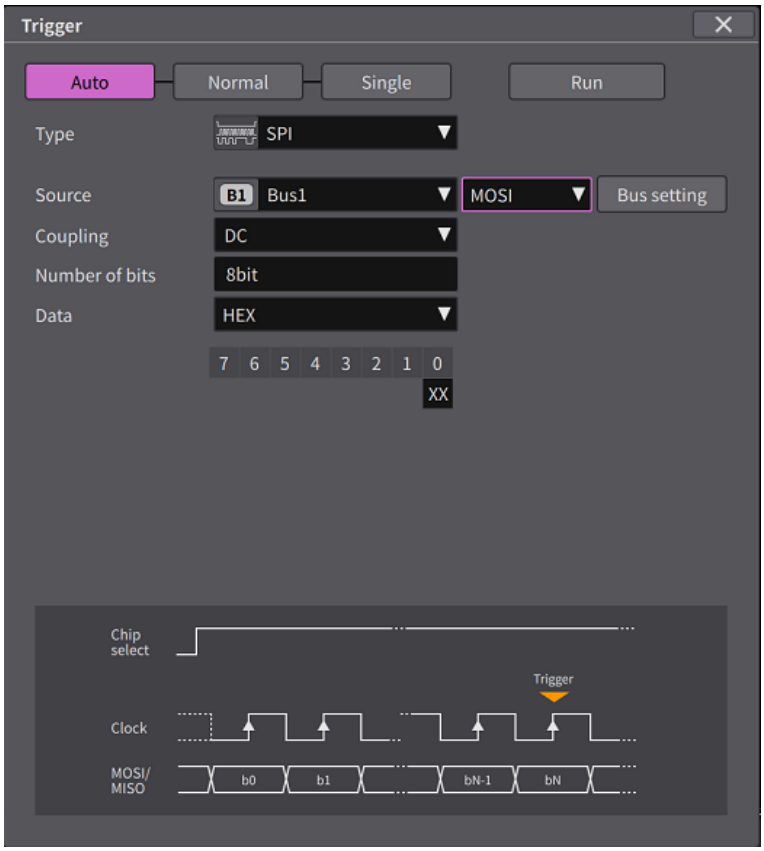


Figure 2.47 Settings Window when the SPI is selected as the Trigger type.

2.4.11.8 Source

Specify the input bus of the trigger and select the data line from MOSI and MISO.

■ Bus Selection

Input method: Combo box with icon
List: Choose from Bus1 / Bus2.

■ Signal Selection

Input method: Combo box
List: Select from MOSI / MISO.

2.4.11.9 Number of bits

Specify the number of bits in the data. Setting range 4 – 64 bit
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.4.11.10 Data

Select the data format. See 2.4.11.6 Data.

2.4.11.11 Type_I2C

Select I2C in the list. It is one of the serial triggers and is used to trigger the I2C signal under the specified conditions.
For I2C, see 2.14 BUS (Serial Bus Signal).

The Settings Window changes when Trigger of the Settings Window is set to Start / Stop / No ACK / Restart, when EEPROM Data Read is set, and when 7bit Address & Data / 10bit Address & Data is set. Each is explained below.
See 2.4.11.15 Trigger.

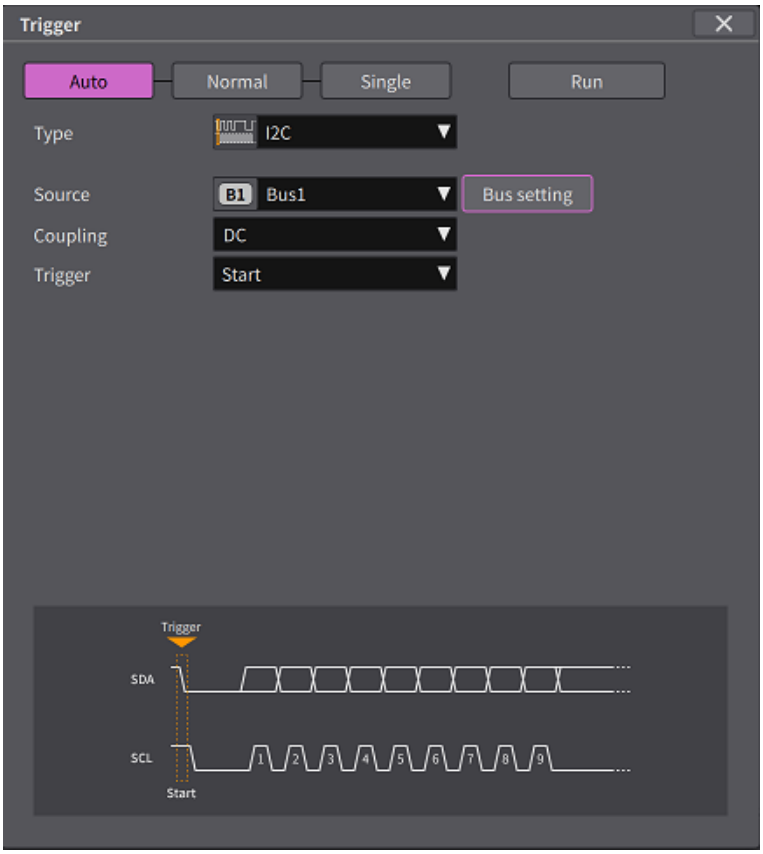


Figure 2.48 Settings Window when the SPI is selected as the Trigger type.

2.4.11.12 Source

Specify the input channel for the trigger
Input method: Combo box with icon
List: Select from Bus1 / Bus2.

2.4.11.13 Bus setting

Displays the Bus Window with the Bus tab selected in Source selected. However, when Source is None, the Bus1 tab is selected.
Change the conditions in the Bus Window as required.
Input method: Button.

2.4.11.14 Coupling

Set the coupling of the trigger input.
Input method: Combo box
List: Select from DC / HF Reject / DC Noise Reject.

2.4.11.15 Trigger

Select the event to trigger.
Input method: Combo box
List: Select from Start / Stop / No ACK / Restart / EEPROM Data Read / 7bit Address & Data / 10bit Address & Data.

Table 2.21 I2C Trigger types

List	Description
Start	A trigger occurs when the start condition is met.
Stop	A trigger occurs when the stop condition is met.
No ACK	A trigger occurs when the specified data pattern is detected.
Restart	A trigger occurs when a parity error is detected.
EEPROM Data Read	A trigger occurs when the comparison result of the data read from the EEPROM and the specified data pattern is true.
7bit Address & Data	A trigger occurs when the specified 7-bit slave address, transfer direction, and data pattern are matched.
10bit Address & Data	A trigger occurs when the specified 10-bit slave address, transfer direction, and data pattern are matched.

Figure 2.48 shows the Settings Window when Trigger is set to Start / Stop / No ACK / Restart.
Figure 2.49 shows the Settings Window when Trigger is set to EEPROM Data Read.
Figure 2.50 shows the Settings Window when Trigger is set to 7bit Address & Data / 10bit Address & Data.

2.4.11.16 Trigger_EEPROM Data Read

The Settings Window when Trigger is set to EEPROM Data Read is shown Figure 2.49.

Figure 2.49 Settings Window when the EEPROM Data Read is selected for the Trigger type.

2.4.11.17 Data

Set the conditional expression of Data and 2 hexadecimal digits.

■ Condition

Set the conditions.
Input method: Combo box
List: Select from = / ≠ / > / <.

■ Data

Specify 2 hexadecimal digits. Specify X for each digit.
Input method: Numeric Input Box

2.4.11.18 Trigger_7bit Address & Data/10bit Address & Data

The Settings Window when Trigger is set to 7bit Address & Data / 10bit Address & Data is shown Figure 2.50.

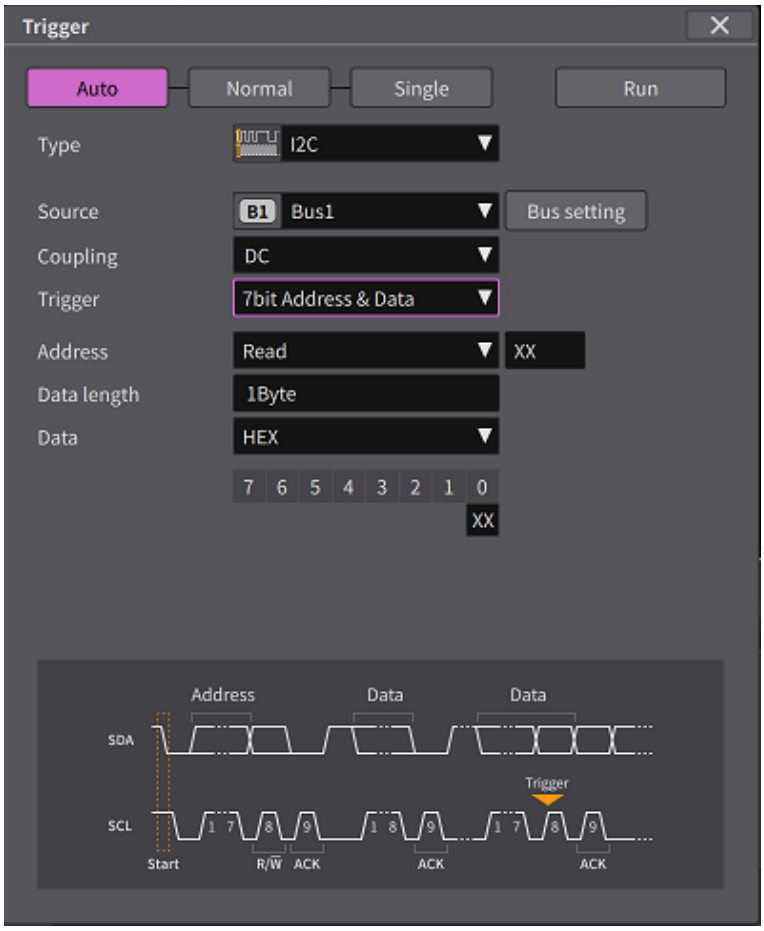


Figure 2.50 Settings Window when the 7bit Address & Data / 10bit Address & Data is selected as the Trigger type.

2.4.11.19 Address

Specify write, read, or read & write.
Input method: Combo box
List: Select from read / write / read & write.

■ Address

Specify the address. Specify 7 bits for hexadecimal, 10 bits for hexadecimal, and X for each digit.
Input method: Numeric Input Box

2.4.11.20 Data length

Set the Data length. Setting range 1 to 5 bytes
Input method: Numeric Input Box

2.4.11.21 Data

■ Format

Select whether to display in binary or hexadecimal.
Input method: Combo box
Select from BIN / HEX.

■ Data

The number of bytes set in Data length is the number of bytes to display and edit.
Input method: Binary editor
Binary number: 0 to 1, Hex number: 00 to FF, X can be specified in each digit.

2.4.12 Type_Sequence

You can use A trigger events with B trigger events to trigger complex waveforms.
Trigger occurs when the condition of B trigger is satisfied after the time specified by the delay timer elapses after the condition of A trigger is satisfied.
If the time specified by the clear timer elapses before the B trigger condition is satisfied, the system returns to waiting for the A trigger.

Table 2.22 Shows the trigger types that can be selected as A trigger and B trigger.

(Yes: Available, No: Unavailable)

Trigger	A Trigger	B Trigger
Edge	Yes	Yes
Edge ALT	No	No
Edge OR	No	No
Pulse Count	Yes	Yes
Pulse Width	No	No
Period	Yes	Yes
Dropout	Yes	Yes
OR, NOR, AND, NAND	No	No
UART, SPI, I2C	Yes	Yes
Transition Time	No	No

Note: Edge does not work on high-speed systems running at 1GHz.
The same Source cannot be specified more than once for A trigger and B trigger.
When UART / SPI / I2C is selected for A trigger [A trigger] or B trigger [B trigger], set multiple Thresholds for the same channel in the Bus1 / Bus2 settings that are the Source. However, in that case, only the highest priority Threshold is used for trigger detection according to Table 2.23.

Table 2.23 Trigger detection

Type		Threshold priority (higher to the left)
A trigger	B trigger	
UART	UART	A:Source > B:Source
	SPI	A:Source > B:Clock > B:MOSI > B:MISO > B:Chip Select
	I2C	A:Source > B:SCL > B:SDA
	Others	A:Source > B:Source
SPI	UART	A:Clock > A:MOSI > A:MISO > A:Chip Select > B:Source
	SPI	A:Clock > A:MOSI > A:MISO > A:Chip Select > B:Clock > B:MOSI > B:MISO > B:Chip Select
	I2C	A:Clock > A:MOSI > A:MISO > A:Chip Select > B:SLC > B:SDA
	Others	A:Clock > A:MOSI > A:MISO > A:Chip Select > B:Source
I2C	UART	A:SCL > A:SDA > B:Source
	SPI	A:SCL > A:SDA > B:Clock > B:MOSI > B:MISO > B:Chip Select
	I2C	A:SCL > A:SDA > B:SCL > B:SDA
	Others	A:SCL > A:SDA > B:Source
Others	UART	A:Source > B:Source
	SPI	A:Source > B:Clock > B:MOSI > B:MISO > B:Chip Select
	I2C	A:Source > B:SLC > B:SDA
	Others	A:Source > B:Source

Trigger_Type Sequence setting window shows Figure 2.51.

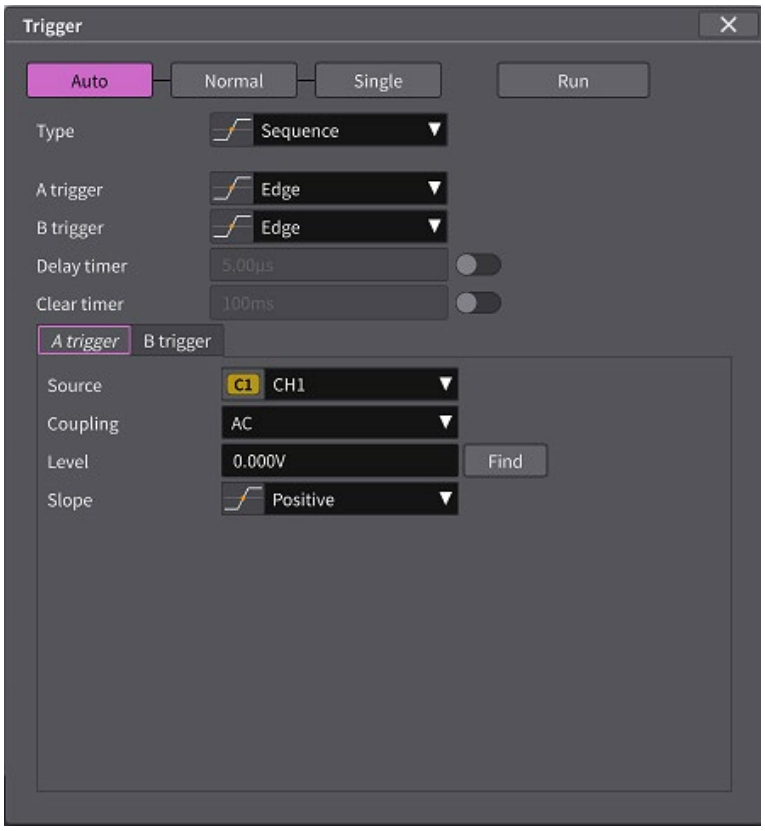


Figure 2.51 Settings window when Trigger_Type is selected as Sequence

2.4.12.1 Delay timer

Sets the time to delay the B trigger event.

Input method: Numeric input box / operation panel (1) Knob Setting range: 30ns to 50s Resolution 10ns

For the input method, see 1.9.8 Numeric Input Box.

2.4.12.2 Clear timer

Set the time to clear the B trigger event.

Input method: Numeric input box / operation panel (1) Knob Setting range: 1µs - 50s Resolution 1µs.

For the input method, see 1.9.8 Numeric Input Box.

2.4.12.3 Horizontal tab _A trigger

On the horizontal tab, tap A trigger.

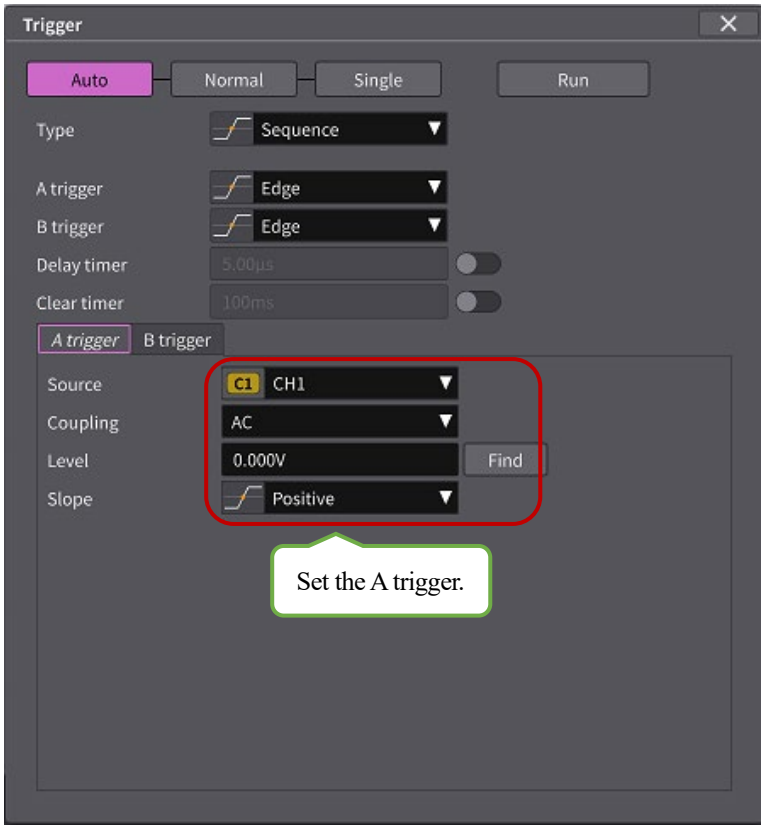


Figure 2.52 Settings window when A trigger is selected on the horizontal tab

2.4.12.4 Source

Sets the coupling of the trigger input.
Specifies the input channel for the trigger.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.4.12.5 Coupling

Sets the coupling of the trigger input.
Input method: Combo box
List: Select from AC / DC / HF Reject / LF Reject / DC Noise Reject.

Note: If UART / SPI / I2C is selected for either or both of A trigger [A trigger] and B trigger [B trigger], and the channels are duplicated in the various settings of Bus1 / Bus2 to be used, the trigger for that channel is used. The Coupling used for detection takes precedence over the A trigger Coupling.

2.4.12.6 Level

Set the trigger level.
Input method: Numeric input box / operation panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.4.12.7 Find

Detects the trigger level.
Input method: Press the button or LEVEL Knob

2.4.12.8 Slope

Specifies the slope of the trigger.
Input method: Combo box with icon
List: Select from Positive / Negative.

2.4.12.9 Horizontal tab _B trigger

Tap B trigger on the horizontal tab.

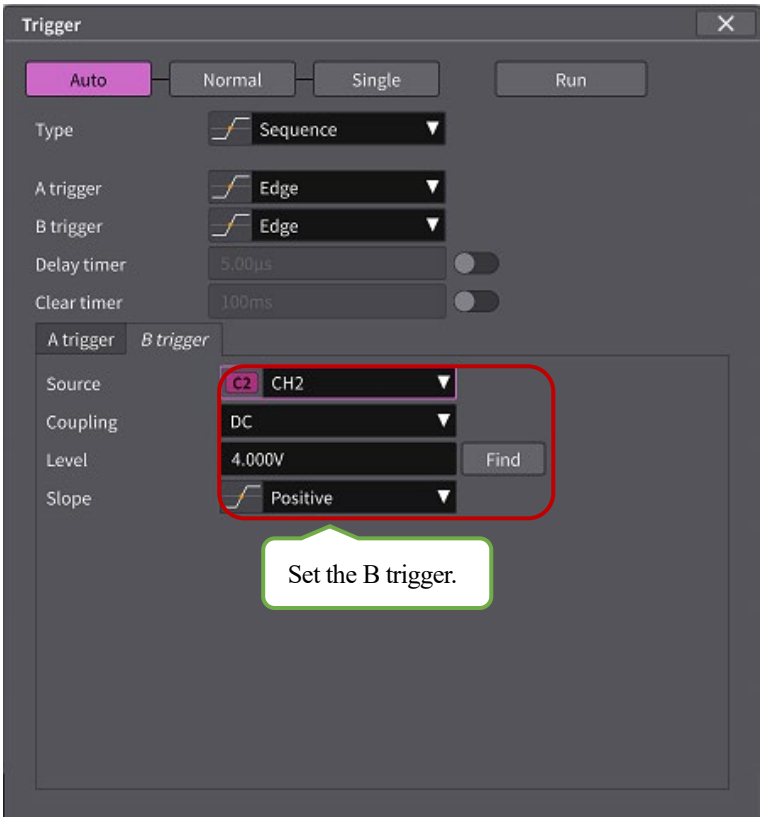


Figure 2.53 Settings window when B trigger is selected on the horizontal tab

2.4.12.10 Source

Specifies the input channel for the trigger.

Input method: Combo box with icon

List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.

For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.4.12.11 Coupling

Sets the coupling of the trigger input.

Input method: Combo box

List: Select from AC / DC / HF Reject / LF Reject / DC Noise Reject.

Note: If UART / SPI / I2C is selected for either or both of A trigger [A trigger] and B trigger [B trigger], and the channels are duplicated in the various settings of Bus1 / Bus2 to be used, the trigger for that channel is used. The Coupling used for detection takes precedence over the A trigger Coupling.

2.4.12.12 Level

Set the trigger level.

Input method: Numeric input box / operation panel (1) Knob

For the input method, see 1.9.8 Numeric Input Box.

2.4.12.13 Find

Detects the trigger level.

Input method: Press the button or LEVEL Knob

2.4.12.14 Slope

Specifies the slope of the trigger.

Input method: Combo box with icon

List: Select from Positive / Negative.

2.4.13 Type_Transition Time

Select Transition Time in the list.

The trigger occurs when the signal specified in Source passes through Level (Low)→Level (High) or Level (High)→ Level (Low) and the time difference meets the condition specified in Transition time. Table 2.24 shows the settings of Slope and the order of Level detection.

Figure 2.54 shows the setting window when Type is set to Transition Time.

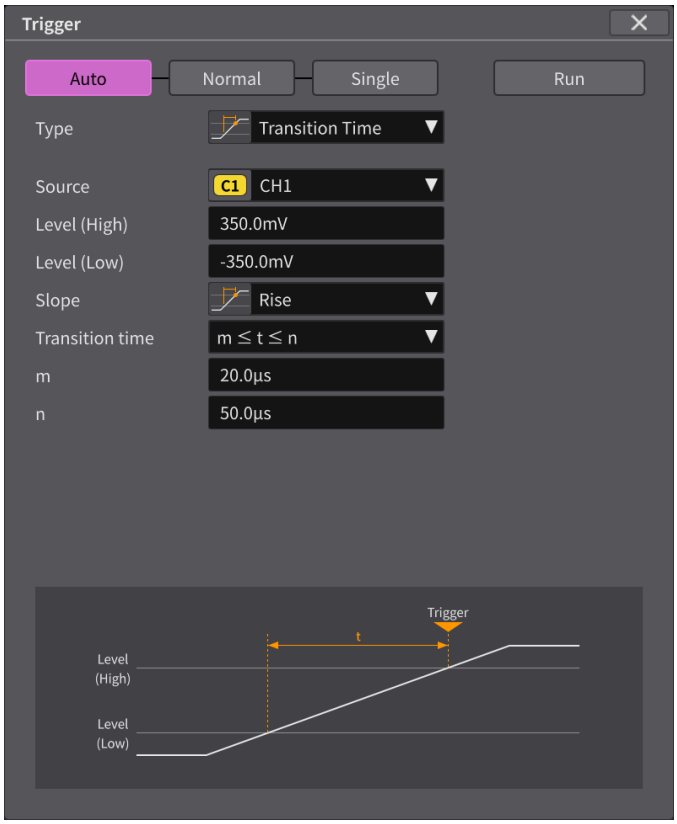
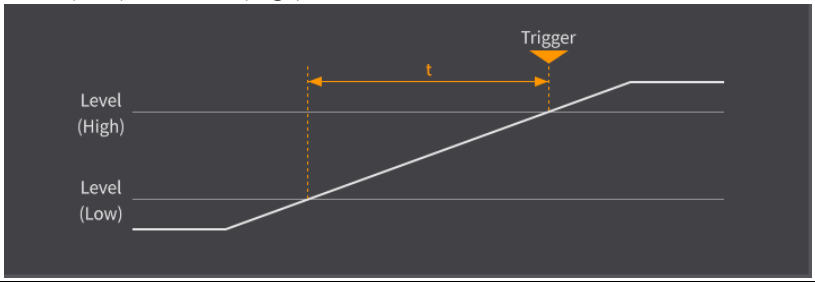
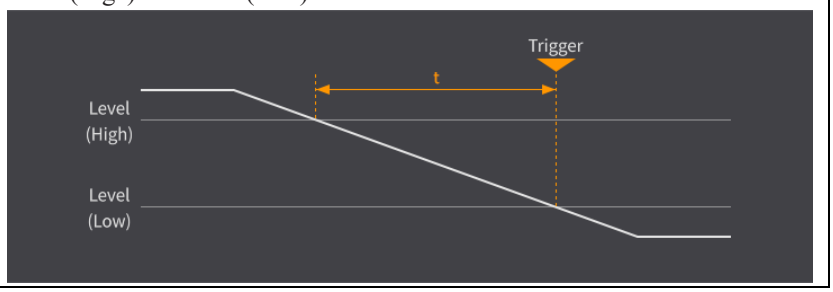


Figure 2.54 The setting window when Type is set to Transition Time.

Table 2.24 The settings of Slope and the order of Level detection

Slope	Level detection order
Rise	Level (Low) → Level (High) 

Fall	Level (High) → Level (Low) 

2.4.13.1 Level (High)

Sets the trigger Level (High). Refer to Table 2.24 for the level detection order.
Always Level (Low) < Level (High).
Setting range: ±4div
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.4.13.2 Level (Low)

Sets the trigger Level (Low). Refer to Table 2.24 for the detection order of Level.
Always Level (Low) <Level (High).
Setting range: ±4div
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.4.13.3 Slope

Specifies the slope of the trigger. See Table 2.24 for the detection order of the levels.
Input method: Combo box with icons
List: Rise/Fall to choose from.

2.4.13.4 Transition time

Selects the condition under which the trigger is applied.
Input method: combo box
List: m≤t / t≤m / m≤t≤n / t≤m, n≤t

2.4.13.5 m

Sets the numerical value m for Transition time. However, m<n is required.
Setting range: 600 ps to 50.0 s (interleaved), 1.20 ns to 50.0 s (non-interleaved)
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.4.13.6 n

Sets the numerical value n for Transition time. However, m<n is required.
Setting range: 2.60ns to 50.0s (interleaved), 3.20ns to 50.0s (non-interleaved)
Displayed only when Transition time is m ≤ t ≤ n or t ≤ m, n ≤ t.
Input method: Numeric Input Box / Operation Panel (1) Knob
For the input method, see 1.9.8 Numeric Input Box.

2.5 Auto Setup Operation and Settings

- Select Auto Setup from the MENU Window and set in the Auto Setup Window.
- Press the AUTO SETUP button on the Operation Panel to run Auto Setup.

Auto setup is a function that initializes the probe settings and automatically set the voltage axis, offset, time axis, and trigger individually or in combination for the optimum waveform display. If you are not satisfied with the set result, you can return to the original setting before execution immediately after execution.

2.5.1 Auto Setup Window

Table 2.25 shows the Operation contents of Auto Setup.

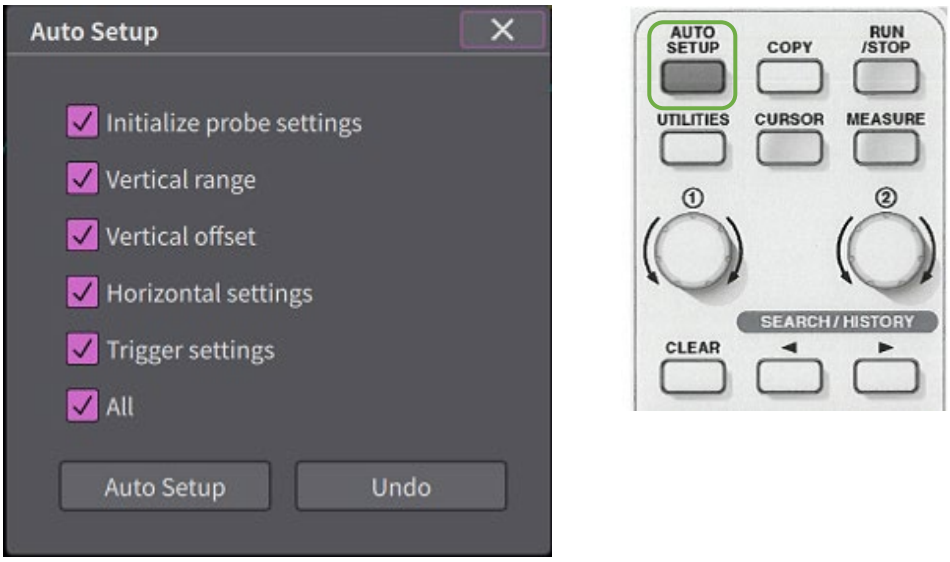


Figure 2.55 Auto Setup window and Operation Panel

2.5.1.1 Initialize probe settings

Initialize the probe settings before executing auto setup.
Input method: Check box

2.5.1.2 Vertical range

Activate the vertical range for auto setup.
Input method: Check box

2.5.1.3 Vertical offset

Activate the offset for auto setup.
Input method: Check box

2.5.1.4 Horizontal settings

Activate the Horizontal settings for auto setup.
Input method: Check box

2.5.1.5 Trigger settings

Activate the trigger settings for auto setup.
Input method: Check box

2.5.1.6 All

Activate everything to run Auto Setup. If you select this check box, all check boxes will be selected.
Input method: Check box

2.5.1.7 Auto Setup

Run auto setup.
Input method: Button

2.5.1.8 Undo

Restores the settings before executing auto setup.

Input method: Button

Table 2.25 Auto Setup Operation

Function	Item	Description
Common	CH	When the display of all channels is OFF, turn On the display of CH1.
	Zoom	Turn off Zoom.
	Persistenc	Turn off Persistence.
Initialize probe settings	Probe	Set Attenuation to Auto.
	Deskew	Set Deskew to 0 s.
	Invert	Turn off Invert.
	Rescale	Turn off Rescale.
Vertical range	Volts/div	Turn off Fine. Set to the highest sensitivity so that the amplitude of the waveform is 10 div or less. However, if the offset cannot be adjusted with that sensitivity, the sensitivity will be reduced. If the amplitude is less than 2 div at 1 mV / div, it is considered as no signal and set to 100 mV/div.
Offset	Offset	Adjust so that the waveform is displayed in the center of the screen.
Horizontal settings	Time/div	Set Time / div so that the signal of the trigger source is displayed for 2 to 5 cycles. (The lower limit frequency that can be detected is 25 Hz)
	Delay	Set Delay to 0 s.
	Mode	Set to Normal sampling.
Trigger settings	Mode	Set to Auto when waveform acquisition is set to Single. Set to Run when the waveform acquisition is Stop,
	Type	Set to Edge.
	Level	Set to the center of the trigger source waveform. When the amplitude of the waveform is 0.5 div or less, set to + 0.2 div in the center of the waveform.
	Source	When the channel set to the Source is display OFF, the least number of channels with amplitude and display on is set to the Source.
	Slope	Set Slope to Positive.
	Coupling	Set to DC.
	Hold off	Set to OFF.

