DLM5034, DLM5038, DLM5054, DLM5058

Mixed Signal Oscilloscope

USER'S MANUAL

Features Guide

YOKOGAWA
Yokogawa Test & Measurement Corporation

IM DLM5058-01EN
4th Edition

Thank you for purchasing the DLM5034, DLM5038, DLM5054, or DLM5058 Series Mixed Signal Oscilloscope. This features guide contains useful information about the features of this instrument. To ensure correct use, please read this manual thoroughly before operation. After reading this manual, keep it in a safe place. The manuals for this instrument are listed on the next page. Please read all manuals.

Contact information of Yokogawa offices worldwide is provided on the following sheet.

Document No.	Description
PIM 113-01Z2	List of worldwide contacts

Notes

- The contents of this manual are subject to change without prior notice as a result of improvements to the product's performance and functionality. Refer to our website to view our latest manuals.
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Revisions

- September 2020 1st Edition
- March 2021 2nd Edition
- April 2023 3rd Edition
- June 2025 4th Edition

4th Edition: June 2025 (YMI)
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Manuals

The following manuals, including this one, are provided as manuals for this instrument. Please read all manuals.

Manuals Included with the Product

Manual Title	Manual No.	Description
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope Getting Started Guide	IM DLM5058-03EN	This guide explains the handling precautions, common operations, troubleshooting measures, and specifications of this instrument.
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope Operation Guide	IM DLM5058-04EN	Explains the basic operations of this instrument. Operations are described in steps from “Preparation” to “Displaying Waveforms,” “Measuring Waveforms,” and “Saving Screen Captures.”
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope Request to Download Manuals	IM DLM5058-73Z2	Describes the manuals provided on the website.
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope	IM DLM5058-92Z1	Document for China
Safety Instruction Manual	IM 00C01C01-01Z1	Safety manual (European languages)

Manuals Provided on the Website

Download the following manuals from the YOKOGAWA website.

Manual Title	Manual No.	Description
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope Features Guide	IM DLM5058-01EN	This document. This manual explains all the instrument’s features other than the communication interface features.
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope User’s Manual	IM DLM5058-02EN	The manual explains how to operate this instrument.
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope Communication Interface User’s Manual	IM DLM5058-17EN	The manual explains the functions of this instrument’s communication interface, how to configure it, and the commands used to control this instrument from a PC through the interface.

For details on downloading manuals, see Request to Download Manuals (IM DLM5058-73Z2). To view the PDF data, you need Adobe Acrobat Reader or a software application that can open PDF data.

The “EN”, “Z1”, and “Z2” in the manual numbers are the language codes.

Online Help

The content similar to the Features Guide, IM DLM5058-01EN, is included in this instrument as a help file (some the content may be omitted). For instructions on how to use the help, see section 3.10 in the *Getting Started Guide*, IM 5058-03EN.

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1 Vertical Axis (Analog Signal)

You can configure the vertical scale, vertical position, input coupling, probe attenuation, linear scaling, and bandwidth limit settings of the CH1 through CH8 input signals.
If you are using a probe that is compatible with this instrument's probe interface, the instrument automatically configures the input impedance (50 Ω or 1 MΩ) and the probe attenuation.

Turning the Display On and Off (Display)

Select whether show or hide each channel's input signal waveform.

- ON: The waveform is shown.
- OFF: The waveform is hidden.

Input Coupling (Coupling)

You can change the coupling used to input analog signals into the vertical (voltage) control circuit.
Select one of the following input coupling options.

AC

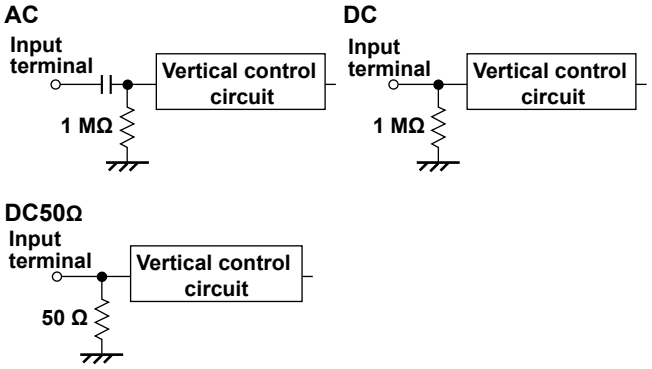
Displays only the AC component of the input signal. The input impedance is 1 MΩ.

DC

Displays both the AC and DC components of the input signal. The input impedance is 1 MΩ.

DC50

Displays both the AC and DC components of the input signal. The input impedance is 50 Ω. Pay attention because the maximum input voltage (current) is small.



If you change the input coupling setting while waveform acquisition is stopped, the input coupling on the instrument is actually changed when waveform acquisition is executed the next time. Be careful of the maximum input voltage.

Probe Attenuation (Probe)

When using a probe, the instrument's attenuation ratio setting must be aligned with the probe attenuation so that the voltage (current) and scale values are displayed correctly. Set the attenuation ratio to match the probe attenuation.

Probe Type (Type)

Select the type of probe to set the attenuation ratio of.

- Voltage: Voltage probe
- Current: Current probe

Attenuation Ratio (Attenuation)

Select the attenuation ratio from the following.

Voltage probe

0.001: 1, 0.002: 1, 0.005: 1, 0.01: 1, 0.02: 1, 0.05: 1, 0.1: 1, 0.2: 1, 0.5: 1, 1: 1, 2: 1, 5: 1, 10: 1, 20: 1, 50: 1, 100: 1, 200: 1, 500: 1, 1000: 1, 2000: 1

Current probe

0.001 A: 1 V (1000 V/A), 0.002 A: 1 V (500 V/A), 0.005 A: 1 V (200 V/A), 0.01 A: 1 V (100 V/A), 0.02 A: 1 V (50 V/A), 0.05 A: 1 V (20 V/A), 0.1 A: 1 V (10 V/A), 0.2 A: 1 V (5 V/A), 0.5 A: 1 V (2 V/A), 1 A: 1 V (1 V/A), 2 A: 1 V (0.5 V/A), 5 A: 1 V (0.2 V/A), 10 A: 1 V (0.1 V/A), 20 A: 1 V (0.05 V/A), 50 A: 1 V (0.02 V/A), 100 A: 1 V (0.01 V/A), 200 A: 1 V (0.005 V/A), 500 A: 1 V (0.002 V/A), 1000 A: 1 V (0.001 V/A), 2000 A: 1 V (0.0005 V/A)

Using a probe has the following advantages.

- Prevents the disturbance of the voltage and current of the circuit being measured.
- Allows signals to be applied with no distortion.
- Expands the voltage range that the instrument can measure.

Automatic Zero Adjustment of Current Probes (Probe Zero CAL)

Automatic zero adjustment of current probes can be executed when all the following conditions are met.

- A current probe compatible with the instrument's probe interface is connected to the signal input terminal.
- The input coupling is set to DC.

If the current probe's residual offset is large, an error may occur when automatic zero adjustment is executed. If this happens, adjust the current probe's residual offset to zero.

Demagnetization and Automatic Zero Adjustment of Current Probes (DEMAG & ZeroCAL)

Demagnetization and automatic zero adjustment of current probes can be executed when all the following conditions are met.

- A current probe with a YOKOGAWA probe interface (e.g., PBC100, PBC050) is connected to the signal input terminal.
- The input coupling is set to DC.

When you demagnetize and perform automatic zero adjustment on a current probe, do not clamp the conductor. If you demagnetize a current probe while the conductor is clamped, the current that flows through the conductor as a result of demagnetization may damage components of the DUT circuitry.

Deskew (Deskew)

You can adjust for the time offsets (skew) between the CH1 to CH8 signals, which are caused by the use of different types of probes, and monitor the signals. You can adjust each channels (CH1 to CH8) separately.
Selectable range: −1000.0 ns to 1000.0 ns (0.01 ns resolution)

Inverted Waveform Display (Invert)

Waveforms can be inverted across the waveform vertical position. The ground level mark is also inverted.
Only the display is inverted. Cursor measurements, automated measurement of waveform parameters, and computation functions are performed on the non-inverted waveform. The trigger function is also executed on the non-inverted waveform.

Linear Scaling (LinearScale)

The following computation is performed based on the specified scaling coefficient A and offset B, and cursor measurement values and automated measurement values of waveform parameters are displayed using the scaled values. You can assign units to scaled values.
By using this function, you can multiply the voltage divider ratio of the external voltage divider to the measured values of this instrument and convert measured voltage into current.

Y(Unit)=AX + B

X: Value before scaling
Y: Value after scaling

Turning Linear Scaling On and Off (Mode)

Set whether to perform linear scaling.

- ON: Linear scaling is performed.
- OFF: Linear scaling is not performed.

Unit (Unit)

You can set the unit using up to four alphanumeric characters.

Scaling Coefficient (A) and Offset (B)

The selectable ranges of scaling coefficient A and offset B are as follows:

Selectable of A and B	−10.000E+30 to +10.000E+30	
Default settings	A	1.0000E+00
	B	0.0000E+00

Label Display (Label)

You can assign labels using up to 8 characters to be displayed.

Turning Label Display On and Off (Display)

- ON: Shows labels
- OFF: Hides labels

Label (Name)

Set the label name when you set the label display to ON.

Bandwidth Limit (Bandwidth Limit)

You can set a upper bandwidth limit on the analog signal for each channel.
This allows you to observe waveforms with components above the specified frequency removed.
Select the frequencies to limit from the following.
FULL (no bandwidth limit), 200 MHz, 150 MHz, 100 MHz, 20 MHz, 10 MHz, 5 MHz, 2 MHz, 1 MHz, 500 kHz, 250 kHz, 125 kHz, 62.5 kHz, 32 kHz, 16 kHz, 8 kHz

When high resolution mode is on, the bandwidth limit is set at 200 MHz even when bandwidth limit is set to FULL.

Offset (Offset)

If you set an offset when measuring an analog signal that is riding on top of a given voltage (or current), the given voltage (or current) is subtracted from the input signal. This allows you to only view the changes in the signal at a higher vertical scale setting. You can set the offset for each channel.

Selectable Range for Voltage

Input Coupling	Voltage Scale (With probe = 1:1)	Selectable Offset Voltage Range
AC/DC	500 µV/div to 50 mV/div	−1.0 V to 1.0 V
	0.1 V/div to 0.5 V/div	−10.0 V to 10.0 V
	1 V/div to 10 V/div	−100.0 V to 100.0 V
DC50	500 µV/div to 50 mV/div	−1.0 V to 1.0 V
	0.1 V/div to 1 V/div	−5.0 V to 5.0 V

You can set the offset in 0.01 div steps. For 500 µV/div, you can set the offset in 5 µV steps.

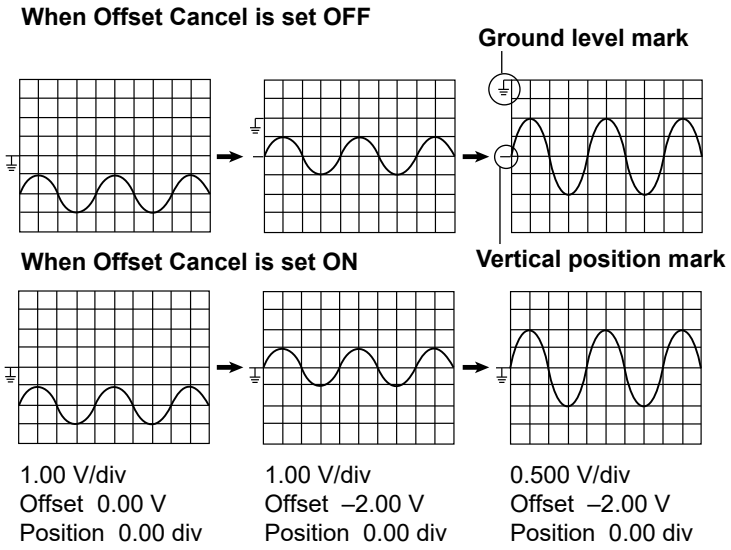
Resetting the Offset

Press the RESET key to set the offset value to 0 V.

Offset Cancel (Offset Cancel)

You can set whether or not to apply the specified offset to various measured values.
The offset-cancel feature ON/OFF setting applies to all channels. The default setting is off.

- OFF: The specified offset is not applied to the result of cursor measurements, computations, and automated measurement of waveform parameters. The offset is not subtracted from the input signal, and various measurements are performed. The vertical position on the screen corresponds to the offset.
- ON: The specified offset is applied to the result of cursor measurements, computations, and automated measurement of waveform parameters. The offset is subtracted from the input signal, and various measurements are performed. The vertical position is set to zero.

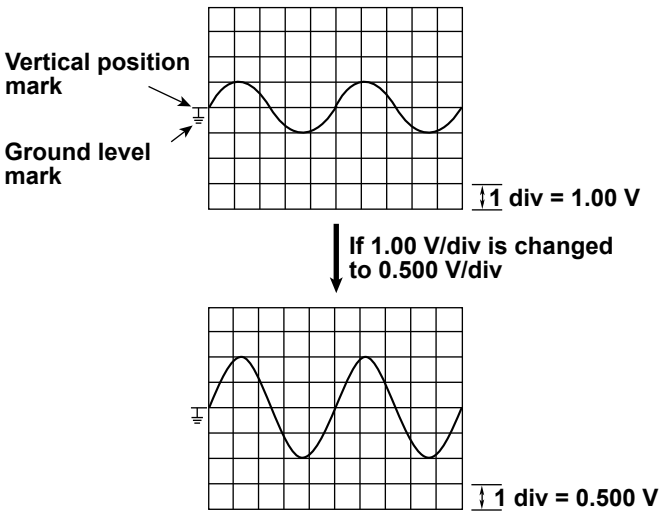


- The offset setting applies to all input coupling settings (AC, DC, DC50).
- If you change the probe attenuation, the vertical scale settings change the values that have been scaled with the new attenuation ratio.
- The offset value does not change even if you change the vertical scale. However, if the offset value goes outside the selectable range, the offset is set to the maximum or minimum value in the vertical scale range. If you do not change the offset and set the vertical scale back to its original value, the offset returns to its original value.

Vertical Scale (SCALE knob)

The vertical scale is used to adjust the displayed waveform amplitude so that you can easily view signals. Set the vertical scale by voltage per grid square (V/div) or current per grid square (A/div) on the screen.
Set the vertical scale using the SCALE knob for each channel.
The SCALE knob is shared between channels. Press the CH1 to CH8 keys to select the channel that you want to set the vertical scale for. The LED between the SCALE and POSITION knobs illuminates in the color assigned to the selected channel (the color enclosing the CH key).

Setup Example



The SCALE knob has a push switch. If you push the SCALE knob, the FINE indicator illuminates, and you can set the vertical scale with higher resolution.

Measurement Resolution and Effective Data Range

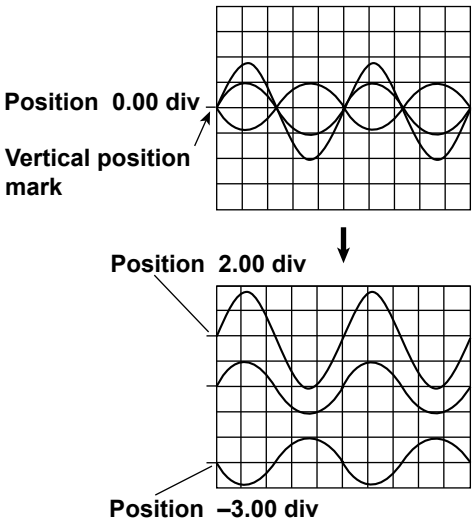
This instrument uses an 8-bit A/D converter to sample the input signal. The instrument's effective data range is 250 levels (LSB). Waveforms are displayed using 25 levels per division on the screen. The effective data range is ±5 divisions from the center of the screen, but only up to ±4 divisions of data can be displayed on the screen. If you move the vertical position after stopping waveform acquisition, you can change the display range of the effective data.

Vertical Scale Setting

To measure the voltage or current with high accuracy, increase the vertical scale so that the input signal is measured with the largest possible amplitude within the effective data range.
If you display multiple waveforms (set the vertical scale to a low value) so that they do not overlap without dividing the screen, the resolution of the A/D converter cannot be used to its fullest potential. To make accurate measurements, divide the screen, and set the vertical scale of each waveform to a high value.

Waveform Vertical Position (POSITION knob)

You can move the display position (vertical position) of each waveform in the range of ±4 divisions.
The vertical scale changes with the vertical position (mark) at the center.
Set the vertical position using the POSITION knob for each channel.
The POSITION knob is shared between channels. Press the CH1 to CH8 keys to select the channel that you want to set the vertical position for. The key corresponding to the selected channel illuminates, and the LED between the SCALE and POSITION knobs illuminates in the color assigned to the selected channel (the color surrounding the CH key).



After stopping signal acquisition, data falling outside the measurement range when you change the vertical position is handled as overflow data.

Channel Utility (CH UTIL)

The channel utility includes useful features for configuring multiple channels, such as showing and hiding the waveforms of analog signal input channels at once and copying channel information.

All ON/All OFF (Display)

You can show or hide the waveforms of analog signal input channels, CH1 to CH8, at once.

You can also set the waveforms of logic signal input ports. For the waveforms of logic signal input ports, see the channel utility explanation in chapter 2, “Vertical Axis (Logic Signal).”

▶ See here.

- **All ON (All ON)**
  Shows all channels at once.
- **All OFF (All OFF)**
  Hides all channels at once.

Copying Channel Information (Copy CH)

You can copy the setup information of an analog signal input channel to other analog signal input channels.

- **Copy Source Channel (Source)**

  From one of the settings below, select the analog signal input channel to copy from.
  CH1 to CH8

- **Copy Destination (Destination)**

  From one of the settings below, select the analog signal input channels to copy to.
  All or one or more channels from CH1 to CH8

- **Copy (Copy)**

  Copies the setup information. Copy is not performed on the channel that is set as the copy source.

Setup Information That Is Copied

Vertical axis settings except the label along with the trigger level, coupling, rejection, and window comparator settings are copied.

2 Vertical Axis (Logic Signal)

You can set the logic signals' vertical display ranges, vertical positions, bits, bus displays, state displays, display order, deskewing, channel utility, and so on. Logic signals are applied through the logic signal input port on the front panel.

Logic Signal Input Ports

This instrument has the following logic signal input ports: LOGIC (A) to LOGIC(D). Each port can receive 8-bit logic signals.
On models without the /L32 option, you can combine ports A and B and use them as large as a 16-bit logic signal port. On models the /L32 option, you can combine ports A, B, C, and D and use them as large as a 32-bit logic signal port.

Turning the Display On and Off (Display)

Select whether to show or hide the logic signal waveform.

- ON: The waveforms are shown.
- OFF: The waveform is hidden.

Setting the Bits (Bit Setup)

For each bit, you can turn on or off the display, set the label (name), and threshold level (Threshold, Level). You can set whether to set the threshold level separately for each bit (Threshold Type) ▶ See here. and noise rejection (Noise Rejection) ▶ See here..

Turning the Display On or Off

For each bit, you can turn the display on or off. For each logic port, LOGIC(A) to LOGIC(D), you can also turn on or off the display of all bits at once. LOGIC(C) and LOGIC(D) are available on models with the /L32 option.

Label (Name)

Set the label that appears when the bit display is turned on using up to eight characters.

Threshold Level (Threshold, Level)

Set the level (threshold level) of the logic signal to detect, high or low.

Preset (Threshold)

Selecting from the following presets automatically sets the threshold level.
If you select Userdef, you can set the level in the range of −10 V to 10 V in 0.1 V steps.

CMOS(5 V)	2.5 V
CMOS(3.3 V)	1.6 V
CMOS(2.5 V)	1.2 V
CMOS(1.8 V)	0.9 V
ECL	−1.3 V
Userdef	−10.0 V to 10.0 V

Setting Specific Threshold Levels (Level)

The selectable range varies depending on the logic probe that you use.

- Model 701988: ±40 V (in 0.05 V steps)
- Model 701989: ±6 V (in 0.05 V steps)

Setting the Threshold Level for Each Bit (Threshold Type)

When the 701989 logic probe is connected, you can select whether to set the threshold level separately for each bit.

- All: Set the threshold level of all bits to the same value
- Each: Set the threshold level for each bit

When you connect one of the following logic probes to the instrument, Threshold Type is set automatically.

- Model 701988: Fixed to All. The setup menu does not appear.
- Model 701989: Each (select All or Each)

Noise Rejection (Noise Rejection)

When the 701989 logic probe is connected, you can apply hysteresis to the threshold level so that the high and low states do not change as long as the signal level changes within that range.
Select the hysteresis from one of the following settings below.

	Hysteresis of approximately 100 mV around the threshold level*
	Hysteresis of approximately 250 mV around the threshold level*

* The above values are approximate values. They are not strictly warranted.

The hysteresis is fixed at approximately 80 mV for the 701988 logic probe, so the setup menu will not appear.

Bus Display (Bus1, Bus2, Bus3, Bus4)

Logic bit signals can be displayed as a bus signal.

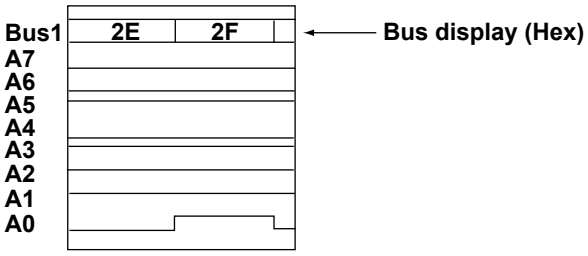
- Models without the /L32 option
  All 16 bits, A0 to A7 and B0 to B7, are assigned to Bus1 and Bus2, respectively.
- Models with the /L32 option
  All 32 bits, A0 to A7, B0 to B7, C0 to C7, and D0 to D7, are assigned to Bus1 to Bus4, respectively.

Turning the Display On and Off (Display)

You can turn the bus display on and off. If you turn it on, a bus display appears according to the specified bus bit assignments (Assignment), label (Name), and format (Format).

- ON: The bus display is shown.
- OFF: The bus display is hidden.

LOGIC(A) Example



Bus Bit Assignments (Assignment)

Set which bits to assign to the bits on the bus (from the MSB to LSB). The bit assignments here are used to measure the bus value during cursor measurement.

Edit Menu

In the assignment edit menu, you can select a position in the bus to assign a bit, delete an assigned bit, and so on.

Bits

Select the bit to assign from the group of bits.

Label (Name)

Set the label that appears when the bus display is turned on using up to eight characters.

Format (Format)

Select the format for displaying the bus.

- Bin: Binary notation
- Hex: Hexadecimal notation

State Display (State)

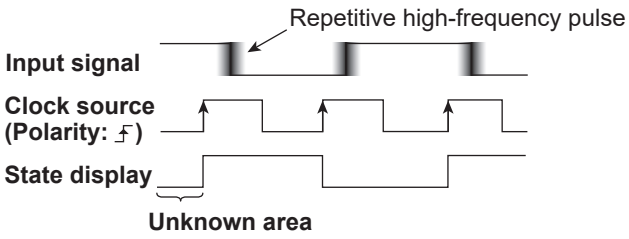
The state display shows logic signal data that has been sampled on the edge of the signal specified as the clock source. Even when the input signal changes, the state is retained until the clock source edge changes.

Display ON/OFF (State)

You can turn the state display on and off. If you turn it on, the state is shown according to the specified clock source (Clock) and clock source polarity (Polarity).

- ON: The state display is shown.
- OFF: The state display is hidden.

State Display Example



Clock Source (Clock)

Select from the following.

Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7)

C0 to C7 and D0 to D7 are available on models with the /L32 option.

Clock Source Polarity (Polarity)

Select the clock source polarity.

⎍	When the clock source changes from low to high
⎎	When the clock source changes from high to low
⎍⎎	When the clock source changes from low to high or from high to low

State Assignment (Assignment)

You can set whether to apply the state display separately for the bus and each bit. You can also set them all at once.

Display Order of Bits and the Buses (Bit Order)

Set the vertical display order of bits and the bus on the screen. Select the bit or bus to move and then specify the destination. You can also reverse the display order of the bits and buses in the specified range.

Deskewing (Deskew Setup)

You can adjust for the time offsets (skew) between the logic signal and other signals, which are caused by the use of different types of probes, to measure signals. For each logic port, LOGIC(A) to LOGIC(D), set deskewing. LOGIC(C) and LOGIC(D) are available on models with the /L32 option.
Range: −1000.0 ns to 1000.0 ns (0.01 ns resolution)

Display Range (SCALE knob)

You can set the logic signal's vertical display range to one of three levels.
Press LOGIC, and use the SCALE knob to set the range while the key is illuminated.

Vertical Position (POSITION knob)

You can move the logic signal's vertical display position within ±4 divisions.
Press LOGIC, and use the POSITION knob to set the position while the key is illuminated.

Channel Utility (CH UTIL)

All ON/All OFF (Display)

You can show or hide the waveforms of logic signal input ports, LOGIC(A) to LOGIC(D), at once.
LOGIC(C) and LOGIC(D) are available on models with the /L32 option.

You can also set the waveforms of analog signal input channels. For the waveforms of analog signal input channels, see the channel utility explanation in chapter 1, "Vertical Axis (Analog Signal)."

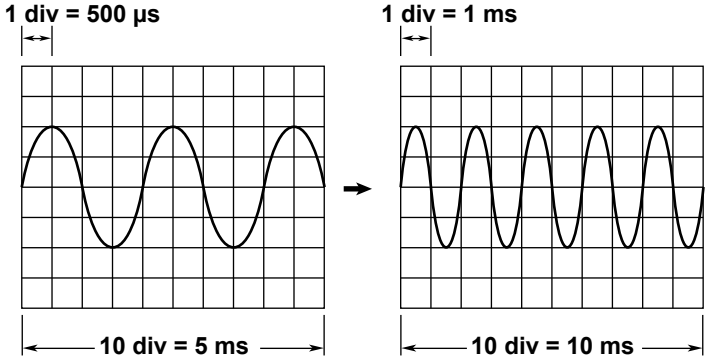
▶ See here.

- **All ON (All ON)**
  Shows at once the waveforms of the logic signal input port to which a logic probe is connected.
- **All OFF (All OFF)**
  Hides all signals at once.

3 Horizontal Axis (Time Axis)

Time Scale (TIME/DIV knob)

Set the time scale as a length of time per grid division. You can adjust the amount of time that you want to display waveforms for by setting the time scale. Because the horizontal display range is 10 divisions, the amount of time displayed is equal to the TIME/DIV setting × 10. The selectable range is 1 ns/division to 500 s/division.



Relationship between the Time Scale, Record Length, and Sample Rate

The relationship between the time scale, record length, and sample rate is as follows:
When the record length and the time scale are set so that the sample rate is at the maximum rate, if you decrease the time scale, the record length is reduced.

Sample rate = Record length/(time scale [s/div] × 10 [div])

When you change the time scale, the sample rate and the record length stored in the acquisition memory also change. For details, see appendix 1, “Relationship between the Time Scale, Record Length, and Sample Rate” in the *Getting Started Guide*, IM DLM5058-03EN.

Time Scale and Roll Mode Display

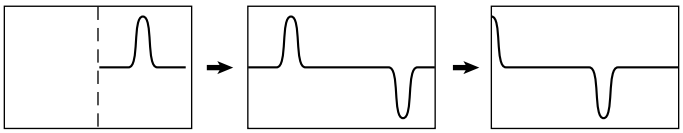
When the following conditions are met, if you set the time scale to one of the settings in the following table, the instrument switches to roll mode display.

- The acquisition mode is not set to Average.
- The trigger mode is Auto, Auto Level, or Single.

Record Length	Time Scale
2.5 Mpoints or less	100 ms/div to 500 s/div
5 Mpoints	200 ms/div to 500 s/div
12.5 Mpoints	500 ms/div to 500 s/div
25 Mpoints	1 s/div to 500 s/div
50 Mpoints	2 s/div to 500 s/div
125 Mpoints	5 s/div to 500 s/div
250 Mpoints	10 s/div to 500 s/div
500 Mpoints	20 s/div to 500 s/div

Roll mode display

In roll mode, the displayed waveform is not updated using triggers. Rather, the oldest data is deleted as new data is acquired, and the waveform flows from the right to the left of the screen. This mode is useful for observing low-frequency signals or signals that change slowly.



About the Roll-Mode Display

- The display is set to roll mode also when the trigger mode is set to single, but the roll mode display stops when the instrument triggers.
- The instrument will not display computed waveforms that have been generated through user-defined computation while it is acquiring waveforms in roll mode. The instrument will display the computed waveforms after it stops acquiring waveforms.
- If normal statistical processing (Continuous), serial bus analysis, waveform histogram display, or harmonic analysis is being executed, automatically measured parameter values are not displayed when waveforms are being acquired in roll mode. Measured values are shown when a trigger occurs and the roll mode display stops.
- If the record length is set such that waveform acquisition operates in single mode,* neither computed waveforms (MATH waveforms) nor automated measurement values of waveform parameters are shown while waveform acquisition in roll mode is in progress. The instrument will display the computed waveforms and automatically measured values after it stops acquiring waveforms.

  * The record length that causes waveform acquisition to operate in single mode varies depending on whether a memory expansion option (/M1, /M2, /M1S, /M2S) is available. If no memory option is available, the record length is 25 Mpoints or more. If the /M1 or /M1S option is available, it is 50 Mpoints or more. If the /M2 or /M2S option is available, it is 125 Mpoints or more.

4 Triggering

Triggers are events used to display waveforms. A trigger occurs when the specified trigger condition is met, and a waveform is displayed on the screen.

Trigger mode (Trigger Mode)

The trigger mode determines the conditions for updating the displayed waveforms. There are five trigger modes.

Auto Mode (Auto)

If the trigger conditions are met within a timeout period, the instrument updates the displayed waveforms on each trigger occurrence. If not, this instrument automatically updates the displayed waveforms. The timeout period is approximately 100 ms or the time corresponding to 10 divisions on the time axis, whichever is larger. If the time scale is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled.

Auto Level Mode (Auto Level)

If a trigger occurs before a timeout, the instrument updates the waveform in the same way that it does in Auto mode.
If a trigger does not occur before a timeout, the instrument automatically changes the trigger level to the center value of the trigger source amplitude, triggers on that value, and updates the displayed waveform. Auto Level mode is valid when the trigger source is set to a channel from CH1 to CH8. For all other cases, Auto Level mode operates in the same way as Auto mode.
If the time scale is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled.

Normal Mode (Normal)

The instrument updates the waveform display only when the trigger conditions are met. If no triggers occur, the display is not updated. If you want to view waveforms that the instrument cannot trigger on, or if you want to check the ground level, use Auto mode.

N Single Mode (N Single)

The instrument acquires signals each time the trigger conditions are met until a specified number of signals have been acquired, stops acquisition, and displays all of the acquired signals. If no triggers occur, the display is not updated.

Single Mode

When the trigger conditions are met, the instrument updates the displayed waveform once and stops signal acquisition. When you press SINGLE on the front panel, the instrument acquires waveforms in Single mode.

▶ See here.

- The trigger mode setting applies to all trigger types.
- The trigger conditions that were used to acquire the displayed waveform appear at the upper right of the screen.
- If you set the trigger mode to Auto when using a trigger combination, the timeout only applies to the trigger A trigger conditions.
- If you are acquiring waveforms in Single mode when using repetitive sampling mode, waveform acquisition is repeated until the required number of display points is collected, and then acquisition stops.
- Repetitive sampling mode is not available in N Single mode. If you select N Single mode when repetitive sampling mode is selected, the sampling mode changes to interpolation.

Trigger Type (Type)

The following trigger types are available.

EDGE

- Edge trigger: Triggers on the edges of a single trigger source (a simple trigger).

ENHANCED

- Edge OR trigger: Triggers on the OR logic of multiple trigger source edges.
- Pattern trigger: Triggers on a pattern match, pattern mismatch, or pattern duration.
- Pulse Width trigger: Triggers on a trigger source pulse-width condition (such as More than, Less than, and Between).
- Rise/Fall Time trigger: Triggers on duration of the trigger rise or time (such as More than, Less than).
- Runt trigger: Triggers on a runt pulse or the duration of a runt pulse.
- Timeout trigger: Triggers when a timeout occurs before the end edge of a pulse.
- Window trigger: Triggers when the signal enters or exits from a specified range (window) or on the duration in which the signal stays within the range or outside the range.
- Window OR trigger: Triggers on the OR logic of multiple trigger sources entering or exiting from each specified range (window).
- Interval trigger: Triggers when the time condition of the signal period is met.
- Serial trigger* (FlexRay, CAN, CAN FD, LIN, CXPI, SENT, PSI5 Airbag, UART, I2C, SPI, User Define): Triggers on various serial bus signal conditions.
- TV trigger (NTSC, PAL, SDTV, HDTV, UserdefTV): Triggers on various TV signal conditions.

* The FlexRay, CAN, CAN FD, LIN, CXPI, SENT, PSI5 Airbag, UART, I2C, and SPI bus triggers are options.

- The active trigger, EDGE or ENHANCED, is the one whose key is illuminated.
- You can also configure the instrument to trigger on the combination of trigger A and trigger B, where trigger A is the trigger configured using the EDGE or ENHANCED key, and trigger B is the trigger configured using the B TRIG key. The combination trigger is active when the B TRIG key is illuminated.

▶ See here.

Forced Trigger [FORCE TRIG]

Pressing FORCE TRIG (SHIFT+B TRIG) on the front panel forces the instrument to trigger even when trigger conditions are not met.

Signal Type and Trigger Type Combinations

The signal type (analog or logic) determines what trigger types you can use.

		CH1 to CH8	Logic	Mixed
Edge		Yes	Yes	–
Edge OR		Yes	No	No
Pattern		Yes	Yes	Yes
Pulse Width		Yes	Yes	–
Rise/Fall Time		Yes	No	–
Runt		Yes	No	–
Timeout		Yes	Yes	–
Window		Yes	No	–
Window OR		Yes	No	No
Interval		Yes	Yes	–
Serial	FlexRay	Yes	No	–
	CAN	Yes	No	–
	CAN FD	Yes	No	–
	LIN	Yes	No	–
	CXPI	Yes	No	–
	SENT	Yes	Yes	–
	PSI5 Airbag	Yes	No	–
	UART	Yes	Yes	–
	I2C	Yes	Yes	No
	SPI	Yes	Yes	No
	User Define	Yes	No	No
TV		Yes	No	–

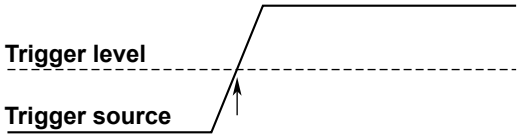
When the maximum record length is in use, CH2, CH4, CH6, CH8, and Logic (C0 to C7, D0 to D7) cannot acquire waveforms, but they can be used as trigger sources.

Basic Trigger Settings

- Trigger source: The trigger source signal.
- Trigger slope: Specifies which edge, rising or falling, the instrument will trigger on.
- Trigger level: The trigger determination level.
- Trigger position: The position where the trigger point will be displayed.
- Trigger delay: The delay from the trigger point.
- Trigger hold-off: The amount of time to hold off the next trigger detection.
- HF rejection: For rejecting high-frequency components in the trigger source.
- Noise rejection: The trigger level margin (the instrument does not trigger on changes in the signal level within this margin).

Edge Trigger [EDGE]

The instrument triggers on trigger source edges (rising or falling edges). A change in the waveform that causes it to pass through a trigger level is called an edge.



The instrument triggers here when the trigger edge is set to rising (↑).

Trigger Source (Source)

Trigger source refers to the signal used to determine whether the specified trigger conditions are met. Select from the following. The available settings vary depending on the model.

CH1 to CH8

A signal that is received through front-panel analog input terminals (the number of input terminals varies depending on the model).

Logic

A signal that is received through a front-panel logic signal input port (LOGIC(A) to LOGIC(D)).
A signal received through a logic input signal port is sampled at 1.25 GHz internally and used as a trigger source. You need to select the source bit (Source: A0 to A7, B0 to B7, C0 to C7, or D0 to D7).

* C0 to C7 and D0 to D7 are available on models with the /L32 options.

EXT (external trigger signal)

Set the source to EXT when using an external signal received through the external trigger input terminal (TRIGGER IN) on the rear panel as a trigger source.

LINE (the instrument's power source)

The instrument only triggers on the rising edge.

The settings that you need to configure vary depending on the selected trigger source as follows:

	CH1 to CH8	Logic	EXT	LINE
Slope	Yes	Yes	Yes	–
HF Rejection	Yes	–	–	–
Noise Rejection	Yes	–	–	–
Probe	–	–	Yes	–
Range	–	–	Yes	–
Source Bit	–	Yes	–	–
Level	Yes	Yes	Yes	–

External Trigger Probe Attenuation (Probe)

When you set the trigger source to EXT, set the probe attenuation (1:1 or 10:1).

External Trigger Input Range (Range)

When the trigger source is set to EXT, select the input range.
Select selectable ranges vary depending on the probe attenuation setting.

- 1:1: ±2 V or ±20 V
- 10:1: ±20 V or ±200 V

Trigger Level (Level)

Trigger level refers to the signal level used as a reference for detecting a signal's rising and falling edges or high and low states. With simple triggers such as the edge trigger, the instrument triggers when the trigger source level passes through the specified trigger level.
The analog signals (CH1 to CH8), logic signal (Logic), and external trigger (EXT) have different selectable trigger level ranges.

Analog Signals

Selectable range: 8 divisions within the screen
Resolution: 0.01 divisions (for example: 0.02 mV when the time scale is set to 2 mV/division)

Logic Signals

The selectable range varies depending on the logic probe that you use.

- Model 701988: ±40 V (0.05 V resolution)
- Model 701989: ±6 V (0.05 V resolution)

External Triggers

Range: ±2 V (±2 V range), ±20 V (±20 V range)
Resolution: 5 mV (±2 V range), 50 mV (±20 V range)

- The trigger level is set using the jog shuttle. If a single trigger source is used (Edge, Pulse Width, Rise/Fall Time, Runt, Timeout, Window, Interval, FlexRay, CAN, CAN FD, LIN, CXPI, SENT, UART, TV), you can also use the front-panel LEVEL knob to set the trigger level.
- When the front-panel LEVEL knob is valid, you can press it to automatically set the trigger level.
- If the jog shuttle is controlling the trigger level, you can press the RESET key to reset the trigger level to the current offset voltage.
- The trigger level is shared between trigger A and trigger B. If the trigger type of one of the triggers has two levels (upper level and lower level) and that of the other has one level, the center value of the two levels and the single level are shared.
- The selectable range of threshold levels used to detect logic signal bit states is the same as the selectable range of the source bit trigger level. How you can set the bit levels varies depending on the logic probe that you are using.
  Model 701988: The level setting applies to all bits.
  Model 701989: The level setting applies to all bits or each bit separately.
- You can also set the level of each bit of the logic signal using Level on the bit setup menu of the LOGIC key (the level is shared). If you change the level on the trigger menu, the Level value on the bit setup menu of the LOGIC key will also change.

Trigger Slope (Slope/ Polarity)

Slope refers to the movement of the signal from a low level to a high level (rising edge) or from a high level to a low level (falling edge). When a slope is used as one of the trigger conditions, it is called a *trigger slope*.
The following trigger slope settings are available for triggering the instrument.

	When the trigger source changes from a level below the trigger level to a level above the trigger level (rising) (Slope)
	When the trigger source changes from a level above the trigger level to a level below the trigger level (falling) (Slope)
	When a rising or falling edge is detected (Slope)
	When the trigger source level enters the specified voltage range (Polarity)
	When the trigger source level goes outside of the specified voltage range (Polarity)

* / is only selectable when the trigger source is an analog signal.