2.6 Setting of the Instrument

■ Select Utilities from the MENU Window and set in the Utilities Window.

2.6.1 Utilities Window

Select the Display / Date & Time / Operation / Plugin / Calibration / Misc. Settings Window on the Horizontal tab.

2.6.2 Utilities_Display

Sets and changes the language of the screen display and the color scheme of the displayed color.
Select from Display / Date & Time / Operation / Plugin / Calibration / Misc. on the Horizontal tab.
Input method: Horizontal tab

This section describes the Settings Window when Display is selected on the Horizontal tab (Figure 2.56).

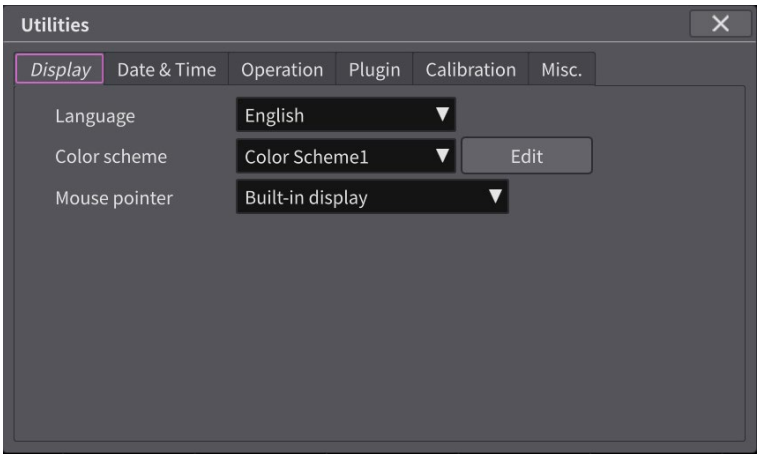


Figure 2.56 Utilities Window

2.6.2.1 Language

Select the display language.
Input method: Combo box
List: Select from English / Japanese

The display language is as shown in Table 2.26. It supports Japanese display, but does not support Japanese input. Also, even if it is set to English, the file name of the USB memory can be displayed in Japanese.

Table 2.26 Display language

Language	Font	Input
English	European fonts, Japanese fonts	Alphanumeric characters, symbols
Japanese	European fonts, Japanese fonts	Alphanumeric characters, symbols

2.6.2.2 Color scheme

There are 3 sets of screen color schemes. Select the color scheme to be displayed among those.
See 1.10 Color scheme.
Input method: Combo box
List: Select from Color scheme1 / Color scheme2 / Color scheme3.

2.6.2.3 Edit

Tap the Edit button to display the Color scheme window shown in Figure 2.57

From this Color scheme window, you can edit the colors that display each waveform, cursor and grid.

Input method: Button

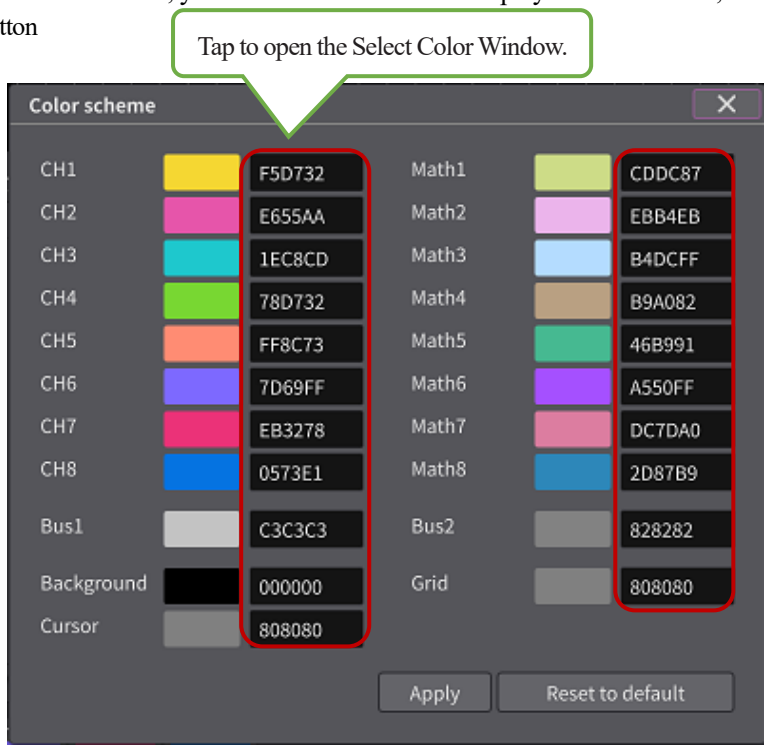


Figure 2.57 Color scheme Window

■ Selects / Edits the color from the color picker on Select Color Window.

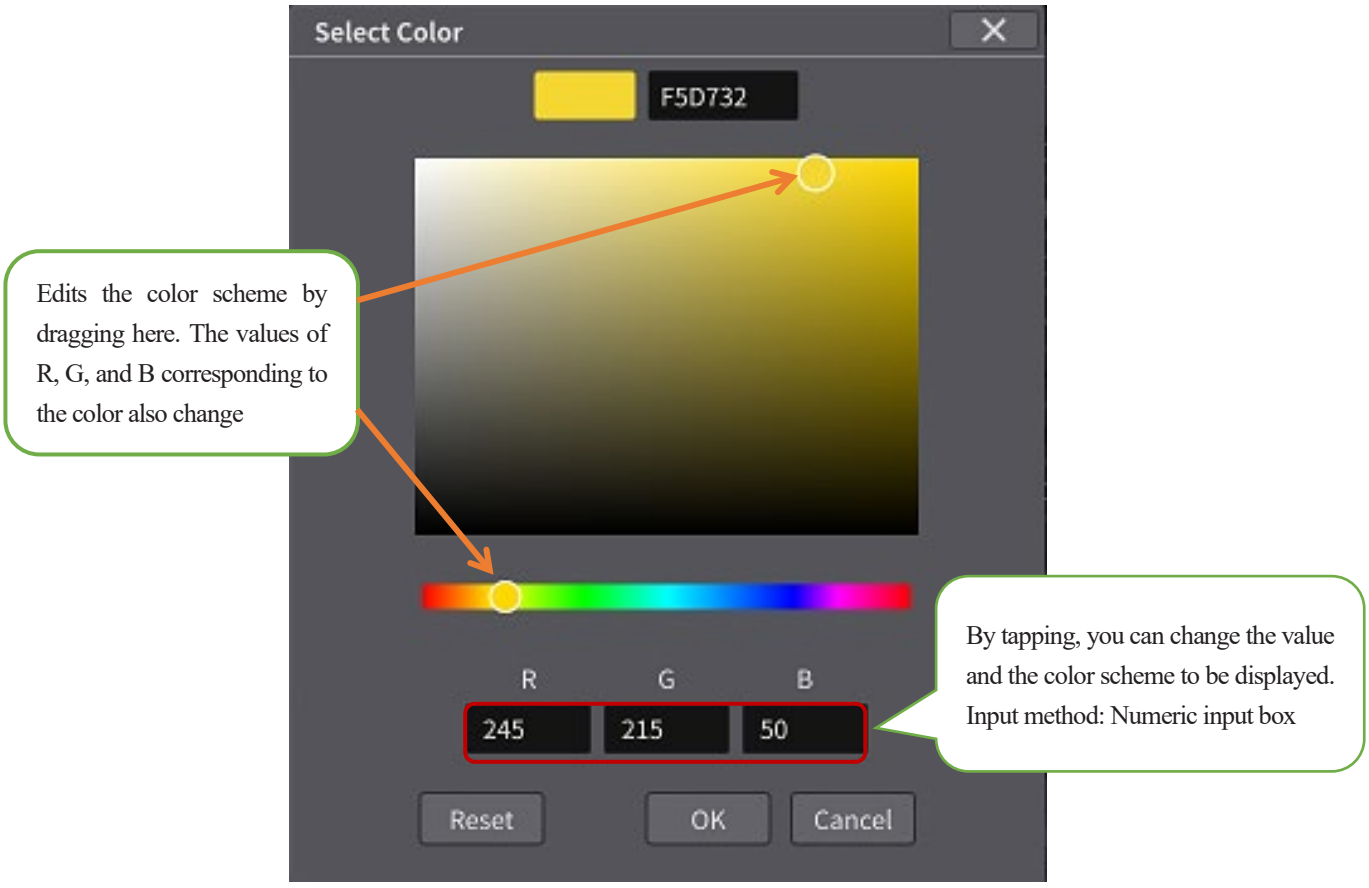


Figure 2.58 Select Color Window

2.6.2.4 Select Color_Reset

Set to the default color.

Input method: Button

2.6.2.5 Apply

Apply the changed color scheme.
Input method: Button

2.6.2.6 Reset to default

Recall and reflect the default setup.
Input method: Button

2.6.2.7 Mouse pointer

Select the display on which the mouse pointer is displayed when an external display is connected to the DVI-D terminal on the side panel and a USB mouse is connected to this device. Table 2.27 shows the displays that display the mouse pointer; if a USB mouse is not connected to this device, the mouse pointer is not displayed. After changing this setting, reboot the device.

Input method: Combo box

List: Built-in display / External display (If available)

Table 2.27 Mouse pointer

Mouse pointer settings	External display	Mouse pointer is displayed on
Built-in display	Connected / Not connected	Built-in display
External display (If available)	Connected	External display
	Not connected	Built-in display

2.6.3 Utilities_Date&Time

Select from Display / Date & Time / Operation / Plugin / Calibration / Misc. on the Horizontal tab.
Select Date & Time on the Horizontal tab to display the Date & Time -related Settings Window.
Input method: Horizontal tab

Figure 2.59 shows the Settings Window when Date & Time is selected on the Horizontal tab.
Set the time zone and the date and time of the built-in clock.
The date and time setting results are displayed as an RTC Readout at the bottom right of the display screen. When the Acquisition timestamp is set in 2.6.3.1 Display, the time when the waveform was acquired is displayed as an ACQ Readout in the upper right corner of the display screen.

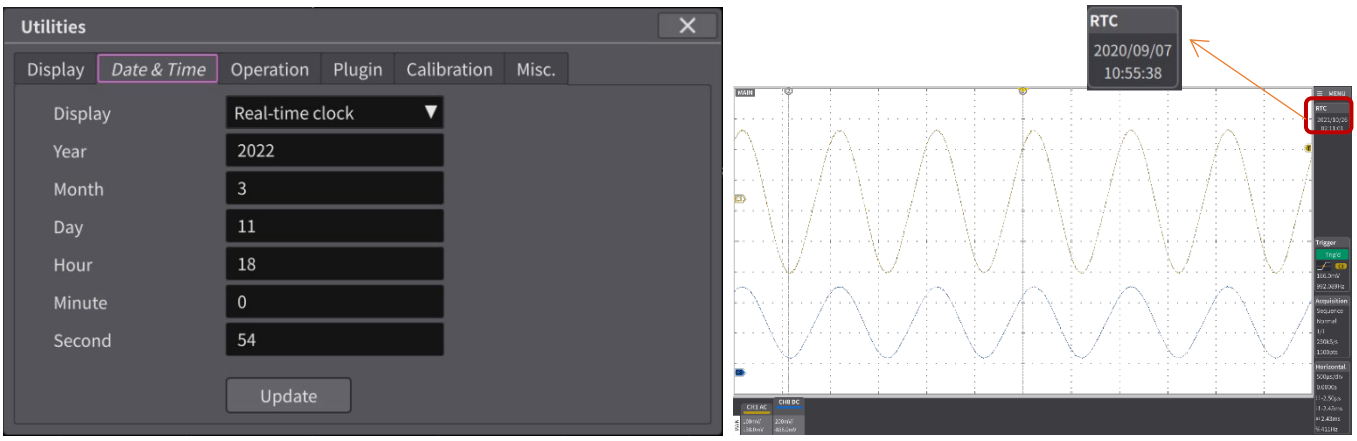


Figure 2.59 Settings Window when Date & Time is selected on the Horizontal tab and Position of RTC Readout

2.6.3.1 Display

The Real-time clock is for the current time, and the Acquisition timestamp is for the time when the waveform was acquired, which is displayed at the bottom right of the screen. Hide it by selecting Off.
Input method: Combo box
List: Select from Real-time clock / Acquisition timestamp / Off.

2.6.3.2 Year

Set the year of the built-in clock.
Input method: Numeric Input Box

2.6.3.3 Month

Set the month of the built-in clock.
Input method: Numeric Input Box

2.6.3.4 Day

Set the date of the built-in clock. The range that can be entered depends on the Year and Month settings.
Input method: Numeric Input Box

2.6.3.5 Hour

Set the hour of the built-in clock.
Input method: Numeric Input Box

2.6.3.6 Minute

Set the minute of the built-in clock.
Input method: Numeric Input Box

2.6.3.7 Second

Set the second of the built-in clock.
Input method: Numeric Input Box

2.6.3.8 Update

The date and time settings are reflected in the built-in clock.
Input method: Button

2.6.4 Utilities_Operation

Select from Display / Date & Time / Operation / Plugin / Calibration / Misc. on the Horizontal tab.
Select Operation on the Horizontal tab to display the Operation-related Settings Window.
Input method: Horizontal tab

The Settings Window when Operation is selected on the Horizontal tab is explained below (Figure 2.60).
Set the offset when changing Volts/div and Time/div, delay, and the beep sound.
Set the correspondence between the previous button and the next button of SEARCH / HISTORY on the operation panel.

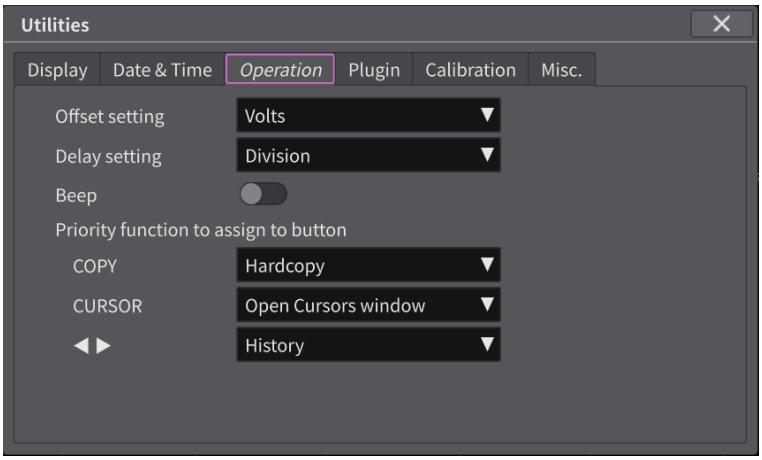


Figure 2.60 Settings Window when Operation is selected on the Horizontal tab

2.6.4.1 Offset setting

Specify selecting method of the offset value when changing the vertical scale.
When Division is selected, the waveform is enlarged or reduced centering on the offset marker.
When Volts is selected, the waveform is enlarged or reduced centering on the center of the screen.
Input method: Combo box
List: Select from Division / Volts.

2.6.4.2 Delay setting

Specify selecting method of the delay value when changing the timebase.
In the case of Division, the waveform is enlarged or reduced centering on the delay marker.
In the case of Time, the waveform is enlarged or reduced centering on the center of the screen.
Input method: Combo box
List: Select from Division / Time.

2.6.4.3 Beep

Set whether to beep during operation.
Input method: Toggle switch

2.6.4.4 Priority function to assign to button COPY

Sets the function to be assigned to the COPY button on the operation panel, which can be used to save a hard copy, a waveform, or both when the COPY button is pressed. Refer to 2.12.5 Save/Recall_Hardcopy and 2.12.4 Save/Recall_Waveform for specifying the file name etc. to be saved.
Input method: Combo box
List: Select from Hardcopy / Save waveform / Hardcopy & Save waveform

2.6.4.5 Priority function to assign to button CURSOR

Sets the function to be assigned to the CURSOR button on the operation panel. The functions to be assigned are shown in Table 2.28.
Input method: Combo box

List: Select from Open Cursor window / Switch cursor type

Table 2.28 Functions assigned to the CURSOR button

CURSOR settings	Open Cursor window	Switch cursor type
Functions assigned to the CURSOR button	When the CURSOR button is pressed, the status changes as follows. No cursor (LED: off) ↓ Cursor displayed (LED: on) ↓ Cursor window displayed (LED: on) ↓ Cursor window hidden and no cursor (LED: off)	When the CURSOR button is pressed, the Cursor Type changes as follows. No cursor (LED: off) ↓ Time (LED: on) ↓ Amplitude (LED: on) ↓ Time & Amplitude (LED: on) ↓ Value at cursor (LED: on) ↓ No cursor (LED: Off)

2.6.4.6 Priority function to assign to button ◄►

Assign to the SEARCH function or HISTORY function in advance.
Input method: Combo box
List: Select from Search / History.

2.6.5 Utilities_Plugin

Select from Display / Date & Time / Operation / Plugin / Calibration / Misc. on the Horizontal tab.
Select Plugin on the Horizontal tab to display the Plugin Software-related Settings Window.
Input method: Horizontal tab

The Settings Window when selected for Plugin on the Horizontal tab is explained below (Fig. 2.58).
Various plugin software can be installed to DS-8000 series and executable that one. A license keycode is required to install plugin software, so that when you purchase the plugin software, you should inform sales of the product name, serial number, and product ID.
(Referred to 2.15 About this Instrument)

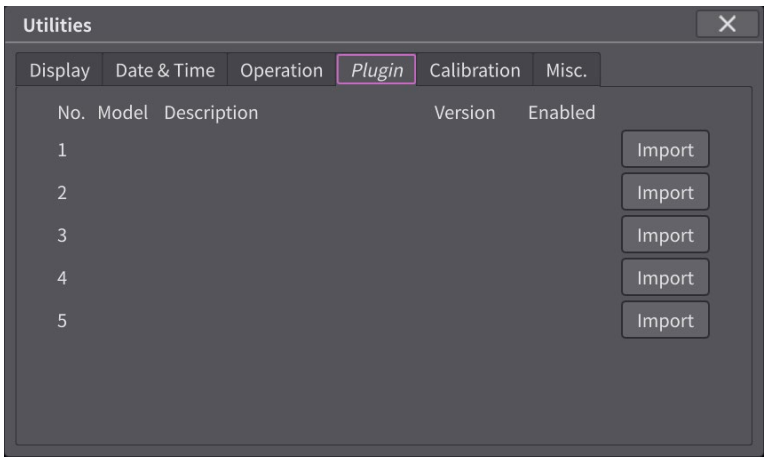


Figure 2.61 Settings Window when Plugin is selected on the Horizontal tab

2.6.6 Utilities_Calibration

Select from Display / Date & Time / Operation / Plugin / Calibration / Misc. on the Horizontal tab.
Select Calibration on the Horizontal tab to display the Calibration-related Settings Window.
Input method: Horizontal tab

The Settings Window when selected for Calibration on the Horizontal tab is explained below (Fig. 2.59).
Set the touch screen calibration and self-calibration.

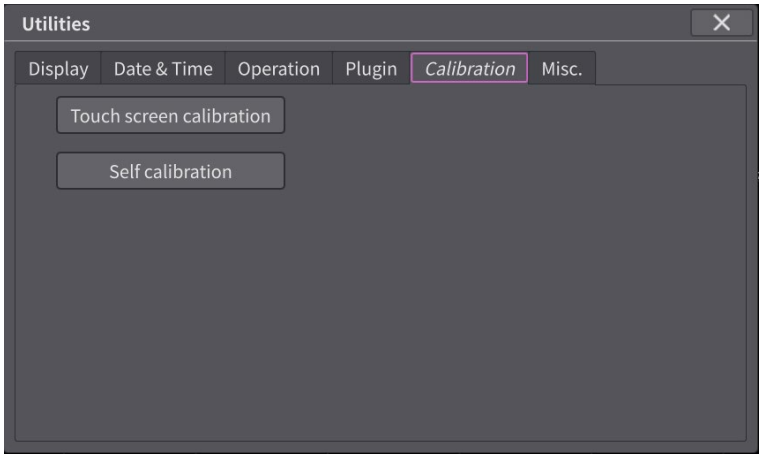


Figure 2.62 Settings Window when Calibration is selected on the Horizontal tab

2.6.6.1 Touch screen calibration

Calibrate the touch screen.
Input method: Button

2.6.6.2 Self calibration

Perform self-calibration of this instrument.
Remove all input signals during self-calibration.
During the calibration, the status line at the bottom of the screen shows the progress of self-calibration. The execution time is about 2 to 3 minutes.

Input method: Button

Self-calibration items

- Calibration of vertical sensitivity (Gain)
- Calibration of vertical sensitivity when the bandwidth is limited (BWL gain)
- Zero position calibration of vertical offset (Offset balance)
- Vertical offset sensitivity calibration (Offset gain)
- Trigger level zero position calibration (Trigger balance)
- Trigger level sensitivity calibration (Trigger gain)

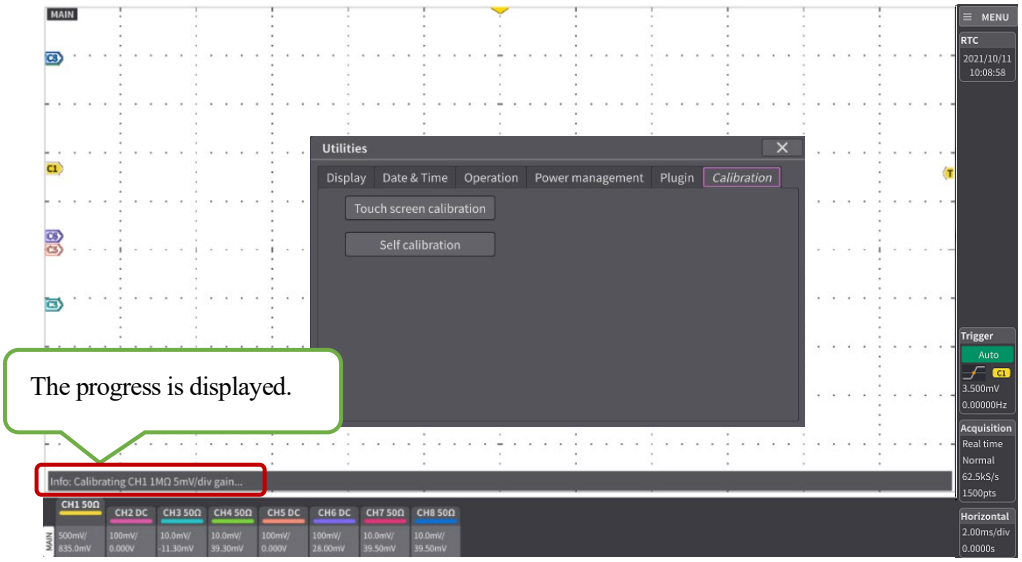


Figure 2.63 Screen when executing self-calibration

2.6.7 Utilities_Misc.

Select from Display / Date & Time / Operation / Plugin / Calibration / Misc. on the Horizontal tab.
Input method: Horizontal tab

The Settings Window when Misc. is selected on the Horizontal tab is described below (Figure 2.64).
Set the time until the backlight is turned off, the brightness of the backlight, and the output signal of the AUX OUT terminal.

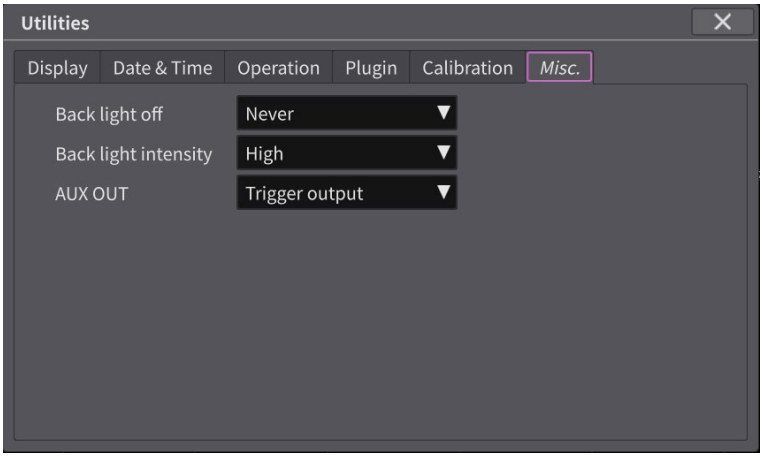


Figure 2.64 Settings Window when Misc. is selected on the Horizontal tab

2.6.7.1 Back light off

Set the time until the backlight turns off.
Input method: Combo box
List: Select from Never / 15 s / 1 min / 5 min / 15 min.

2.6.7.2 Back light intensity

Set the brightness of the backlight.
Input method: Combo box

List: Select from High / Medium / Low.

2.6.7.3 AUX OUT

This parameter sets the output contents of the AUX OUT terminal. When Trigger output is selected, 2.9.3.5 Output pulse (AUX OUT) cannot be set other than Not executed.

This item is not displayed when the external trigger DS-601 (DS8K EXT-TRIG-IN) option is installed.

Input Method: Combo Box

List: Select from Trigger output / Pass/Fail output.

2.7 Cursor Operation and Setting

Select Cursors from the MENU Window and set in the Cursors Window.
You can also press the CURSOR button on the Operation Panel to display the Cursors Window. (Only if 2.6.4.5 Priority function to assign to button CURSOR is set to Open Cursor window.)

2.7.1 Cursors Window

Change the setting of the cursor that measures time and voltage.

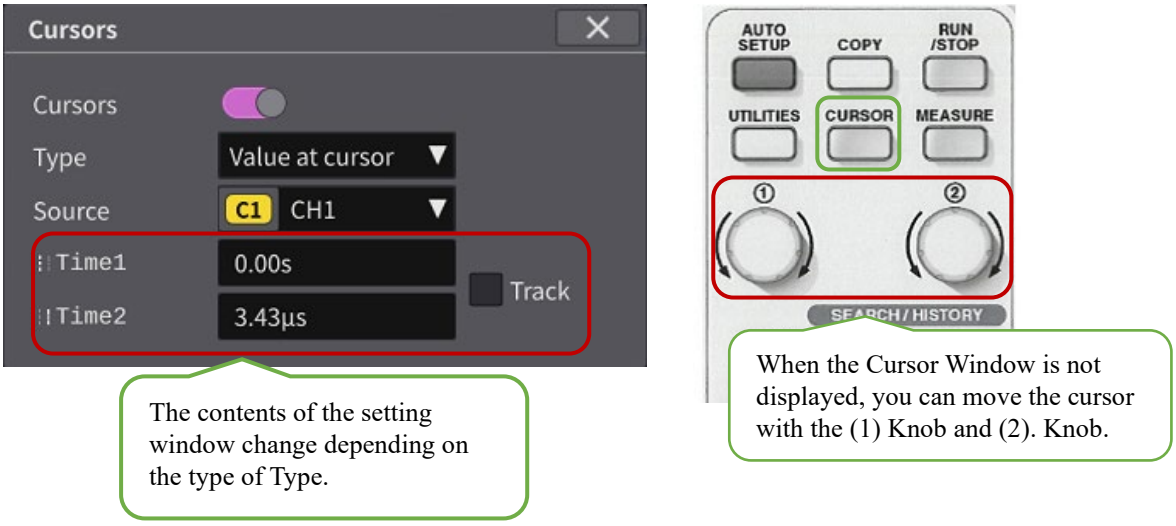


Figure 2.65 Cursor Window and CURSOR button and Knob

2.7.1.1 Cursors

Select the cursor ON / OFF.
Input method: Toggle switch

2.7.1.2 Type

Select the cursor type. There are four types. The contents of the Settings Window change depending on the Type.
Input method: Combo box
List: Select from Time / Amplitude / Time & Amplitude / Value at cursor.

Table 2.29 Cursor types

(Yes: Available, No: Unavailable)

Type	Description	Time cursor		Amplitude cursor	
		1	2	1	2
Time	Measure the position of each cursor (time difference from the trigger point) and the time difference Δt between the cursors.	Yes	Yes	No	No
Amplitude	Measure the position (voltage) of each cursor and the voltage difference ΔV between the cursors.	No	No	Yes	Yes
Time & Amplitude	The combination of time and amplitude above.	Yes	Yes	Yes	Yes
Value at cursor	Measure the position of each cursor (time difference from the trigger point) and the time difference between cursors. In addition, measure the voltage value at the intersection of the cursor and the waveform.	Yes	Yes	Yes	No

2.7.1.3 Source

Select the channel or Math for which you want to measure by cursor.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math8.

2.7.1.4 Time1

Set the measured / set value for time cursor1.
Input method: Numeric Input Box

2.7.1.5 Time2

Set the measured / set value of time cursor2.
Input method: Numeric Input Box

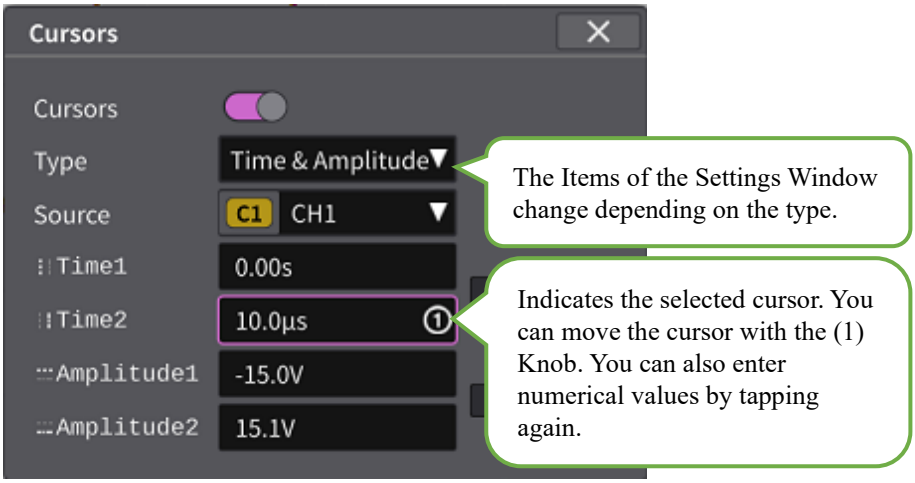


Figure 2.66 Settings Window when the Time & Amplitude is selected as the Measure Type.

2.7.1.6 Amplitude1

Set the measured / set value of the amplitude cursor1.
Input method: Numeric Input Box

2.7.1.7 Amplitude2

Set the measured / set value of the amplitude cursor2.
Input method: Numeric Input Box

2.7.1.8 Track

When the track is turned on, it moves at the same time while keeping the distance between cursor1 and cursor2.