HF Rejection (HF Rejection)

Use HF rejection when you want to remove the high-frequency components (above approximately 15 kHz or 20 MHz) from the trigger signal. You can select from one of the settings below. You cannot use HF rejection when the trigger source is set to Logic, EXT, or LINE.
OFF, 20MHz, 15kHz

Noise Rejection (Noise Rejection)

Noise rejection establishes a trigger level margin (hysteresis) so that the instrument does not trigger if the signal level change is within the margin.
Select the hysteresis from one of the following settings below. You cannot use noise rejection when the trigger source is set to EXT or LINE.

	Approximately 0.3 divisions* of hysteresis around the trigger level
	Approximately 0.5 divisions* of hysteresis around the trigger level
	Approximately 1 divisions* of hysteresis around the trigger level

* The above values are approximate values. They are not strictly warranted.

When the trigger source is Logic, you can apply hysteresis to the threshold level so that the high and low states do not change as long as the signal level changes within that range.
If the 701989 logic probe is connected, select the hysteresis from one of the following settings below.

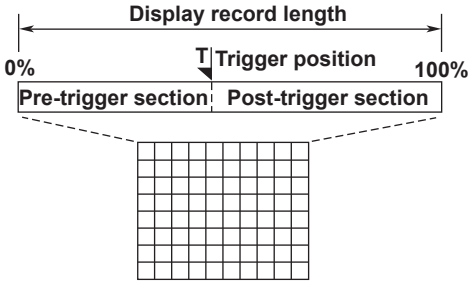
	Hysteresis of approximately 100 mV around the threshold level*
	Hysteresis of approximately 250 mV around the threshold level*

* The above values are approximate values. They are not strictly warranted.

The hysteresis is fixed at approximately 80 mV for the 701988 logic probe, so the setup menu will not appear.

Trigger Position (POSITION knob)

When you move the trigger position, the ratio of the displayed data before the trigger point (the pre-trigger section) to the data after the trigger point (the post-trigger point) changes.
When the trigger delay is 0 s, the trigger point and trigger positions coincide.



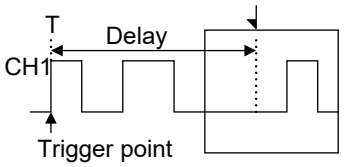
Selectable range: 0 to 100% of the display record length
Resolution: 1%

- If you change the trigger position when waveform acquisition is stopped, the instrument re-displays waveforms using the new position.
- The time values of cursor measurements are based on the trigger position. If you change the trigger position, the measured values will change (except during roll mode display).
- If you change the TIME/DIV setting, the location of the trigger position does not change.

Trigger Delay (DELAY)

The instrument normally displays waveforms before and after the trigger point. You can set a trigger delay to display waveforms that the instrument has acquired a specified amount of time after the trigger occurrence.
Range: −(post-trigger time*) to 10 s
Resolution: (1 ÷ sample rate)/10) or 10 ps, whichever is longer

* Post-trigger time: The time between the trigger position and the right edge of the main window



T: Mark that indicates the trigger point
: Mark that indicates the trigger position

Delay Cancel (Delay Cancel)

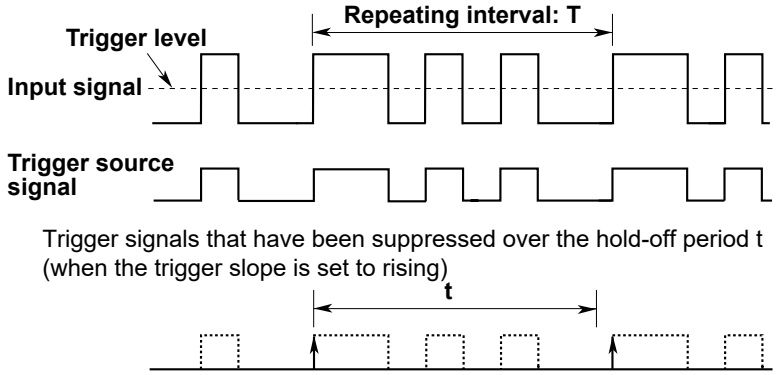
You can select whether or not to apply the specified delay to the time measurement values.
The default setting is ON.

- ON: Measures time with the trigger position set to 0 s (does not apply the delay to time measurement)
- OFF: Measures time with the trigger point set to 0 s (applies the delay to time measurement)

The delay value is retained even if you change the TIME/DIV setting.

Trigger Hold-off (Holdoff)

The trigger hold-off feature temporarily stops the detection of the next trigger once a trigger has occurred. This feature is useful when you want to change the signal acquisition interval, such as when you are observing a pulse code modulation (PCM) code or other pulse train signal or when you are using the history feature.



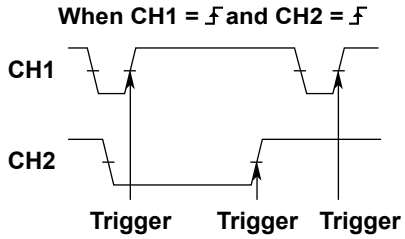
Range: 20 ns to 10.0000 s (the default value is 20 ns)
Resolution: 5 ns

- In repetitive sampling mode, waveform updating may slow down. If this happens, reduce the hold-off time setting.
- To trigger with the hold-off time set longer than the timeout period of auto trigger and auto level trigger, set the trigger mode to Normal. The timeout period of auto trigger and auto level trigger is approximately 100 ms or the time corresponding to 10 divisions on the time axis, whichever is larger.
- When combination trigger is in use, hold-off is applied only to trigger A.

Edge OR Trigger [ENHANCED]

The instrument triggers on the OR logic of multiple trigger source edges.

Example



Trigger Source Pattern (Pattern)

Set the trigger slope for each channel. The available channel settings vary depending on the model.

↓	When the trigger source changes from a level below the trigger level to a level above the trigger level (rising)
↑	When the trigger source changes from a level above the trigger level to a level below the trigger level (falling)
↕	When a rising or falling edge is detected

Logic, EXT, and LINE signals cannot be used as the trigger source of Edge OR triggers.

Trigger Level (Level), HF Rejection (HF Rejection)
Noise Rejection (Noise Rejection)

Set these items for each trigger source.

These items are the same as those of the edge trigger.

▶ See here.

Trigger Position (POSITION), Trigger Delay (DELAY), Trigger Hold-Off (Holdoff)

These items are the same as those of the edge trigger.

▶ See here.

Pattern Trigger [ENHANCED]

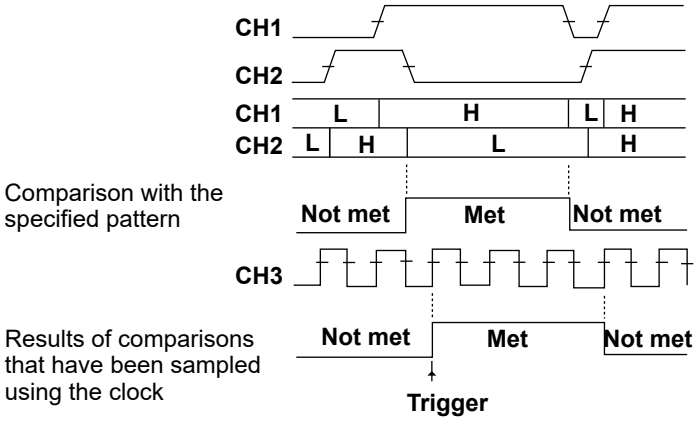
The instrument triggers on whether the trigger source pattern matches the specified patter or on the pattern duration. You can also use a clock source.

When a Clock Source Is Specified

Example 1

The results of comparing the combination (Logic) of the trigger source signal pattern (Pattern) and the specified pattern are sampled on the edges of the clock source, and the instrument triggers at the point of change in the comparison results (Enter or Exit of the trigger condition (Condition)).

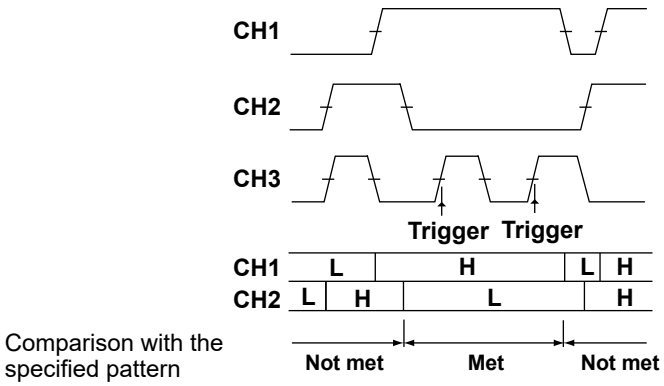
Clock source: CH3 ↓
Pattern: CH1 = H, CH2 = L, other channels = X, Logic = AND
Condition: Enter



Example 2

When the result of comparing the combination (Logic) of the trigger source signal pattern (Pattern) and the specified pattern is true or false as specified by the trigger condition (Condition), the instrument triggers on the edge of the clock source.

Clock source: CH3 ↓
Pattern: CH1 = H, CH2 = L, other channels = X, Logic = AND
Condition: True

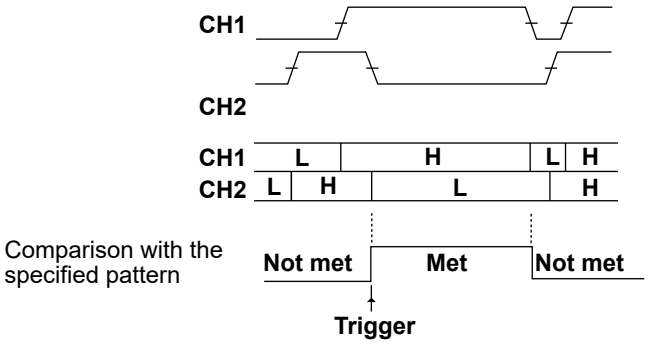


When a Clock Source Is Not Specified

Example 1

The instrument triggers at the point of change in the results (Enter or Exit of the trigger condition (Condition)) of comparing the combination (Logic) of the trigger source signal pattern (Pattern) and the specified pattern are sampled on the edges of the clock source.

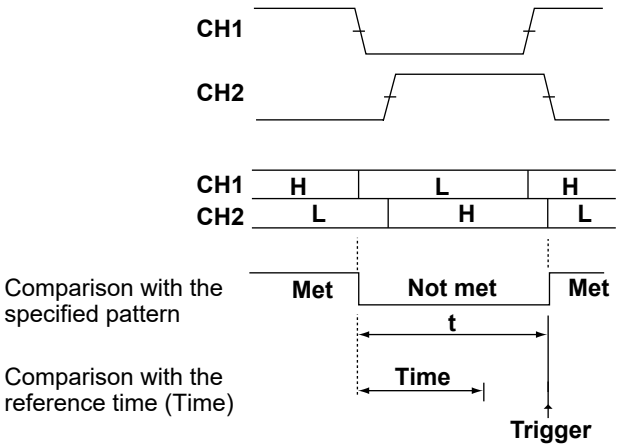
Clock source: None
Pattern: CH1 = H, CH2 = L, other channels = X, Logic = AND
Condition: Enter



Example 2

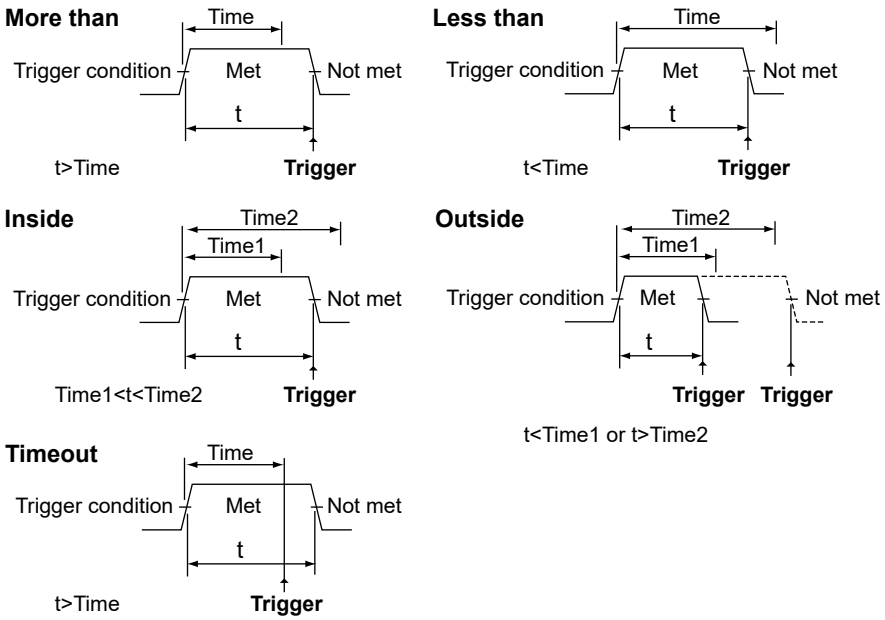
The instrument triggers when the relationship between the duration the result (Enter or Exit of the trigger condition (Condition)) of comparing the combination (Logic) of the trigger source signal pattern (Pattern) and the reference time meets the specified time condition (Time Qualification). When the time condition is set to timeout, the instrument triggers when a timeout occurs.

Clock source: None
Pattern: CH1 = H, CH2 = L, other channels = X, Logic = AND
Condition: False
Time Qualification: More than(t>Time)



Examples of Various Time Conditions

The following figure illustrates the trigger points when various time conditions are met.
More than, Less than, Inside, Outside: Triggers at the end point of the trigger condition achievement time (t)
Timeout: Triggers when a timeout occurs



Clock Source (Clock)

Select from the following. The available settings vary depending on the model.
If you select Logic, set the source bit.

- CH1 to CH8
- Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7)*
- None (not specify a clock source)

* C0 to C7 and D0 to D7 are available on models with the /L32 options.

Clock Source Slope

Select the clock source slope.

⨍	When the source changes from a level below the specified level to a level above the specified level (rising)
⨏	When the source changes from a level above the specified level to a level below the specified level (falling)
⨍⨏	When a rising or falling edge is detected

You cannot set a pattern to a signal that is set as the clock source.

Comparison Condition

Trigger Source Pattern (Pattern)

Select the trigger sources (CH1 to CH8, A0 to A7, B0 to B7, C0 to C7,* D0 to D7,* excluding the clock source) from one of the following settings.

* C0 to C7 and D0 to D7 are available on models with the /L32 options.

H	When the signal level is high
L	When the signal level is low
X	Don't care.

Combination (Logic)

Select the trigger source combination from one of the settings below.

AND	Allows triggering when all the trigger source signal patterns match the specified pattern
OR	Allows triggering when any of the trigger source signal patterns matches the specified pattern

Trigger Condition (Condition)

Select the condition for judging the results of comparing the trigger source signal pattern and the specified pattern.

With a Clock Source

Enter	Detects changes in the comparison results from a mismatched condition to a matched condition at the clock source sampling timing. The instrument triggers at the point of change.
Exit	Detects changes in the comparison results from a matched condition to a mismatched condition at the clock source sampling timing. The instrument triggers at the point of change.
True	Detects matches in the comparison results. The instrument triggers at the clock source sampling points while the match is true.
False	Detects mismatches in the comparison results. The instrument triggers at the clock source sampling points while the mismatch is true.

Without a Clock Source

Enter	Detects changes in the comparison results from a mismatched condition to a matched condition. The instrument triggers at the point of change.
Exit	Detects changes in the comparison results from a matched condition to a mismatched condition. The instrument triggers at the point of change.
True	Detects matches in the comparison conditions. The trigger timing varies depending on time conditions, explained later.
False	Detects mismatches in the comparison conditions. The trigger timing varies depending on time conditions, explained later.

Time Condition (Time Qualification)

Set what kind of relationship must be established between the trigger condition achievement time and the specified reference time (Time, Time1, Time2). You can set this when the clock source is set to None and the trigger condition (Condition) is true or false.

More than	When the trigger condition achievement time (t) is longer than the specified reference time (Time)
Less than	When the trigger condition achievement time (t) is shorter than the specified reference time (Time)
Inside	When the trigger condition achievement time (t) is longer than reference time Time1 and shorter than reference time Time2.
Outside	When the trigger condition achievement time (t) is longer than reference time Time1 and shorter than reference time or Time2
Timeout	When the trigger condition achievement time (t) is longer than the specified reference time (Time)

Reference Times (Time or Time1 and Time2)

The selectable range for Time or Time1 and Time2 varies depending on the time condition. You can set this when the clock source is set to None and the trigger condition (Condition) is true or false.

More than	Time: 2 ns to 10 s
Less than	Time: 4 ns to 10 s
Inside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s
Outside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s
Timeout	Time: 4 ns to 10 s

Resolution: 2 ns

Level (Level), HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)

Set these items for the trigger source.

These items are the same as the trigger level, HF rejection, and noise rejection* of edge trigger.

* You can set this only when the trigger source is set to Logic and the 701989 logic probe is connected.

▶ See here.

Trigger Position (POSITION), Trigger Delay (DELAY), Trigger Hold-Off (Holdoff)

These items are the same as those of the edge trigger.

▶ See here.

- The instrument may not trigger properly if the spacing between signals or the time detection width is less than 1 ns.
- For details on time accuracy, see section 6.2 in the Getting Started Guide (IM DLM5058-03EN).

Pulse Width Trigger [ENHANCED]

The instrument triggers when the relationship between the trigger source's pulse width and the specified reference times meets the selected time condition. For examples, see "Examples of Various Time Conditions" for the pattern trigger [ENHANCED].

Trigger Source (Source)

You can select the trigger sources from CH1 to CH8, and Logic. The available settings vary depending on the model.

If you set the trigger source to Logic, set the source bit.

Configure the polarity, HF rejection, noise rejection, and trigger level settings for the selected trigger source.

Polarity (Polarity)

Select which trigger source polarity will cause the comparison of the pulse width with the reference times. The trigger source polarity is based on the trigger level.

	When the signal level is high
	When the signal level is low

Time Condition (Time Qualification)

Set what kind of relationship must be established between the trigger source's pulse width and the specified reference times (Time, Time1, and Time2) for the instrument to trigger.

More than	When the pulse width is longer than the specified reference time (Time)
Less than	When the pulse width is shorter than the specified reference time (Time)
Inside	When the pulse width is longer than Time1 but shorter than Time2
Outside	When the pulse width is shorter than Time1 or longer than Time2
Timeout	When the pulse width is longer than the specified reference time (Time)

Reference Times (Time or Time1 and Time2)

The selectable range for Time or Time1 and Time2 varies depending on the time condition.

More than	Time: 2 ns to 10 s
Less than	Time: 4 ns to 10 s
Inside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s
Outside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s
Timeout	Time: 4 ns to 10 s

Resolution: 2 ns

Level (Level), HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)

Set these items for the trigger source.

These items are the same as those of the edge trigger.

▶ See here.

Trigger Position (POSITION), Trigger Delay (DELAY), Trigger Hold-Off (Holdoff)

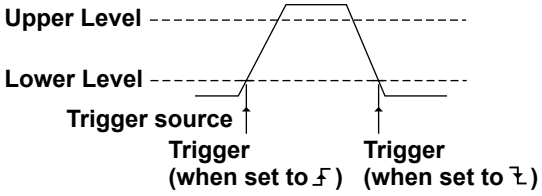
These items are the same as those of the edge trigger.

▶ See here.

- The instrument may not trigger properly if the spacing between signals or the time detection width is less than 1 ns.
- For details on time accuracy, see section 6.2 in the Getting Started Guide (IM DLM5058-03EN).

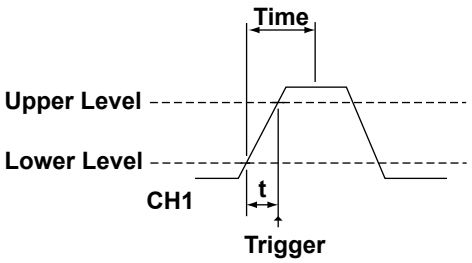
Rise/Fall Time Trigger [ENHANCED]

The instrument triggers when the relationship between the trigger source's rising or falling times and the specified reference times meets the selected time condition.



Example

Source: CH1⤴
Time Qualification: Less than (t < Time)



Trigger Source (Source)

You can select the trigger sources from CH1 to CH8. The available settings vary depending on the model.
Configure the polarity, HF rejection, noise rejection, and trigger level settings for the selected trigger source.

Trigger Slope (Slope)

Select which trigger source slope in reference to the trigger level will cause the comparison of the rise time or fall time with the reference times.

⤴	When the trigger level passes through the lower limit and then reaches the upper limit (rising)
⤵	When the trigger level passes through the upper limit and then reaches the lower limit (falling)
⤴⤵	When a rising or falling edge is detected

Time Condition (Time Qualification)

Set what kind of relationship must be established between the trigger source's rising or falling times and the specified reference times (Time1 and Time2) for the instrument to trigger.

More than	When the rise time or fall time is longer than the specified reference time
Less than	When the rise time or fall time is shorter than the specified reference time
Inside	When the rise time or fall time is longer than reference time Time1 and shorter than reference time Time2.
Outside	When the rise time or fall time is shorter than reference time Time1 or longer than reference time Time2.

Reference Times (Time or Time1 and Time2)

The selectable range for Time or Time1 and Time2 varies depending on the time condition.

More than	Time: 2 ns to 10 s
Less than	Time: 4 ns to 10 s
Inside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s
Outside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s

Resolution: 2 ns

Reference Range (Upper Level/Lower Level)

Set the upper and lower levels of the reference range.

HF Rejection (HF Rejection)

Set this item for the trigger source.

This item is the same as those of the edge trigger.

▶ See here.

Trigger Position (POSITION), Trigger Delay (DELAY), Trigger Hold-Off (Holdoff)

These items are the same as those of the edge trigger.

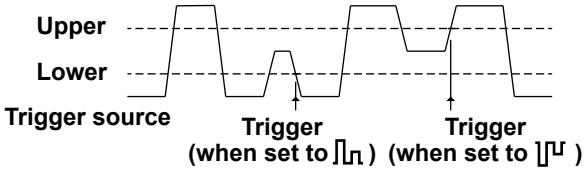
▶ See here.

- The instrument may not trigger properly if the spacing between signals or the time detection width is less than 1 ns.
- For details on time accuracy, see section 6.2 in the Getting Started Guide (IM DLM5058-03EN).

Runt Trigger [ENHANCED]

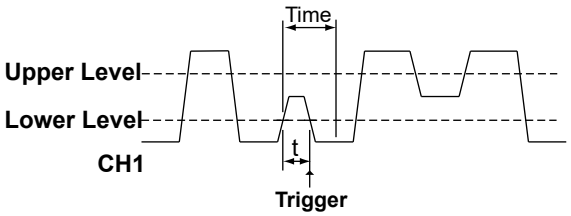
Runt pulses* are used to trigger the instrument. The instrument also triggers when the relationship between the runt pulse width and the specified reference times meets the selected time condition.

* A signal that passes through the first threshold level but returns to the original level without passing the other threshold level.



Example

Source: CH1, Polarity: ⎍
Time Qualification: Less than (t < Time)



Trigger Source (Source)

You can select the trigger sources from CH1 to CH8. The available settings vary depending on the model. Configure the polarity, HF rejection, noise rejection, and trigger level settings for the selected trigger source.

Polarity (Polarity)

Select which trigger source polarity will cause the comparison of the pulse width with the reference times. The trigger source polarity is based on the trigger level.

⎍	When the trigger source is Pos (positive polarity)
⎎	When the trigger source is Neg (negative polarity)
⎏	When the trigger source is Pos (positive polarity) or Neg (negative polarity)

Time Condition (Time Qualification)

Set what kind of relationship must be established between the trigger source's runt pulse width and the specified reference times (Time, Time1, and Time2) for the instrument to trigger.

None	No reference time
More than	When the runt pulse width is longer than the specified reference time
Less than	When the runt pulse width is shorter than the specified reference time
Inside	When the runt pulse width is longer than Time1 but shorter than Time2
Outside	When the runt pulse width is shorter than Time1 or longer than Time2

Reference Times (Time or Time1 and Time2)

Range

The selectable range for Time or Time1 and Time2 varies depending on the time condition.

More than	Time: 2 ns to 10 s
Less than	Time: 4 ns to 10 s
Inside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s
Outside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s

Resolution: 2 ns

Reference Range (Upper Level/Lower Level)
Set the upper and lower levels of the reference range.

HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)
Set these items for the trigger source.
These items are the same as those of the edge trigger.
▶ See here.

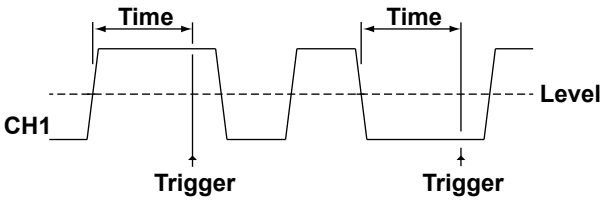
Trigger Position (POSITION), Trigger Delay (DELAY), Trigger Hold-Off (Holdoff)
These items are the same as those of the edge trigger.
▶ See here.

- The instrument may not trigger properly if the spacing between signals or the time detection width is less than 1 ns.
- For details on time accuracy, see section 6.2 in the Getting Started Guide (IM DLM5058-03EN).

Timeout Trigger [ENHANCED]
The instrument triggers when a timeout occurs before the end edge of a pulse.

Example

Trigger source: CH1, ⨍ (Both)



Trigger Source (Source)
You can select the trigger sources from CH1 to CH8, and Logic. The available settings vary depending on the model.
If you set the trigger source to Logic, set the source bit.
Configure the polarity, HF rejection, noise rejection, and trigger level settings for the selected trigger source.

Polarity (Polarity)
Select which trigger source polarity will cause the comparison with the timeout period. The trigger source polarity is based on the trigger level.

⨍	Pos (positive polarity)
⨍	Neg (negative polarity)
⨍	Pos (positive polarity) or Neg (negative polarity)

Timeout Period (Time)
Selectable range: 4 ns to 10 s
Resolution: 2 ns

Level (Level), HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)
Set these items for the trigger source.
These items are the same as those of the edge trigger.
▶ See here.

Trigger Position (POSITION), Trigger Delay (DELAY), Trigger Hold-Off (Holdoff)

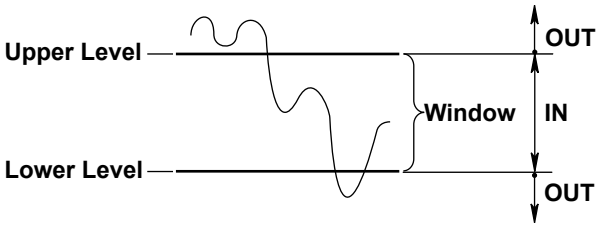
These items are the same as those of the edge trigger.

▶ See here.

- The instrument may not trigger properly if the spacing between signals or the time detection width is less than 1 ns.
- For details on time accuracy, see section 6.2 in the Getting Started Guide (IM DLM5058-03EN).

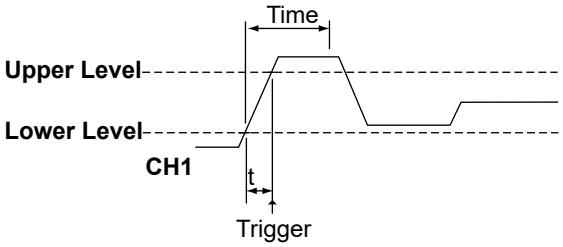
Window Trigger [ENHANCED]

Window refers to a range set by upper level and lower level. The instrument triggers when the waveform moves from inside (IN) the window to outside (OUT) the window or from outside (OUT) to the inside (IN) or when the relationship between the time that the waveform stays in the IN or OUT condition and the specified reference time meets the selected time condition. When the time condition is timeout, the instrument triggers when a timeout occurs.



Example

Source: CH1, Polarity:
Time Qualification: Less than (t < Time)



Trigger Source (Source)

You can select the trigger sources from CH1 to CH8. The available settings vary depending on the model. Configure the polarity, HF rejection, noise rejection, and trigger level settings for the selected trigger source.

Polarity (Polarity)

Select the polarity from the following. The polarity varies depending on the time condition.

- Without a time condition

	When the trigger source level enters the specified range (window)
	When the trigger source level goes outside of the specified range (window)

- With a time condition

	When the trigger source level remains inside the specified range (window)
	When the trigger source level remains outside the specified range (window)

Reference Range (Upper Level/Lower Level)

Set the upper and lower levels of the reference range.

Time Condition (Time Qualification)

Set whether the trigger source must be inside (IN) the specified range or outside (OUT) the specified range (Window) and what kind of relationship must be established with the specified reference times (Time or Time1 and Time2) for the instrument to trigger.

None	Without a time condition
More than	When the time that the waveform stays inside or outside the window is longer than the specified reference time (Time)
Less than	When the time that the waveform stays inside or outside the window is shorter than the specified reference time (Time)
Inside	When the time that the waveform stays inside or outside the window is longer than reference time Time1 and shorter than reference time Time2.
Outside	When the time that the waveform stays inside or outside the window is shorter than reference time Time1 or longer than reference time Time2.
Timeout	When the time that the waveform stays inside or outside the window is longer than the specified reference time (Time)

Reference Times (Time or Time1 and Time2)

The selectable range for Time or Time1 and Time2 varies depending on the time condition.

More than	Time: 2 ns to 10 s
Less than	Time: 4 ns to 10 s
Inside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s
Outside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s
Timeout	Time1: 4 ns to 10 s

Resolution: 2 ns

HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)

Set these items for the trigger source.

These items are the same as those of the edge trigger.

▶ See here.

Trigger Position (POSITION), Trigger Delay (DELAY), Trigger Hold-Off (Holdoff)

These items are the same as those of the edge trigger.

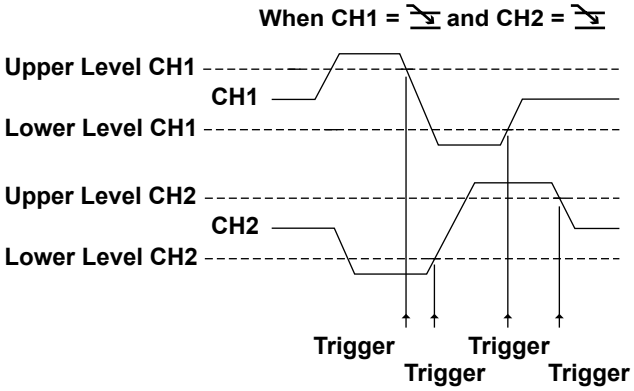
▶ See here.

- The instrument may not trigger properly if the spacing between signals or the time detection width is less than 1 ns.
- For details on time accuracy, see section 6.2 in the Getting Started Guide (IM DLM5058-03EN).

Window OR Trigger [ENHANCED]

The instrument triggers on the OR logic of the ranges (window) of multiple trigger sources.

Example



Required Condition (Pattern)

Set the trigger sources and polarities.

Trigger Sources

You can select the trigger sources from CH1 to CH8, and All. The available settings vary depending on the model.

If you select All, CH1 to CH8 become trigger sources.

Polarity

Select the polarity from the following.

	When the trigger source level enters the specified voltage span (window)
	When the trigger source level goes outside of the specified voltage span (window)

Trigger Levels (Levels)

Set the reference range and HF or noise rejection.

Reference Range (Upper Level/Lower Level)

Set the upper and lower levels of the reference range.

HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)

Set these items for the trigger source.

These items are the same as those of the edge trigger.

▶ See here.

Trigger Position (POSITION), Trigger Delay (DELAY), Trigger Hold-Off (Holdoff)

These items are the same as those of the edge trigger.

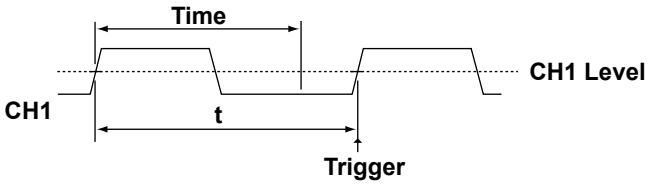
▶ See here.

Interval Trigger [ENHANCED]

The instrument triggers when the relationship between the trigger source's period (i.e., the interval between edges) and the specified reference times meets the selected time condition. When the time condition is timeout, the instrument triggers when a timeout occurs.

Example

Source: CH1 ↓, Time Qualification: More than (t > Time)



Trigger Source (Source)

You can select the trigger sources from CH1 to CH8, and Logic. The available settings vary depending on the model.

If you set the trigger source to Logic, set the source bit.

Trigger Slope (Slope)

For the signal assigned to be the trigger source, select which trigger slope to compare with the reference time.

↓	When the trigger source changes from a level below the trigger level to a level above the trigger level (rising)
↑	When the trigger source changes from a level above the trigger level to a level below the trigger level (falling)

Time Condition (Time Qualification)

Set what kind of relationship must be established between the trigger source's period and the specified reference times (Time, Time1, and Time2) for the instrument to trigger.

More than	The period must be longer than the specified reference time (Time).
Less than	The period must be shorter than the specified reference time (Time).
Inside	The period must be longer than reference time Time1 and shorter than reference time Time2.
Outside	The period must be shorter than reference time Time1 or longer than reference time Time2.
Timeout	The period must be longer than the reference time specified (Time).

Reference Times (Time or Time1 and Time2)

The selectable range for Time or Time1 and Time2 varies depending on the time condition.

More than	Time: 2 ns to 10 s
Less than	Time: 4 ns to 10 s
Inside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s
Outside	Time1: 2 ns to [10 s-2 ns], Time2: 4 ns to 10 s
Timeout	Time1: 4 ns to 10 s

Resolution: 2 ns

Level (Level), HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)

Set these items for each trigger source.

These items are the same as those of the edge trigger.

▶ See here.

Trigger Position (POSITION), Trigger Delay (DELAY), Trigger Hold-Off (Holdoff)

These items are the same as those of the edge trigger.

▶ See here.

- The instrument may not trigger properly if the spacing between signals or the time detection width is less than 1 ns.
- For details on time accuracy, see section 6.2 in the Getting Started Guide (IM DLM5058-03EN).

Serial Bus Trigger [ENHANCED]

The instrument has trigger features that capture the following ten types of serial bus signals. Of these types, FlexRay, CAN, CAN FD, LIN, CXPI, SENT, PSI5 Airbag, UART, I2C, and SPI bus triggers are options.

FlexRay Bus Trigger

The FlexRay bus trigger is used to capture FlexRay bus signals. FlexRay is an automotive LAN communication protocol established by the FlexRay Consortium.

CAN Bus Trigger

The CAN bus trigger is used to capture CAN bus signals.
Controller Area Network (CAN) is a serial communication protocol that has been standardized internationally by the ISO (International Organization for Standardization). The instrument is equipped with a symbolic trigger function.*

* Using YOKOGAWA free software, you can convert a CANdb file (.dbc) to a physical value/symbol definition file, (.sbl), load the file into the instrument, and use it as a set of trigger conditions. You can obtain the free software from the YOKOGAWA website (http://www.yokogawa.com/tm/).
CANdb files (.dbc) are signal definition database files created using the CANdb or CANdb++ software produced by Vector Informatik.

CAN FD Bus Trigger

The CAN FD bus trigger is used to capture CAN FD bus signals.
CAN FD is an abbreviation for CAN with Flexible Data Rate. It is based on CAN and supports high-speed data-phase transfer rates. The length of data that can be embedded in a single Data Field is expanded to up to 64 bytes, and the CRC generator polynomial is also expanded. As with CAN, symbolic triggering is possible.

LIN bus trigger

The LIN bus trigger is used to capture LIN bus signals.
A Local Interconnect Network (LIN) is a serial communication protocol mainly used in automobiles.

CXPI Bus Trigger

The CXPI bus trigger is used to capture CXPI bus signals.
CXPI is an acronym for Clock Extension Peripheral Interface and is an on-vehicle LAN communication protocol used for human machine interface (HMI) and other interfaces of automotive electronic systems.

SENT Trigger

The SENT bus trigger is used to capture SENT signals.
SENT is an abbreviation for Single Edge Nibble Transmission. It is a point-to-point unidirectional serial communication protocol. The instrument supports SAE J2716 ARP2016 and earlier versions.

PSI5 Airbag Trigger

The PSI5 Airbag trigger is used to capture PSI5 Airbag signals.
PSI is an acronym for Peripheral Sensor Interface. It is a bidirectional communication protocol developed for communication between on-vehicle sensors and control units. PSI5 Airbag is a substandard exclusive for airbags.

UART trigger

The UART trigger is used to capture UART signals.
A Universal Asynchronous Receiver Transmitter (UART) is an integrated circuit that performs serial-to-parallel conversion and parallel-to-serial conversion. UART signals are generally used in inter-device communication such as with EIA-232 (RS-232).

I2C bus trigger

The I^2C bus trigger is used to capture I^2C bus signals.
An Inter Integrated Circuit (I^2C) bus is a bi-directional bus for inter-IC communications.

SPI bus trigger

The SPI bus trigger is used to capture SPI bus signals.
A Serial Peripheral Interface (SPI) is a synchronous serial bus that is widely used for inter-IC communications and data communications.

User-Defined Trigger

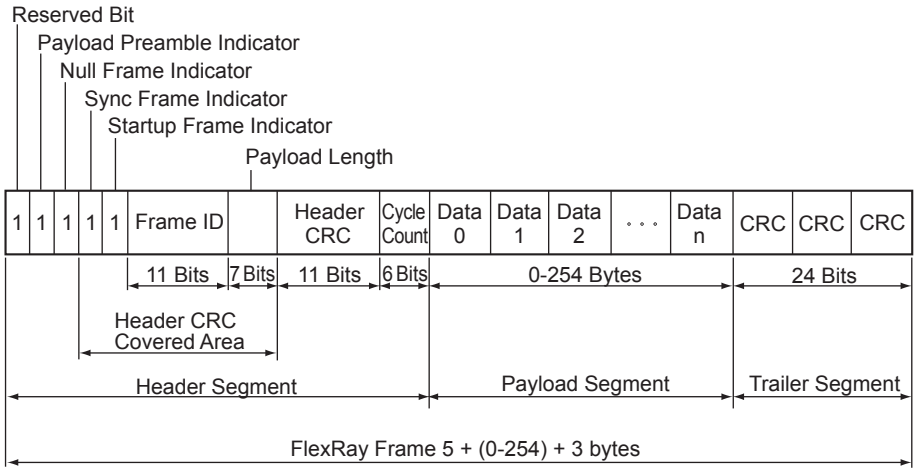
The user-defined trigger is used to capture user-defined serial bus signals.
The instrument synchronizes to the selected clock signal and detects a serial data pattern. You can specify up to 128 bits for the serial data pattern used for triggering. You can set the CS signal, which controls the period over which the data source is checked, and the latch source, which specifies when patterns are compared.

Auto Setup

If you specify the serial bus type and the trigger source, the instrument can automatically configure the bit rate and source level settings and then trigger based on those settings. The auto setup feature will not work properly on some input signals. This feature is in the serial bus signal search feature.

FlexRay Bus Trigger [ENHANCED, option]

The instrument triggers based on the trigger conditions of a particular frame or type of data in a FlexRay bus signal.



Trigger Mode (Mode)

Select the FlexRay trigger mode from one of the settings below.
Frame Start: Triggers on the start of a frame
Error: Triggers on errors
ID/Data: Triggers on the AND of the ID bit pattern and Data pattern
ID OR: Triggers on the OR of multiple ID bit patterns

Frame Start

The instrument triggers on the start of FlexRay bus signal frames.

Error

The instrument triggers when it detects various types of errors.

- **Error Type (Error Type OR)**

  Select the types of errors to detect from the following. The instrument triggers if any of the selected errors is detected.

CRC	When a Header CRC or Frame CRC error is detected
BSS	When a BSS error is detected (there is no BSS falling edge at the specified position)
FES	When an FES error is detected (there is no FES rising edge at the specified position)

ID/Data

The instrument triggers on the AND of Frame Start, Indicator, ID, Cycle Count, Data1, and Data2.

- **Trigger Condition (Condition Setup)**

  On the Condition Setup screen, set the Indicator, ID, Cycle Count, Data1, and Data2 trigger conditions.

Frame Start

The instrument triggers on the start of FlexRay bus signal frames. Frame Start of ID/Data is always selected as a trigger condition.