Input method: Check box

Table 2.30 Cursor types and setting ranges

Cursor Type	Range
Time Cursors	Screen Center ± 6 div
Amplitude Cursors	Screen Center ± 5 div

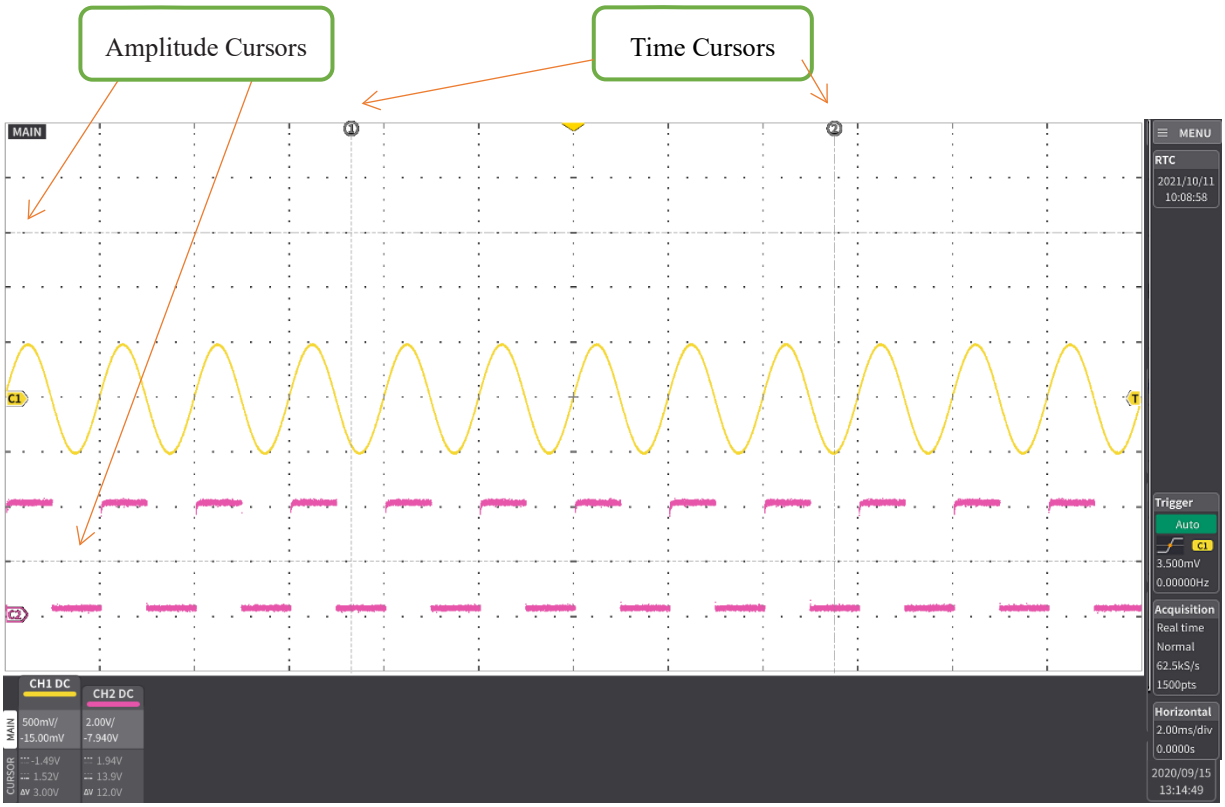


Figure 2.67 Time cursors and amplitude cursors

2.8 Waveform Measurement and Settings

■ Select the Measure Window from the MENU Window and set in the Measure Window.

2.8.1 Measure Window

Set and changes the measurement conditions in the Measure Window
Signal Tr (rise time), Mean (average value), Frequency (frequency), etc. 14 items in the horizontal axis direction, 12 items in the vertical axis direction and 9 other items. A total of 35 measurement items can be measured, simultaneously with 8 items.
The target source of the measurement item can be selected from the waveforms of CH1 to CH8 and Math1 to Math8 (4CH model: CH1 to CH4 and Math1 to Math8).
The part where the CHx and Mathx waveform data does not exist is excluded from the measurement target.
When you select a measurement item, the measurement results for each measurement item are displayed in the list display area at the bottom of the screen.

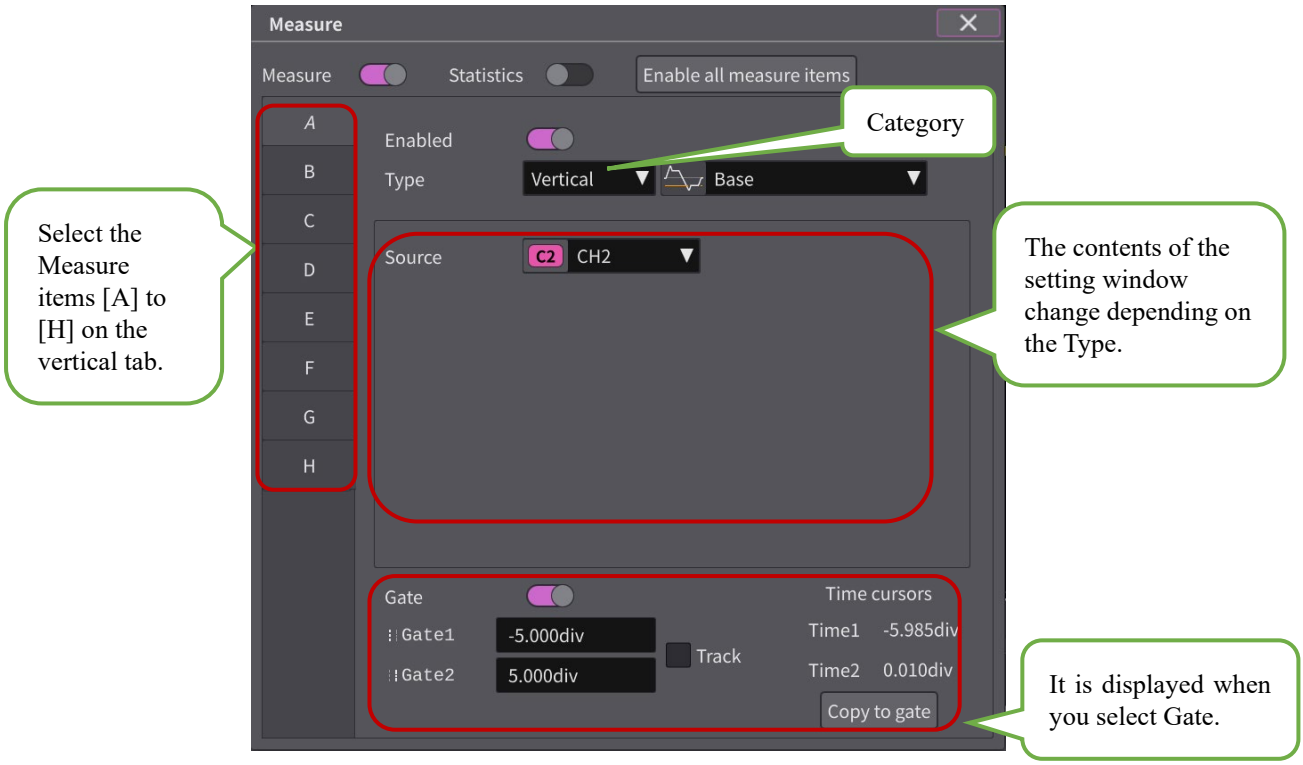


Figure 2.68 Measure Window

2.8.1.1 Measure selection

Select and set Measure items [A] to [H] on the vertical tab.
Input method: Vertical tab

2.8.1.2 Measure settings

Set measurement ON/OFF. If ON, the Measure list is displayed.
See 1.6.3 List Table.
Input method: Toggle switch

2.8.1.3 Statistics

Set the statistics display ON / OFF. When ON, the statistics display list is displayed.
See 1.6.3 List Table.
Input method: Toggle switch

2.8.1.4 Enable all measure items

Turn on all measurement items.
Input method: Button

2.8.1.5 Enabled

Set enables / disables the measurement of [A] to [H].
Input method: Toggle switch

2.8.1.6 Category

Select the classification of the measurement type. The contents of the list of measurement types will change depending on the selection. See Table 2.31 for the contents of the list when each classification is selected. If All is selected, the contents of the list are all measurement types.
Input method: Combo box
List: All / Vertical / Horizontal / Other

2.8.1.7 Type

Specify the type of measurement. The contents of the Settings Window change depending on the type of measurement type.
Input method: Combo box with icon
List: Select from Maximum / Minimum / Peak-Peak / Top / Base / Top-Base / RMS / Cyclic RMS / Mean / Cyclic Mean / + Overshoot/ -Overshoot / Transition Time / Tr 20-80% / Tf 80-20% / Tr 10-90% / Tf 90-10% / Tr (Level) / Tf (Level) / Frequency / Period / + Pulse Count / -Pulse Count / + Pulse Width/ -Pulse Width / Duty Cycle / dV/dt / Integral / Integral (Absolute) / Integral (Positive) / Integral (Negative) / Skew (%) / Skew Level / Phase (%) / Phase (Level).

When the list is Maximum / Minimum / Peak-Peak / Top / Base / Top-Base / RMS / Cyclic RMS / Mean / Cyclic Mean / + Overshoot / -Overshoot, it will be explained in the Settings Window in Figure 2.68 (Select Base as Type).

When the list is Transition Time, see 2.8.2 Type_Transition Time.
When the list is Tr 20-80% / Tf 80-20% / Tr 10-90% / Tf 90-10%, see 2.8.3 Type_Tr 20-80%.
When the list is Tr (Level) / Tf (Level), see 2.8.4 Type_Tr (Level).
When the list is dV/dt, see 2.8.5 Type_dV/dt.
When the list is Integral, see 2.8.6 Type_Integral.
When the list is Skew (%), see 2.8.7 Type _Skew (%).
When the list is Skew Leve, see 2.8.8 Type _Skew (Level).
When the list is Phase (%), see 2.8.9 Type _Phase (%).
When the list is Phase Leve, see 2.8.10 Type _Phase (Level).

Table 2.31 shows an overview of the measurement types.

Table 2.31 Measurement Type

	Measurement Type	Description	Unit
Vertical	Maximum	Maximum value of waveform	V
	Minimum	Minimum value of waveform	
	Peak-Peak	Maximum / minimum difference	
	Top	Upper flat part of the waveform	
	Base	Lower flat part of the waveform	
	Top-Base	Difference between Top and Base	
	RMS	RMS (Root Mean Square) of waveform	
	Cyclic RMS	RMS of waveform for one cycle	
	Mean	Average value of waveform	
	Cyclic Mean	Average value of waveform for one cycle	
	+OverShoot	Overshoot at the rising edge of the waveform	%
	-OverShoot	Overshoot at the falling edge of the waveform	

Table is continued to next page.

Table 2.31 Measurement Type(continued)

	Measurement Type	Description	Unit
Horizontal	Transition Time	Waveform rise / fall time	s
	Tr 20-80%	20-80% rise time of waveform	
	Tf 80-20%	80-20% fall time of waveform	
	Tr10-90%	10-90% rise time of waveform	
	Tf 90-10%	90-10% fall time of waveform	
	Tr (Level)	Rise time of waveform (detection threshold specified by real number)	
	Tf (Level)	Fall time of waveform (detection threshold specified by real number)	
	Frequency	Waveform frequency	Hz
	Period	Waveform period	s
	+Pulse Count	Number of positive pulses	-
	-Pulse Count	Negative pulse number	-
	+Pulse Width	Positive pulse width	s
	-Pulse Width	Negative pulse width	
	Duty Cycle	Waveform duty ratio (positive pulse width / period)	%
Other	dV/dt	Waveform rising / falling edge slope	V/s
	Integral	Waveform integral	Vs
	Integral (Absolute)	Integral the absolute value of the waveform	
	Integral(Positive)	Integral only positive waveforms (negative values are treated as 0)	
	Integral(Negative)	Integral only negative waveforms (positive values are treated as 0)	
	Skew (%)	Time difference between the edges of the waveform (edge detection threshold specified in %)	s
	Skew Level	Time difference between the edges of the waveform (edge detection threshold specified by real number)	
	Phase (%)	Time difference between waveform phases (edge detection threshold specified in %)	Degree, Radian, %
	Phase Level	Time difference between waveform phases (edge detection threshold specified by real number)	

2.8.1.8 Source

Select the source to be measured.

Input method: Combo box with icon

List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.

For the 8CH model, select from CH1 to CH4 and Math1 to Math8.

2.8.1.9 Gate

Set whether to use the Gate. When OFF, Gate1, Gate2 and Track are disabled.

See 1.7.8 Gate.

Input method: Toggle switch

2.8.1.10 Gate1
Set Gate1.
Input method: Numeric Input Box

2.8.1.11 Gate2
Set Gate2.
Input method: Numeric Input Box

2.8.1.12 Track
When ON, keep the distance between Gate1 and Gate2 constant.
Input method: Check box

2.8.1.13 Time cursors_Time1
Displays the position of the set cursor and the position of the time cursor1 that was set immediately before.
Label displays the position of time cursor1.

2.8.1.14 Time cursors_Time2
Displays the position of the set cursor and the position of the time cursor2 that was set immediately before.
The label indicates the position of time cursor2.

2.8.1.15 Copy to gate
Copy the time cursor value to the appropriate gate.
Input method: Button

2.8.2 Type_Transition Time

Measure the rise / fall time of the waveform.
Figure 2.69 shows the Settings Window when Type is Transition Time.

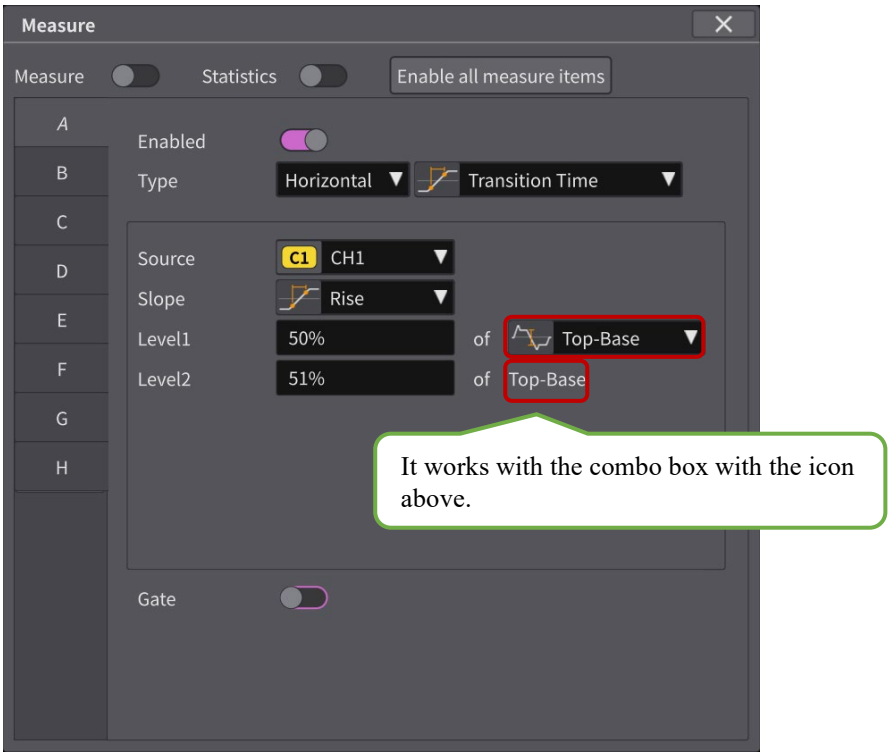


Figure 2.69 Settings Window when the Transition Time is selected as the Measure Type.

2.8.2.1 Source

Select the source to be measured.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math8.

2.8.2.2 Slope

Set the slope.
Input method: Combo box with icon
List: Select from Rise / Fall.

2.8.2.3 Level1

Input method: Numeric Input Box / (1) Knob.
Setting range:
Set slope to Rise 10-89%, Resolution: 1%
Set slope to Fall 11-90%, Resolution: 1%

Input method: Combo box with icon
List: Select from Peak-Peak / Top-Base.

2.8.2.4 Level2

Input method: Numeric Input Box / (1) Knob.
Setting range:
Set slope to Rise 11-90%, Resolution: 1%
Set slope to Fall 10-89%, Resolution: 1%

Works with the label Level1.

2.8.3 Type_Tr 20-80%

Measure the rise / fall times of 20-80% and 10-90% of the waveform.
The case where Type is Tr 20-80% is explained in the setting window shown in Figure 2.70.
Table 2.32 shows the measurement items in other cases.

Table 2.32 Measurement items

Type	Description
Tr 20-80%	20 to 80% rise time of waveform
Tf 80-20%	80 to 20% fall time of waveform
Tr 10-90%	10 to 90% rise time of waveform
Tf 90-10%	90 to 10% fall time of waveform

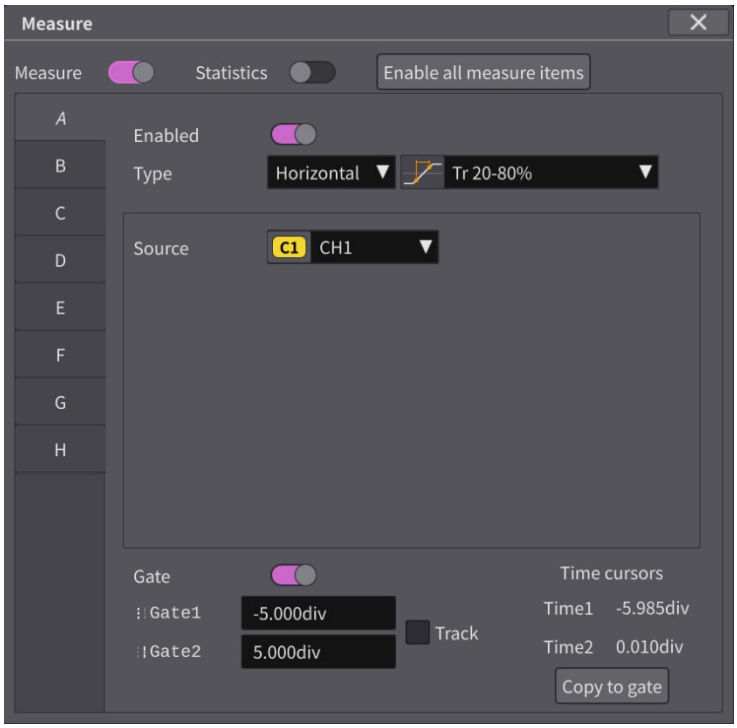


Figure 2.70 Settings Window when Type is Tr 20-80%

2.8.3.1 Source

Select the source to be measured.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math8.

2.8.4 Type_Tr (Level)

The case where Type is Tr (Level) is illustrated in the setting window shown in Figure 2.71.
Tr (Level) measures the rise time of the transition from Level1 to Level2. It is always Level1 < Level2.
Tf (Level) measures the fall time of the transition from Level1 to Level2. It is always Level1 > Level2.

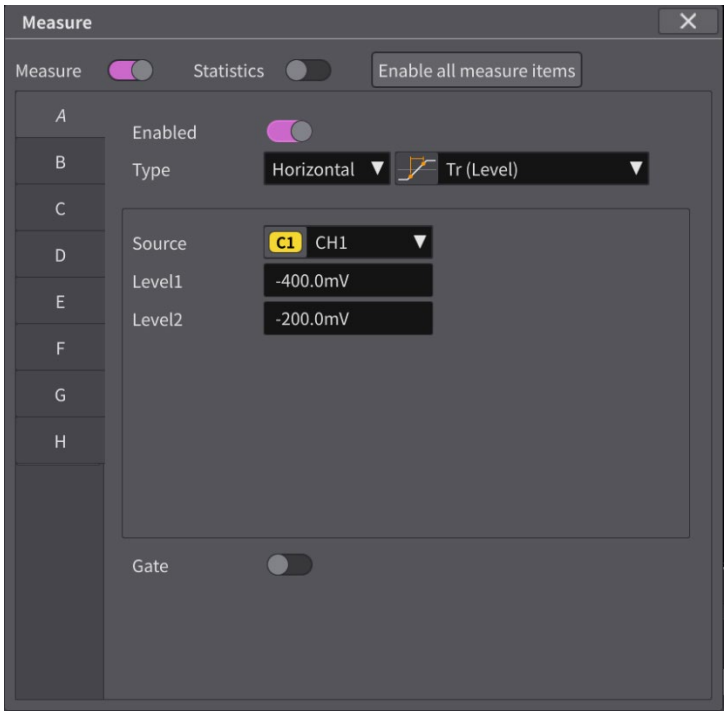


Figure 2.71 Setting window when the Tr (Level) is selected as the Measure Type.

2.8.4.1 Source

List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math8.

2.8.4.2 Level1

Set Level 1.
Input method: Numeric input box Setting range: ±5 div of screen center, voltage conversion

2.8.4.3 Level2

Set Level 2.
Input method: Numeric input box Setting range: ±5 div from the center of the screen, voltage conversion

2.8.5 Type_dV/dt

Measure the slope of the rising / falling edges of a waveform.
The Settings Window is the same as Type_Transition Time in Figure 2.69.

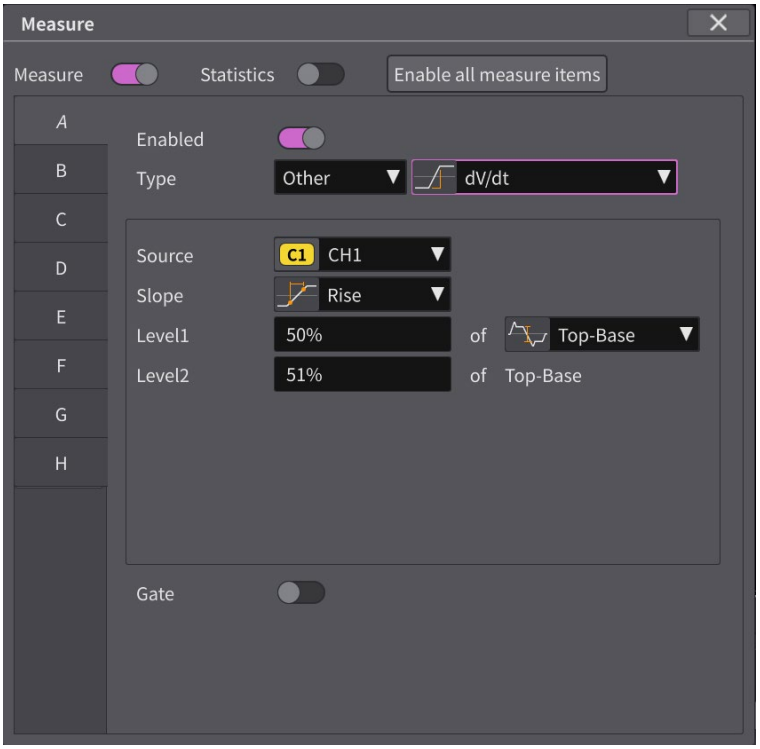


Figure 2.72 Settings Window when the dV/dt is selected as the Measure Type.

2.8.6 Type_Integral

Measures the area (integral) of the waveform within the measurement range.
Figure 2.73 shows the Settings Window when the measurement type is Integral.

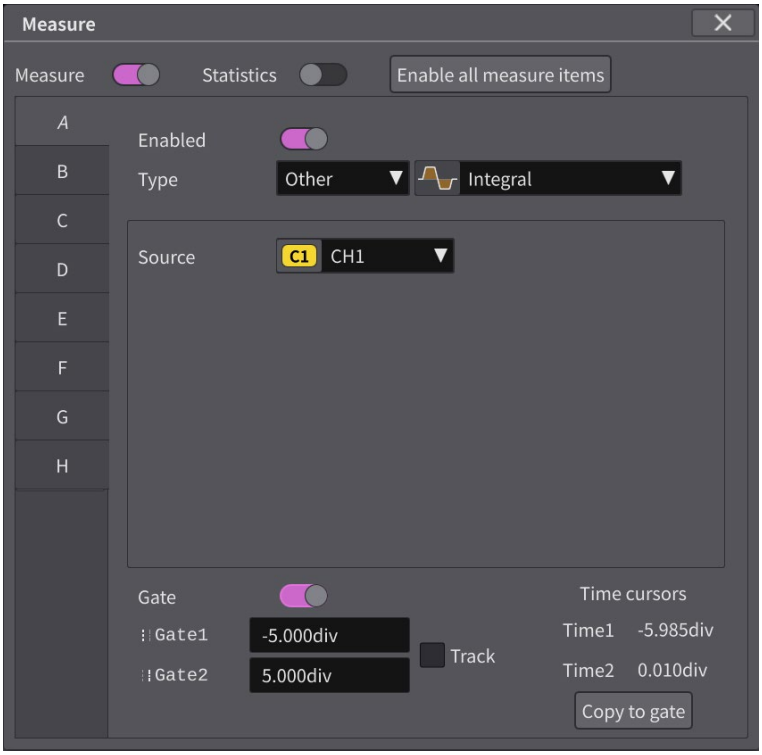


Figure 2.73 Settings Window when the Integral is selected as the Measure Type.

■ Integral

Measure the area (integral) of the waveform within the measurement range. In the area (integral) measurement, the reference level (GND level) of the CH is used as the reference.

Figure 2.74 shows a measurement example. In this example, the integrated value of -S1 + S2-S3 + S4-S5 + S6 (black part) is measured in the measurement range between Gate1 and Gate2 with reference to the reference level (GND level).

In addition to Integral, there are Integral (Absolute), Integral (Positive), and Integral (Negative).

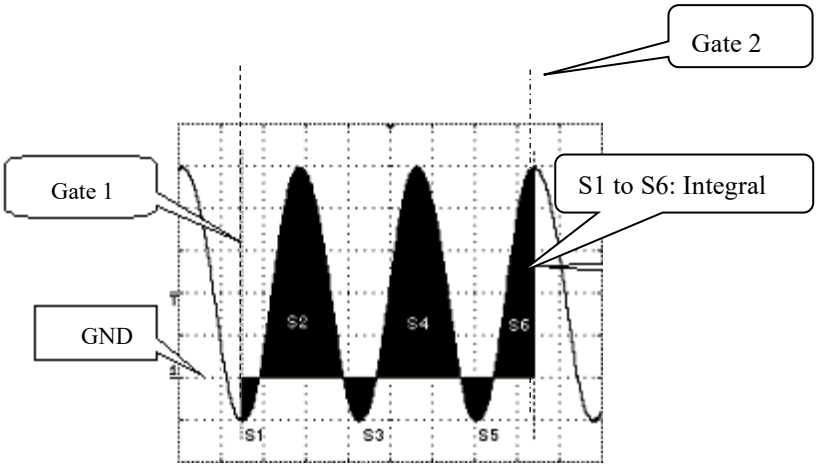


Figure 2.74 Integral measurement

2.8.7 Type_Skew (%)

Measure the time difference between two measurement points..

Figure 2.75 shows the Settings Window when Measure Type is Skew (%).

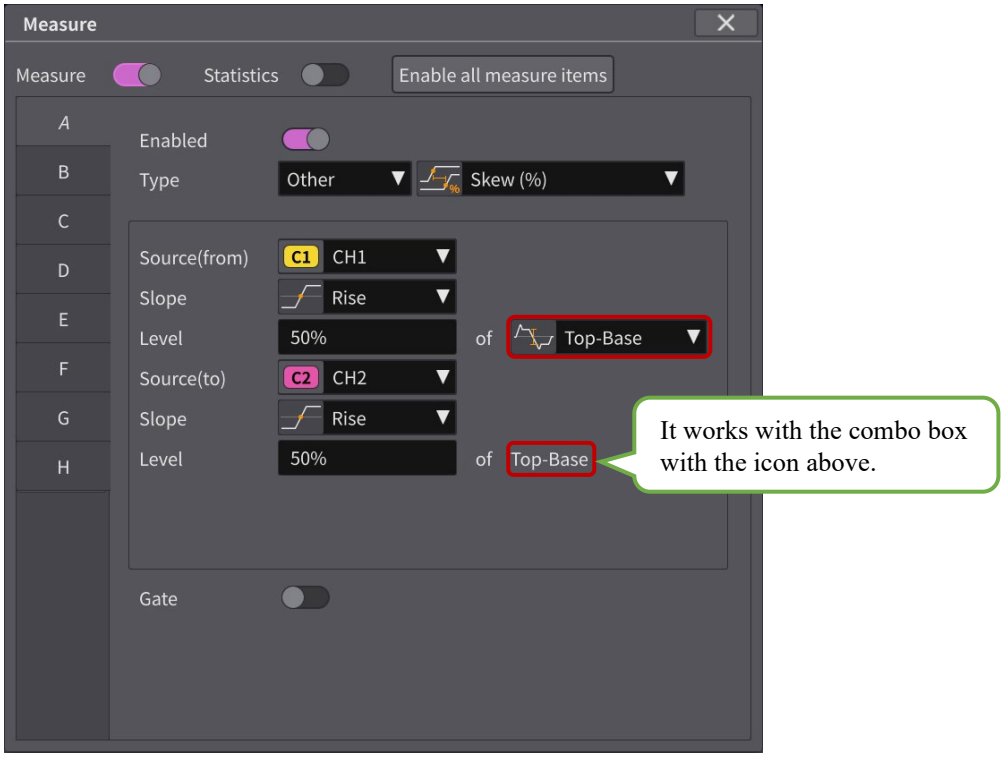
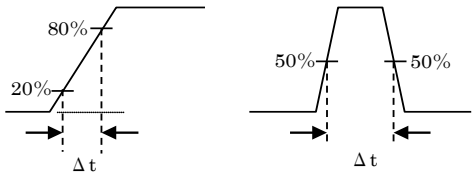


Figure 2.75 Settings Window when the Skew (%) is selected as the Measure Type.

■ Measure Skew (%)

The level of the measurement point is set in relative percentage (%) to the amplitude. Figure 2.76 shows the measurement image.



Measure the time difference between two measurement points in the same channel or different channels.
The two examples on the left are measured on the same channel.

Figure 2.76 Skew (%) measurement ımage

Note: Skew (%) detects edge 2 after the time when edge 1 was detected.
When the detection time of edge 2 is before the detection time of edge 1, the automatic measurement result will be displayed "*********".

2.8.7.1 Source (from)

Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math 8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math 8.

2.8.7.2 Slope

Input method: Combo box with icon
List: Select from Rise / Fall.

2.8.7.3 Level

Input method: Numeric Input Box. Setting range: 10 to 90%, Resolution: 1%
Input method: Combo box with icon
List: Select from Peak-Peak / Top-Base.

2.8.7.4 Source (to)

Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math 8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math 8.

2.8.7.5 Slope

Input method: Combo box with icon
List: Select from Rise / Fall.

2.8.7.6 Level

Input method: Numeric Input Box. Setting range 10 to 90%, Resolution: 1%
Work with list selection of the label 2.8.7.3 Level.

2.8.8 Type_Skew (Level)

Measure the time difference between two measurement points..
Figure 2.77 shows the Settings Window when Type is Skew (Level).