Indicator

You can use the states of four indicators as trigger conditions. The Indicator trigger condition is met when the input-signal Indicator bit pattern matches the specified bit pattern.

Bit Pattern (Indicator Setup)

Select the bit patterns of the four indicators from one of the following settings.

Payload Preamble	
X	Don’t care.
0	There is no option header in the payload segment.
1	There is a network management vector in the payload segment (static segment). There is a message ID in the payload segment (dynamic segment).
Null Frame	
X	Don’t care.
0	There is invalid data included in the payload segment.
1	There is valid data included in the payload segment.
Sync Frame	
X	Don’t care.
0	The frame is not a sync frame.
1	The frame is a sync frame.
Startup Frame	
X	Don’t care.
0	The frame is not a startup frame.
1	The frame is a startup frame.

ID

You can use an 11-bit ID value as a trigger condition.

Comparison Condition (Condition)

The frame ID trigger condition is met when the relationship between the reference value and the input-signal ID value matches the specified comparison condition.

ID=a[1]	When the value is equal to the reference value
ID≠a[1]	When the value is not equal to the reference value
a≤ID[1]	When the value is greater than or equal to the reference value
ID≤b[1]	When the value is less than or equal to the reference value
a≤ID≤b[2]	When the value is within the reference range (including the reference values)
ID<a, b<ID[2]	When the value is outside the reference range (excluding the reference values)

1 Set one reference value

2 Set two reference values

Reference Values (a and b)

You can set the reference values within the range of 1 to 2047.

Cycle Count

You can use a 6-bit cycle-count value as a trigger condition.

Comparison Condition (Condition) and Reference Values (a and b)

The cycle-count trigger condition is met when the relationship between the reference values and the input-signal cycle-count value matches the specified comparison condition. The comparison conditions are the same as those listed for Frame ID. You can set the reference values within the range of 0 to 63.

Data1/Data2

You can use the value of up to 8 consecutive bytes of data from Data 0 to Data 253 as a trigger condition.

Data Length (Size)

Set how many consecutive data bytes of the payload segment will be compared.

Selectable range: 1 to 8 bytes

Comparison Start Position (Position)

Set the comparison start position. For example, to start from Data1 in the payload segment, set this value to 1.

Selectable range: 0 to 253 bytes

Comparison Condition (Condition)

The data trigger condition is met when the relationship between the reference values and the input-signal data value matches the specified comparison condition.

True	When the value matches the data pattern
False	When the value does not match the data pattern
Data=a[1]	When the value is equal to the reference value
Data≠a[1]	When the value is not equal to the reference value
a ≤ Data[1]	When the value is greater than or equal to the reference value
Data ≤ b[1]	When the value is less than or equal to the reference value
a ≤ Data ≤ b[2]	When the value is within the reference range (including the reference values)
Data<a, b < Data[2]	When the value is outside the reference range (excluding the reference values)

1 Set one reference value

2 Set two reference values

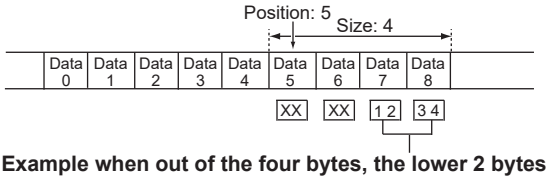
Data Pattern (Hex/Bin)

If the comparison condition is set to True or False, set the data pattern for the specified data size in hexadecimal (Hex) or binary (Bin) notation.

If you specify X in the pattern, the condition is assumed to be met regardless of the corresponding bit status.

If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

Example When the Comparison Start Position Is Set to 5 and the Data Length Is Set to 4



Example when out of the four bytes, the lower 2 bytes is set to 1234

Reference Values (a and b)

If the comparison condition is set to Data = A, Data ≠ a, a ≤ Data, Data ≤ b, a ≤ Data ≤ b, or "Data < a or b < Data," set the reference values in decimal notation. You must set the byte order (Endian), sign (Sign), and comparison range (MSB or LSB). The selectable ranges are as follows:

Unsigned (Unsign)	0 to 9E+18 The selectable maximum value is limited by the data length and bit position, which is determined by the Size and MSB/LSB settings, respectively.
Signed (Sign)	−9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position, which are determined by the Size and MSB/LSB settings, respectively.

The value is displayed in scientific notation when the number of digits exceed seven (example: 1234567E+10).

Byte Order (Endian)

Set the data byte order to big endian (Big) or little endian (Little).

Sign (Sign)

Set whether to use a signed (Sign) or unsigned (Unsign) data format.

The selectable range of data reference values varies depending on whether the data is signed or unsigned.

Comparison Range (MSB/LSB)

Set the MSB (MSB) or LSB (LSB) bit positions for the data that you will compare.

Selectable range: 0 to (the number of bytes of data No 8 − 1). The maximum value is 63.

▶ See here.

ID OR

The instrument triggers when ID or Cycle Count matches any of the patterns that you set in ID1 to ID4.

Of ID1 to ID4, IDs whose check boxes are selected are used as trigger conditions. The instrument triggers when (1) the relationship between an ID reference value and the input-signal ID value matches the specified comparison condition and (2) the relationship between the cycle-count reference values and the input-signal cycle-count value matches the specified comparison condition.

The ID and cycle-count comparison conditions and reference values are the same as those for the ID/Data setting, except that for the cycle count, the comparison condition can be set to "Don't care" (so that the cycle count is not used as a trigger condition).

▶ See here.

Source (Source)

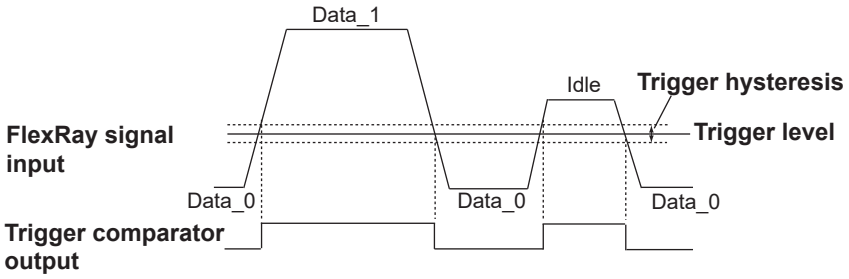
Select the trigger source. After selecting the trigger source, configure the trigger level, hysteresis, bit rate, bus channel assignment, HF rejection, and other settings.

Trigger Level (Level)

You can set the FlexRay bus signal trigger level for each channel from CH1 to CH8.
Set the trigger level between the idle level and the Data_0 level. This will cause the trigger circuit to detect Data_1 and Idle as “H”, Data_0 as “L.”

- You can set the trigger level in 0.01 division steps to a value that fits within the 8 divisions of the screen. For example, when the voltage scale is 200 mV/division, you can set the trigger level in 2 mV steps.
- You can reset the trigger level to the current offset voltage by pressing RESET.

Hysteresis (Hysteresis)



Bit Rate (Bit Rate)

Select the FlexRay bus signal’s transfer rate from one of the settings below.
2.5Mbps, 5Mbps, 10Mbps

Bus Channel Assignment (Channel)

Select whether to use channel A or B of the FlexRay bus signal.

HF Rejection (HF Rejection)

Set these items for the trigger source.
This item is the same as those of the edge trigger.

▶ See here.

Trigger Point

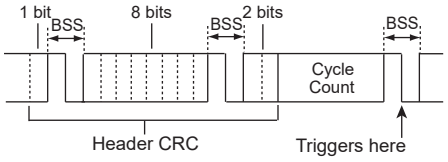
The trigger occurs near the BSS falling edge immediately after all the trigger conditions are met. The only exception is that the trigger occurs near the FES rising edge when the trigger mode is set to Error, there is no CRC error in the FlexRay bus signal header, and there is only a CRC error in the frame.

Frame Start mode

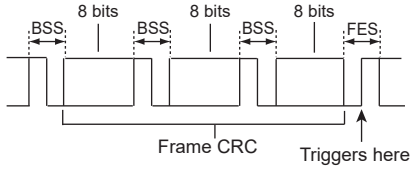


Error mode

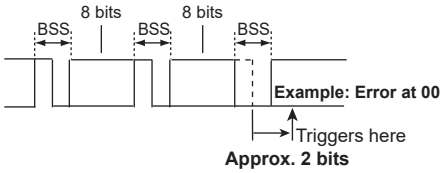
- **When there is a CRC error in the header**



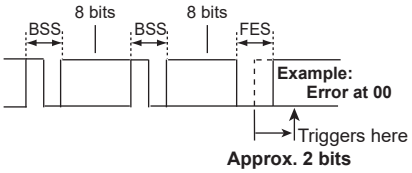
- **When there is a CRC error in the frame**



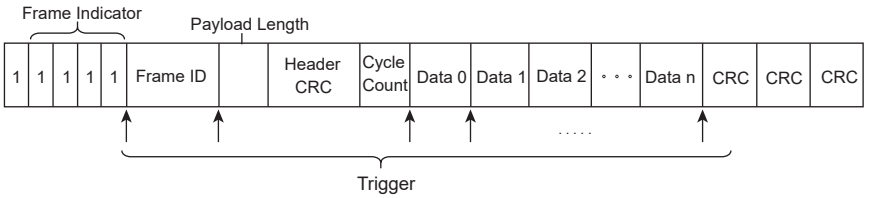
- **When there is a BSS error**



- **When there is an FES error**



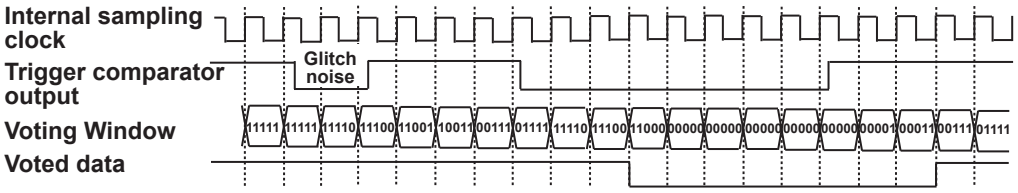
ID/Data mode



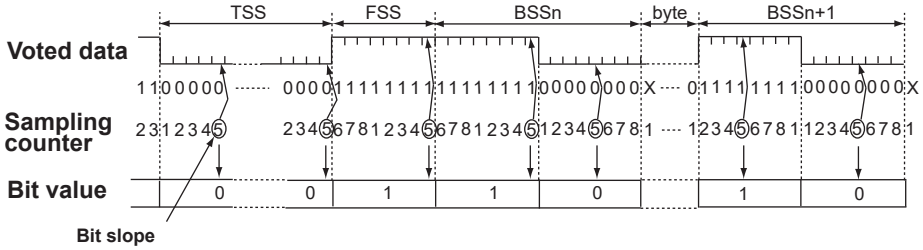
When the trigger mode is set to Error, the instrument uses its internal sampling clock for sampling, so jitter equal to one period of the sampling clock arises. One period of the sampling clock is a period of time equal to 1/8 of the bit width at the specified bit rate. For example, when the bit rate is 5 Mbps, the jitter is 25 ns.

Digitalization in the Trigger Circuit

After the input signal from the FlexRay bus is digitized by the trigger comparator, the trigger circuit samples it using the internal clock. Then noise is removed by the majority filter in the Voting Window.

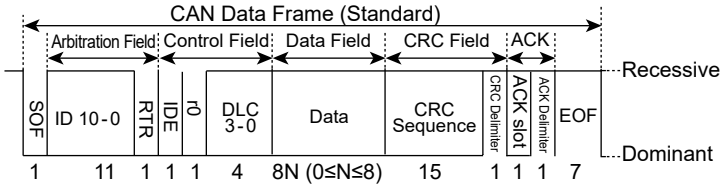


1 bit is equal to 8 sampling clock periods. The sampling counter is reset at the BSS falling edge of the voted data. The voted data value when the value of this sampling counter reaches 5 is used as the bit value for detecting the trigger conditions.



CAN Bus Trigger [ENHANCED, option]

The instrument triggers based on the trigger conditions of a particular frame or type of data in a CAN bus signal.



Trigger Mode (Mode)

Select the CAN bus trigger mode from one of the settings below.

SOF: Triggers on the start of a frame

Error: Triggers on errors

ID/Data: Triggers on the AND of the ID bit pattern and Data pattern

ID OR: Triggers on the OR of multiple ID bit patterns

SOF(Start of Frame)

The instrument triggers on the start of CAN bus signal frames.

Error

The instrument triggers on error frames (when the error flag is active) or when it detects various errors.

- **Error Type (Error Type OR)**

  Select the types of errors to detect from the following. The instrument triggers if any of the selected errors is detected.

Error Frame	When an active error flag (indicated by six consecutive dominant bits) is detected
Stuff	When stuff bits are not inserted properly
CRC	When a CRC error is detected

ID/Data

The instrument triggers based on data frames and remote frames in the standard format (Standard) and the extended format (Extend).
The instrument triggers on the AND of the SOF, ID, frame type (Remote Frame or Data Frame), Data, and ACK conditions.

- If you specify X in the ID bit pattern or data pattern, the condition is assumed to be met regardless of the corresponding bit status.
- In a bit pattern or data pattern setting, if a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

- **Trigger Condition (Condition Setup)**

  On the Condition Setup screen, set the trigger conditions such as the ID, frame type (Remote Frame or Data Frame) and data.

  Frame Format

  Select the frame format.
  - Standard: Standard format
  - Extend: Extended format

  SOF

  Triggers on the start of a CAN bus signal frame when the trigger condition is set to SOF only. SOF of ID/Data is always selected as a trigger condition.

  ID

  Input Format (Input format)

  Select the ID input format from one of the settings below.
  - Pattern: Set the bit pattern of each ID in hexadecimal or binary notation.
  - Message: Select this setting to set the ID or Data trigger conditions by using messages and signals that are defined in the symbol definition file (sbl).

  Bit Pattern (Hex/Bin)

  Set the 11-bit standard format ID bit pattern or the 29-bit extended format ID bit pattern in hexadecimal (Hex) or binary (Bin) notation. The ID trigger condition is met when the input signal ID bit pattern matches the specified bit pattern. You can only set these items when you set the trigger source frame to Pattern.

  Remote Frame/Data Frame

  Set the trigger source frame to Remote Frame or Data Frame.

  Data

  You can set a trigger condition based on the data field value. Specify the DLC, Condition, and data pattern settings. You can only set these items when you set the trigger source frame to Data Frame.

  DLC(Data Length Code)

  Set the data length of the data field. The DLC trigger condition is met when the specified value matches the input signal DLC value.
  Selectable range: 0 to 8 bytes

Comparison Condition (Condition)

The data trigger condition is met when the result of comparing the data pattern or reference value to the input signal's data field meets the specified comparison condition.

True	When the value matches the data pattern
False	When the value does not match the data pattern
Data=a[1]	When the value is equal to the reference value
Data≠a[1]	When the value is not equal to the reference value
a≤Data[1]	When the value is greater than or equal to the reference value
Data≤b[1]	When the value is less than or equal to the reference value
a≤Data≤b[2]	When the value is within the reference range (including the reference values)
Data<a, b<Data[2]	When the value is outside the reference range (excluding the reference values)

1 Set one reference value

2 Set two reference values

Data Pattern (Hex/Bin)

If the comparison condition is set to True or False, set the data pattern for the data whose length was set with DLC in hexadecimal (Hex) or binary (Bin) notation.

Reference Values (a and b)

If the comparison condition is set to Data = A, Data ≠ a, a ≤ Data, Data ≤ b, a ≤ Data ≤ b, or "Data < a or b < Data," set the reference values in decimal notation. You must set the byte order (Endian), sign (Sign), and comparison range (MSB or LSB). The selectable ranges are as follows:

Unsigned (Unsign)	0 to 9E+18 The selectable maximum value is limited by the data length and bit position, which are determined by the DLC and MSB/LSB settings, respectively.
Signed (Sign)	−9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position, which are determined by the DLC and MSB/LSB settings, respectively.

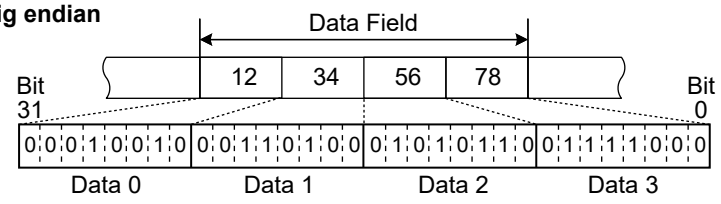
The value is displayed in scientific notation when the number of digits exceed seven (example: 1234567E+10).

If the comparison condition is a ≤ Data ≤ b or "Data < a or b < Data," the two reference values are automatically adjusted so that the lower limit is less than or equal to the upper limit.

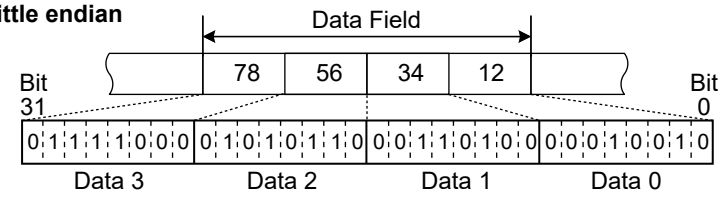
Byte Order (Endian)

Set the byte order of the data stream to Big Endian (Big) or Little Endian (Little). The following figure illustrates a 4-byte data stream on the bus. The data field value is 12345678 in hexadecimal notation.

Big endian



Little endian



Sign (Sign)

Set whether to use a signed (Sign) or unsigned (Unsign) data format.

The selectable range of data reference values varies depending on whether the data is signed or unsigned.

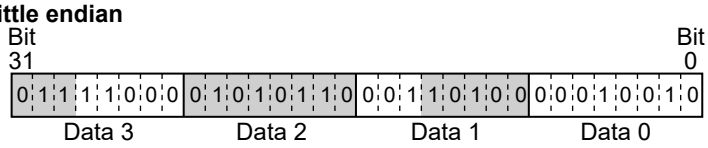
Comparison Range (MSB/LSB)

Set the MSB (MSB) or LSB (LSB) bit positions for the data that you will compare. For example, if you want to compare bits 5 through 20 of a 4-byte data value (12345678: hexadecimal), set the MSB to 20 and the LSB to 5. In this case, the bits that are compared are those that are shaded in the following figure.
Selectable range: 0 to (the number of bytes of data No 8 − 1). The maximum value is 63.

Big endian



Little endian



ACK Mode

You can set a trigger condition based on the ACK slot state. The ACK trigger condition is met when the specified state matches the input signal ACK slot state.

NON ACK	When the status is recessive
ACK	When the status is dominant
NON or ACK	When the status is recessive or dominant

Message/Signal

The messages and symbols in the physical value/symbol definition file (.sbl) that has been loaded into the instrument can be used to set the trigger condition.* Messages and signals can be used when the ID input format is set to Message.

* Physical value/symbol definition files (.sbl) are derived by converting CANdb files (.dbc).

Message

Select the ID from the Message list in the sbl file that has been loaded. The message trigger condition is met when the selected message matches the input signal ID.

Signal

Select the data from the Signal list in the sbl file that has been loaded. The signal trigger condition is met when the selected signal matches the input signal data.

Comparison Condition (Condition) and Reference Values (a and b)

The signal trigger condition is met when the result of comparing the reference values to the input signal data meets the specified comparison condition.
The method of setting the comparison condition and reference values (a and b) is the same as with the ID/Data mode when the input format is set to Pattern. However, you cannot set the comparison condition to True or False.

The values loaded from the sbl file are used for the Endian, Sign, MSB/LSB, and ACK items.

ID OR

The instrument triggers based on data frames and remote frames in the standard format (Standard) and the extended format (Extend).
The instrument triggers on the AND of the SOF, multiple IDs, frame type (Remote Frame or Data Frame), and ACK conditions.
The ID trigger condition is met when the ID matches any of the patterns that you set in ID1 to ID4.

- **Trigger Condition (Condition Setup)**
  On the Condition Setup screen, set the ID, ACK, and other trigger conditions.

  Frame Format
  Select the frame format. This setting applies to ID1 to ID4.
  - Standard: Standard format
  - Extend: Extended format

  SOF
  Triggers on the start of a CAN bus signal frame when the trigger condition is set to SOF only. SOF of ID OR is always selected as a trigger condition.

  ID Input Format (ID Input format)
  Select the ID input format from one of the settings below.
  - Pattern: Set the bit pattern of each ID in hexadecimal or binary notation.
  - Message: Select this setting to set the ID trigger conditions by using messages that are defined in the symbol definition file (sbl).

    ID1 to ID4
    You can set up to four IDs. IDs whose check boxes are selected are used as trigger conditions.
    The ID trigger condition is met when the input signal ID bit pattern matches any of the specified ID bit patterns. The method for setting the bit pattern of each ID is the same as with the ID/Data setting.
    ▶ See here.

  Remote Frame/Data Frame
  Set the trigger source frame to Remote Frame or Data Frame.

  ACK Mode
  You can set a trigger condition based on the ACK slot state. The ACK trigger condition is met when the specified state matches the input signal ACK slot state.

NON ACK	When the status is recessive
ACK	When the status is dominant
NON ACK or ACK	When the status is recessive or dominant

  Message
  The messages in the physical value/symbol definition file (.sbl) that has been loaded into the instrument can be used to set the trigger condition. Messages can be used when the ID input format is set to Message. The method for setting the message is the same as with the ID/Data setting.
  ▶ See here.

Source (Source)

Select the trigger source. After selecting the trigger source, configure the trigger level, hysteresis, bit rate, recessive level, HF rejection, sample point, and other settings.

Source (Source)

Set the trigger source to one of the settings below. The available settings vary depending on the model.
CH1 to CH8

Bit Rate (Bit Rate)

Select the CAN bus signal's transfer rate from one of the settings below.
33.3 kbps, 83.3 kbps, 125 kbps, 250 kbps, 500 kbps, 1 Mbps, User Define
If you select User Define, set the transfer rate in the range of 10 kbps to 1 Mbps in 0.1-kbps steps.

Recessive Level (Recessive)

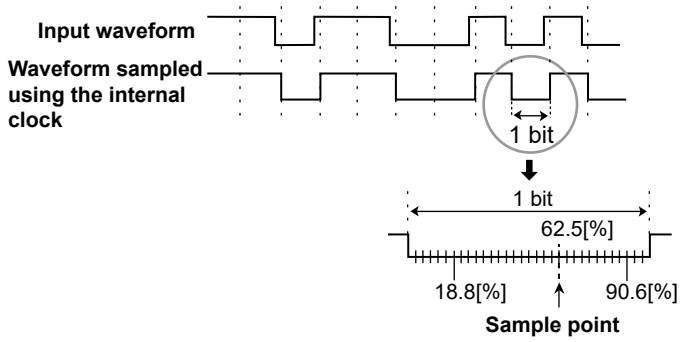
Select the recessive level from one of the settings below. In either setting, the logical value of the recessive level is 1, and the logical value of the dominant level is 0.

H	The recessive level is greater than the dominant level.
L	The recessive level is less than the dominant level.

Sample Point (Sample Point)

You can set the reference that will be used to determine the bus level (recessive or dominant) in the range of 18.8 to 90.6% in 3.1% steps.
The instrument's CAN bus signal trigger circuit samples the input CAN bus signal using the internal clock and detects the point of change from recessive to dominant. Set the sample point as a percentage, with the detected point of change equal to 0% and the point that is bit time after the point of change equal to 100%. The bit time is the inverse of the set bit rate.

If the sample point is set to 62.5%



Level (Level), HF Rejection (HF Rejection)

Set these items for the trigger source.
These items are the same as those of the edge trigger.

▶ See here.

Hysteresis (Hysteresis)

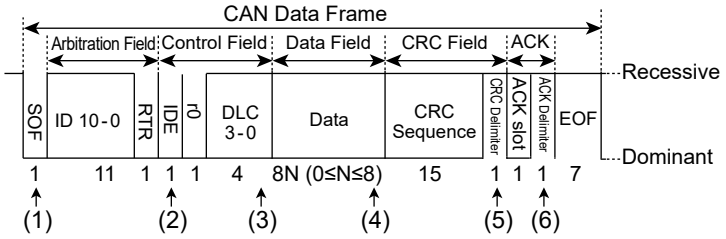
You can apply a hysteresis to the detection level so that level changes within the range will not be detected as edges.
Range: 0.3 div to 8.0 div
Resolution: 0.1 div

Frame Format and Trigger Point

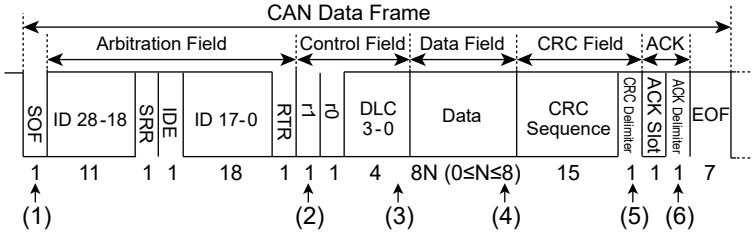
The following figures illustrate the formats and trigger points of the various frames.

Data Frame (Data Frame)

- **Standard format**



- **Extended format**



Positions (1) to (6) above are trigger points for the following conditions.

(1) SOF

(2) ID

(3) Data Frame (when DLC = 0)

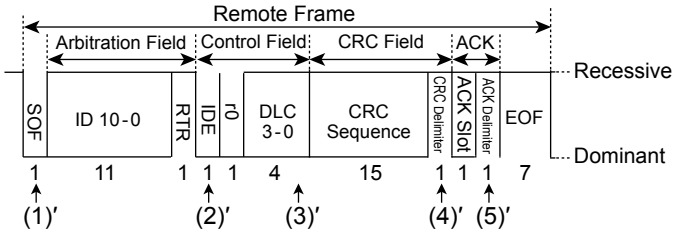
(4) Data Frame (when DLC ≠ 0)

(5) CRC Error

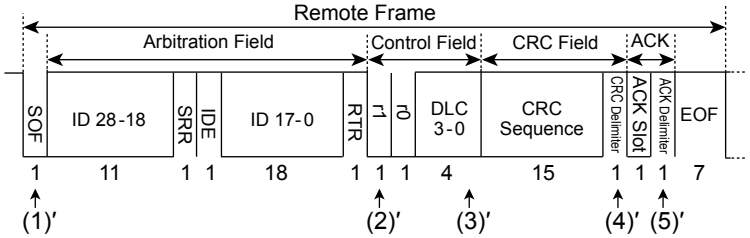
(6) ACK

Remote Frame (Remote Frame)

- **Standard format**



- **Extended format**



Positions (1)’ and (5)’ above are trigger points for the following conditions.

(1)’ SOF

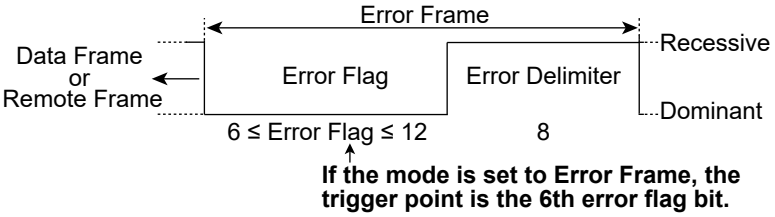
(2)’ ID

(3)’ Remote Frame (when DLC = 0)

(4)’ CRC Error

(5)’ ACK

Error Frame (Error Frame)



Stuff Error (Stuff Error)

The trigger point is the sample point of the bit that violates the bit stuffing rule.

CRCError (CRC Error)

CRC errors are indicated in the data-frame and remote-frame figures.

If multiple field types and frame types are combined, the trigger point is the point where the last type appears on the time axis.

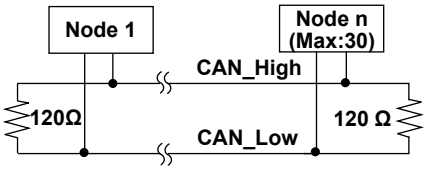
High speed CAN (ISO11898) and Low speed CAN (ISO11519-2)

The primary standards for the CAN physical layer are High-speed CAN (ISO11898) and Low-speed CAN (ISO11519-2).

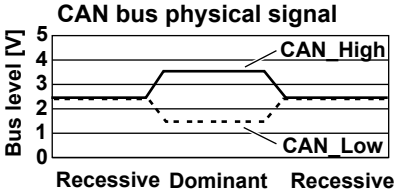
As shown in the following figure, the bus level is determined by the potential difference between two buses, CAN_High and CAN_Low, in either standard.

High speed CAN (ISO11898)

Transfer rate: 1 Mbps or less

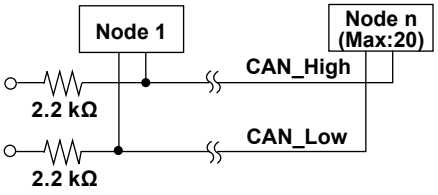


CAN bus physical signal

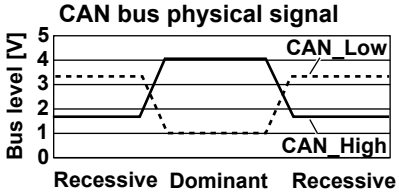


Low speed CAN (ISO11519-2)

Transfer rate: 125 kbps or less



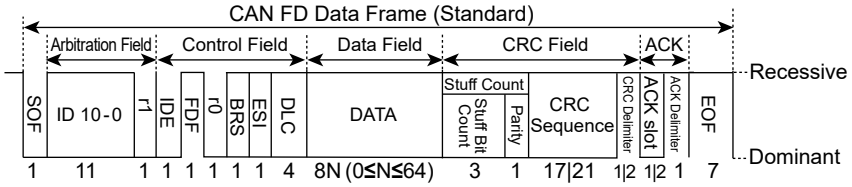
CAN bus physical signal



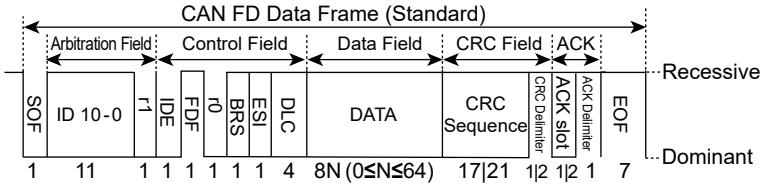
CAN FD Bus Trigger [ENHANCED, option]

The instrument triggers based on the trigger conditions of a particular frame or type of data in a CAN FD bus signal (ISO 11898-1: 2015 or non-ISO).

CAN FD (ISO 11898-1: 2015)



CAN FD (non-ISO)



Trigger Mode (Mode)

Select the CAN FD bus trigger mode from one of the settings below.

SOF: Triggers on the start of a frame

Error: Triggers on errors

ID/Data: Triggers on the AND of the ID bit pattern and Data pattern

ID OR: Triggers on the OR of multiple ID bit patterns

FDF: Triggers on the FDF bit state

ESI (ErrorPassive): Triggers when the ESI bit is recessive (error passive)

SOF (Start of Frame)

The instrument triggers on the start of CAN FD bus signal frames.

Error

The instrument triggers on an error (when the error flag is active) or when it detects various errors.

- **CAN FD Standard (FD Standard)**

  Select the compliant standard for the CAN FD bus signal to be applied.

  ISO:ISO 11898-1: Captured as a 2015-compliant CAN FD bus signal.

  non-ISO:ISO 11898-1: Captured as a CAN FD bus signal compliant to a standard before 2015.

- **Error Type (Error Type OR)**

  Select the types of errors to detect from the following. The instrument triggers if any of the selected errors is detected.

Error Frame	When an active error flag (indicated by six consecutive dominant bits) is detected
Stuff	When stuff bits are not inserted properly
Fixed Stuff	When fixed CRC stuff bits are not inserted properly
CRC	When a CRC error is detected If the aforementioned CAN FD standard is set to ISO, select the CRC error factor from one of the settings below. You can also select both. Stuff Count, CRC Sequence

ID/Data

The instrument triggers based on data frames and remote frames in the standard format (Standard) and the extended format (Extend).
The instrument triggers on the AND of the SOF, ID, frame type (Remote Frame or Data Frame), Data, and ACK conditions.

- If you specify X in the ID bit pattern or data pattern, the condition is assumed to be met regardless of the corresponding bit status.
- In a bit pattern or data pattern setting, if a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

- **Trigger Condition (Condition Setup)**

  On the Condition Setup screen, set the trigger conditions such as the ID, frame type (Remote Frame or Data Frame) and data.

  Frame Format

  Select the frame format.
  - Standard: Standard format
  - Extend: Extended format

  SOF

  Triggers on the start of a CAN FD bus signal frame when the trigger condition is set to SOF only. SOF of ID/Data is always selected as a trigger condition.

  ID

  Input Format (Input format)

  Select the ID input format from one of the settings below.
  - Pattern: Set the bit pattern of each ID in hexadecimal or binary notation.
  - Message: Select this setting to set the ID or Data trigger conditions by using messages and signals that are defined in the symbol definition file (sbl).

  Bit Pattern (Hex/Bin)

  Set the 11-bit standard format ID bit pattern or the 29-bit extended format ID bit pattern in hexadecimal (Hex) or binary (Bin) notation. The ID trigger condition is met when the input signal ID bit pattern matches the specified bit pattern. You can only set these items when you set the trigger source frame to Pattern.

  Remote Frame/Data Frame

  Set the trigger source frame to Remote Frame or Data Frame.

  Data

  You can set a trigger condition based on the data field value. Specify the size, position, condition, and data pattern settings. You can only set these items when you set the trigger source frame to Data Frame.

  Comparison Size (Size)

  Set the data length to be compared. The data pattern with the specified data length is compared to the input signal data pattern. If "0" is specified, the instrument triggers regardless of the input signal's data field value.
  Selectable range: 0 to 8 bytes

  Comparison Start Position (Position)

  Set the position to start comparing the data pattern. The left end of the data field is position 0.
  Selectable range: 0 to 63 bytes

- If the comparison size (Size) is set to 0, comparison start position (Position) cannot be set.
- The selectable range for position is limited so that Size + Position is less than or equal to 64.

Comparison Condition (Condition)

The data trigger condition is met when the result of comparing the data pattern or reference value to the input signal's data field meets the specified comparison condition.

True	When the value matches the data pattern
False	When the value does not match the data pattern
Data=a[1]	When the value is equal to the reference value
Data≠a[1]	When the value is not equal to the reference value
a≤Data[1]	When the value is greater than or equal to the reference value
Data≤b[1]	When the value is less than or equal to the reference value
a≤Data≤b[2]	When the value is within the reference range (including the reference values)
Data<a, b<Data[2]	When the value is outside the reference range (excluding the reference values)

1 Set one reference value
2 Set two reference values

Data Pattern (Hex/Bin)

If the comparison condition is set to True or False, set the data pattern for the specified data size in hexadecimal (Hex) or binary (Bin) notation.

Reference Values (a and b)

If the comparison condition is set to Data = A, Data ≠ a, a ≤ Data, Data ≤ b, a ≤ Data ≤ b, or "Data < a or b < Data," set the reference values in decimal notation. You must set the byte order (Endian), sign (Sign), and comparison range (MSB or LSB).
The selectable ranges are as follows:

Unsigned (Unsign)	0 to 9E+18 The selectable maximum value is limited by the data length and bit position, which are determined by the Size and MSB/LSB settings, respectively.
Signed (Sign)	−9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position, which are determined by the Size and MSB/LSB settings, respectively.

The value is displayed in scientific notation when the number of digits exceed seven (example: 1234567E+10).

If the comparison condition is a ≤ Data ≤ b or "Data < a or b < Data," the two reference values are automatically adjusted so that the lower limit is less than or equal to the upper limit.

Byte Order (Endian), Sign (Sign), and Comparison Range (MSB/LSB)

These items are the same as those of the CAN bus trigger.
▶ See here.

ACK Mode

These items are the same as those of the CAN bus trigger.
▶ See here.

Message/Signal

These items are the same as those of the CAN bus trigger.
▶ See here.

ID OR

These items are the same as those of the CAN bus trigger.

▶ See here.

FDF

Set the FDF bit state as a trigger condition.

0 (CAN): When the FDF bit is dominant, the instrument assumes that the frame is a CAN bus signal frame and triggers.

1 (CAN FD): When the FDF bit is recessive, the instrument assumes that the frame is a CAN FD bus signal frame and triggers.

ESI (ErrorPassive)

The instrument triggers when the ESI bit is recessive (error passive).

Source (Source)

Select the trigger source. After selecting the trigger source, configure the trigger level, hysteresis, bit rate, recessive level, HF rejection, and sample point.

Source (Source)

Set the trigger source to one of the settings below. The available settings vary depending on the model.

CH1 to CH8

Bit Rate (Bit Rate)

Select the CAN FD bus signal's arbitration phase data transfer rate from one of the settings below.

250 kbps, 500 kbps, 1 Mbps, User Define

If you select User Define, set the transfer rate in the range of 20 kbps to 1 Mbps in 0.1-kbps steps.

Sample Point (Sample Point)

You can set the reference that will be used to determine the bus level (recessive or dominant) of the CAN FD bus signal's arbitration phase in the range of 18.8 to 90.6% in 0.1% steps. The idea of sample point is the same as CAN bus signals.

▶ See here.

Data Bit Rate (Data Bit Rate)

Select the CAN FD bus signal's data phase data transfer rate from one of the settings below.

500 kbps, 1 Mbps, 2 Mbps, 4 Mbps, 5 Mbps, 8 Mbps, User Define

If you select User Define, set the transfer rate in the range of 250 kbps to 10 Mbps in 0.1-kbps steps.

The data bit rate can be set as high as 16 times the arbitration phase bit rate.

Sample Point of the Data Phase (Sample Point)

You can set the reference that will be used to determine the bus level (recessive or dominant) of the CAN FD bus signal's data phase in the range of 18.8 to 90.6% in 0.1% steps. The idea of sample point is the same as CAN bus signals.

▶ See here.



If the data bit rate exceeds 16 times the bit rate, the rates are automatically adjusted according to the last set value so that the relationship "data bit rate ≤ bit No 16" is maintained.

Recessive Level (Recessive)

These items are the same as those of the CAN bus trigger.

▶ See here.

Level (Level), HF Rejection (HF Rejection)

Set these items for the trigger source.

These items are the same as those of the edge trigger.

▶ See here.

Hysteresis (Hysteresis)

This item is the same as that of the CAN bus trigger.

▶ See here.

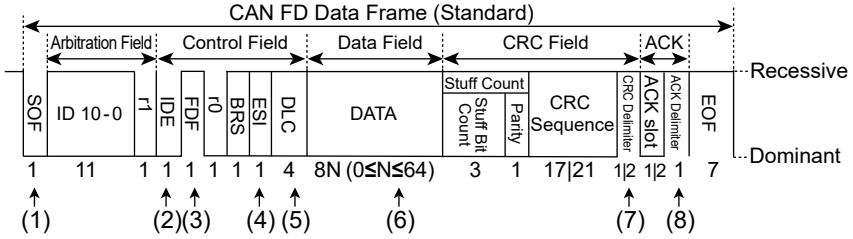
Frame Format and Trigger Point

The following figures illustrate the formats and trigger points of the various frames.