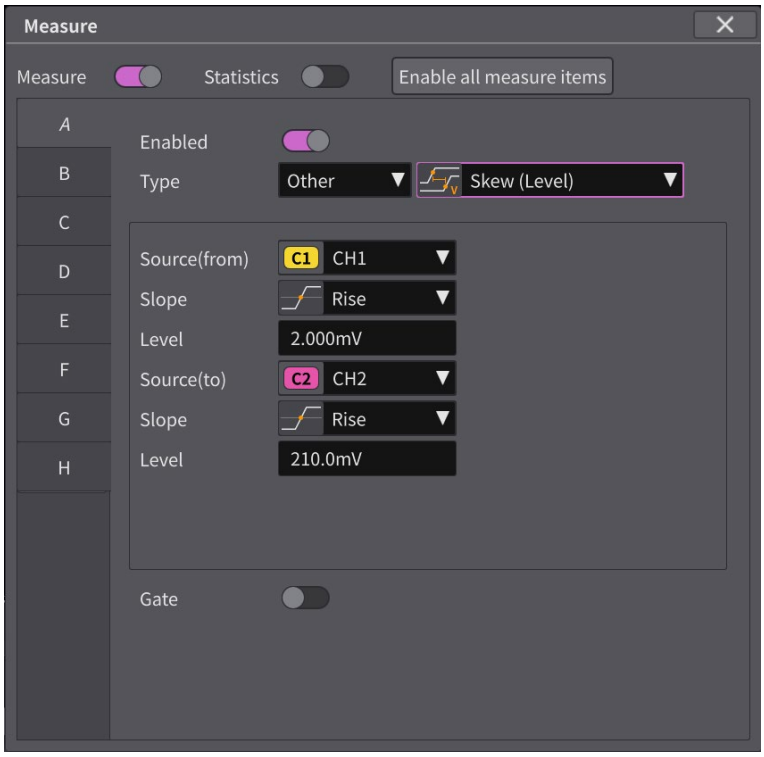
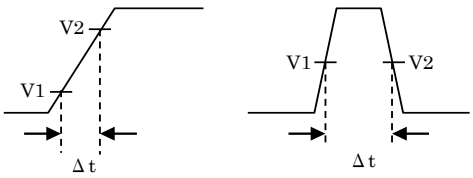


Figure 2.77 Settings Window when the Skew (Level) is selected as the Measure Type.

■ Measure Skew (Level)

The level of the measurement point is set in absolute value (for voltage, the unit is V). Figure 2.78 shows the measurement image.



Measure the time difference between two measurement points in the same channel or different channels.
The two examples on the left are measured on the same channel.

Figure 2.78 Skew (Level) measurement image

Note: Skew (Level) detects edge 2 after the time when edge 1 was detected.
When the detection time of edge 2 is before the detection time of edge 1, the automatic measurement result will be displayed "*********".

2.8.8.1 Source (from)

Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and MATH1 to MATH8.
For the 4CH model, select from CH1 to CH4 and MATH1 to MATH8.

2.8.8.2 Slope

Set the slope.
Input method: Combo box with icon
List: Select from Rise / Fall.

2.8.8.3 Level

Set the level.
Input method: Numeric Input Box. Setting range: center of screen ± 5 div, voltage conversion
Input method: Combo box with icon
List: Select from Peak-Peak / Top-Base.

2.8.8.4 Source (to)

Input method: Combo box with icon

List: For the 8CH model, select from CH1 to CH8 and MATH1 to MATH8.
For the 4CH model, select from CH1 to CH4 and MATH1 to MATH8.

.

2.8.8.5 Slope

Set the slope.

Input method: Combo box with icon

List: Select from Rise / Fall.

2.8.8.6 Level

Set the level.

Input method: Numeric Input Box Setting range: Screen center ± 5 div, voltage conversion

2.8.9 Type_Phase (%)

Measure the phase difference between waveform Source1 and waveform Source2. Set the measurement point for measuring the phase difference in% of each waveform. The measurement result can be selected from Degree, Radian and %.

The case where Type is Phase (%) is explained in the setting window in Figure 2.79.

Figure 2.79 Settings Window when the Phase (%) is selected as the Measure Type.

2.8.9.1 Source1

Input method: Combo box with icon

List: For the 8CH model, select from CH1 to CH8 and MATH1 to MATH8.
For the 4CH model, select from CH1 to CH4 and MATH1 to MATH8.

2.8.9.2 Slope

Input method: Combo box with icon

List: Select from Rise / Fall.

2.8.9.3 Level

Input method: Numeric Input Box. Setting range: 10 to 90%, resolution: 1%
Input method: Combo box with icon
List: Select from Peak-Peak / Top-Base.

■ How to set Level

2.8.9 Type_Phase (%) sets the measurement point (Level) from the ratio of Peak-Peak or Top-Base waveform.
2.8.10 Type_Phase (Level) sets the measurement point (Level) by voltage.
The measurement result displays the ratio of the phase difference to one cycle. Select the unit from Degree, Radian and%.

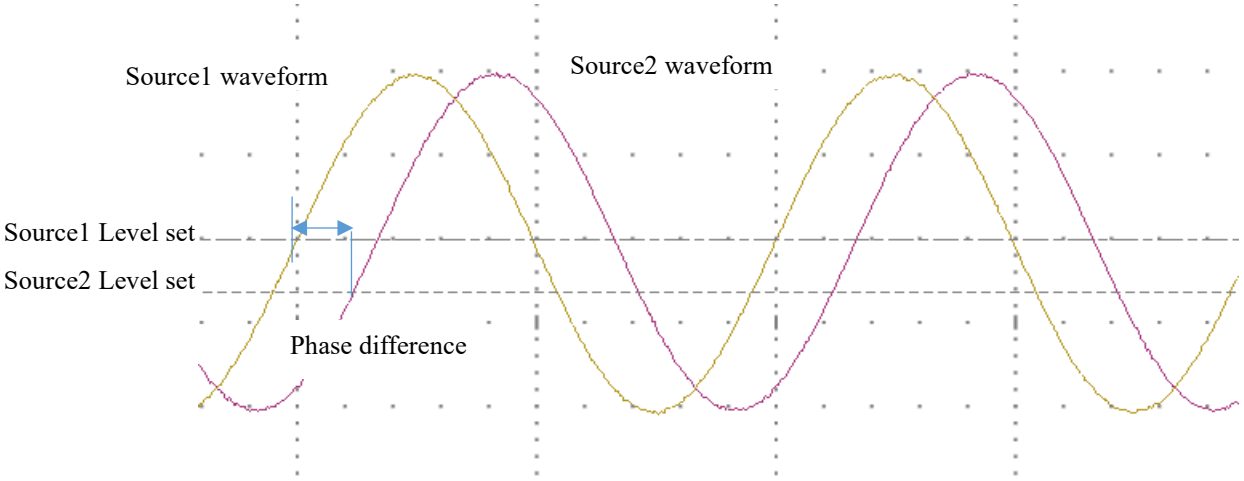


Figure 2.80 Level setting in Phase measurement

2.8.9.4 Source2

Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and MATH1 to MATH8.
For the 4CH model, select from CH1 to CH4 and MATH1 to MATH8.

2.8.9.5 Slope

Input method: Combo box with icon
List: Select from Rise / Fall.

2.8.9.6 Level

Input method: Numeric Input Box. Setting range 10 to 90%, resolution: 1%
Work with list selection of the label 2.8.9.3 Level.

2.8.9.7 Unit

Input method: Combo box
List: select from Degrees / Radians / Percent.

2.8.10 Type_Phase (Level)

Measure the phase difference between waveform Source1 and waveform Source2.
The measurement point is set by the voltage level of the measurement waveform. See Figure 2.80.
The case where Type is Phase (Level) is explained in the setting window in Figure 2.81.

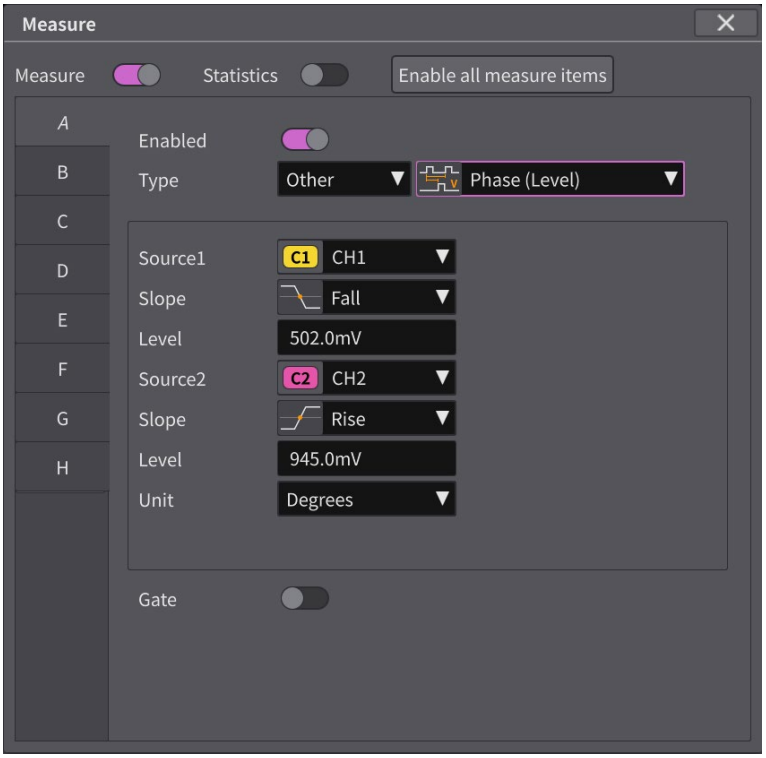


Figure 2.81 Settings Window when the Phase (Level) is selected as the Measure Type.

2.8.10.1 Source1

Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and MATH1 to MATH8.
For the 4CH model, select from CH1 to CH4 and MATH1 to MATH8.

2.8.10.2 Slope

Input method: Combo box with icon
List: Select from Rise / Fall.

2.8.10.3 Level

Enter the measurement point of Source2 as a voltage value.
Input method: Numeric input box

2.8.10.4 Source2

Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and MATH1 to MATH8.
For the 4CH model, select from CH1 to CH4 and MATH1 to MATH8.

2.8.10.5 Slope

Input method: Combo box with icon
List: Select from Rise / Fall.

2.8.10.6 Level

Enter the measurement point of Source2 as a voltage value.
Input method: Numeric input box

2.8.10.7 Unit

Input method: Combo box
List: select from Degrees / Radians / Percent.

2.9 Pass/Fail Operation and Settings

- Select Pass/Fail from the menu window and set up the Pass/Fail window.
- Tap the Pass/Fail column in the Measure List to display the Pass/Fail window.

2.9.1 Pass/Fail Window

The Pass/Fail window evaluates the measurement results of Measure, makes an overall pass/fail judgment, and displays the results in the Measure list. Based on the results of the pass/fail judgment, the processing specified by the Actions is executed. The structure of the pass/fail judgment is shown in Figure 2.82. Set the Condition and Pass if in the Judgment tab, and set the Actions in the Actions tab.

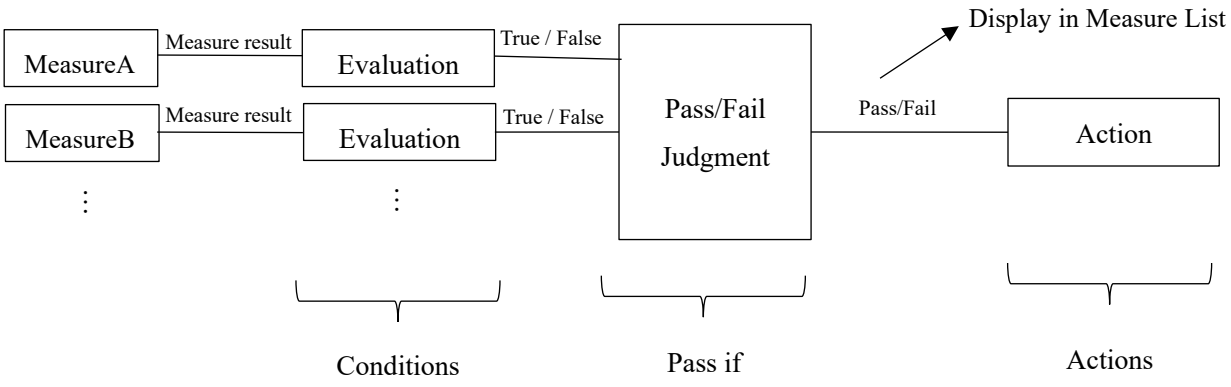


Figure 2.82 The structure of Pass/Fail

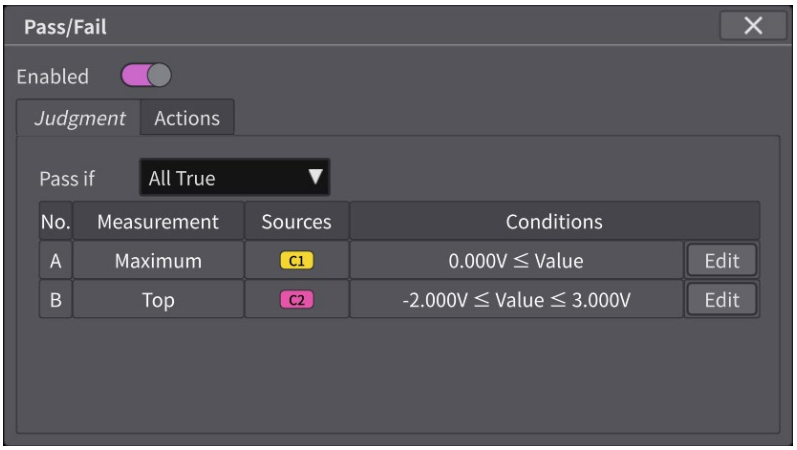


Figure 2.83 Pass/Fail window (Judgment tab)

2.9.1.1 Enabled

Enables/disables the pass/fail judgment.
Input method: Toggle switch

2.9.2 Judgment Tab

The Judgment tab is used to set the evaluation conditions for each measurement and the conditions under which the pass/fail judgment result will be passed.

2.9.2.1 Pass if

Sets the conditions under which the pass/fail judgment result will pass. Depending on the selection, the result will be Pass as shown in Table 2.33.
Input method: Combo box
List: All True/All False/Any True/Any False

Table 2.33 Pass if selection details

Selection	Conditions for Pass/Fail judgment result to be Pass
All True	When all evaluation results are True
All False	When all evaluation results are False
Any True	When at least one evaluation result is True
Any False	When at least one evaluation result is False

2.9.2.2 Edit

Set the evaluation conditions for each measurement. Tap the Edit button of the measurement for which you want to set the evaluation condition. The Edit condition window will appear as shown in Figure 2.84. Edit the evaluation condition in this window.

Input method: button

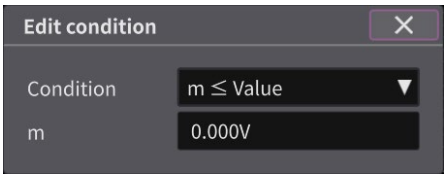


Figure 2.84 Edit condition window

2.9.2.3 Condition

The Edit condition window is used to set the evaluation condition.

Input method: combo box

List: Select from None / m≤Value / Value≤m / m≤Value≤n / Value≤m, n≤Value Set

2.9.2.4 m

Set the value of m for the evaluation condition selected in Condition.

Input method: Numeric input box

2.9.2.5 n

Sets the value of n for the evaluation condition selected under Condition, which can be set only when Condition is set to m ≤ Value ≤ n or Value ≤ m, n ≤ Value.

Input method: Numeric input box

2.9.3 Actions Tab

The Actions tab is used to set the process to be executed according to the pass/fail judgment result. Depending on the process you wish to execute, select the respective action as shown in Table 2.34. Tap the Configure button (if available) to configure the details of the process to be executed.

Actions are not available when Sample mode is Sequence or Acquisition mode is Average.

Figure 2.85 Pass/Fail window (Actions tab)

Table 2.34 What action is selected and what is to be executed

Selection	Process to be executed
Not executed	Not executed.
Result is Pass	Execute when the result of Pass/Fail judgment is Pass.
Result is Fail	Execute when the result of Pass/Fail judgment is Fail.
Any Results	Execute when the result of Pass/Fail judgment is "Pass" or "Fail".

2.9.3.1 Stop sweep

Sets the condition to stop waveform acquisition.

Input method: Combo box

List: Not executed / Result is Pass / Result is Fail

2.9.3.2 Save hardcopy

Sets the condition for saving the hardcopy.

Input method: Combo box

List: Not Executed / Result is Pass / Result is Fail / Any Results.

2.9.3.3 Save waveform

Sets the conditions for saving the waveform.

Input method: Combo box

List: Not Executed / Result is Pass / Result is Fail / Any Results

2.9.3.4 Save setup

Sets the conditions for saving the setup.

Entry method: Combo box

List: Not Executed / Result is Pass / Result is Fail / Any Results

2.9.3.5 Output pulse (AUX OUT)

Sets the condition for outputting pulses from the AUX OUT terminal. If the setting cannot be set other than Not executed, set 2.6.7.3 AUX OUT to Pass/Fail output.

When the external trigger DS-601 (DS8K EXT-TRIG-IN) option is installed, the AUX OUT terminal is not mounted and is always set to Not executed.

Input method: Combo box

List: Not executed / Result is Pass / Result is Fail / Any Results.

2.9.3.6 Beep

Sets the condition for beep.

Input method: Combo box

List: Not Executed / Result is Pass / Result is Fail / Any Results.

2.10 Waveform Math Operation and Settings

- Select Math from the MENU Window and set it in the Math Window.
- Also tap the Math Readout to display the Math Window.

2.10.1 Math Window

Eight types of math waveforms can be displayed. Select Math1 to Math8 on the vertical tab, then select the horizontal tab with the label name related to what you want to set and set it from the settings window.

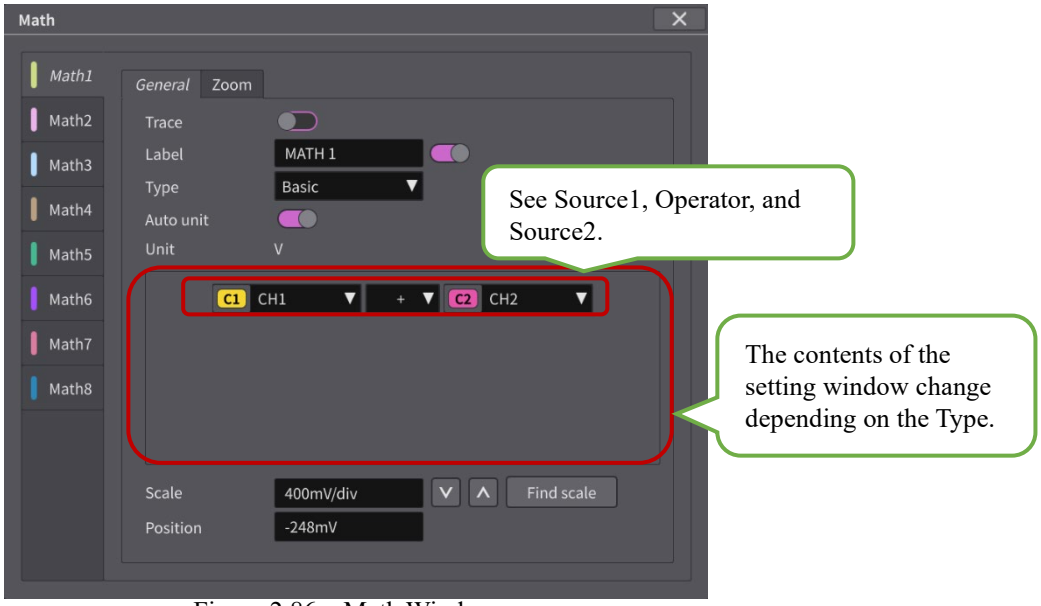


Figure 2.86 Math Window

2.10.1.1 Math settings

Select the Math waveform from Math1 to Math8 on the Vertical tab.

2.10.1.2 Math_General

Select General / Zoom on the Horizontal tab.
Figure 2.86 shows the Settings Window when General is selected on the Horizontal tab.

2.10.1.3 Trace

Set the Math waveform ON / OFF.
Input method: Toggle switch

2.10.1.4 Label

Set the character string to be displayed around the Math waveform, and set the display ON / OFF.
Input method: Character string input box
Input method: Toggle switch

2.10.1.5 Type_Basic

Select the Math Type.
Input method: Combo box
List: Select from Basic / Absolute / Invert / Integral / Derivative / Memory / FFT / SMA.

Figure 2.86 shows the Settings Window when Basic is selected.
When you selected Absolute / Invert / Integral / Derivative, see 2.10.2 Type_Absolute.
When you selected Memory, see 2.10.3 Type_Memory.
When you selected FFT, see 2.10.4 Type_FFT.
When you selected SMA [Simple Moving Average], see 2.10.5 Type_SMA.

2.10.1.6 Auto unit

Set the unit for selected math operation automatically by software.
Input method: Toggle switch

2.10.1.7 Unit

This indicates math unit. When Auto unit setting is Off, you can set letters by maximum 3 letters.
Input method: String Input Box

2.10.1.8 Source1

Specify the channel to calculate.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math8.
Refer to 2.10.7 The selection condition for Math source.

2.10.1.9 Operator

Specify the Math operator.
Input method: Combo box
List: Select from + / - / × / ÷.

2.10.1.10 Source2

Specify the channel to calculate.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math8.
Refer to 2.10.7 The selection condition for Math source.

2.10.1.11 Scale

Set the scale of the vertical axis of Math.
Input method: Numeric Input Box (with Up / Down button)

2.10.1.12 Find scale

The scale of the vertical axis of Math is automatically set.
Input method: Button

2.10.1.13 Position

Set the display position in the vertical direction of Math.
Input method: Numeric Input Box

2.10.2 Type_Absolute

Select the Math Type.
Input method: Combo box
List: Select from Basic / Absolute / Invert / Integral / Derivative / Memory / FFT / SMA.

Figure 2.87 shows the Math Type Settings Window when Absolute is selected.
See Table 2.35 for the operation types.

Table 2.35 Math Types

Math Type	Description
Absolute	Calculates the absolute value.
Invert	Calculates inversion.
Integral	Calculates the time integral.
Derivative	Calculates the time derivative.

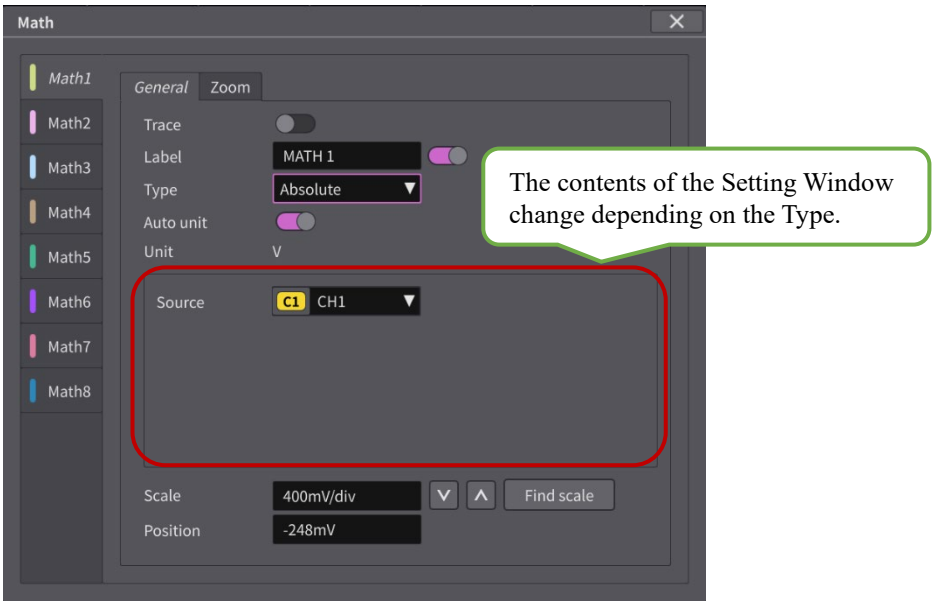


Figure 2.87 Settings Window when the Absolute is selected as the Math Type.

2.10.2.1 Source

Specify the channel to calculate.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math8.
Refer to 2.10.7 The selection condition for Math source.

2.10.3 Type_Memory

Select the type of Math.
Input method: Combo Box
List: Select from Basic / Absolute / Invert / Integral / Derivative / Memory / FFT / SMA.

The case where Memory is selected is illustrated here in the settings window shown in Figure 2.88.
Memory can copy the waveform data of the channel or Math selected in Source to the Memory waveform. When a new waveform is acquired in another channel or Math, the waveform in Memory is retained, allowing the new waveform to be compared with the previously copied waveform.

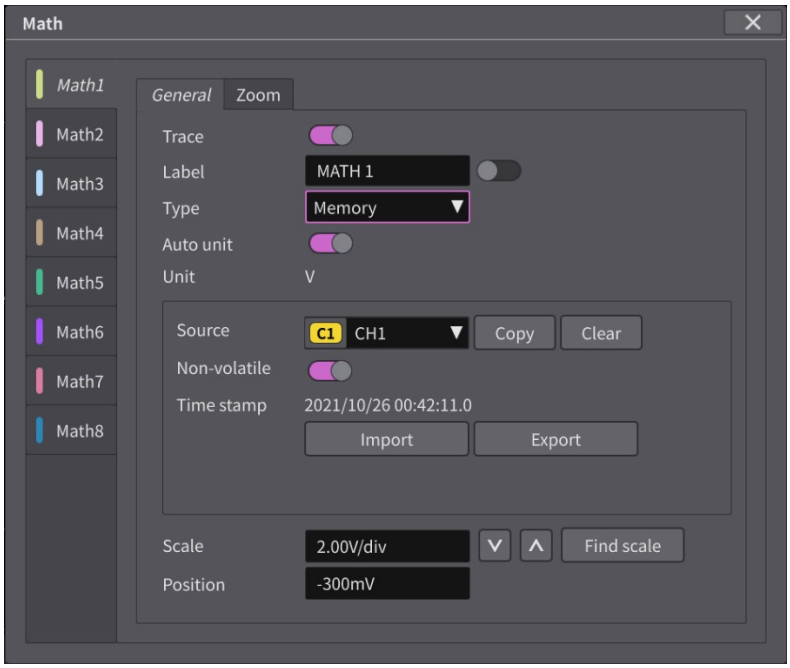


Figure 2.88 Settings Window when the Memory is selected as the Math Type.

2.10.3.1 Source

Specifies the channel or Math to copy from.
Input method: Combo box with icons
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math8.
Refer to 2.10.7 The selection condition for Math source.

2.10.3.2 Copy

Copies waveform data from the channel or Math specified in Source to Memory waveform.
Input method: button

2.10.3.3 Clear

Clear the Memory waveform.
Input method: button

2.10.3.4 Non-volatile

Sets whether waveforms are stored in non-volatile internal memory. If the waveform is saved to non-volatile internal memory, the contents of the Memory waveform are retained even when the power is turned off. If there is no space in the internal memory, it may not be possible to save the data.
Input method: Toggle switch

2.10.3.5 Time stamp

Displays the date and time when the waveform displayed in the Memory waveform was acquired.

2.10.3.6 Import

Import a memory waveform from a file. Only files saved with Export can be imported.
Input method: button

2.10.3.7 Export

Outputs the Memory waveform to a file. The file will be in proprietary format with the extension "ref". Saved files can be input with Import.
Input method: button

2.10.4 Type_FFT

Select the type of Math.
Input method: Combo box
List: Select from Basic / Absolute / Invert / Integral / Derivative / Memory / FFT / SMA.
Figure 2.89 shows the Settings Window when FFT is selected.

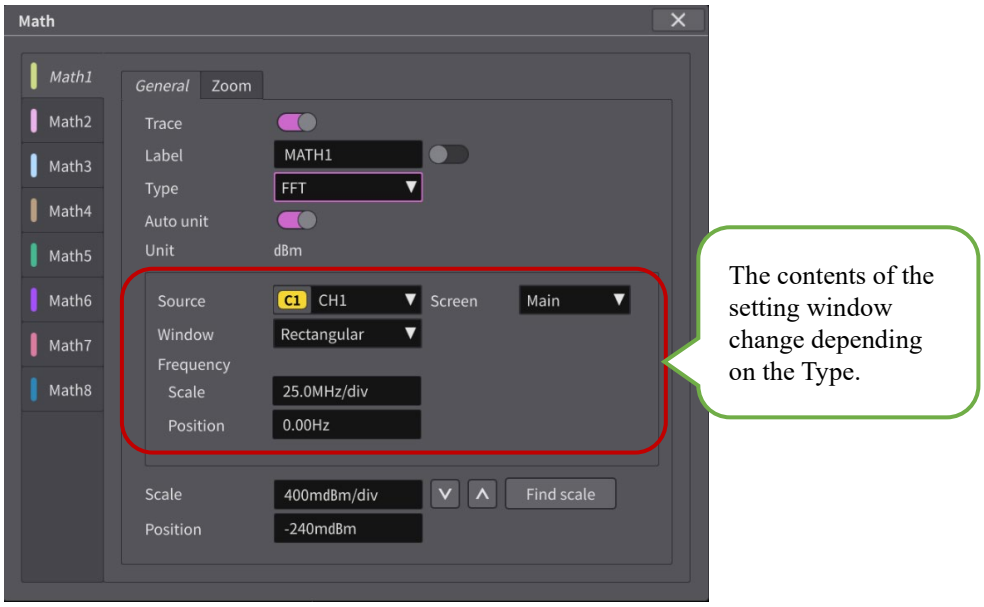


Figure 2.89 Settings Window when the FFT is selected as the Math Type.

2.10.4.1 Source

Specify the channel for FFT calculation. The maximum memory length of a waveform that can be input is 1.5 M points; if the waveform exceeds 1.5 M points, the message “The maximum memory length of FFT is 1.5 M points”.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math8.
Refer to 2.10.7 The selection condition for Math source.

2.10.4.2 Screen

Specifies the screen that is the input for the FFT operation. The result of the FFT operation on the waveform of the specified screen is displayed on the Main screen.
Input method: Combo box
List: Select from Main / Zoom1 / Zoom2.
Zoom1 and Zoom2 can be selected when the Zoom1 and Zoom2 screens are displayed, respectively.

2.10.4.3 Window

Specify the window for FFT calculation.
Combo box with icon
List: Select from Rectangular / VonHann / Flat Top.
See Table 2.36 Window functions

Table 2.36 Window functions

Window function	Description
Rectangular	It is suitable for analysis of transient phenomena such as burst waveforms in which waveforms are continuous before and after the calculation range.
VonHann	Suitable for frequency analysis of repetitive waveforms.
Flat Top	Suitable for amplitude analysis of repetitive waveforms.

2.10.4.4 Frequency

■ Scale

Specify the scale of the frequency axis.
The unit of the Numeric Input Box is Hz.

■ Position

Specify the position of the frequency axis.
The unit of the Numeric Input Box is Hz.