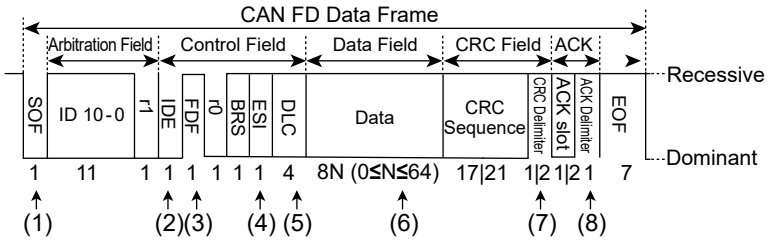
Data Frame (Data Frame)

- **Standard format**

CAN FD (ISO 11898-1: 2015)

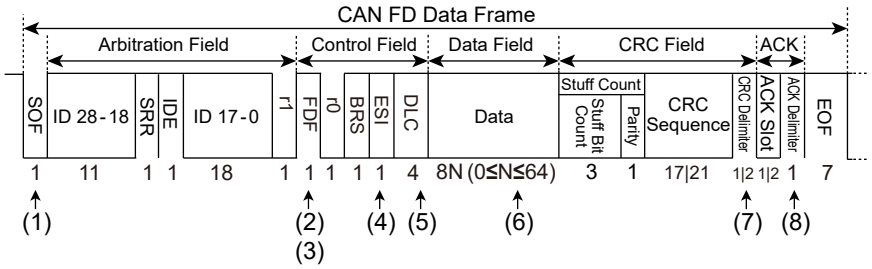


CAN FD (non-ISO)

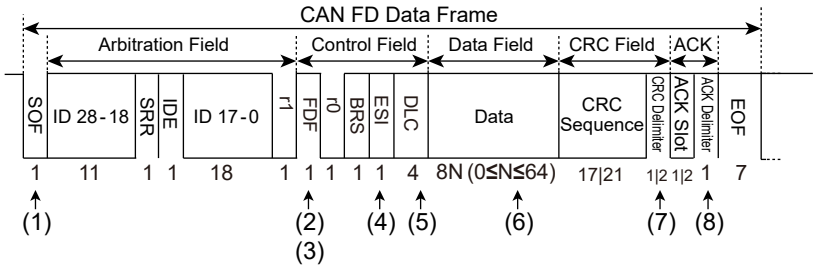


- **Extended format**

CAN FD (ISO 11898-1: 2015)



CAN FD (non-ISO)



Positions (1) to (8) above are trigger points for the following conditions.

(1) SOF	(5) Data Frame (when Size = 0)
(2) ID	(6) Data Frame (when Size ≠ 0)[1]
(3) FDF	(7) CRC Error[2]
(4) ESI	(8) ACK[3]

1 Where the data patterns match.

2 If the CAN FD standard (FD Standard) is set to ISO, the detected point for both stuff count and CRC sequence errors are at the CRC Delimiter position.

3 If both CRC Delimiter and ACK Slot are 2 bits long, the trigger point is the second bit of ACK Slot. The detected point when you use the search feature of the instrument is the ACK Delimiter position regardless of the CRC Delimiter or ACK Slot condition.

Remote Frame (Remote Frame)

This is the same as the CAN bus trigger.

▶ See here.

Error Frame (Error Frame)

This is the same as the CAN bus trigger.

▶ See here.

Stuff Error (Stuff Error, Fixed Stuff)

The trigger point is the sample point of the bit that violates the bit stuffing rule.

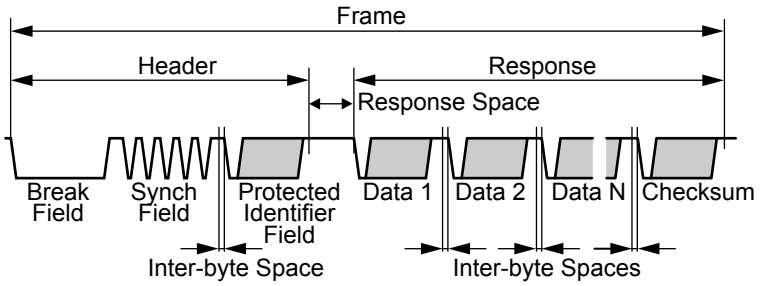
CRCError (CRC Error)

CRC errors are indicated in the data-frame and remote-frame figures.

If multiple field types and frame types are combined, the trigger point is the point where the last type appears on the time axis.

LIN Bus Trigger [ENHANCED, option]

The instrument triggers based on the conditions of a particular field or type of data in a LIN bus signal. The following figure shows the LIN bus signal frame format.



Trigger Mode (Mode)

Select the LIN bus trigger mode from one of the settings below.

Break Synch: Triggers on a break field or synch field

Error: Triggers on errors

ID/Data: Triggers on the AND of the ID bit pattern and Data pattern

ID OR: Triggers on the OR of multiple ID bit patterns

Break Synch

The instrument triggers when it detects a break field and then a synch field (Break Field + Synch Field).

- **Break Length**

  Select the low-pulse bit length that is used to detect breaks from one of the options below.

  10 or longer, 11 or longer, 12 or longer, or 13 or longer

If the instrument detects a break field and then a synch field (Break Field + Synch Field) in the middle of a LIN bus frame, it discards the frame and triggers the next time it detects a protected identifier field.

Error

The instrument triggers when it detects various types of errors.

- **Error Type (Error Type OR)**

  Select the types of errors to detect from the following. The instrument triggers if any of the selected errors is detected.

Parity	The instrument calculates the parity of the protected identifier field. If the result does not satisfy the following equations, the instrument triggers on the protected identifier field's stop bit position. Even Parity Check: ID0 xor ID1 xor ID2 xor ID4 xor P0 = 0 P0 = ID0 xor ID1 xor ID2 xor ID4 ODD Parity Check: ID1 xor ID3 xor ID4 xor ID5 xor P1 = 1 P1 = ¬(ID1 xor ID3 xor ID4 xor ID5)
Sync	If the synch field is not 0x55, the instrument triggers on the synch field's stop bit position.

ID/Data

The instrument triggers on the AND of ID and Data conditions.

- If you specify X in the ID bit pattern or data pattern, the condition is assumed to be met regardless of the corresponding bit status.
- In a bit pattern or data pattern setting, if a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

- **Trigger Condition (Condition Setup)**

  On the Condition Setup screen, set the ID, data, and other trigger conditions.

Break Synch(10bit)

Triggers on a synch field that comes after a break field when the trigger condition is set to Break Synch only. Break Synch of ID/Data is always selected as a trigger condition.

ID

Set the bit pattern for the 6-bit protection ID (ID0 to ID5) in the protected identifier field in hexadecimal or binary notation. The ID trigger condition is met when the input signal ID bit pattern matches the specified bit pattern.

- Hex: Select this setting to set the ID bit pattern in hexadecimal notation.
- Bin: Select this setting to set the ID bit pattern in binary notation.

Data Frame

You can specify a value from Data 1 to Data 8 as a trigger condition.

Data Length (Size)

Set how many consecutive data bytes will be compared.
Selectable range: 1 to 8 bytes

Comparison Condition (Condition)

The data trigger condition is met when the relationship between the data pattern or the reference value and the input signal data value matches the specified comparison condition.

True	When the value matches the data pattern
False	When the value does not match the data pattern
Data=a[1]	When the value is equal to the reference value
Data≠a[1]	When the value is not equal to the reference value
a≤Data[1]	When the value is greater than or equal to the reference value
Data≤b[1]	When the value is less than or equal to the reference value
a≤Data≤b[2]	When the value is within the reference range (including the reference values)
Data<a, b<Data[2]	When the value is outside the reference range (excluding the reference values)

1 Set one reference value
2 Set two reference values

Data Pattern (Hex/Bin)

If the comparison condition is set to True or False, set the data pattern for the specified data size in hexadecimal (Hex) or binary (Bin) notation.

Reference Values (a and b)

If the comparison condition is set to Data = A, Data ≠ a, a ≤ Data, Data ≤ b, a ≤ Data ≤ b, or “Data < a or b < Data,” set the reference values in decimal notation. You must set the byte order (Endian), sign (Sign), and comparison range (MSB or LSB). The selectable ranges are as follows:

Unsigned (Unsign)	0 to 9E+18 The selectable maximum value is limited by the data length and bit position, which are determined by the Data Size and MSB/ LSB settings, respectively.
Signed (Sign)	−9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position, which are determined by the Data Size and MSB/ LSB settings, respectively.

The value is displayed in scientific notation when the number of digits exceed seven (example: 1234567E+10).

If the comparison condition is a ≤ Data ≤ b or “Data < a or b < Data,” the two reference values are automatically adjusted so that the lower limit is less than or equal to the upper limit.

Byte Order (Endian)

Set the data byte order to big endian (Big) or little endian (Little).

Sign (Sign)

Set whether to use a signed (Sign) or unsigned (Unsign) data format.
The selectable range of data reference values varies depending on whether the data is signed or unsigned.

Comparison Range (MSB/LSB)

Set the MSB (MSB) or LSB (LSB) bit positions for the data that you will compare.
Selectable range: 0 to (the number of bytes of data No 8 − 1). The maximum value is 63.

▶ See here.

ID OR

The instrument triggers when the ID matches any of the patterns that you set in ID1 to ID4.

- **Trigger Condition (Condition Setup)**

  On the Condition Setup screen, set the ID trigger conditions.

  Break Synch

  Triggers on a synch field that comes after a break field when the trigger condition is set to Break Synch only. Break Synch of ID OR is always selected as a trigger condition.

  ID

  ID1 to ID4

  IDs whose check boxes are selected are used as trigger conditions.

  The ID trigger condition is met when the input signal ID bit pattern matches any of the specified ID bit patterns. The method for setting the bit pattern of each ID is the same as with the ID/Data setting.

  ▶ See here.

Source (Source)

Select the trigger source. After selecting the trigger source, configure the bit rate, sample point, HF rejection, trigger level, hysteresis, and other settings.

Source (Source)

Set the trigger source to one of the settings below. The available settings vary depending on the model.

CH1 to CH8

Bit Rate (Bit Rate)

Select the LIN bus signal's transfer rate from one of the settings below.

1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, User Define

If you select User Define, set the transfer rate in the range of 1000 bps to 20000 bps in 10-bps steps.

Sample Point (Sample Point)

You can set the reference that will be used to determine the bus level in the range of 18.8 to 90.6% in 3.1% steps.

The instrument's LIN bus signal trigger circuit samples the input LIN bus signal using the internal clock and detects the point of level change. Set the sample point as a percentage, with the detected point of change equal to 0% and the point that is bit time after the point of change equal to 100%. The bit time is the inverse of the set bit rate.

▶ See here.

Level (Level), HF Rejection (HF Rejection)

Set these items for the trigger source.

These items are the same as those of the edge trigger.

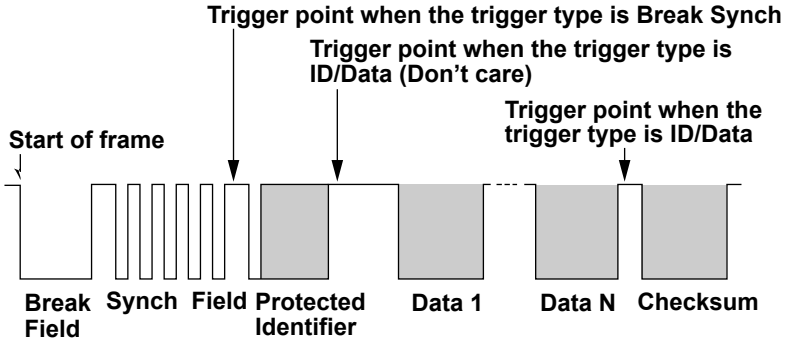
▶ See here.

Hysteresis (Hysteresis)

This item is the same as that of the CAN bus trigger.

▶ See here.

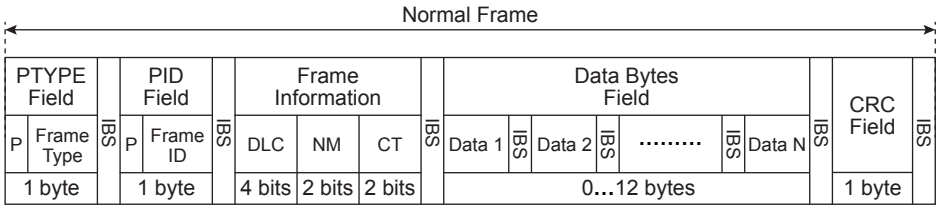
Trigger Point



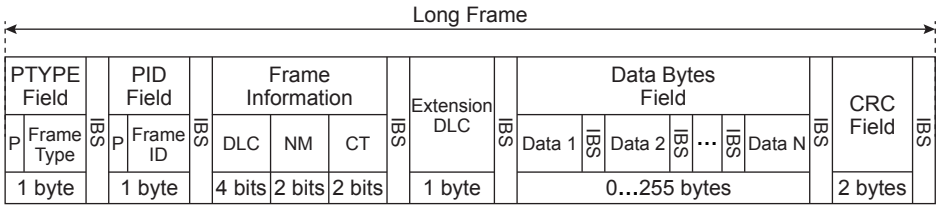
CXPI Bus Trigger [ENHANCED, option]

The trigger function uses the start of a CXPI bus signal frame or the combination of the start of a frame and the bit pattern (PID or PTYPE field) at the start of the frame. The following figure shows the CXPI bus signal frames.

Normal Frame



Long Frame



PTYPE at the start of each frame is an option for the polling method.
When the option is not used, the start of the frame is a PID. Refer to this figure along with the figures in "Trigger Point."

Trigger Mode (Mode)

Select the CXPI bus trigger mode from one of the settings below.
SOF: Triggers on the start of a frame
Error: Triggers on errors
PTYPE: Triggers on PTYPE
ID/Data: Triggers on the position where the AND condition of the ID bit pattern, frame information, and data pattern is met
ID OR: Triggers on the OR of multiple ID bit patterns
Wakeup/Sleep: Triggers on wakeup pulses, wakeup states, sleep frames, and sleep states

SOF(Start of Frame)

The instrument triggers on the start of CXPI bus signal frames.
Triggers can be activated on SOF alone.
* The start of a frame is found by detecting a logic 0 following 20 or more consecutive bits of logic 1's.

Error

The instrument triggers when it detects various types of errors.

- **Error Type (Error Type OR)**

  Select the types of errors to detect from the following. The instrument triggers if any of the selected errors is detected.

Parity	When a parity error is detected
CRC	When a CRC error is detected
Data Length	When the DLC value and the number of data pieces in the data field (data length) do not match
Framing	When the logical value of the stop bit of a field or the stop bit of data is 0
IBS	When the number of IBS bits is 10 or more
Clock	When the clock width exceeds the specified tolerance

PTYPE

The instrument triggers on PTYPE.
Every PTYPE: The instrument triggers on every PTYPE.
No Response: The instrument triggers when a PID is not detected after PTYPE.

ID/Data

The instrument triggers on the AND of SOF, ID, frame information, and data.

- If you specify X in the ID bit pattern, frame information, or data pattern, the condition is assumed to be met regardless of the corresponding bit or item status.
- In a bit pattern or data pattern setting, if a binary pattern contains any Xs, the corresponding hexadecimal display will be “$.”

- **SOF**

  The instrument triggers on the start of a CXPI bus signal frame when the trigger condition is set to SOF only. SOF of ID/Data is always selected as a trigger condition.

- **ID**

  with PTYPE

  The instrument triggers on whether a frame contains PTYPE.
  - Yes: Triggers on the ID of a frame containing PTYPE
  - No: Triggers on the ID of a frame not containing PTYPE
  - X: Triggers on the ID regardless of the presence of PTYPE

  Bit Pattern (Hex/Bin)

  Set the 7-bit ID bit pattern in hexadecimal (Hex) or binary (Bin) notation. The instrument triggers when the specified bit pattern matches the input signal’s ID bit.

- **Frame Information**

  The instrument triggers on the wakeup and sleep indicators of frame information and CT bit value.
  - Wakeup: Set the wakeup indicator bit value to 0, 1, or X.
  - Sleep: Set the sleep indicator bit value to 0, 1, or X.
  - CT: Set the counter bit value to a value from 0 to 3 or X.

- **Data**

  The instrument triggers by detecting a data value. Specify the size, position, and condition.

  Comparison Size (Size)

  Set the data length to be compared. The data pattern with the specified data length is compared to the input signal data pattern. If “0” is specified, the instrument assumes that a point has been detected regardless of the input signal’s data value.
  Selectable range: 0 to 8 bytes

  Comparison Start Position (Position)

  Set the data pattern start point. The left end of the data is position 0.
  Selectable range: 0 to 254 bytes

- If the comparison size (Size) is set to 0, comparison start position (Position) cannot be set.
- The selectable range for position is limited so that Size + Position is less than or equal to 255.

  Comparison Condition (Condition)

  The data trigger condition is met when the relationship between the data pattern or the reference value and the input signal data value matches the specified comparison condition.

True	When the value matches the data pattern
False	When the value does not match the data pattern
Data=a[1]	When the value is equal to the reference value
Data≠a[1]	When the value is not equal to the reference value
a≤Data[1]	When the value is greater than or equal to the reference value
Data≤b[1]	When the value is less than or equal to the reference value
a≤Data≤b[2]	When the value is within the reference range (including the reference values)
Data<a, b<Data[2]	When the value is outside the reference range (excluding the reference values)

1 Set one reference value
2 Set two reference values

  Data Pattern

  If the comparison condition is set to True or False, set the data pattern for the specified size in hexadecimal (Hex) or binary (Bin) notation.

  Reference Values (a and b)

  If the comparison condition is set to Data = A, Data ≠ a, a ≤ Data, Data ≤ b, a ≤ Data ≤ b, or “Data < a or b < Data,” set the reference values in decimal notation. You must set the byte order (Endian), sign (Sign), and comparison range (MSB or LSB).
  The selectable ranges are as follows:

Unsigned (Unsign)	0 to 9E+18 The selectable maximum value is limited by the data length and bit position, which are determined by the Size and MSB/LSB settings, respectively.
Signed (Sign)	−9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position, which are determined by the Size and MSB/LSB settings, respectively.

  The value is displayed in scientific notation when the number of digits exceed seven (example: 1234567E+10).

If the comparison condition is a ≤ Data ≤ b or “Data < a or b < Data,” the two reference values are automatically adjusted so that the lower limit is less than or equal to the upper limit.

Byte Order (Endian), Sign (Sign), and Comparison Range (MSB/LSB)
These items are the same as those of the CAN bus trigger.
▶ See here.

ID OR

The instrument triggers on the AND condition of SOF and multiple IDs.
The ID trigger condition is met when the ID matches any of the patterns that you set in ID1 to ID4.

- **Trigger Condition (Condition Setup)**
  On the Condition Setup screen, set the PTYPE, ID, and other trigger conditions.
  SOF
  The instrument triggers on the start of a CXPI bus signal frame when the trigger condition is set to SOF only.
  SOF of ID OR is always selected as a trigger condition.

  ID
  - **with PTYPE**
    The instrument triggers on whether a frame contains PTYPE.
    Yes: Triggers on the ID of a frame containing PTYPE
    No: Triggers on the ID of a frame not containing PTYPE
    X: Triggers on the ID regardless of the presence of PTYPE
  - **ID1 to ID4**
    You can set up to four IDs. IDs whose check boxes are selected are used as trigger conditions.
    The ID trigger condition is met when the input signal ID bit pattern matches any of the specified ID bit patterns. The method for setting the bit pattern of each ID is the same as with the ID/Data setting.

Wakeup/Sleep

The instrument triggers on any of the following: wakeup pulses, wakeup states, sleep frames, or sleep states.

- **Trigger Type (Type)**

Wakeup Pulse	When a pulse in the dominant period between 250 µs and 2500 µs is detected
Wakeup	When a transition from a state in which there is no clock after a sleep detection to a state in which there is a clock is detected
Sleep Frame	When the sleep frame ID value is 1F (hexadecimal)
Sleep	When 5 ms elapses after a transition is made from a state in which there is a clock to a state in which there is no clock

Source (Source)

Select the trigger source. After selecting the trigger trigger source, configure the bit rate, T Sample, clock tolerance, HF rejection, trigger level, hysteresis, and other settings.

Source (Source)

Set the trigger source to one of the settings below. The available settings vary depending on the model.
CH1 to CH8

Bit Rate (Bit Rate)

Select the CXPI bus signal's transfer rate from one of the settings below.
4800 bps, 9600 bps, 19200 bps, User Define
If you select User Define, set the transfer rate in the range of 4000 bps to 50000 bps in 10-bps steps.

T Sample(T Sample)

Set the sum value, T Sample, for determining the logical value of the current bit.
The value in which T Sample is added to the low width of logical value 1 detected with the last bit is used as the threshold to determine the value as follows:

- Logical value 1 when the low width of the current bit is less than or equal to the threshold
- Logical value 0 when the low width of the current bit is greater than the threshold

Selectable range: 0.010 Tbit to 0.300 Tbit
Resolution: 0.001 Tbit

* Tbit is the time width of a bit calculated from the bit rate.