When displaying the FFT waveform, when it contains a frequency component higher than 1/2 of the data sampling rate (Nyquist frequency), aliasing will occur and it will be displayed as a waveform with a lower frequency component than it actually is.

Memo: Prevention of aliasing
How to prevent aliasing:
・ Increase the sampling rate.
a) Increase the maximum memory length.
b) With the Horizontal axis (YT) waveform displayed, turn the Time / div Knob clockwise to increase the sampling rate.
・ Remove components above the Nyquist frequency from the observation signal.
c) Remove high frequency components with Bandwidth, Coupling in the Channels Window and Coupling in the Trigger Window.

2.10.4.5 Scale

Set the scale of the vertical axis of the FFT.
The energy (power) for each signal frequency component is displayed in dBm on the vertical axis.
dBm is a voltage (0.316 Vpk / 0.224 Vrms) equivalent to 1 mW with a 50 Ω load.
Input method: Numeric Input Box (with Up / Down button)

2.10.4.6 Find scale

The scale of the vertical axis of the FFT is automatically set.
Input method: Button

2.10.4.7 Position

Set the display position in the vertical direction of the FFT.
Input method: Numeric Input Box

2.10.5 TYP_SMA [Simple Moving Average]

Select the type of Math.
Input method: Combo box
List: Select from Basic / Absolute / Invert / Integral / Derivative / Memory / FFT / SMA.

The case where SMA is selected is explained in the Setting Window of Figure 2.90.
Performs SMA [Simple Moving Average] calculation, which is a simple moving average.

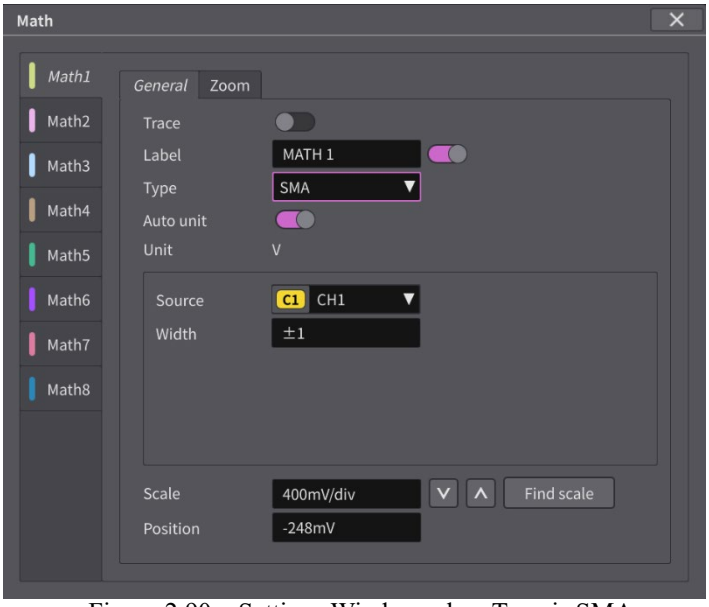


Figure 2.90 Settings Window when Type is SMA

2.10.5.1 Source

Specify the channel source for SMA calculation
Input method: Combo box with icon
List: For the 8CH model, select from CH1 to CH8 and Math1 to Math8.
For the 4CH model, select from CH1 to CH4 and Math1 to Math8.
Refer to 2.10.7 The selection condition for Math source.

2.10.5.2 Width

Performs a simple moving average operation.
Specify the number of points for averaging from ±1 to ±128 points. When specified with ±N points, averaging is performed at 2N + 1 points centered on the sampling point.
Input method: Numeric input box / (1) Knob Range: ±1 to ±128

■ SMA [Simple Moving Average] Restrictions

When the Width setting is ± N, SMA calculation is performed assuming that there are N data at the left end of the operation target channel before the left end. Similarly, after the rightmost data of the operation target channel, SMA [Simple Moving Average] calculation is performed assuming that there are N rightmost data.
When the number of waveform data is less than 2N, the Width is internally rounded within the number of waveform data and the SMA [simple moving average] operation is performed

2.10.6 Math_Zoom

Select General / Zoom on the Horizontal tab.
Select Zoom on the Horizontal tab to display the Zoom-related Settings Window.

Figure 2.91 shows the Settings Window when Zoom is selected on the Horizontal tab.

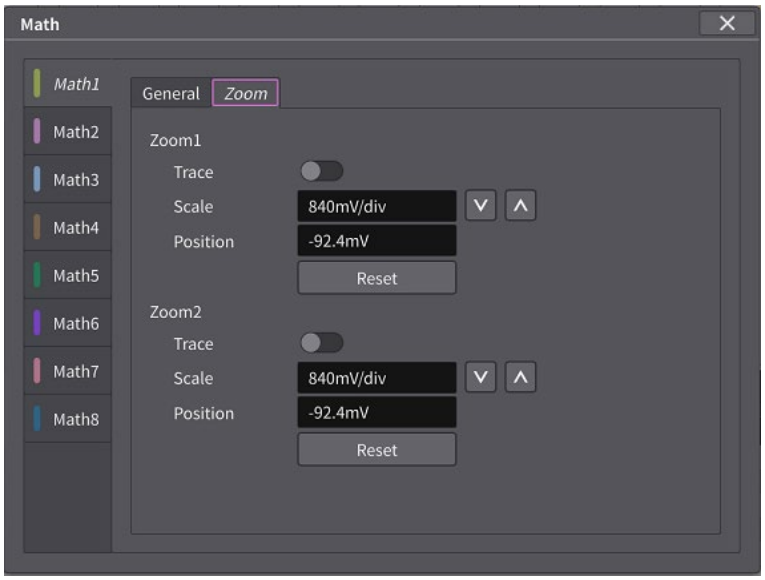


Figure 2.91 Settings Window when Zoom is selected on the Horizontal tab

2.10.6.1 Zoom1 / Zoom2_Trace

Set the Zoom1 / Zoom2 waveform ON / OFF.
Input method: Toggle switch

2.10.6.2 Zoom1 / Zoom2_Scale

Set the scale of vertical axis of Zoom1 / Zoom2.
Scale cannot be changed if 2.1.5.2 or 2.1.6.2 Enable vertical zoom is disabled.
Input method: Numeric Input Box (with Up / Down button)

2.10.6.3 Zoom1 / Zoom2_Position

Set the vertical zoom position of Zoom1 / Zoom2.
Position cannot be changed if 2.1.5.2 or 2.1.6.2 Enable vertical zoom is disabled.
Input method: Numeric Input Box

2.10.6.4 Zoom1 / Zoom2_Reset

Set Scale and Position to the same magnification and screen center as the main screen, respectively..
Reset cannot be executed if 2.1.5.2 or 2.1.6.2 Enable vertical zoom is disabled.
Input method: Button

2.10.7 The selection condition for Math source

There are restrictions to select math source as follows.

- You can’t select self-math number as a source math number.
- You can select math number of which source is set to math, but no operation is performed.
- You can select math number of which Type is set to Memory or FFT, but no operation is performed.
- Math unit is not indicated when Auto unit setting is On.

2.11 Waveform Data Search

■ Select Search from the MENU Window and set the search conditions from the Settings Window.

This function searches for the next position in the waveform (page) displayed on the screen. The maximum number of searches is 40,000.

Search results are displayed as markers at the top of waveform display area and the list table. The marker for Bus decoding results and the marker for Search results cannot be displayed at the same time.

■ Waveform data search is possible not only on the Main Screen but also on Zoom Screens 1 and 2.

2.11.1 Search Window

In the Search Window, set the search criteria.

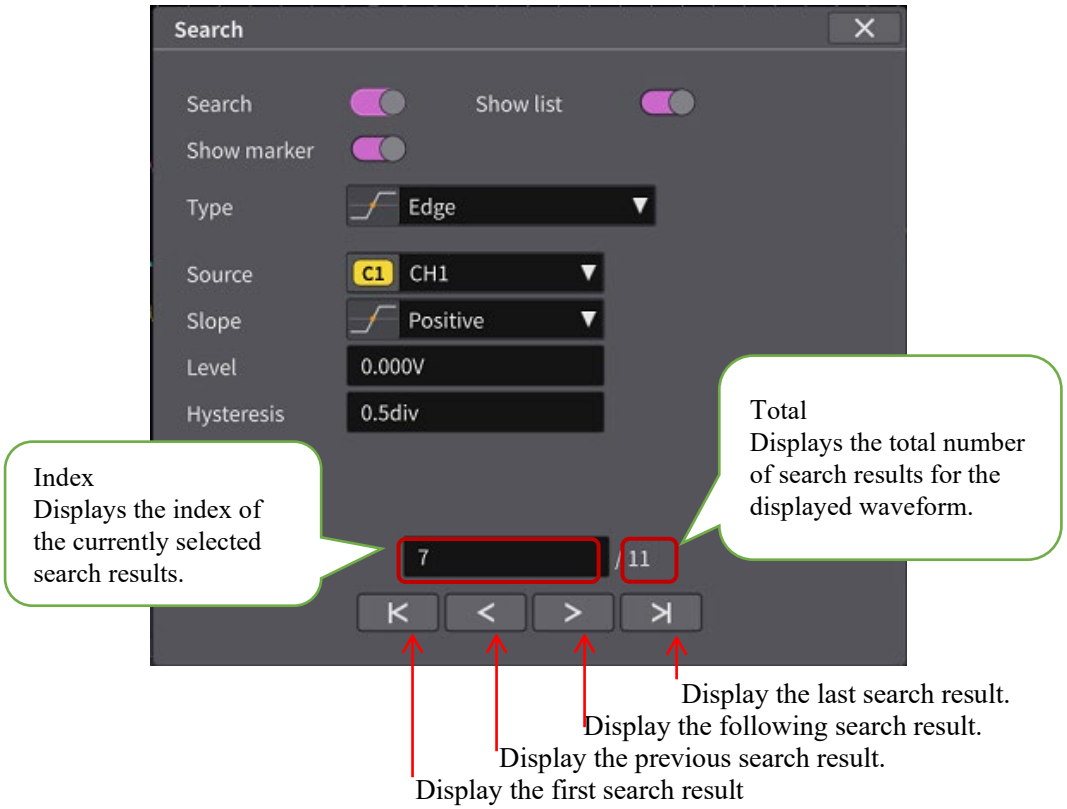


Figure 2.92 Search Window

2.11.1.1 Search

Set whether to execute Search.
Input method: Toggle switch

2.11.1.2 Show list

Set whether to display the Search list table.
Input method: Toggle switch

2.11.1.3 Show marker

Set whether to display the marker at the position of the search result.
Input method: Toggle switch

2.11.1.4 Type

Specify the search target. The items of the Settings Window change depending on the type of measurement type.
Input method: Combo box with icon
List: select from Edge / Cyclic RMS / Cyclic Mean / Frequency / Period / Pulse Width / Duty Cycle / Transition Time

・The case where Edge is selected is explained in the Settings Window of Figure 2.92. When Edge is selected, the search target is the positive and negative edge search of the waveform.
・When the list selection is Cyclic RMS / Cyclic Mean / Frequency / Period / Duty Cycle /, it will be explained in the Settings Window of Figure 2.96.
・When the list selection is Pulse Width, it will be explained in the Settings Window in Figure 2.97.

・When the list selection is Transition Time, it is described in the Settings Window in Figure 2.98.

2.11.1.5 Source

Specify CHx (Waveform) to search for edges.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.11.1.6 Slope

Specify the slope of the edge to search.
Input method: Combo box
List: Select from Positive / Negative

2.11.1.7 Level

Specify the level of edges to search.
Input method: Numeric Input Box / Operation Panel (1) Knob

2.11.1.8 Hysteresis

Specify the hysteresis of the edge to search.
Hysteresis sets the width to ignore fluctuations in the waveform data. This is useful for searching for noisy signal waveforms.
Input method: Numeric Input Box / Operation Panel (1) Knob Setting range 0.1to2.0div, Resolution: 0.1div

2.11.1.9 Index

Displays the index of the currently selected search results.
Change the index value.
Input method: Numeric Input Box / Operation Panel (1) Knob

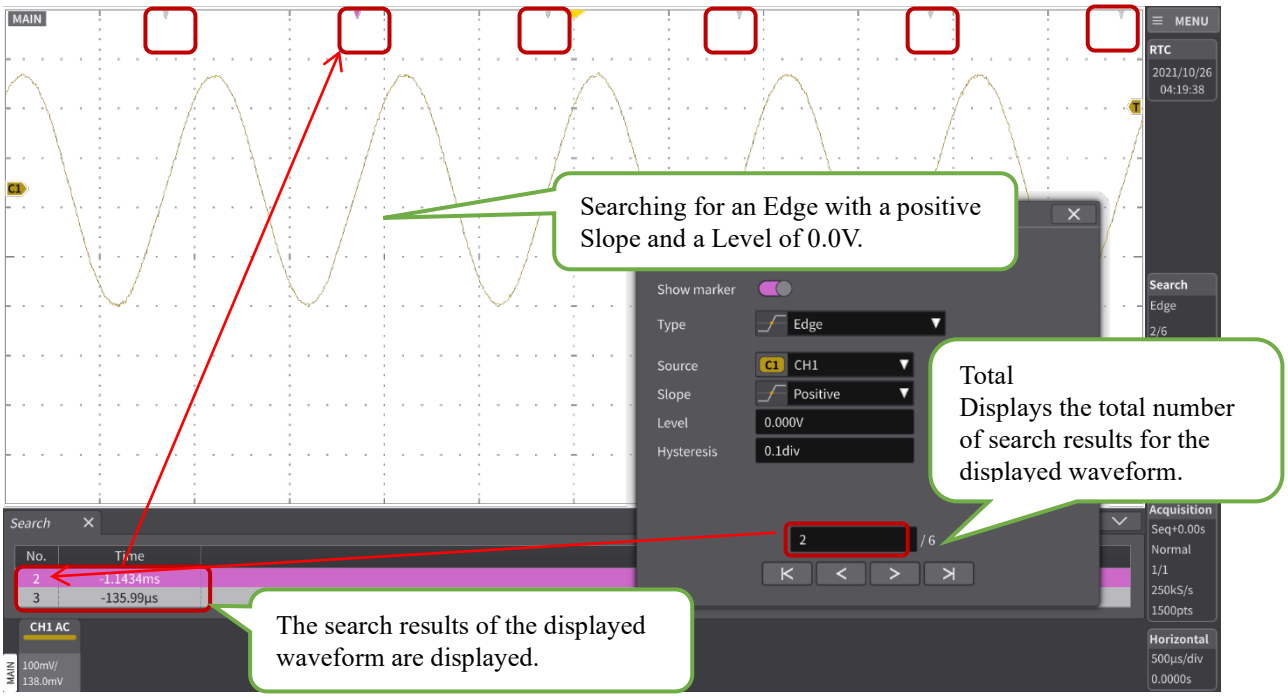
Operations with the previous and next buttons of SEARCH / HISTORY on the operation panel must be set to Search with 2.6.4.6 Priority function to assign to button in advance.

2.11.1.10 Total

Displays the total number of waveform search results.
Display with label

■ An example search result is shown in Figure 2.93.

Condition
Type: Edge
Source: CH1
Slope: Positive
Level: 0.000V



Results
Total number of searches: 6
The displayed result is the second

Figure 2.93 Search result display example

Figure 2.94 shows an example of searching for Index 21 on the Main screen and the display position of the Zoom screen. Figure 2.95 shows an example of searching Index 32 on the Search readout. The search point moves on the Main screen, but is always centered on the Zoom screen. In the example, it is ZOOM1, but when ZOOM2 is selected, it is displayed in the center of the ZOOM2 screen.

■ Index 21 search example display position on the Main screen and Zoom screen display the position

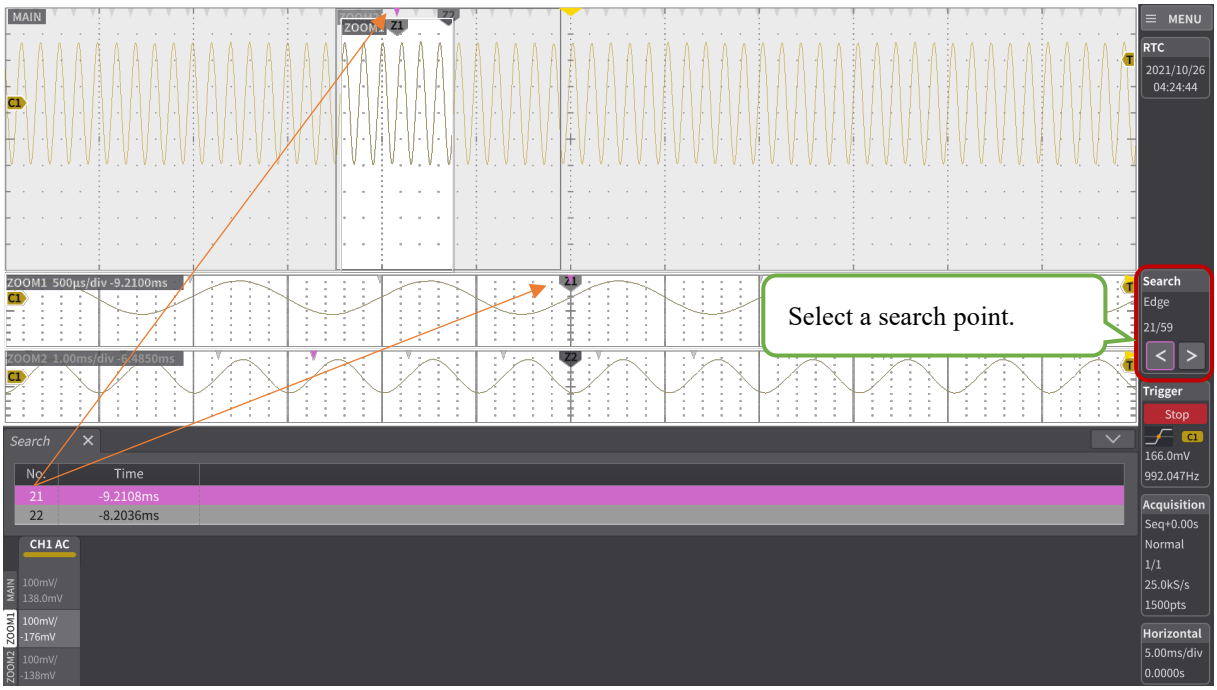


Figure 2.94 Index 21 search example on the Main screen

■ Index 32 search example display position on the Main screen and Zoom screen display the position

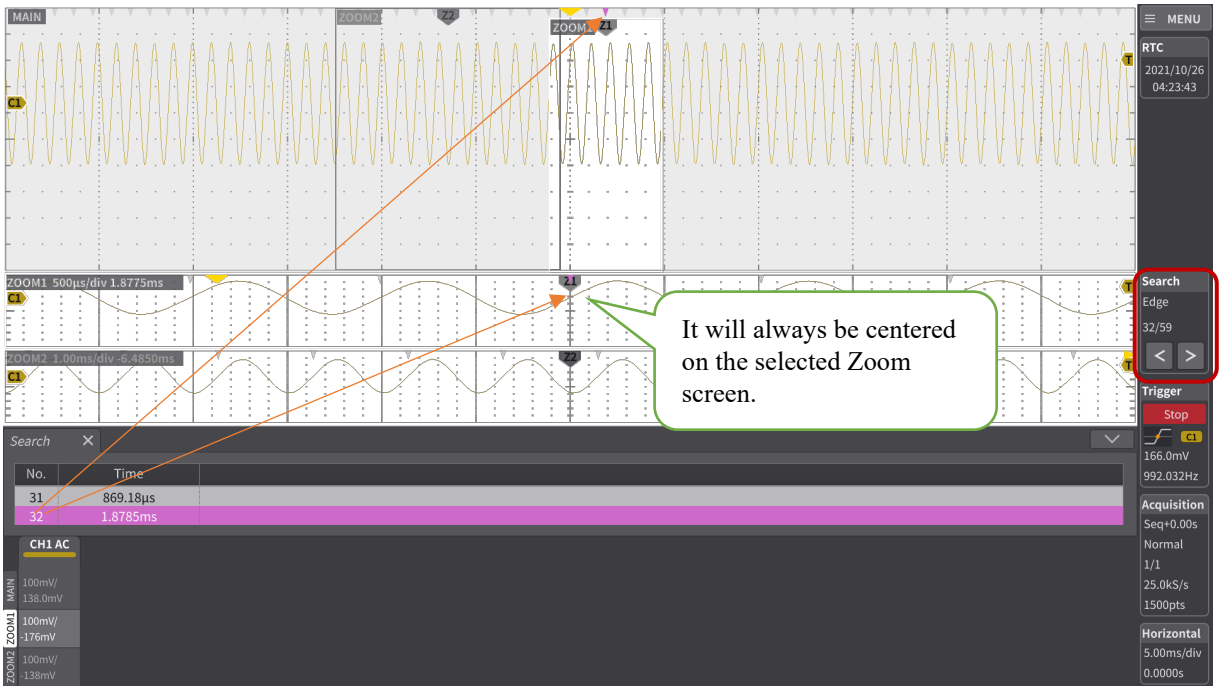


Figure 2.95 Index 32 search example on the Main screen

2.11.2 Type_Cyclic RMS

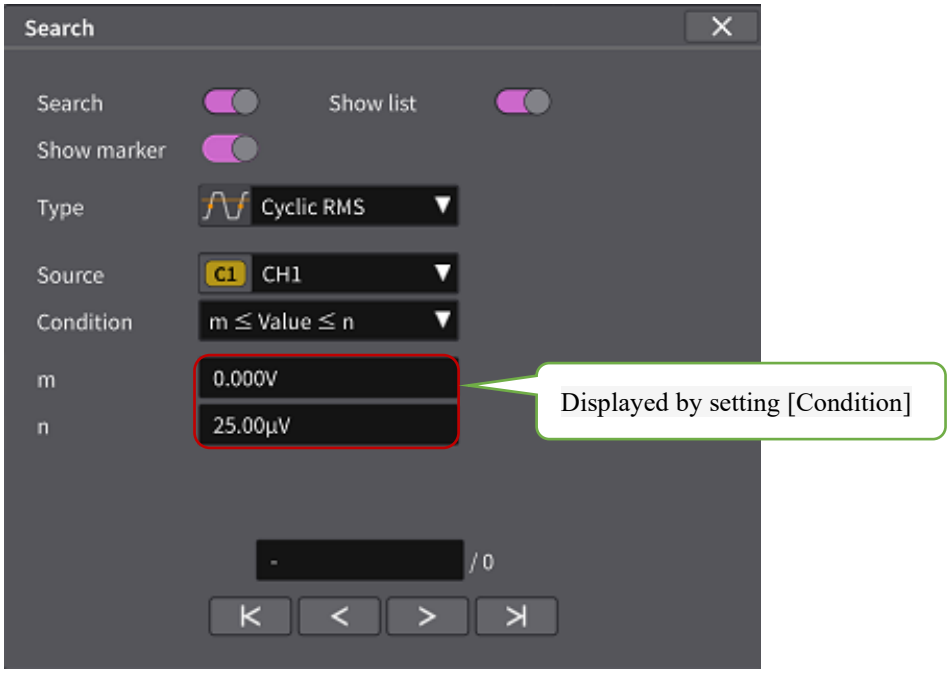


Figure 2.96 Settings Window when the Cyclic RMS is selected as the Search Type

2.11.2.1 Type

Input method: Combo box with icon
List: Select from Cyclic RMS / Cyclic Mean / Frequency / Period / Duty Cycle

Depending on the type, the search target and conditions are shown in Table 2.37 and Table 2.38.

Table 2.37 Search type and search target

Type	Search target
Cyclic RMS	Position where the effective value for one cycle becomes the specified value
Cyclic Mean	Position where the average value for one cycle becomes the specified value
Frequency	The position where the frequency becomes the specified value
Period	Position where the period becomes the specified value
Pulse Width	The position where the pulse width becomes the specified value
Duty Cycle	Position where the duty ratio becomes the specified value

Table 2.38 Search type and search conditions

Type	search conditions	Remarks
Cyclic RMS Cyclic Mean Frequency Period Pulse Width Duty Cycle	Specify with Source and one of the following。 All values m≦values Values≦m m≦values≦n Values≦m, n≦values	Equivalent to Measure.

2.11.2.2 Source

Specify CHx (Waveform) to search
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.11.2.3 Condition

Specify the search conditions.
Input method: Combo box
List: Select from Any values / m≦Value / Value≦m / m≦Value≦n / Value≦m, n≦Value

2.11.2.4 m

Specify the m value of the search condition.
The unit is displayed according to the Type.
Input method: Numeric Input Box / Operation Panel (1) Knob

2.11.2.5 n

Specify the n value of the search condition.
The unit is displayed according to the Type.
Input method: Numeric Input Box / Operation Panel (1) Knob

2.11.3 Type_Pulse Width

The search target is the position where the pulse width becomes the specified value.

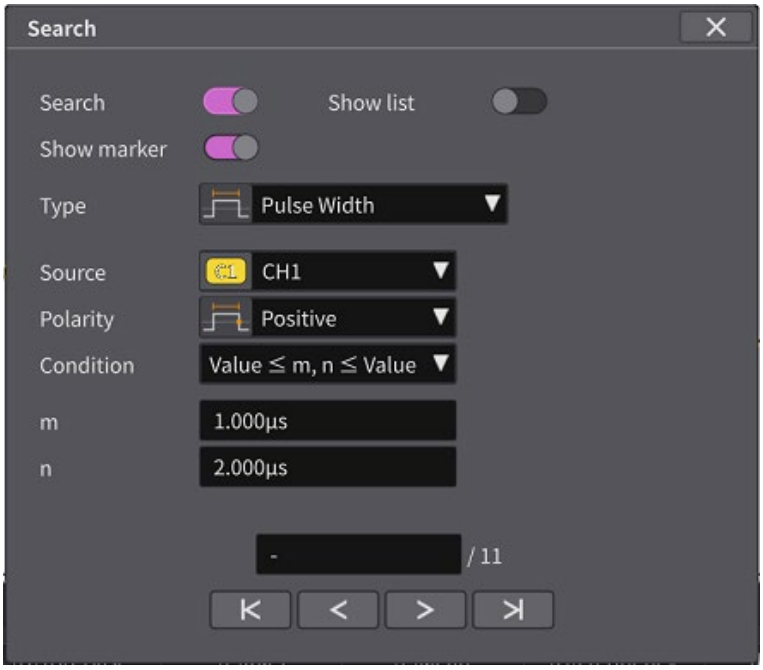


Figure 2.97 Settings Window when the Pulse Width is selected as the Search Type.

2.11.3.1 Polarity

Specify the polarity.
Input method: Combo box
List: Select from Positive / Negative

2.11.3.2 Condition

Specify the search conditions
Input method: Combo box
List: Select from Any values / m≦Value / Value≦m / m≦Value≦n / Value≦m, n≦Value

2.11.3.3 m

Specify the m value of the search condition
Input method: Numeric Input Box / Operation Panel (1) Knob Setting range: -999 to 999 pV to TV (for voltage)

2.11.3.4 n

Specify the n value of the search condition
Input method: Numeric Input Box / Operation Panel (1) Knob Setting range: -999 to 999 pV to TV (for voltage)

2.11.4 Type_Transition Time

The search target is the position where the rising and falling times of the waveform reach the specified value.

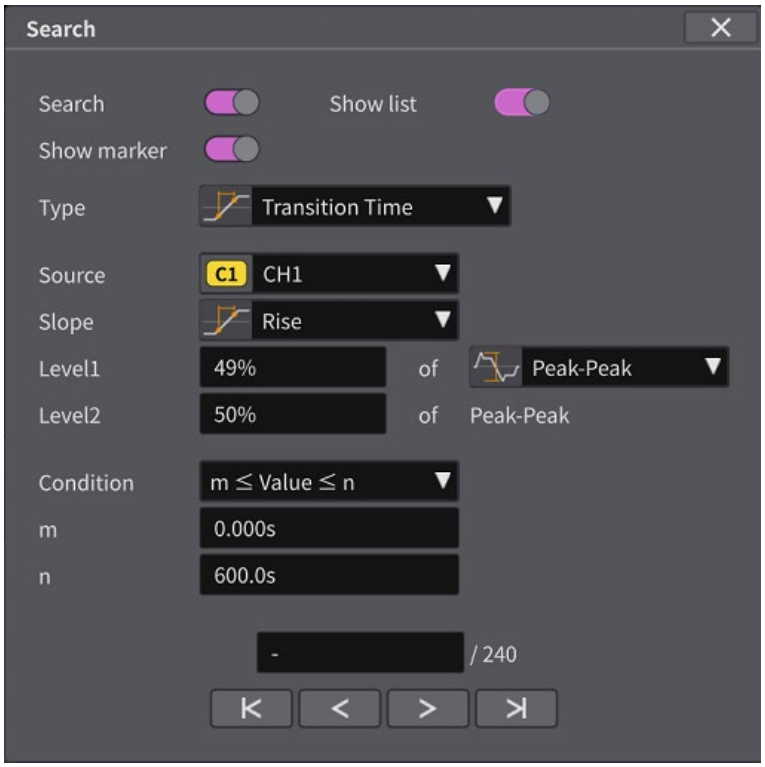


Figure 2.98 Settings Window when the Transition Time is selected as the Search Type.

2.11.4.1 Source

Specify CHx (Waveform) to search
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.11.4.2 Slope

Specify the slope of the edge to search.
Input method: Combo box
List: Select from Rise / Fall

2.11.4.3 Level1

Specify the rise or fall detection start level in percent. The basis for this percentage level is the Peak-Peak or Top-Base of the waveform.
Input method: Numeric Input Box / Operation Panel (1) Knob Setting range: 10 to 89%, Resolution: 1%
Input method: Combo box
List: select from Peak-Peak / Top-Base

2.11.4.4 Level2

Specify the rise or fall detection start level in percent. This percentage criterion works with Level1.
Input method: Numeric Input Box / Operation Panel (1) Knob Setting range: 11 to 90%, Resolution: 1%
Display: Label
Works with Level1.

2.11.4.5 Condition

Specify the search conditions
Input method: Combo box
List: Select from Any values / m≦Value / Value≦m / m≦Value≦n / Value≦m, n≦Value

2.11.4.6 m

Specify the m value of the search condition
Input method: Numeric Input Box / Operation Panel (1) Knob Setting range: -999 to 999 pV to TV (for voltage)

2.11.4.7 n

Specify the n value of the search condition
Input method: Numeric Input Box / Operation Panel (1) Knob Setting range: -999 to 999 pV to TV (for voltage)

2.12 Waveform Data Processing and Settings

- Select Save/Recall from the MENU Window and set in the Save/Recall Window.

2.12.1 Save/Recall Window

Describes how to set up and handle internal memory, files, and hard copy.
Select the relevant Horizontal tab and set from the Settings Window.

- In the Horizontal tab_Internal memory Settings Window, you can save the settings of the Oscilloscope in the internal memory, or recall from in the internal memory. Select the Setup 1 to 5 on the vertical tab.
- In the Horizontal tab_Setup Settings Window, you can set the save / recall of the setting data of the Oscilloscope to the internal storage and external storage.
- In the Horizontal tab_Waveform Settings Window, you can set the save / recall of the waveform data of the Oscilloscope to the internal storage and external storage.
- In the Horizontal tab_Hardcopy Settings Window, you can set the save / recall of the screen image of the Oscilloscope to the internal storage and external storage.

2.12.2 Save/Recall_Internal memory

Select Internal memory / File / Hardcopy on the Horizontal tab.
Select File on the Horizontal tab to display the Internal memory -related Settings Window.

This is explained in the Settings Window shown in Figure 2.99 when Internal memory is selected on the Horizontal tab.

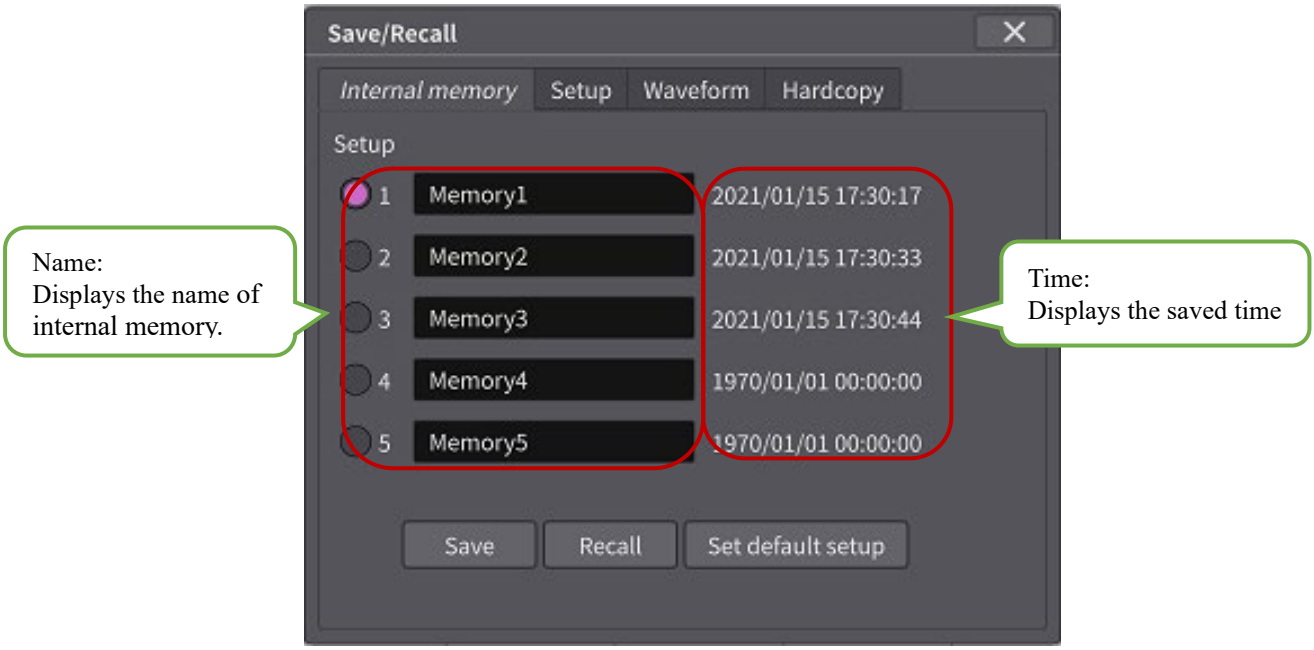


Figure 2.99 Save/Recall Window

2.12.2.1 Setup

Save the Oscilloscope settings in Internal memory (Setup 1 to Setup 5) as the save destination / caller.
Select on the vertical tab.
Input method: Radio button
The case where Setup 1 is selected is explained below from the Settings Window shown in Figure 2.99.

2.12.2.2 Name

Set the name.
Input method: Character string input box

2.12.2.3 Time
Displays the saved time.
Display: Label

2.12.2.4 Save
Save to Setup 1 in internal memory.
Input method: Button

2.12.2.5 Recall
Recall Setup 1 from internal memory.
Input method: Button

2.12.2.6 Set default setup
Recall the default setup.
Input method: Button

2.12.3 Save/Recall_Setup
Select Internal memory / Setup / Waveform / Hardcopy on the Horizontal tab.
Select File on the Horizontal tab to display the File-related Settings Window.
Describes how to save / recall the setting data and waveform data of the Oscilloscope in the Settings Window shown in Figure 2.100 when Setup is selected on the Horizontal tab.

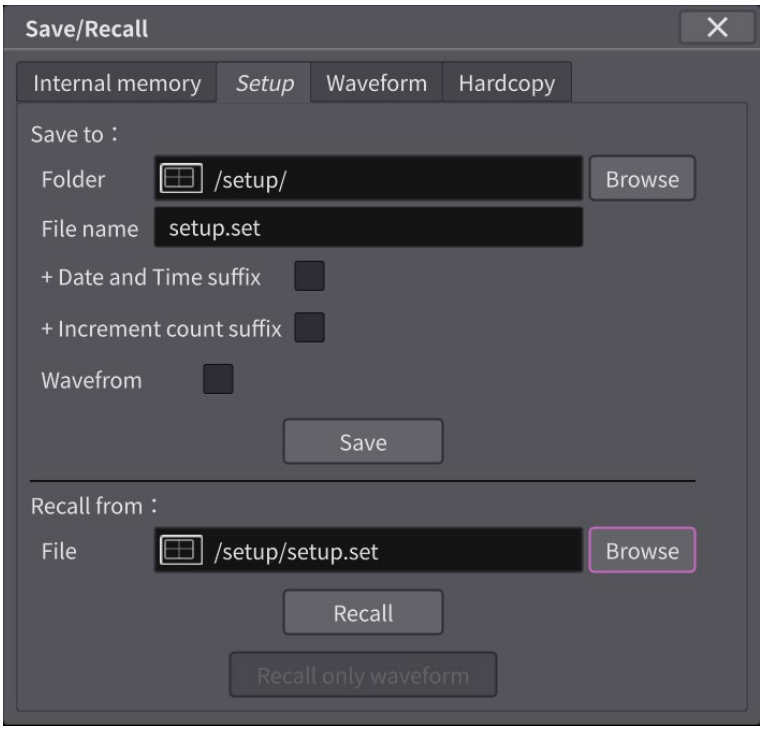


Figure 2.100 Settings Window when Setup is selected on the Horizontal tab

2.12.3.1 Save to:
Set the save destination

2.12.3.2 Folder
Selected folder name is displayed. To change the folder name, press the Browse button and select the file name from the Select Folder Dialog. The maximum number of characters for the folder name is 224 characters.

2.12.3.3 Browse

A Select Folder Dialog is displayed. Folders can be selected.
Input method: Button

Operating procedure

1. Tap the Browse button to open the Select Folder Dialog.
   Figure 2.101 shows an example of the Select Folder Dialog when a USB memory is selected.
2. In the Select Folder Dialog, select the folder to save.
3. Tap the OK button.
   In the Select Folder Dialog, you can create and delete folders.

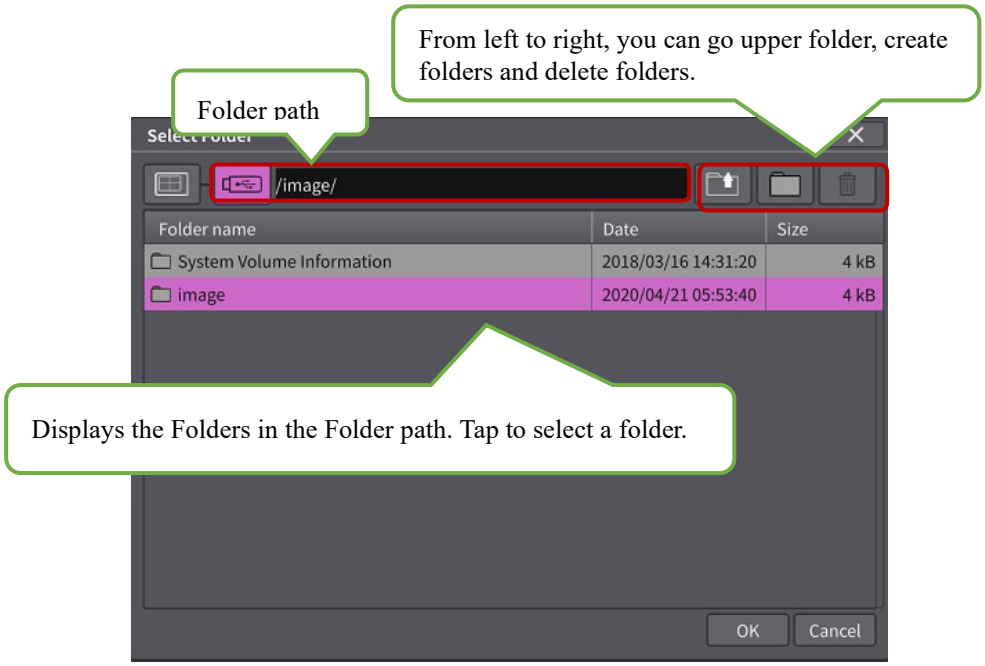


Figure 2.101 Select Folder Dialog

2.12.3.4 File name

The name of the previously saved file is displayed.
By tapping, you can enter the name of the file to save. The maximum number of characters is 32.
The 9 characters that cannot be used as a file name are ¥, /, :, *, ?, ", <, >, |.
Also, file names that start with a period (.) Cannot be used.
Input method: Character string input box

2.12.3.5 + Date and Time suffix

Set whether to add the date and time to the file name.
Input method: Check box

2.12.3.6 + Increment count suffix

This checkbox determines whether or not the file name is suffixed with a serial number. If this checkbox is checked, Count will appear as shown in Figure 2.102, Figure 2.105, and Figure 2.110.
Input method: Check box

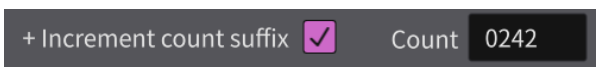


Figure 2.102 Count displayed when +Increment count suffix is turned on

2.12.3.7 Count

Sets the number to be added to the end of the file name as a serial number. This number is the same for Setup, Waveform, and Hardcopy saves. The number is added by 1 when each save is executed independently, when a save is executed by

pressing the COPY button, or when a save is executed in the Pass/Fail Actions.

2.12.3.8 Waveform

Set whether to include waveform data in the setup file. The setup file extension changes depending on the setup file type as shown in Table 2.39.
Input method: Check box

Table 2.39 Setup file type

Setup File	Extension	Description
No waveform data	SET	Various measurement conditions can be saved in a file without waveform data, and the saved file can be read.
With waveform data	WFM	Various measurement conditions can be saved in a file with waveform data, and the saved file can be read.

2.12.3.9 Save

Save the file.
Input method: Button

2.12.3.10 Recall from:

Specify the folder containing the files.

2.12.3.11 File

Shows the file to call.
Tap the Browse button on the right and select a file from the Select File Dialog.

2.12.3.12 Browse

Displays a Select File Dialog shown in Figure 2.103.
Input method: Button

Operating procedure

1. Tap the Browse button. The Select File Dialog shown in Figure 2.103 is displayed.
2. Tap and select the file displayed in the Select File Dialog.
3. The selected file name is displayed in File name.
4. Tap OK.

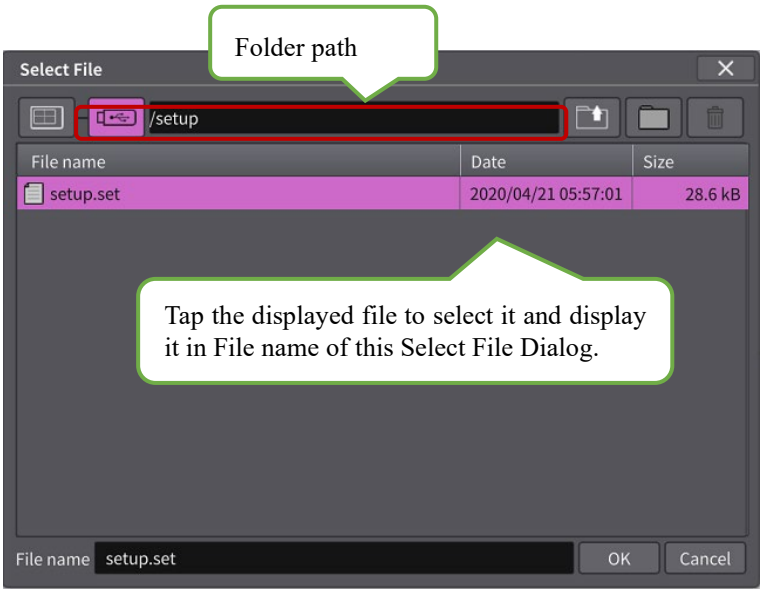


Figure 2.103 Select File Dialog

2.12.3.13 Recall

Performs a read from a file.
Input method: Button

2.12.3.14 Recall only waveform

Recalls only the waveform from the file.

Input method: Button

2.12.4 Save/Recall_Waveform

Select Internal memory / Setup / Waveform / Hardcopy on the Horizontal tab.
Explained in the setting window shown in Figure 2.104 when Waveform is selected on the horizontal tab.
This section describes how to [Save / Recall] waveform data to a file in text format or binary format.
The extension is (.csv) for text format and (.bin) for binary format.
See Appendix 4.1 for details.

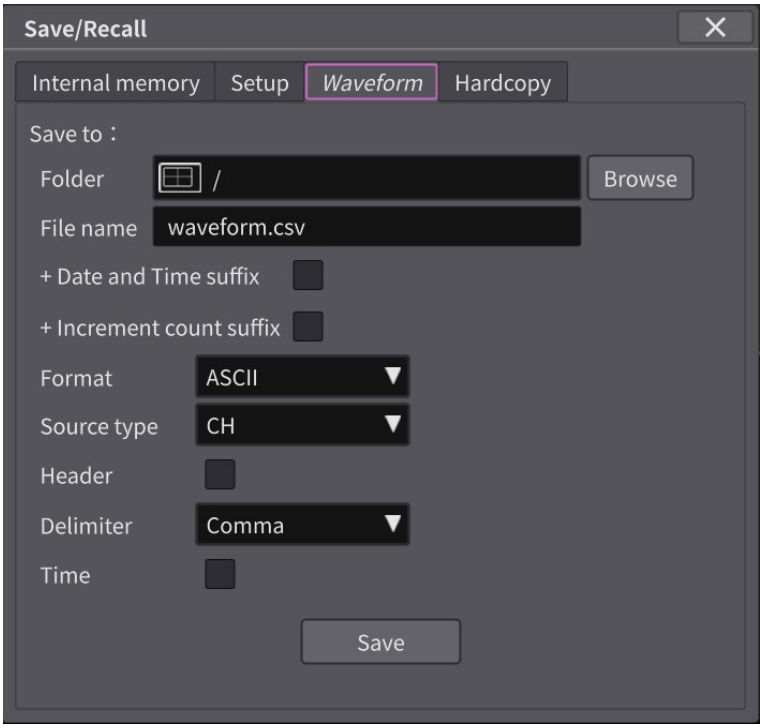


Figure 2.104 Settings Window when Waveform is selected

2.12.4.1 Save to

Set the save destination

2.12.4.2 Folder

Selected folder name is displayed.
To change the folder name, press the Browse button and select the file name from the Select Folder Dialog.

2.12.4.3 Browse

A Select Folder Dialog is displayed.
Input method: Button

2.12.4.4 File name

Tap the Browse button to display the selected file name. Or enter the file name to save.
The maximum number of characters is 32.
The 9 characters that cannot be used as a file name are ¥, /, :, *, ?, ", <, >, |.
Also, file names that start with a period (.) Cannot be used.
Input method: Character string input box

2.12.4.5 + Date and Time Suffix

Set whether to add the date and time to the file name.
Input method: Check box

2.12.4.6 + Increment count suffix

This checkbox determines whether or not the file name is suffixed with a serial number. If this checkbox is checked, Count will appear as shown in Figure 2.102, Figure 2.105, and Figure 2.110.
Input method: Check box

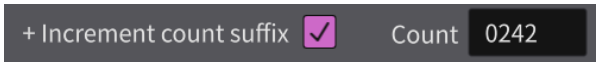


Figure 2.105 Count displayed when +Increment count suffix is turned on

2.12.4.7 Count

Sets the number to be added to the end of the file name as a serial number. This number is the same for Setup, Waveform, and Hardcopy saves. The number is added by 1 when each save is executed independently, when a save is executed by pressing the COPY button, or when a save is executed in the Pass/Fail Actions.

2.12.4.8 Format

Select the save format of the waveform data. See Chapter 4 Appendix for details on the save format.
Input method: Combo box
List: Select from ASCII / Binary.

This section describes the case where ASCII is selected.
If you select Binary, see 2.12.4.17 Format_Binary.

2.12.4.9 Source type

This parameter determines whether the waveform is saved in CH or MATH. If Source type is set to MATH, the Source combo box will appear as shown in Figure 2.106.
Input method: Combo box
List: Select from CH / MATH.

Figure 2.106 When Source type is set to MATH

2.12.4.10 Source

When Source type is set to MATH, set the Math to save the waveform. A Math whose type is set to Memory cannot be set as the Source.
Input method: Combo box
List: Select from MATH1 to MATH8.

2.12.4.11 Header

Set whether to save the header.
Input method: Check box

2.12.4.12 Delimiter

Set the delimiter.
Input method: Combo box
List: Select from Comma / Space / Tab.

2.12.4.13 Time or Frequency

Set whether to save the time or frequency axis data. Frequency is selected when Math, which performs FFT operations, is selected as the Source.
Figure 2.107 shows the settings window when Time is checked.
Input method: Check box

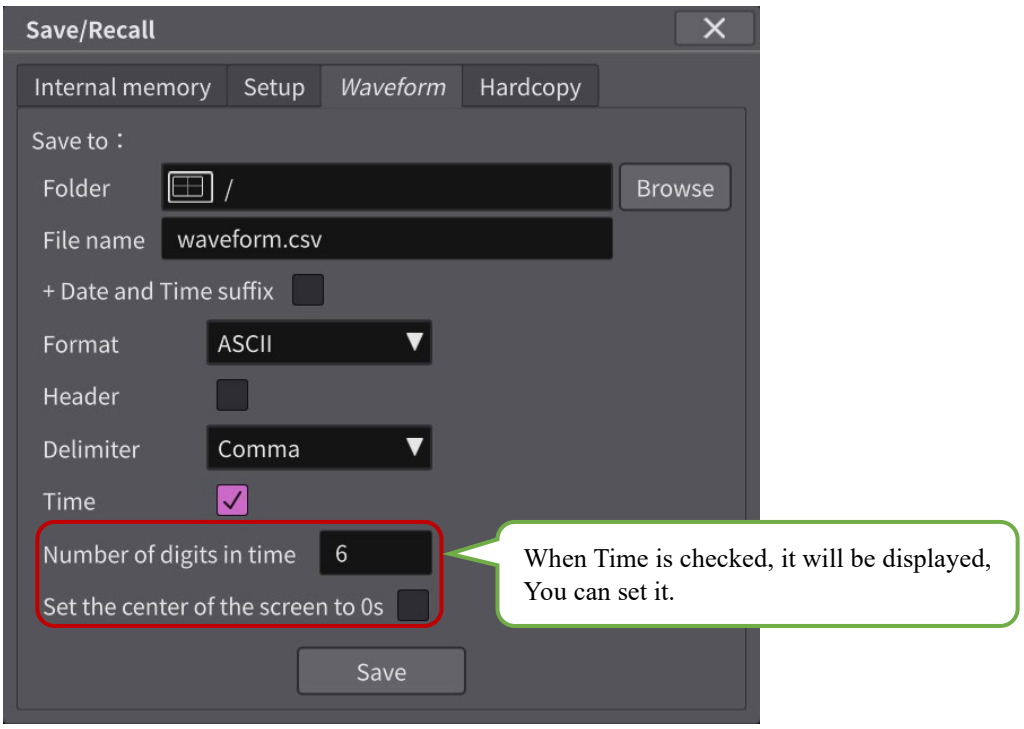


Figure 2.107 Setting window when Time is checked

2.12.4.14 Number of digits in time or Number of digits in frequency

Set the number of digits of the time or frequency data of the file to be saved.
Input method: Numeric input box / operation panel (1) Knob Setting range: 6 to 15

2.12.4.15 Set the center of the screen to 0s

Sets whether to save time axis data with the center of the screen as 0s.
Input method: Check box

2.12.4.16 Save

Saves the file.
Input method: Button

2.12.4.17 Format_Binary

The case where Binary is selected in Format is explained in the setting window in Figure 2.108.

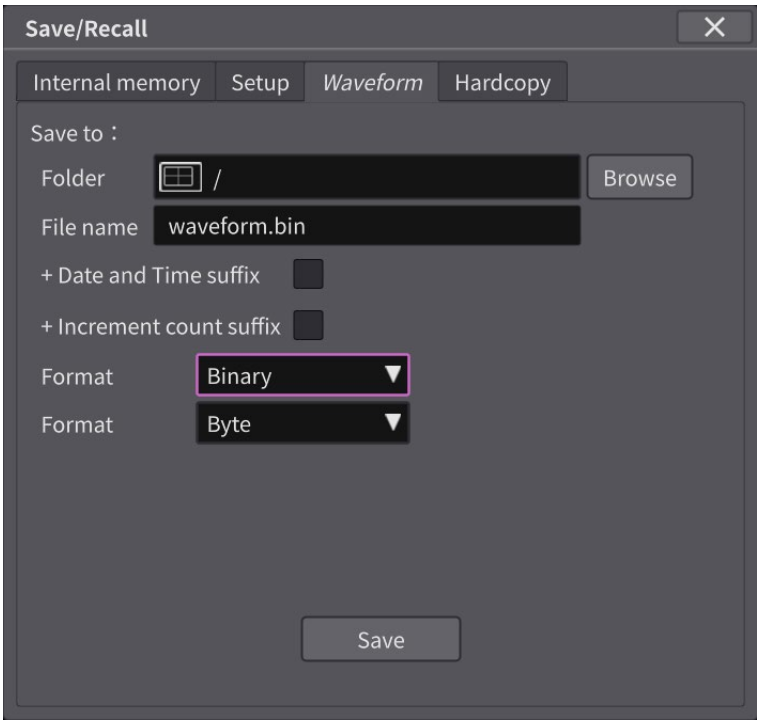


Figure 2.108 Setting window when Format is Binary.

2.12.4.18 Format

Select the format for saving waveform data in binary format.
See Chapter 4 Appendix for details on the save format.
Input method: Combo box
List: Select from Byte / Word.

2.12.4.19 Save

Executes saving to a file.
Input method: Button

2.12.5 Save/Recall_Hardcopy

Select Internal memory / File / Hardcopy on the Horizontal tab.
This is explained in the Settings Window shown in Figure 2.109 when Hardcopy is selected.
In this Settings Window, set the method of [save / recall] the screen image and the image file name and attributes created when the COPY button on the operation panel is pressed.
The file format is PNG and the extension is (.png).

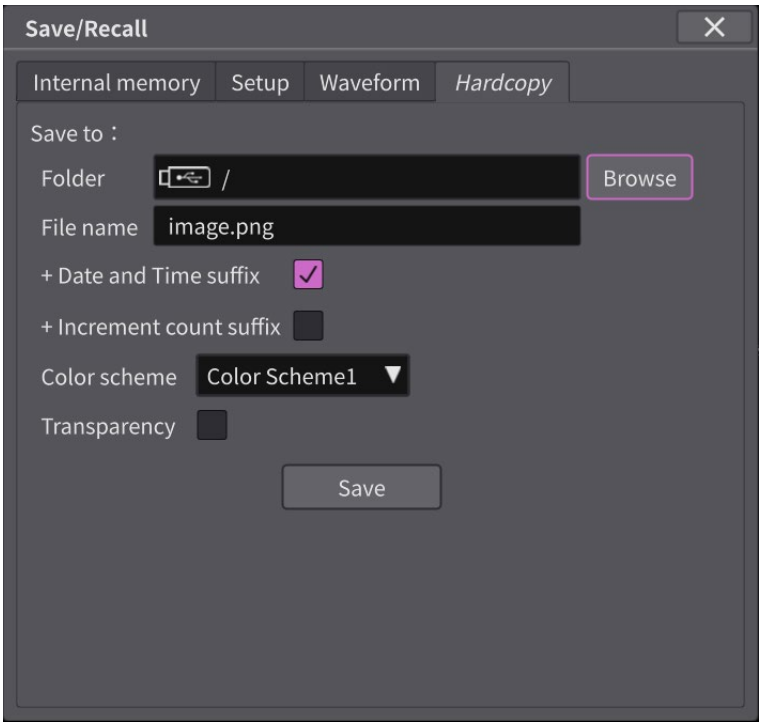


Figure 2.109 Settings Window when Hardcopy is selected on the Horizontal tab

2.12.5.1 Save to:

Set the save destination.

2.12.5.2 Folder

Press the Browse button to display the selected folder name.

2.12.5.3 Browse

Displays a Select Folder Dialog.
See 2.12.3.3 Browse.
Input method: Button

2.12.5.4 File name

Press the Browse button to display the selected file name. Or enter the file name to save.
The maximum number of characters is 32.
Input method: Character string input box

2.12.5.5 + Date and Time Suffix

Set whether to add the date and time to the file name.
Input method: Check box

2.12.5.6 + Increment count suffix

This checkbox determines whether or not the file name is suffixed with a serial number. If this checkbox is checked, Count will appear as shown in Figure 2.110.
Input method: Check box

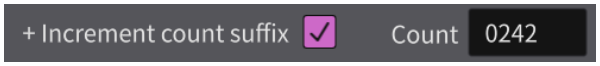


Figure 2.110 Count displayed when +Increment count suffix is turned on

2.12.5.7 Count

Sets the number to be added to the end of the file name as a serial number. This number is the same for Setup, Waveform, and Hardcopy saves. The number is added by 1 when each save is executed independently, when a save is executed by pressing the COPY button, or when a save is executed in the Pass/Fail Actions.

2.12.5.8 Color scheme

Select a color scheme when saving a file (hard copy).
See 1.10 Color scheme
Input method: Combo box
List: Select from Color scheme1 / Color scheme2 / Color scheme3.

2.12.5.9 Transparency

When the File format is PNG, select whether to make the background transparent.
Input method: Check box

2.12.5.10 Save

Performs a file (hard copy) save.
Input method: Button

2.13 Remote Control and Settings

Select Remote from the MENU Window and set in the Remote Window.
The instrument can be operated remotely via USB or LAN. For details on the remote control method and commands, see the “DS-8000 Series Remote Control Manual" included in the attached Manual CD.

2.13.1 Remote Window

When you select USB or LAN as the interface, the Settings Window change.

2.13.1.1 Interface_LAN

Select an interface.
Input method: Combo box
List: Select from USB / LAN.

Figure 2.111 shows the Settings Window when LAN is selected.
When you chose USB, see 2.13.2 Interface_USB.

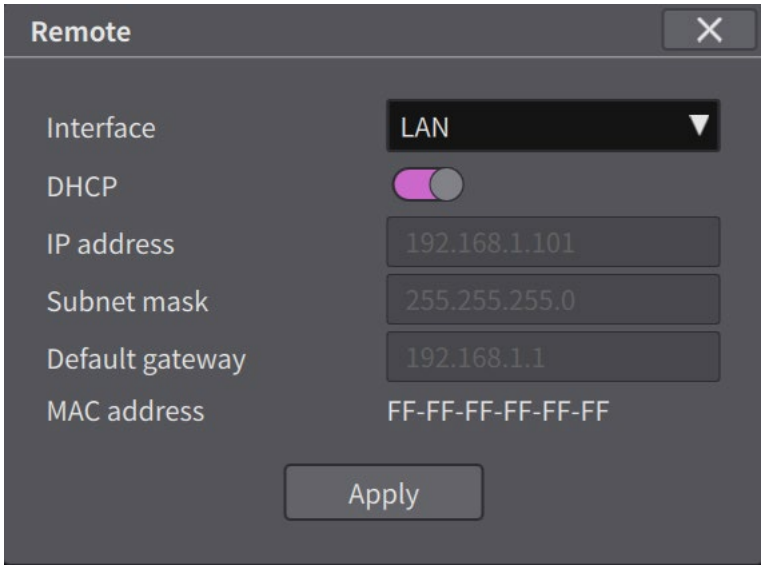


Figure 2.111 Settings Window when LAN is selected in Interface

2.13.1.2 DHCP

Set whether to enable DHCP.
When DHCP is ON, the IP address, Subnet mask, and Default gateway are non-editable.
Input method: Toggle switch

2.13.1.3 IP address

Set the IP address.
Input method: Character string input box

2.13.1.4 Subnet mask

Set the subnet mask.
Input method: Character string input box

2.13.1.5 Default gateway

Set the default gateway.
Input method: Character string input box

2.13.1.6 MAC address

Displays the MAC address.
Display: Label

2.13.1.7 Apply

The changes will be reflected. Press Apply to enable changes.
Input method: Button

2.13.2 Interface_USB

Select an interface.
Input method: Combo box
Figure 2.112 shows the Settings Window when USB is selected.

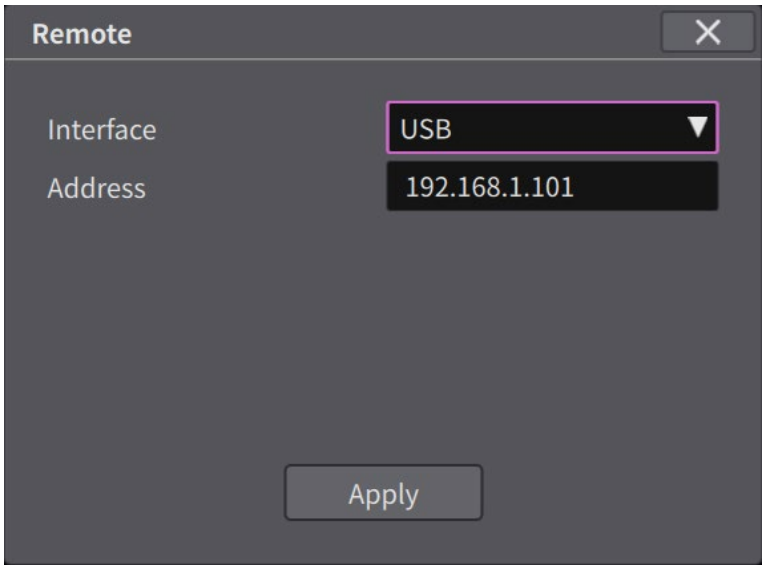


Figure 2.112 Settings Window when UAB is selected in Interface

2.13.2.1 Address

Enter the address value.
Input method: Character string input box

2.13.2.2 Apply

The changes will be reflected. Press the key to enable changes.
Input method: Button

2.14 BUS (Serial Bus Signal) Operation and Setting

- Select Bus from the MENU Window and set in the Bus Window.
- Tap the Bus readout to display the Bus Window.

Bus manages UART, SPI and I2C signal input channels and parameters. The screen shows the decoded result. The decoding position can be displayed on the screen with a marker.

Table 2.40 Serial Bus Signals

Serial bus signal	Description
UART	UART communication is asynchronous serial communication, and since data is exchanged with one signal line, the transmitting side sends out 1 bit at a time and the receiving side takes in 1 bit at a time. For transmission and reception, a total of two signal lines are used, one for transmission and one for reception. Communication is performed using only two lines, the transmit data TXD and the receive data RXD.
SPI	SPI communication is synchronous / full-duplex master-slave serial communication. Data from the master (SPI master) or slave (SPI slave) is synchronized by the rising or falling edges of the clock. There are four signals: ・ Clock (SPI CLK, SCLK) ・ Chip select (CS) ・ Master output / slave input (MOSI) ・ Master input / slave output (MISO)
I2C	I2C communication is connected between one master and one or more slaves in a party line with two lines, SCL and SDA. The master always has authority, and the data signal is transferred on the SDA line based on the clock signal SCL transmitted by the master. Each slave has an address, a specific slave is selected by specifying the address from the master, and the receiving side returns an ACK signal for each byte transfer, and data transfer is performed while confirming each other.

2.14.1 Bus Window

Select Bus1 and Bus2 on the vertical tab and set in the Settings Window.
The Settings Window changes depending on the type of the Type.

2.14.2 Bus Setting Change

Select Bus1 / Bus2 to be set on the Vertical tab.
Input method: Vertical tab
Figure 2.113 shows the Settings Window when Bus1 is selected.

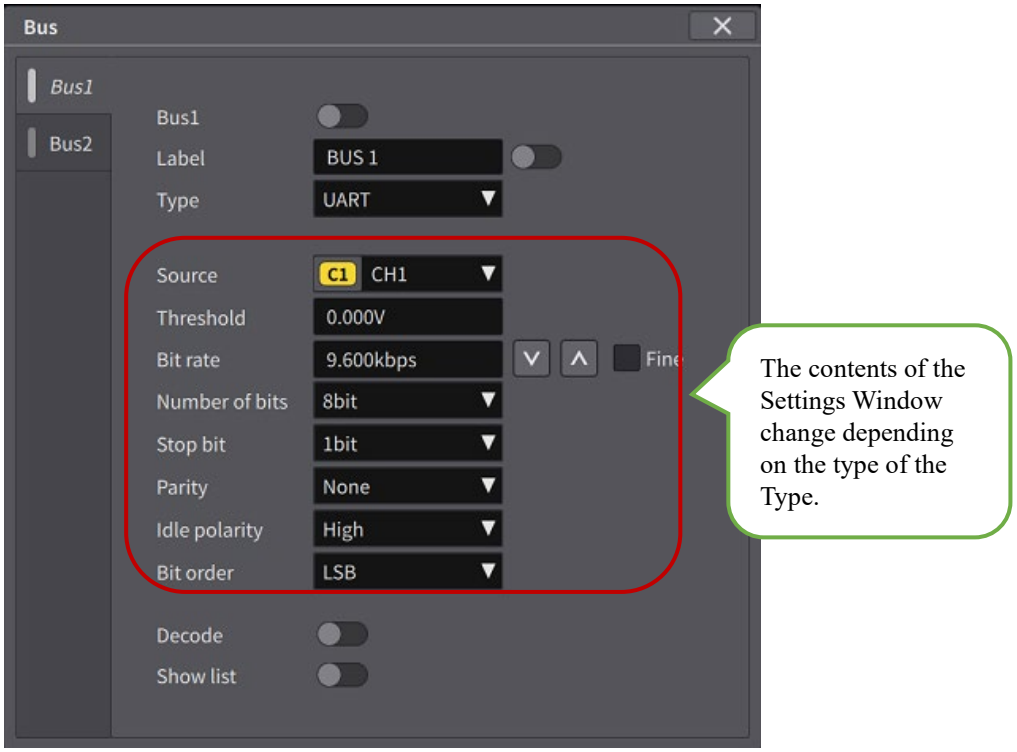


Figure 2.113 Bus Window

2.14.2.1 Bus1

Turns ON / OFF the Bus waveform selected on the Vertical tab.
Input method: Toggle switch

2.14.2.2 Label

Enter the label name and tap the toggle switch to display the label name around the Bus decoding result.
Input method: Character string input box
Input method: Toggle switch

2.14.3 Type_UART

Select the Bus Type. The Settings Window changes depending on the type of Bus.
Input method: Combo box
List: Select from UART / SPI / I2C.

Figure 2.113 shows the Settings Window when UART is selected.
When you select SPI, see 2.14.4 Type_SPI.
When you select I2C, see 2.14.5 Type_I2C.

2.14.3.1 Source

Specify the channel to input the UART signal.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.14.3.2 Threshold

Set the threshold value when binarizing the input signal.
Input method: Numeric Input Box. Setting range: Center of screen ± 5div, Unit is V

2.14.3.3 Bit rate

Set the bit rate.
Input method: Numeric Input Box (with Up / Down button)
List: Select form 1.000 kbps / 1.200 kbps / 1.800 kbps / 2.000 kbps / 2.400 kbps / 3.600 kbps / 4.800 kbps / 7.200 kbps / 9.600 kbps / 14.40 kbps / 15.20 kbps / 19.240 kbps / 28.80 kbps / 38.40 kbps / 56.00k bps / 57.60 kbps / 62.50 kbps / 76.80 kbps / 115.2 kbps / 128.0 kbps / 230.4 kbps / 460.8 kbps / 921.6 kbps / 1.000 Mbps.

2.14.3.4 Fine

Set whether to use fine adjust for the bit rate setting.
Input method: Check box
List: Select from 1.000 kbps to 1.000 Mbps. Resolution 100 bps

2.14.3.5 Number of bits

Specify the number of bits.
Input method: Combo box
List: Select from 5 bit / 6 bit / 7 bit / 8 bit.

2.14.3.6 Stop bit

Select the stop bit.
Input method: Combo box
List: Select from 1 bit / 2 bit.

2.14.3.7 Parity

Select the presence / absence and type of parity.
Input method: Combo box
List: Select from None / Even / Odd.

2.14.3.8 Idle polarity

Select the polarity when idle.
Input method: Combo box
List: Select from Low / High.

2.14.3.9 Bit order

Select a bit order.
Input method: Combo box
List: Select from MSB / LSB

2.14.3.10 Decode

Set whether to display the decoding result.
Input method: Toggle switch

2.14.3.11 Show list

Set whether to display the list.
Input method: Toggle switch

2.14.4 Type_SPI

Select the Bus type. The Settings Window changes depending on the type of Bus.
Input method: Combo box
List: Select from UART / SPI / I2C.

Figure 2.114 shows the Settings Window when SPI is selected.
When you select I2C, see 2.14.5 Type_I2C.

2.14.4.1 Horizontal tab_Clock

Select Clock / MOSI / MISO / Chip Select on the Horizontal tab.

This section describes the case when Clock is selected on the Horizontal tab.
When you select MOSI, see 2.14.4.7 Horizontal tab_MOSI.
When you select MISO, see 2.14.4.10 Horizontal tab_MISO.
When you select Chip Select, see 2.14.4.13 Horizontal tab_Chip Select.

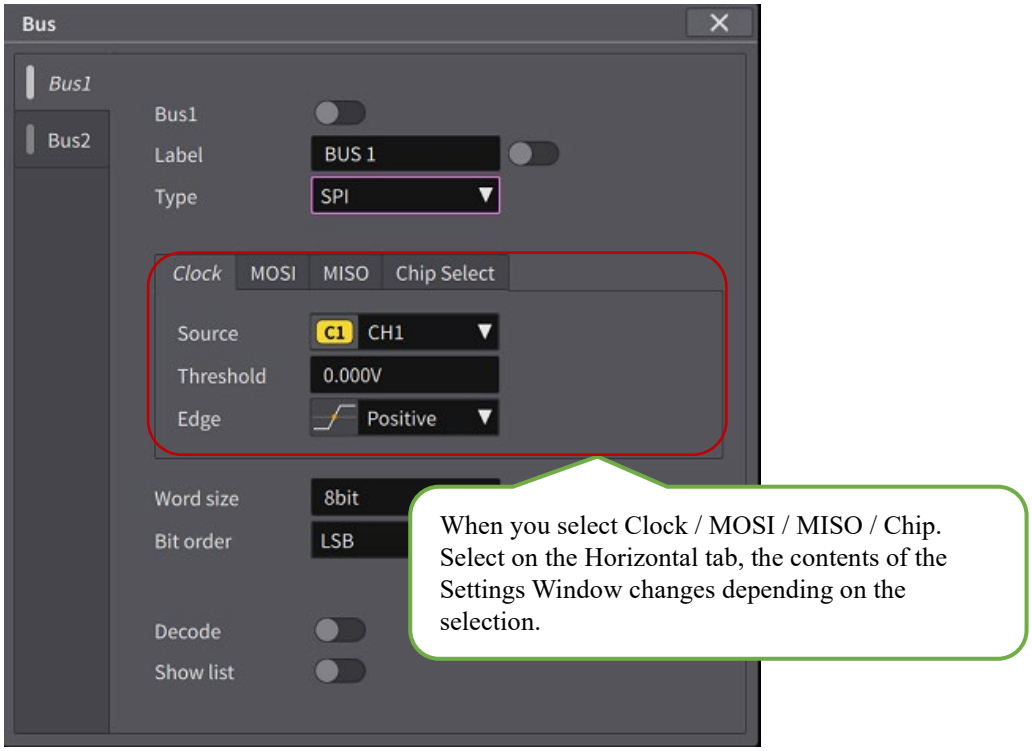


Figure 2.114 Settings Window when Clock is selected on the Horizontal tab

2.14.4.2 Source

Specify the channel to input the clock signal.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.14.4.3 Threshold

Specify the threshold for binarizing the signal.
Input method: Numeric Input Box. Setting range: Center of screen ± 5 div, Unit is V

2.14.4.4 Edge

Specify the edge to detect the clock.
Input method: Combo box with icon
List: Select from Positive / Negative.

2.14.4.5 Word size

Specify the word size for decoding.

Input method: Numeric Input Box. Setting range: 4 to 16-bit

2.14.4.6 Bit order

Specify the bit order for decoding.
Input method: Combo box
List: Select from LSB / MSB.

2.14.4.7 Horizontal tab_MOSI

Figure 2.115 shows the Settings Window when MOSI is selected on the Horizontal tab.

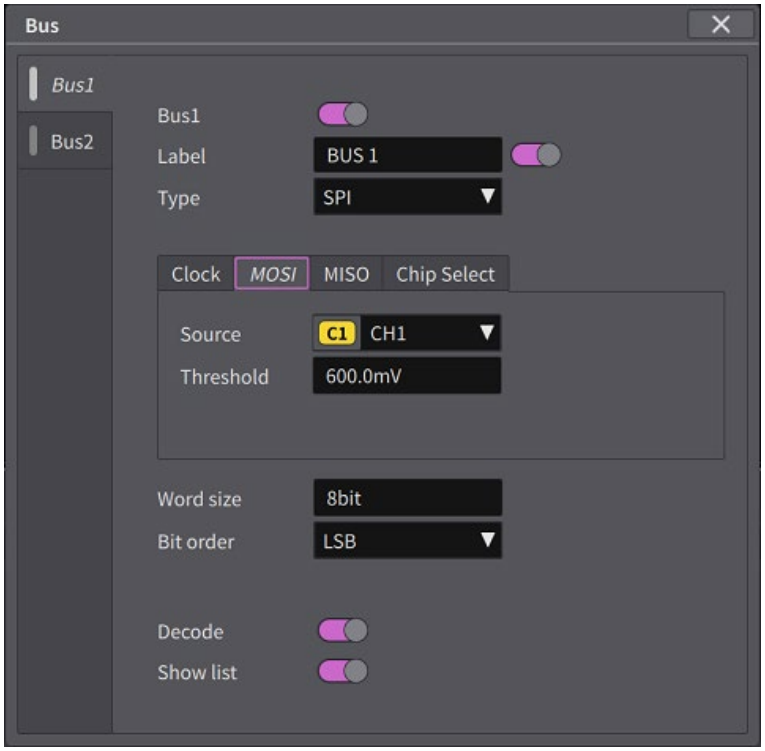


Figure 2.115 Settings Window when MOSI is selected on the Horizontal tab

2.14.4.8 Source

Specify the channel to input MOSI signal.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.14.4.9 Threshold

Specify the threshold for binarizing the signal.
Input method: Numeric Input Box. Setting range: Center of screen ± 5div, Unit is V

2.14.4.10 Horizontal tab_MISO

Figure 2.116 shows the Settings Window when MISO is selected on the Horizontal tab.

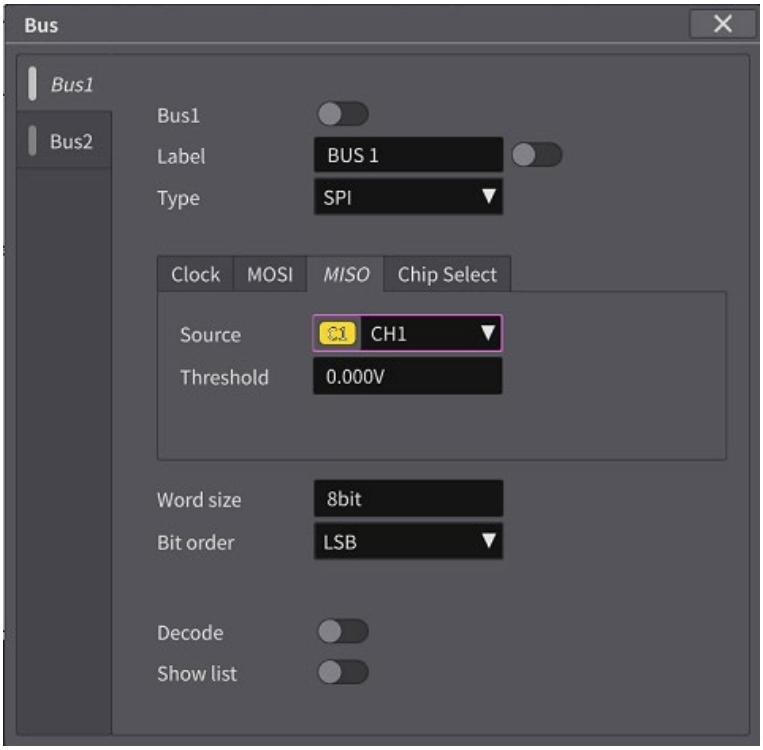


Figure 2.116 Settings Window when MISO is selected on the Horizontal tab

2.14.4.11 Source

Specify the channel to input the MISO signal.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.14.4.12 Threshold

Specify the threshold for binarizing the signal.
Input method: Numeric Input Box. Setting range: Center of screen ± 5 div, Unit is V

2.14.4.13 Horizontal tab _Chip Select

Figure 2.117 shows the Settings Window when MISO is selected on the Horizontal tab.

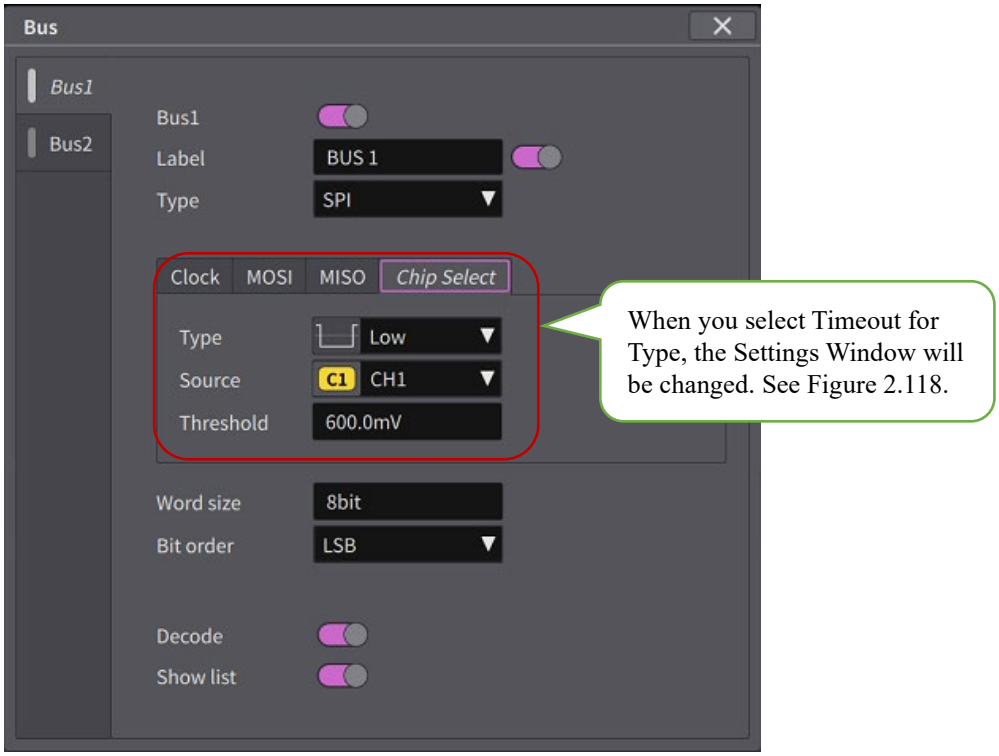


Figure 2.117 Settings Window when Chip Select is selected on the Horizontal tab

2.14.4.14 Type

Select the type of Chip Select.
Input method: Combo box with icon
List: Select from Low / High / Timeout.

Figure 2.117 shows the Settings Window when Low / High is selected as the chip select type.
When you select Timeout as the chip select type, the Settings Window will be changed.
See 2.14.4.17 Type_Timeout.

2.14.4.15 Source

Specify the channel to which the chip select signal is input.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.14.4.16 Threshold

Specify the threshold for binarizing the signal.
Input method: Numeric Input Box. Setting range: Center of screen ± 5 div, Unit is V

2.14.4.17 Type_Timeout

Figure 2.118 shows the Settings Window when Timeout is selected as the Chip Select Type.

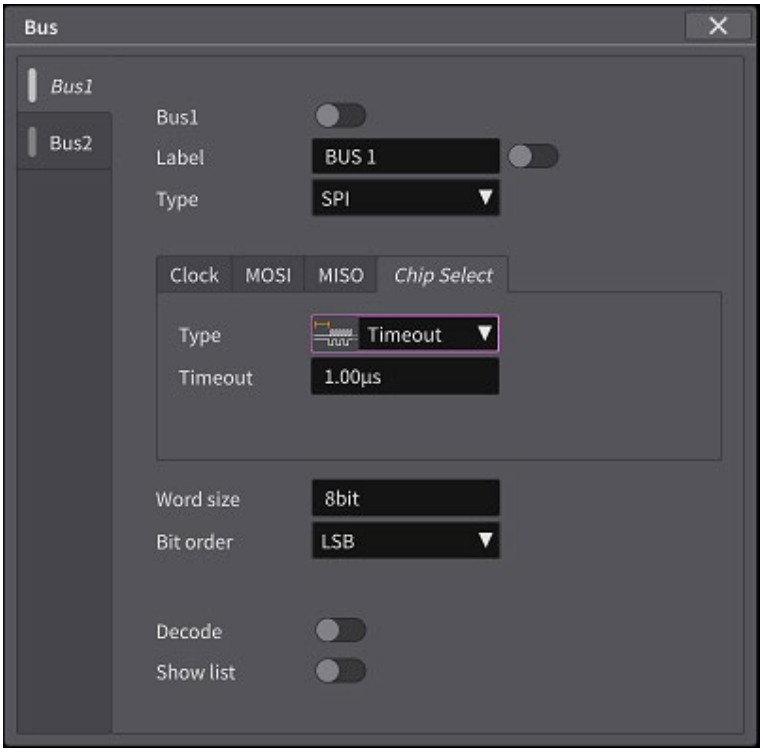


Figure 2.118 Settings Window when Timeout is selected as the Type

2.14.4.18 Timeout

Specify the timeout period.
Input method: Numeric Input Box. Setting range: 100 ns to 10.0 s

2.14.5 Type_I2C

Select the Bus type. The Settings Window changes depending on the type of bus.
Input method: Combo box
List: Select from UART / SPI / I2C.
Figure 2.119 shows the Settings Window when I2C is selected.

2.14.5.1 Horizontal tab_SCL

Select SCL / SDA on the Horizontal tab.

Figure 2.119 shows the Settings Window when SCL is selected.
When you select SDA, see 2.14.5.5 Horizontal tab_SDA.

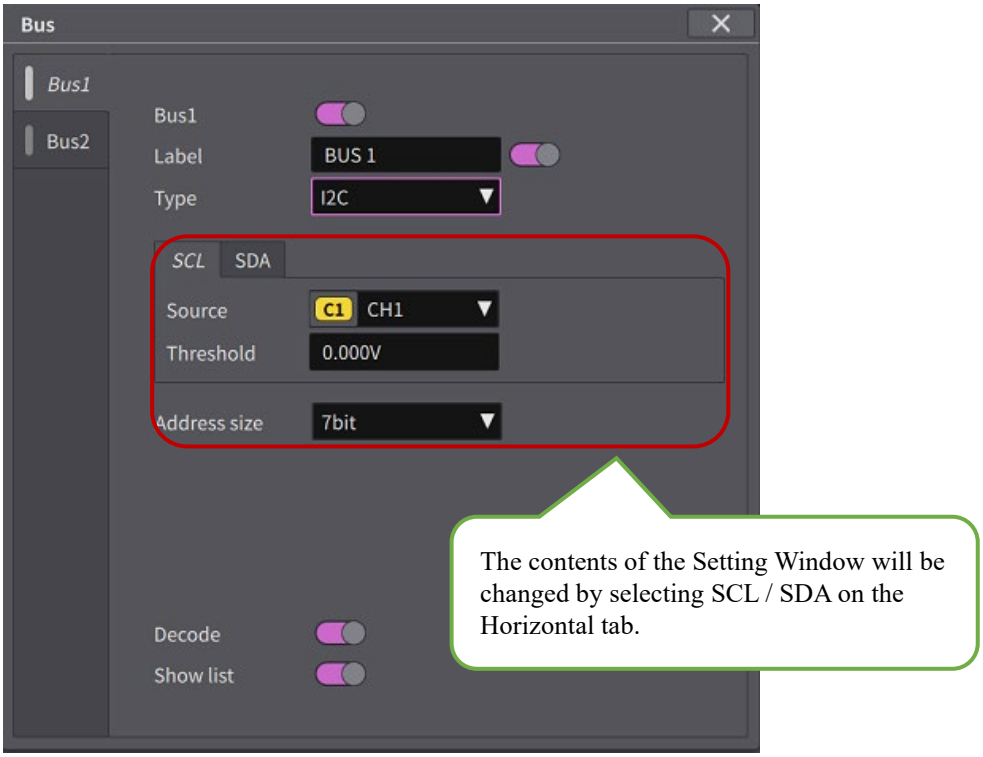


Figure 2.119 Settings Window when SLC is selected on the Horizontal tab

2.14.5.2 Source

Specify the channel to input SCL (clock) signal.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.14.5.3 Threshold

Specify the threshold for binarizing the signal.
Input method: Numeric Input Bo. Setting range: Center of screen ± 5 div, Unit is V

2.14.5.4 Address size

Specify the number of bits in the address when decoding.
Input method: Combo box
List: Select from 7bit / 10bit.

2.14.5.5 Horizontal tab_SDA

Select SCL / SDA on the Horizontal tab.

Figure 2.120 shows the Settings Window when SDA is selected.

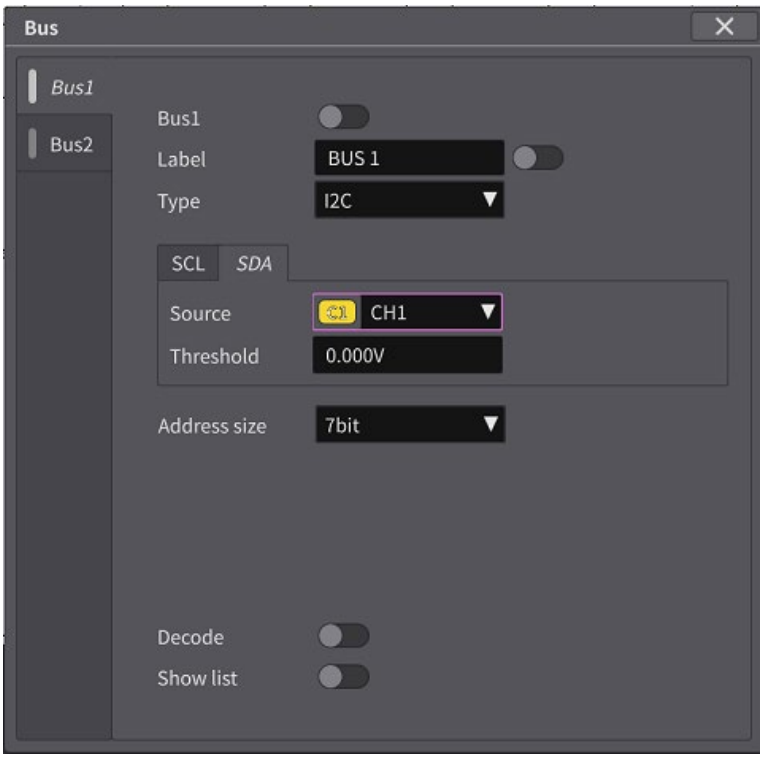


Figure 2.120 Settings Window when SDA is selected on the Horizontal tab

2.14.5.6 Source

Specify the channel to input SCL (clock) signal.
Input method: Combo box with icon
List: For the 8CH model, select from CH1 / CH2 / CH3 / CH4 / CH5 / CH6 / CH7 / CH8.
For the 4CH model, select from CH1 / CH2 / CH3 / CH4.

2.14.5.7 Threshold

Specify the threshold for binarizing the signal.
Input method: Numeric Input Box. Setting range: Center of screen ± 5 div, Unit is V

2.14.5.8 Address size

Specify the number of bits in the address when decoding.
Input method: Combo box
List: Select from 7 bit / 10 bit.

2.15 About this Instrument

Select About on the MENU Window to display the About Window.

2.15.1 About Window

Display information about this instrument.
Please use the information when making inquiries about this instrument.

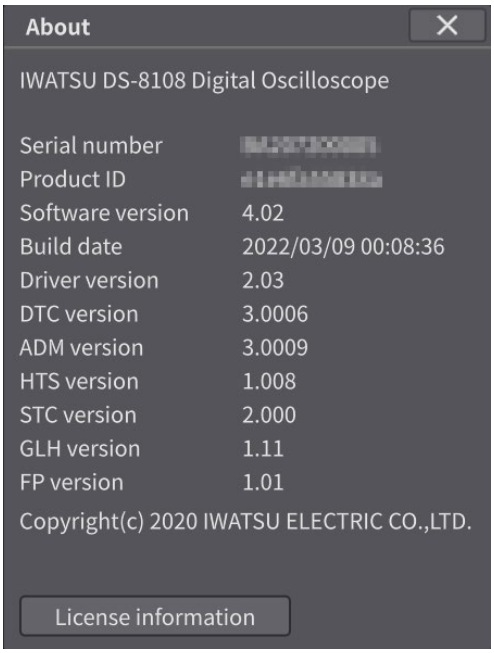


Figure 2.121 About Window

2.16 Safe Removal of USB Memory

Select Remove USB Memory on the MENU Window, and then remove the USB memory.

2.16.1 Remove USB Memory

In case you do not remove the USB memory properly, there is a risk of error display or data loss.
Follow the operating procedure to remove the USB memory.

Operating procedure

1. Before removing the USB memory, select Remove USB Memory from the MENU Window.
2. "Info: USB Memory can be safely removed" is displayed for a few seconds in the status line at the bottom of the screen.
3. After the display is complete, remove the USB memory from the instrument.

2.17 History

- Select History from the MENU Window to display the History Window.
- The History function always works without any special settings.
- When the sample mode is Equivalent Sample and the waveform acquisition mode is Average mode, you cannot see the history.

2.17.1 History Window

The History Window is a Settings Window for displaying history in a list. It is valid only in stopping acquisition.

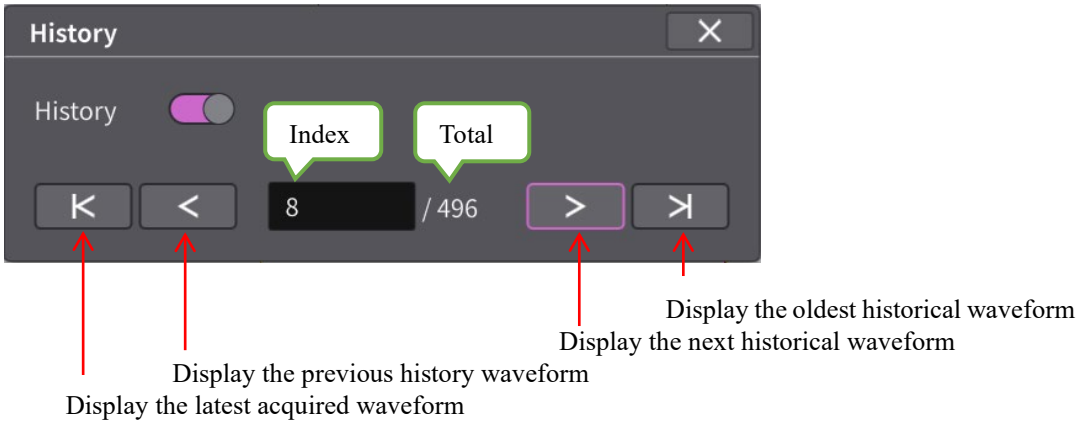


Figure 2.122 History Window

2.17.1.1 History

Set to Display / hide History Readout.
Input method: Toggle switch

2.17.1.2 Index

Displays the index number of the currently selected history. The Index number is "1", which indicates the latest acquired waveform, and the Index number increases as it becomes the past acquired waveform.
Change the index value.
Input method: Numeric Input Box / Operation Panel (1) Knob

Operations with the previous and next buttons of SEARCH / HISTORY on the operation panel must be set to History with 2.6.4.6 Function to assign to button in advance.

2.17.1.3 Total

Displays the total number of waveform histories. The maximum number of waveforms that can be recorded in History is 32,768 waveforms, which depends on the memory length. Also, when the maximum number of waveforms is reached, the oldest acquired waveform will be overwritten.
Display Total by label.

Chapter 3 Performance

This chapter describes the specifications, general and environmental characteristics of the Instrument.
The terms are abbreviated as follows.

FS: Full scale value
Reading: Measured voltage value
Voffset: Offset set voltage value

3.1 Vertical Axis (Y axis)

Table 3.1 Vertical axis (Y axis)

Item	Specifications
Channels	DS-8xx8: 8CH (Interleaving 4CH) DS-8xx4: 4CH (Interleaving 2CH)
Frequency Bandwidth	DS-810x: 1 GHz DS-805x: 500 MHz DS-803x: 350 MHz
AC coupling lower limit frequency (-3 dB)	≦10 Hz
Bandwidth Limit Frequency Filter is Analog method	DS-810x: 500 MHz,100 MHz,20 MHz DS-805x / DS-803x: 100 MHz,20 MHz
Bandwidth Limit Frequency Filter is Digital method	Hardware processing, independent setting for each channel Filter type: Select either LPF / HPF / SMA / OFF for each channel
	LPF / HPF (digital filter) is selected Cutoff frequency range: Minimum setting value: Sampling frequency x 0.040 Maximum setting value: Sampling frequency x 0.460 Number of setting steps: 421 Steps for each sampling frequency Attenuation of cutoff point -6 dB Filter type: FIR, using humming window
	SMA (Simple Moving Average) is selected Setting width: 1 to 25 Number of points: 2N + 1
Sensitivity: Coarse (range)	1 MΩ: 1 mV to 10 V/div (1-2-5 Sequence) 50 Ω: 1 mV to 1 V/div (1-2-5 Sequence)
Sensitivity: Fine (variable)	Expanded by software from the center of the screen 100 or 150 steps between ranges
DC Accuracy/ DC Gain Accuracy	1 mV/div: ±(2% + 1%FS) Other ranges: ±(2% + 0.5%FS)
Offset Range	50 Ω 1 mV/div to 20 mV/div: ±1 V 20.1 mV/div to 50 mV/div: ±5 V 50.1 mV/div to 100 mV/div: ±10 V 101 mV/div to 1 V/div: ±50 V 1 MΩ 1 mV/div to 50 mV/div:±1 V 50.1 mV/div to 500 mV/div:±10 V 501 mV/div to 10 V/div:±200 V

Offset Accuracy	50 Ω 1 mV/div to 20 mV/div: ±(0.8%ofSetting+0.5%FS+2 mV) 20.1 mV/div to 50 mV/div: ±(0.8%ofSetting+0.5%FS+10 mV) 50.1 mV/div to 100 mV/div: ±(0.8%ofSetting+0.5%FS+20 mV) 101 mV/div to 1 V/div: ±(0.8%ofSetting+0.5%FS+100 mV) 1 MΩ 1 mV/div to 50 mV/div: ±(0.5%ofSetting+0.5%FS±2 mV) 50.1 mV/div to 500 mV/div: ±(0.5%ofSetting+0.5%FS±20 mV) 501 mV/div to 10 V/div: ±(0.5%ofSetting+0.5%FS±400 mV)
Input Impedance	50 Ω ±1.5% 1 MΩ ±1% // 16 pF ±2 pF
Input Coupling	GND, DC 1 MΩ, AC 1 MΩ, DC 50 Ω
Maximum Input Voltage	1 MΩ: 400 Vpk 50 Ω: 5 Vrms
Probe Automatic Detection (probe sense)	Yes
Probe Attenuation Ratio	0.1:1, 1:1, 5:1, 10:1, 20:1, 50:1, 100:1, 200:1, 250:1, 500:1, 1000:1, 2000:1, 5000:1, 10000:1 (1:1,10:1,100:1 and 1000:1 are Automatic detection)
Probe Setup	Corresponding probe: Specified IWATSU branded probes Model-specific defaults: unit, probe attenuation ratio, input coupling, bandwidth, rescale, skew
Probe Power Supply	Yes
DC Balance	See offset accuracy
DC Measurement Accuracy / Relative Voltage	1 mV/div: ±(0.02*Reading + 0.01*FS) Other ranges: ±(0.02*Reading + 0.005*FS)
DC Measurement Accuracy / Absolute Voltage	50 Ω 1 mV/div to 20 mV/div: ±{0.02*(Reading-Voffset) + 0.008*Voffset + 0.005*FS + 2 mV} 20.1 mV/div to 50 mV/div: ±{0.02*(Reading-Voffset) + 0.008*Voffset + 0.005*FS + 10 mV} 50.1 mV/div to 100 mV/div: ±{0.02*(Reading-Voffset) + 0.008*Voffset + 0.005*FS + 20 mV} 101 mV/div to 1 V/div: ±{0.02*(Reading-Voffset) + 0.008*Voffset + 0.005*FS + 40 mV} 1 MΩ 1 mV/div to 50 mV/div: ±{0.02*(Reading-Voffset) + 0.005*Voffset + 0.005*FS + 2 mV} 50.1 mV/div to 500 mV/div: ±{0.02*(Reading-Voffset) + 0.005*Voffset + 0.005*FS + 20 mV} 501 mV/div to 10 V/div: ±{0.02*(Reading-Voffset) + 0.005*Voffset + 0.005*FS + 400 mV}
VSWR	<1.5
Invert	Inverted display of AD value
Convert/Rescale	The display of input voltage sensitivity can be converted by the following formula. a x input voltage + b (a and b are user-set values) a: Fraction (0.01 to 1.00) * Base(10) ^ Exponent (-6 to + 3)
Conversion/Unit	Volt, Ampere, Watt, ℃, Ω, No Unit

3.2 Sampling System

Table 3.2 Sampling system

Item	Specifications
Maximum Sampling Rate Equivalent Sampling Rate	5 GS/s @12-bit (Interleaving), 2.5 GS/s @12-bit (all CH) 200 GS/s
Acquisition memory length	Standard 60 Mpts (all CH) 120 Mpts (Channel combine)
Maximum Duration at highest sample rate	24 ms (Channel combine)
Vertical Resolution / ADC Resolution	12-bit
High Resolution (arithmetic)	12.5- to 16-bit
Waveform Update Rate	Maximum 2,000 waveform/s
Peak Detection	Captures glitches as narrow as 400 ps. Resolution 400 ps
Average Number of times	2 to 65,536 Waveform
Channel Combine	At the time of Channel combine: 5 GS/s, 120 Mpts

3.3 Horizontal Axis (X Axis)

Table 3.3 Horizontal system (X axis)

Item		Specifications
Time sweep Range		DS-810x: 200 ps/div to 50 s/div DS-805x / DS-803x: 500 ps/div to 50 s/div Note: T/div can be set to any value within the range.
Horizontal Axis Resolution		2.5 ps
Timebase Accuracy		10 ppm
Delay Time Range	RUN	-500 s to +6 div(10 ms/div to 20 s/div) -5 s to +6 div(10 µs/div to 5 ms/div) -5 ms to +6 div(up to 5 µs/div)
	STOP	-500 s to +750 s
Deskew Range		When the number of points in the waveform is within 150k points ・Adjustment range 1: Up to 100 µs/div→ ±10 µs ・Adjustment range 2: From 200 µs/div→ ±1 div (More than) Others depend on the sampling rate. See Table 2.2 and Table 2.3 for details.
Timebase Accuracy		≦10 ppm
Interpolator Resolution		5 ps
Sample Mode		Real time, Sequence, Equivalent, Roll
Waveform Acquisition mode		Normal, Peak Detect, Average, High Resolution, Advanced High Resolution, Sin(x)/x Interpol
Roll operation range		100 ms/div to 50.0 s/div (1.25 MS/s max)

3.4 Trigger System

Table 3.4 Trigger system

Item			Specifications
Trigger Mode			Auto, Normal, Single
Trigger Source			DS-8xx8: CH1 to CH8, Line(*) DS-8xx4: CH1 to CH4, Line(*) (*) Ext 0.5V and Ext 1.2V if this instrument implements DS-601(DS8K EXT-TRIG-IN) factory option.
Trigger Coupling			AC, DC, HF Reject, LF Reject, Noise Reject
Trigger Coupling Cutoff Frequency			AC: Typical Value 7.5 Hz HF-Rej, LF-Rej: Typical Value 50 kHz Single pole filter 20 dB/decade AC, LF-Reject: Cutoff frequency 1.0 div Sync 0.1×Cutoff frequency 1.0 div Not sync HF-Reject: Cutoff frequency 1.0 div Sync 10×Cutoff frequency 1.0 div Not sync
Slope			Rise and fall
Hold off			OFF, 200 ns to 50 s
Trigger Level	Level range		±6 div
	Level accuracy		+/- (5% + 30% of input sensitivity [volts / div]) (1 kHz at Sine wave)
Trigger Jitter	Dropout, serial trigger		≦10 ns
Noise Reject			Cannot synchronize with signals of about 1 div or less
Type Classification	Basic	Edge trigger	Edge, Edge Alternate, Edge OR
		Event trigger	Pulse width, period, dropout, number of pulses
		Logic pattern trigger	Pattern
		Serial trigger	UART, 2C, SPI
		Advanced trigger	Transition Time
Type	Edge	operation	Trigger at the edge of the selected slope
		Trigger Sensitivity	DS-810x DC (30 Hz) to 10 MHz 0.5 div Up to 250 MHz 1.0 div Up to 1 GHz 1.5 div DS-805x DC (30 Hz) to 10 MHz 0.5 div Up to 250 MHz 1.0 div Up to 500 MHz 1.5 div DS-803x DC (30 Hz) to 10 MHz 0.5 div Up to 250 MHz 1.1 div Up to 350 MHz 1.5 div When coupling other than DC (AC, LF-Reject, HF-Reject), the trigger sensitivity is attenuated by each filter characteristic.

	Edge OR	Operation	・Target CH: Selected CH ・Rise, fall, and invalid can be selected for each CH
		Trigger Sensitivity	DC to 250 MHz 1.5 div
		Trigger Skew between CH	<1.5 ns
	Edge Alternate	Operation	Alternate triggers on rising and falling edges
		Trigger Sensitivity	Same as Edge trigger
	Event		Maximum trigger frequency: 33 MHz Minimum pulse width: 30 ns
		Period	40 ns to 50 s
		Pulse Width	m<t, t<m, m<t<n, m<t, t > n m and n are set values 30 ns to 50 s t is the pulse width measurement result
		Dropout (timeout)	50 ns to 50 s
		Number of Pulses (count)	2 to 9,999
	Pattern	Operation	Logical operation: AND, NAND, OR, NOR Target CH: Selected CH CH Setting: High, Low, Disabled can be selected for each CH
		Trigger Skew between CH	<1.5 ns
		Trigger Sensitivity	1.5 div
		Minimum input pulse width	2 ns
		Minimum calculation result pulse width	2 ns
	Serial Trigger	UART	Yes
		I2C	Yes
		SPI	Yes
	Sequence Trigger	B Trigger (Arming Trigger)	Available trigger mode in edge, pulse count, period, dropout and serial. Delay timer and Clear timer Setting range: Delay timer: 30 ns to 50 s Clear timer: 1 µs to 50 s
	Advanced Trigger	Transition Time	m<t, t<m, m<t<n, m<t, t > n m and n are set values 1.2 ns to 50 s (non-interleaved) 600ps to 50s (interleaved) t is the transition time measurement result
		Trigger coupling	DC only
		Level range	±4div
External Trigger(*)	Trigger Type		Only edge
	Input	Input impedance	approximately 10kΩ
		Maximum rating	-6V to +11V
		Operating range	0V to +5V
		Threshold Level	Select from +0.5V or +1.2V
		Level accuracy	±0.15V
		Slope	Rise and fall

		Minimum trigger sensitivity	120mVpp
		Frequency	Maximum 100MHz at 50Ω termination
		Trigger skew	Maximum ±1.5ns

(*) If this instrument implements DS-601(DS8K EXT-TRIG-IN) factory option.

3.5 Display

Table 3.5 Display

Item			Specifications
LCD	Type		15.6 inch
	Resolution		Full-HD 1920×1080 pixels (High Definition)
	Display Area		193.59 mm x 344.16 mm (10 vertical, 12 horizontal divisions)
Waveform Refresh Rate			50 Frame/sec (software waveform processing)
Zoom			Main: 1 screen Zoom: up to 2 screens
Touch Screen			Electrostatic
Trace	Label		Labels can be set with character strings. Display around the waveform.
	Display Color		Trace display color can be set
Waveform Display	Style		Vector, dot, variable persistence, infinite persistence
	Format		Single, Split, XY, XY Single, XY Split, Off
	Vector / dot		Vector display (LINEAR interpolation), dot display
	Division number		YT mode Vertical axis ±5 div Horizontal axis ±6 div XY mode Vertical axis ±5 div Horizontal axis ±5 div
	Grid type	type	Grid, Axis, Frame
		brightness	0 to 100% (Resolution 10%)
Persistence	Brightness Adjustment		Yes
	Afterimage Time		OFF, 100 ms, 200 ms, 500 ms, 1 s, 2 s, 5 s, 10 s, infinite
	Gradation		monochromatic
Trace Brightness adjustment	Range		Possible (0 to 100%)
Grid Brightness adjustment	Range		Possible (0 to 100%)
Waveform data search	Search type: Edge, Cyclic RMS, Cyclic Mean, Frequency, Period, Pulse Width, Duty Cycle, Transition Time		Search target: DS-8xx8: CH1 to CH8 DS-8xx4: CH1 to CH4 Maximum number of searches are 40,000 Search result marker display is available Other search conditions are Slope, level and hysteresis setting
History	Operation, Number of pages		Display possible, maximum 32,768 waveform

3.6 Cursor

Table 3.6 Cursor

Item		Specifications
Cursor Types		Time, Amplitude, Waveform
YT Mode (Single, Split, XY Single, XY Split)	Time	Yes
	Amplitude	Yes
	Time & Amplitude	Yes
	Cursor value	Yes
XY Mode (XY, XY Single, XY Split)	X axis	Yes
	Y axis	Yes

3.7 Parameter Measurement

Table 3.7 Parameters Measurement

Item		Specifications
Parameters	Voltage	**12 items** Maximum, Minimum, Peak-Peak, RMS, Cyclic RMS, Mean, Cyclic Mean, Top, Base, Top-Base, +Overshoot, -Overshoot
	Time	**14 items** Transition Time, Tr 20-80%, Tf 80-20%, Tr 10-90%, Tf 90-10%, Tr (Level), Tf (Level), Frequency, Period, +Pulse Count, -Pulse Count, +Pulse Width, -Pulse Width, Duty Cycle
	Other	**9 items** dV/dt, Integral, Integral (Absolute), Integral(Positive), Integral (Negative), Skew (%), Skew (Level), Phase (%), Phase (Level)
Number of Simultaneous Measurement Displays		8
Gate Measurement		Gate can be set for each measurement item
Statistics function		Value, Maximum, Minimum, Mean, Std dev, Number

3.8 Trigger Counter

Table 3.8 Trigger Counter

Item		Specifications
Trigger Frequency Counter	Resolution	6-digits
	Frequency Range	4 Hz to 1 GHz (The upper limit is limited by the frequency band of the model)
	Accuracy	10 ppm

3.9 Arithmetic Processing

Table 3.9 Arithmetic Processing

Item		Specifications
Waveform Calculation	Number of MATH traces	8
	Computation Source	DS-8xx8: CH1 to CH8 DS-8xx4: CH1 to CH4
	Operator (Math Type)	Addition, subtraction, multiplication, division, integration, differentiation, absolute value, inversion, memory, FFT, SMA
FFT	Point	maximum 1.5Mw
	Window	Square, flat top, von Han
	Calculation Range specification	Screen center fixed

3.10 Storage

Table 3.10 Storage

Item			Specifications
Save/Recall	Panel Setup	Save destination, caller	Internal memory: 5 Internal storage External USB memory
	Waveform Data	file format	ASCII (voltage value), binary (AD value)
		Save destination, caller	Internal storage External USB memory
	Default Configuration		Revert panel setup to default setup
Hard Copy (Print)	File Format		Only PNG (24-bit color) is supported
	Color Scheme		Usually, you can choose the color scheme for printing
	Background Color		Transparent can be selected
	Output Device	USB memory	Yes
		Built-in memory	Yes

3.11 Interface

Table 3.11 Interface

Item		Specifications
Remote Interface	LAN	・10 / 100 / 1000Base - T ・RJ-45 connector x 1
	USB	USB 3.0 Device x 1
Other I / O Ports	External monitor output	DVI-D (Only compatible with resolution 1920 x 1080)
	USB	USB host: Front USB port x 2 Side USB port x 1
	AUX_OUT (TRIG OUT)	BNC connector Output resistance: 120 Ω ± 10% H level: 0.9 V or higher (at the end of 50 Ω) L level: 0.1 V or less (at the end of 50 Ω) Pulse width: 1.5 µs ± 0.5 µs (at trigger output) Maximum output voltage at no load: 3.3V
Calibration Output for Probe	Output signal waveform	Square wave
	Output frequency	1 kHz ± 0.5%
	Output amplitude	4 V ± 3%
Clear Function	operation	Clear by panel operation
	Target to clear	All pages of replay waveform, average, afterglow display, Automatic measurement Max value / Min value
Display	The language of the Oscilloscope Application	English, Japanese
	Screen color scheme	Color scheme 1 to 3
	Set color scheme	Set color scheme 1 to 3
Built-in Clock	Date and Time Display	Hidden, time, time stamp when triggered
	Clock Accuracy	Monthly difference within ± 60 seconds (ambient temperature 0 °C to + 30 °C)
Device Settings	Offset setting	Unit selection: Division, Volts
	Delay setting	Unit selection: Division, Time
	Function assignment of SEARCH / HISTORY button on the operation panel	Selectable function to operate with priority from SEARCH function and HISTORY function.
	Beep	ON, OFF selection
Power Management	Backlight OFF	Invalid, 5 min, 15 min, 30 min, 60 min Note: End of operation →After the [Set time] has elapsed → Light OFF
	Backlight Brightness	High, medium, low
Calibration	Auto Calibration	Automatic calibration (calibration of full scale, offset, and linearity of built-in ADC) is performed at startup and when the ambient temperature changes by 5 °C.
	Self-calibration	User Operation
Auto Setup		Yes
Kensington Lock		Rear Side

3.12 Fan Motor

Table 3.12 Fan motor

Item		Specifications
Fan Motor	Dimensions	120 mm × 120 mm
	MTBF	70,000 hours (40 °C, 55%Rh)

3.13 Power Source

Table 3.13 Power Source

Item	Specifications
Power Voltage Range/ Frequency	100 to 240 V ±10%, 50 / 60 Hz
Power line consumption	360 VA (325 W)
Standby power consumption	34 VA (9 W)
Insulation Resistance	500 VDC 100 MΩ or more
Hi-Pot Test	1500 VAC for 2 seconds 1 mA or less

3.14 Physical Characteristics

Table 3.14 Physical characteristics

Item	Specifications
Dimensions (W x H x D)	445 (W) x 324.6 (H) x 200 (D)
Weight	11.5 kg

3.15 Environmental Specifications

Table 3.15 Environmental specifications

Item		Specifications
Temperature	Operating	0 °C to +40 °C
	Performance guarantee	+10 °C to +35 °C
	Non-operating	–20 °C to +60 °C
Humidity	Operating	Relative humidity 5% to 80% (≤ 30 °C, No condensation) Relative humidity 5% to 55% (≤ 40 °C, No condensation)
	Non-operating	5% to 80% Relative humidity (No condensation)
Warm up Operation		20 minutes or more
Altitude	Operating	Up to 2,000 m

3.16 Compliance Information

Table 3.16 Compliance Standards

Directive	Description
Low Voltage Directive (Safety)	EN61010-1: 2010/A1: 2019 Pollution degree 2 Overvoltage category (installation category) II
EMC Directive	EN61326-1: 2013 (Group1,ClassA) EN61000-3-2: 2014 EN61000-3-3: 2013
RoHS Directive	EN IEC 63000: 2018

3.17 Accessory

Table 3.17 Accessory List

Item	Quantity
Front Panel Cover	1
Probe PML711i-R0	4
Power Cord	1
Cord Strap	1
Manuals	Manual CD (Instruction Manual, Remote Control Manual and Readme) 1
	User's Guide 1
Accessory Storage Case	1

3.18 External Dimensions

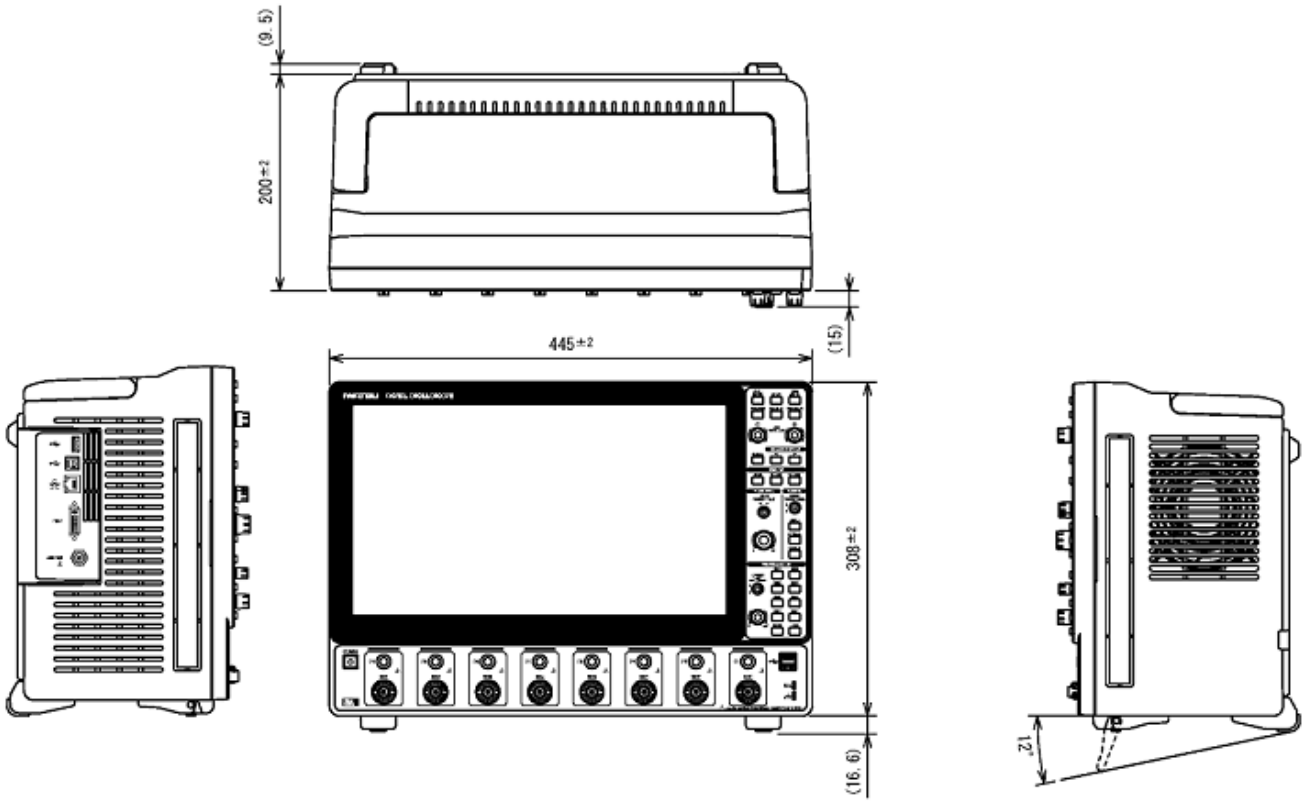


Figure 3.1 Example of DS-8108

○Unit: mm

○Regarding the difference between the 8CH model and the 4CH model, the number of CH input terminals, the number of probe power connectors, and the number of Vertical CH buttons are different from 8 for the 8CH model and 4 for the 4CH model.

Chapter 4 Appendix

4.1 Format of Waveform Data

You can save waveform data to a file in text format or binary format. The extension is csv for text format and bin for binary format.

Table 4.1 Format of waveform data

Format	Setting		Description
Text (ASCII)	Header	None	Do not output the header.
		Yes	Output the header.
	Delimiter		Select the delimiter for text output from commas, spaces, or tab.
	Time data	None	Do not output time data.
		Yes	Output time data together with waveform data.
Binary	Saving format		Select the save format from bytes (8 bits) and words (16 bits).

4.1.1 Text (ASCII)

When saving waveform data in text format, the format differs for channels, Math (excluding FFT and Memory), and Math (FFT).

4.1.1.1 Channel

The table below shows the contents of the waveform information saved as the header of the CSV file when the channel waveform data is saved in text format.

Table 4.2 Contents of Header (waveform information) when saving channel waveform data in text format

Item	Description	Example (when the delimiter is a comma)
ModelName	Model name	ModelName,DS-8108
FileVersion	Format version number	FileVersion,1
AcquisitionTime	Time when the waveform was acquired	Acquisition Time,2020/04/21 10:30:15.7
Time/div(second)	Time axis range [s/div]	Time/div(second),10.0E-6
Delay(second)	Delay [s]	Delay(second) ,0.0000E+00
Delta(second)	Sampling period [s]	Delta(second),8.00E-6
Acquisition Mode	Normal Peak Detect Average High Resolution Sin(x)/x Interpolation	Acquisition Mode,Normal
CHx Display	Whether the CHx waveform has been acquired (x is the channel number)	CH1 Display,On
CHx Volt/div	CHx voltage axis range (x is channel number)	CH1 Volt/div,500E-3
CHx Offset	Offset voltage of CHx (x is channel number)	CH1 Offset,-10.0E-3
CHx Coupling	CHx coupling (x is the channel number) AC1M: AC1MΩ GND: the ground level DC1M: DC1MΩ DC50: DC50Ω	CH1 Coupling,DC1M
Points	Number of waveform points	Points,16

The format of waveform data of text format is as shown in the table below. When outputting time data, output in seconds in the first column. The waveform data of each channel is output as a voltage value in order of channel number from the left. Channels that have not acquired waveform data output only the delimiter.

Table 4.3 Binary Format of channel waveform data

```
Time,Ch1,Ch2,Ch3,Ch4,
-5.11351E-05,-9.90977E-01,-5.37109E-03,-4.95313E-03,,
-4.31351E-05,-9.88535E-01,-5.12695E-03,-5.19727E-03,,
-3.51351E-05,-9.81211E-01,-7.08008E-03,-3.48828E-03,,
-2.71351E-05,-9.84873E-01,-8.54492E-03,-1.53516E-03,,
-1.91351E-05,-9.90977E-01,-6.59180E-03,-7.15039E-03,,
-1.11351E-05,-9.93418E-01,-7.81250E-03,-6.41797E-03,,
-3.13505E-06,-9.95859E-01,-3.90625E-03,-8.37109E-03,,
4.86495E-06,9.93887E-01,-4.63867E-03,-5.19727E-03,,
```

4.1.1.2 Math (excluding FFT and Memory)

When saving Math (excluding FFT and Memory) waveform data in text format, Table 4.4 shows the waveform information saved as the header of the CSV file.

Table 4.4 Contents of Header (waveform information) when saving Math (excluding FFT and Memory) waveform data in text format

Item	Description	Example (when the delimiter is a comma)
ModelName	Model name	ModelName,DS-8108
FileVersion	Format version number	FileVersion,1
AcquisitionTime	Time when the waveform was acquired	Acquisition Time,2020/04/21 10:30:15.7
Time/div(second)	Time axis range [s/div]	Time/div(second),10.0E-6
Delay(second)	Delay [s]	Delay(second) ,0.0000E+00
Scale	Scale	Scale,100E-03
Position	Position	Position,0.00E+00
Type	Math Type	Type,ADD
Points	Number of waveform points	Points,1502

The format of waveform data in text format is shown in Table 4.5. When time data is output, it is output in seconds in the first column.

Table 4.5 Binary Format of Math (excluding FFT and Memory) waveform data

```
Time,Math1
-5.11351E-05,-4.95313E-03
-4.31351E-05,-5.19727E-03
-3.51351E-05,-3.48828E-03
-2.71351E-05,-1.53516E-03
-1.91351E-05,-7.15039E-03
-1.11351E-05,-6.41797E-03
-3.13505E-06,-8.37109E-03
4.86495E-06,-5.19727E-03
```

4.1.1.3 Math (FFT)

When saving Math (FFT) waveform data in text format, Table 4.6 shows the waveform information saved as the header of the CSV file.

Table 4.6 Contents of Header (waveform information) when saving Math (FFT) waveform data in text format

Item	Description	Example (when the delimiter is a comma)
ModelName	Model name	ModelName,DS-8108
FileVersion	Format version number	FileVersion,1
AcquisitionTime	Time when the waveform was acquired	Acquisition Time,2020/04/21 10:30:15.7
Frequency Scale	Frequency scale [Hz/div]	Frequency Scale,31.2E+06
Frequency Position	Always 0 Hz	Frequency Position,0.00E+00
Scale	Scale [dBm/div]	Scale,10.3E+00
Position	Position [dBm]	Position,26.5E+00
Type	Math Type	Type,FFT
Points	Number of waveform points	Points,753

The format of waveform data in text format is shown in Table 4.7. When frequency data is output, it is output in Hz in the first column.

Table 4.7 Binary Format of Math (FFT) waveform data

```
Frequency,Math1
0.00000E+00,1.62947E+01
4.15559E+05,7.70263E+00
8.31117E+05,1.90613E+01
1.24668E+06,2.06788E+01
1.66223E+06,1.19222E+01
2.07779E+06,7.37463E+00
2.49335E+06,5.70888E+00
```

4.1.2 Binary

Binary format waveform data is saved in channel order with Format in the Table 4.8. The byte order is little endian.

Table 4.8 Binary format of waveform data

Memory area	Size
Number of bytes of CH1 waveform data: N_1	4 bytes
CH1 waveform data	N_1 bytes
Number of bytes of CH2 waveform data: N_2	4 bytes
CH2 waveform data	N_2 bytes
Number of bytes of CH3 waveform data: N_3	4 bytes
CH3 waveform data	N_3 bytes
Number of bytes of CH4 waveform data: N_4	4 bytes
CH4 waveform data	N_4 bytes
Number of bytes of CH5 waveform data: N_5	4 bytes
CH5 waveform data	N_5 bytes
Number of bytes of CH6 waveform data: N_6	4 bytes
CH6 waveform data	N_6 bytes
Number of bytes of CH7 waveform data: N_7	4 bytes
CH7 waveform data	N_7 bytes
Number of bytes of CH8 waveform data: N_8	4 bytes
CH8 waveform data	N_8 bytes

The Table 4.9 shows an example when the save format is set to word (16 bits).

Table 4.9 Example of binary format waveform data when the save format is word (16-bit)

Binary format waveform data		Description
Address	Value	
00000000	c6	Number of bytes of CH1 waveform data: 002dc6c6 (Base 16) 3000006 (Base 10)
00000001	c6	
00000002	2d	
00000003	00	
00000004	a0	CH1waveform data#1: a0a0 (Base 16)
00000005	a0	
00000006	20	CH1waveform data#2: 9f20 (Base 16)
00000007	9f	
…	…	…
002dc6c8	90	CH1waveform data#1500003: a190 (Base 16)
002dc6c9	a1	
002dc6ca	c6	Number of bytes of CH2 waveform data: 002dc6c6 (Base 16) 3000006 (Base 10)
002dc6cb	c6	
002dc6cc	2d	
002dc6cd	00	
002dc6ce	e0	CH2waveform data#1: b0 e0 (Base 16)
002dc6cf	b0	
…	…	…

The formula for converting waveform data to a voltage value is as shown in the Table 4.10.

Table 4.10 Binary format waveform data to voltage value conversion formula

Format	Conversion formula to voltage value
Bytes(8bit)	Waveform data÷25.6×Voltage axis range-offset voltage
Word(16bit)	Waveform data÷6553.6×Voltage axis range-offset voltage

DS-8108/DS-8104/DS-8058/DS-8054/DS-8038/DS-8034

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