Clock Tolerance(Clock Tolerance)

Set the tolerance of the clock width calculated from the bit rate.
Selectable range: ±0.5% to ±5.0%
Resolution: 0.1%

Level (Level), HF Rejection (HF Rejection)

Set these items for the trigger source.
These items are the same as those of the edge trigger.

▶ See here.

Hysteresis (Hysteresis)

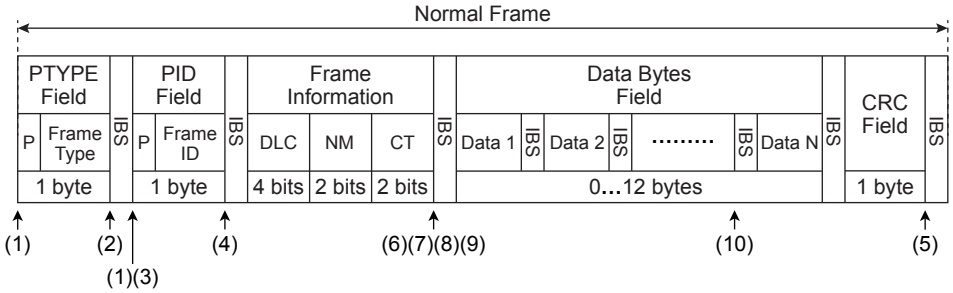
This item is the same as that of the CAN bus trigger.

▶ See here.

Trigger Point

The following figure shows the trigger points.

- **Normal Frame**

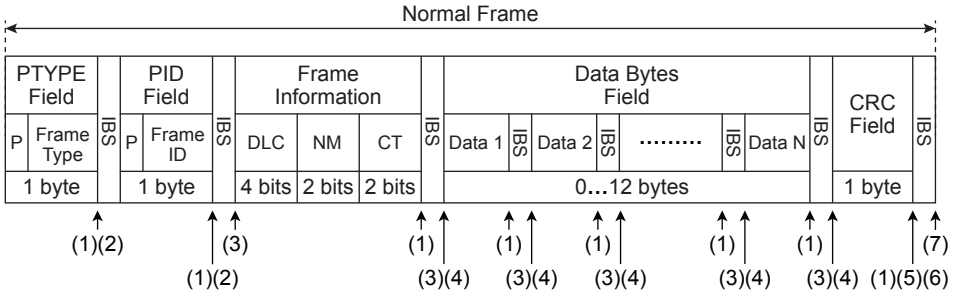


PTYPE is an option for the polling method.

Positions (1) to (9) above are trigger points for the following conditions.

(1) SOF	End position of the start bit of a PTYPE or PID field
(2) Every PTYPE	End position of the stop bit of a PTYPE field
(3) No Response	End position of the 10th consecutive bit with logical value 1 counted from the end position of the stop bit of the PTYPE field
(4) ID	End position of the stop bit of a PID field
(5) Sleep frame	End position of the stop bit of a CRC field
(6) Wakeup	End position of the stop bit of a frame information field
(7) Sleep	End position of the stop bit of a frame information field
(8) CT	End position of the stop bit of a frame information field
(9) Data (when Size = 0)	End position of the stop bit of a frame information field
(10) Data (when Size ≠ 0)	End position of the stop bit of a specified data bytes field

Error Trigger Points

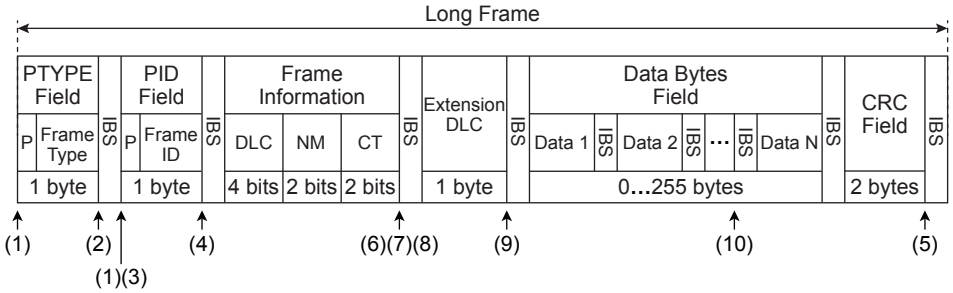


Positions (1) to (7) above are trigger points for the following errors.

(1) Fraiming Error	End position of the bit corresponding to the stop bit of each field
(2) Parity Error	End position of a PTYPE or PID stop bit
(3) IBS Error	End position of the 10th consecutive logical value 1 bit from the end position of the stop bit of each field (excluding PTYPE)
(4) Data Length Error (When data length < DLC)	End position of the 10th consecutive bit with logical value 1 counted from the end position of the stop bit of the last data bytes field
(5) CRC Error	End position of the stop bit of a CRC field
(6) Counter Error*	End position of the stop bit of a CRC field
(7) Data Length Error (When data length > DLC)	End position of the start bit of an exceeding byte field

* Counter Error is not a trigger point but a counter error detection point.

- **Long Frame**

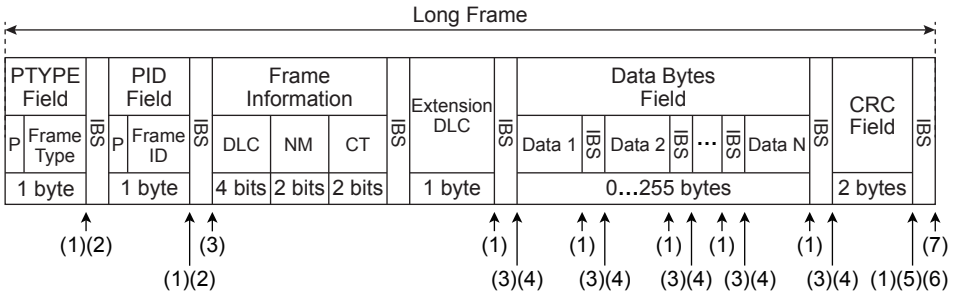


PTYPE is an option for the polling method.

Positions (1) to (9) above are trigger points for the following conditions.

(1) SOF	End position of the start bit of a PTYPE or PID field
(2) Every PTYPE	End position of the stop bit of a PTYPE field
(3) No Response	End position of the 10th consecutive bit with logical value 1 counted from the end position of the stop bit of the PTYPE field
(4) ID	End position of the stop bit of a PID field
(5) Sleep frame	End position of the stop bit of a CRC field
(6) Wakeup	End position of the stop bit of a frame information field
(7) Sleep	End position of the stop bit of a frame information field
(8) CT	End position of the stop bit of a frame information field
(9) Data (when Size = 0)	End position of the stop bit of a extension DLC field
(10) Data (when Size ≠ 0)	End position of the stop bit of a specified data bytes field

Error Trigger Points



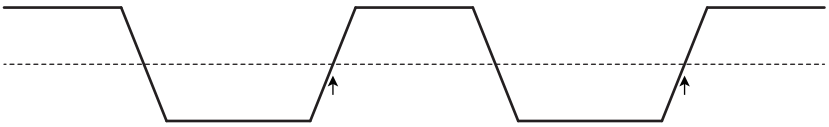
Positions (1) to (7) above are trigger points for the following errors.

(1) Fraiming Error	End position of the bit corresponding to the stop bit of each field
(2) Parity Error	End position of a PTYPE or PID stop bit
(3) IBS Error	End position of the 10th consecutive logical value 1 bit from the end position of the stop bit of each field (excluding PTYPE)
(4) Data Length Error (When data length < DLC)	End position of the 10th consecutive bit with logical value 1 counted from the end position of the stop bit of the last data bytes field
(5) CRC Error	End position of the stop bit of a CRC field
(6) Counter Error*	End position of the stop bit of a CRC field
(7) Data Length Error (When data length > DLC)	End position of the start bit of an exceeding byte field

* Counter Error is not a trigger point but a counter error detection point.

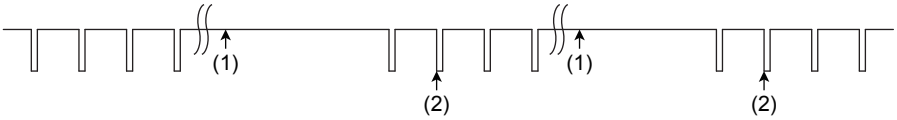
- **Wakeup Pulse**

  The trigger point is the rising edge after a dominant period ranging from 250 µs to 2500 µs.



Rising edge after a specified dominant period

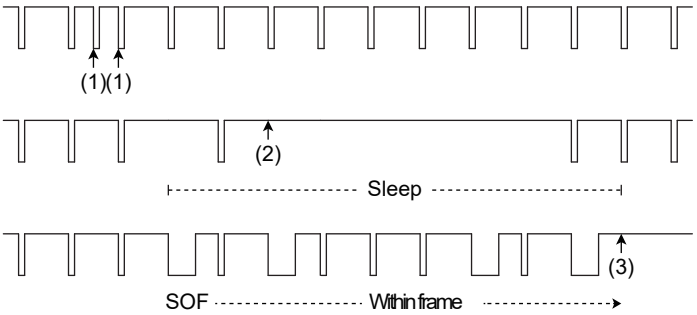
- **Wakeup/Sleep**



Positions (1) and (2) above are trigger points for the following conditions.

(1) Sleep	Position at 5 ms from the last falling edge of the ending clock
(2) Wakeup	Clock detection position after sleep (where 1 clock is guaranteed)

- **Clock Error**

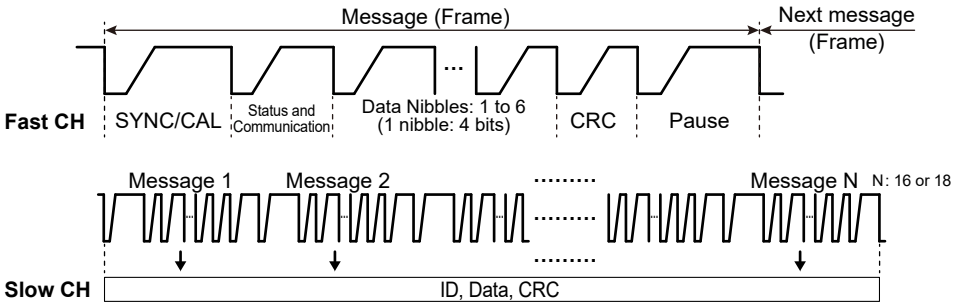


Positions (1) to (3) above are trigger points for the following conditions.

(1) Clock Error	Position where a clock less than clock error 1 Tbit No (1 − (absolute value of clock tolerance)/100)
(2) Clock Error	Position at 1 Tbit No + (absolute value of clock tolerance)/100) from the falling edge detected during sleep
(3) Clock Error	Position at 1 Tbit No (1 + (absolute value of clock tolerance)/100) from the last falling edge of the ending clock within the frame

SENT Trigger [ENHANCED, option]

The instrument triggers on a specific pulse or nibble (Nibble) in a SENT signal. The following figure shows the SENT signal frame format.



The instrument's SENT signal trigger circuit detects the section of the signal where the period between successive falling edges of the signal is 56 clock ticks* (including the specified clock tolerance) as SYNC/CAL. If consecutive 56-clock-tick signals occur, the last signal is detected as SYNC/CAL. The previous signals are handled as pause pulses or errors.

* In SENT signals, the reference clock period is expressed in clock ticks. The time between consecutive falling edges of the signal is counted using this period in order to detect SYNC/CAL and calculate nibble values.

Trigger Mode (Mode)

Select the SENT trigger mode from one of the settings below.

Every Fast CH: Triggers when a fast channel message is detected
Fast CH S&C: Triggers on the status and communication bit pattern
Fast CH Data: Triggers on the AND of the fast channel data
Every Slow CH: Triggers when a slow channel message is detected
Slow CH ID/Data: Triggers on the AND of the slow channel ID and data
Error: Triggers on errors

Every Fast CH

The instrument triggers when it detects a fast channel message.

Fast CH S&C

The instrument triggers on the fast channel status and communication bit pattern.

- If you specify X in the bit pattern or data pattern, the condition is assumed to be met regardless of the corresponding bit status.
- In a bit pattern or data pattern setting, if a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

- **Trigger Condition (Condition Setup)**

  Set the 4-bit status and communication bit pattern in hexadecimal (Hex) or binary (Bin) notation. The trigger condition is met when the input signal status and communication bit pattern match the specified bit pattern.

Fast CH Data

The instrument triggers on the AND of fast channel Data conditions.

- **Data Type (Data Type)**
  Select the fast channel data type from one of the settings below.
  Nibble: Set a 4 to 24 bit data pattern in unit of nibbles (4 bits).
  User: Set the data sizes of Data1 to Data4 in the range of 0 to 24 bits.

- **User Setup (User Setup)**
  When the data type is USER, set the comparison conditions for Data1 to Data4, the data size, and nibble order.
  Data size (Size): The total number of bits for Data1 to Data4 is up to 24. If you try to exceed the total number of bits, the data size of other pieces of Data is reduced.
  Nibble order (Order): Select Big or Little.
  When version is APR 2016 and Multiplexing is on, the data size of Data 1 is fixed to 4 bits to correspond to FC.

- **Trigger Condition (Condition Setup)**
  Set the fast channel data trigger conditions.

  When the data type is nibble
  - **Comparison Condition (Condition)**
    The data trigger condition is met when the result of comparing the data pattern to the input signal's data value meets the specified comparison condition.

True	When the value matches the data pattern
False	When the value does not match the data pattern

  - **Data Pattern (Hex/Bin)**
    Set the data pattern for the data nibble in hexadecimal (Hex) or binary (Bin) notation.

  When the data type is User
  - **Comparison Condition (Condition)**
    The data trigger condition is met when the result of comparing the user-specified Data1 to Data4 values to the input signal's data value meets the specified comparison condition. Only the data pieces that were selected to be comparison conditions can be specified.

Data=a[1]	When the value is equal to the reference value
Data≠a[1]	When the value is not equal to the reference value
a≤Data[1]	When the value is greater than or equal to the reference value
Data≤b[1]	When the value is less than or equal to the reference value
a≤Data≤b[2]	When the value is within the reference range (including the reference values)
Data<a, b<Data[2]	When the value is outside the reference range (excluding the reference values)

    1 Set one reference value
    2 Set two reference values

  - **Reference Values (a and b)**
    Set the reference values in decimal notation.
    Selectable range: 0 to $2^N - 1$
    N: Data size (bits) assigned in User settings

If the comparison condition is a ≤ Data ≤ b or "Data < a or b < Data," the two reference values are automatically adjusted so that the lower limit is less than or equal to the upper limit.

Every Slow CH

The instrument triggers when it detects a slow channel message. To trigger using Every Slow CH, select the slow channel message type from one of the settings below. This is selectable when the format version (explained later) is APR2016 or JAN2010.

- Short: Short message
- Enhanced: Enhanced message

Slow CH ID/Data

The instrument triggers on the AND of the slow channel ID and Data conditions.

- **Slow CH Message Type (Slow CH Type)**

  This item is the same as that of “Every Slow CH” explained earlier.

  ▶ See here.

- **Trigger Condition (Condition Setup)**

  Set the slow channel id/data trigger conditions.

  When the message type is Short

  - **Input Format (Input Format)**

    Set the ID and data pattern input format to Hex (hexadecimal) or Dec (decimal).

  - Comparison Condition (Condition)

    The data trigger condition is met when the result of comparing the ID and data reference values to the input signal’s ID and data values meets the specified comparison condition.

    - Select whether to compare the ID or data. If you select both, the instrument triggers on the AND condition.
    - Set the comparison conditions for ID and data.

Data	True[1]	When the value matches the specified data pattern
	False[1]	When the value does not match the specified data pattern
ID=a[2] Data=a[2]		When the value is equal to the reference value
ID≠a[2] Data≠a[2]		When the value is not equal to the reference value
a≤ID[2] a≤Data[2]		When the value is greater than or equal to the reference value
ID≤b[2] Data≤b[2]		When the value is less than or equal to the reference value
a≤ID≤b[3] a≤Data≤b[3]		When the value is within the reference range (including the reference values)
ID<a, b<ID[3] Data<a, b<Data[3]		When the value is outside the reference range (excluding the reference values)

1 Set the data pattern for the data nibble in hexadecimal (Hex) or binary (Bin) notation. If the slow channel type is Short, set an 8 bit data pattern. If slow channel type is Enhanced and the ID and Data message format (explained later) (Configuration bit) is “12bit data, 8bit ID,” set a 12 bit data pattern. If the slow channel type Enhanced and the ID and Data message format is “16bit data, 4bit ID,” set a 16 bit data pattern.

2 Set one reference value

3 Set two reference values

- **Reference Values (a and b)**

  Set the reference values in Hex (hexadecimal) or Dec (decimal) according to the input format. The selectable ranges are as follows:

ID		Data	
Hex	**Dec**	**Hex**	**Dec**
0 to F	0 to 15	00 to FF	0 to 255

If the comparison condition is a ≤ ID ≤ b, a ≤ Data ≤ b, “ID < a or b < ID,” or “Data < a or b < Data,” the two reference values are automatically adjusted so that the lower limit is less than or equal to the upper limit.

When the message type is Enhanced

- **Configuration bit**
  Select the ID and data message format from one of the settings below.
  - 12bit data, 8bit ID: When the data field is 12 bits and the message ID is 8 bits
  - 16bit data, 4bit ID: When the data field is 16 bits and the message ID is 4 bits

- **Input Format (Input Format), Comparison Condition (Condition)**
  These are the same functions as when the message type is Short. ▶ See here.

- **Reference Values (a and b)**
  Set the reference values in Hex (hexadecimal) or Dec (decimal) according to the input format. The selectable ranges are as follows:

Message Format	ID		Data	
	Hex	Dec	Hex	Dec
12bit data, 8bit ID	00 to FF	0 to 255	000 to FFF	0 to 4095
16bit data, 4bit ID	0 to F	0 to 15	0000 to FFFF	0 to 65535

Error

The instrument triggers when it detects various types of errors.

- **Error Type (Error Type OR)**
  Select the types of errors to detect from the following. The instrument triggers if any of the selected errors is detected.

Successive CAL Pulses	The instrument triggers when successive SYNC/CAL pulses differ by 1/64 clock ticks or more. The comparison condition varies depending on the format setting (explained later).
Nibble Number	The instrument triggers when the number of nibbles in the message does not match the specified number of nibbles.. The specified number of nibbles varies depending on the number of data nibbles and the presence or absence of a pause pulse.
Nibble Data Value	The instrument triggers when any of the clock tick states of status and communication, Data, and CRC is outside the 12 to 27 clock tick range.
Fast CH CRC	The instrument triggers when it detects a fast channel CRC error.
Status and Communication	The instrument triggers when the status and Bit 0 or bit 1 is 1. Specify the bit to detect in the format settings (explained later).
Slow CH CRC	The instrument triggers when it detects a slow channel CRC error.

- **Slow CH Message Type (Slow CH Type)**
  This item is the same as that of “Every Slow CH” explained earlier.
  ▶ See here.

Format (Format)

Set the version and signal properties of the SENT signal.

SENT Signal Version (Version)

Set the version of the SENT signal.
APR2016: SENT signal complying with the version released in April 2016
JAN2010: SENT signal complying with the version released in January 2010
FEB2008 and older: SENT signal complying with the version released in February 2008 and earlier

Clock Tick

Set the reference clock period of SENT signals. The time between consecutive falling edges of the signal is counted using this period.
Selectable range: 1.00 µs to 100.00 µs
Resolution: 0.01 µs

Clock Tick Tolerance (Clock Tolerance)

Set the clock tick tolerance.
Selectable range: ±1.0% to ±30.0%
Resolution: 0.1%

Number of Data Nibbles (Data Nibbles)

Set the number of data nibbles of fast channel messages.
Selectable range: 1 to 6

Pause Pulse ON/OFF (Pause Pulse)

Select whether to include pause pulses in Fast CH messages. Select this for version APR2016 and JAN2010. This is fixed to off for version FEB2008 and older.
ON: Pause pulses are included.
OFF: Pause pulses are not included.

CRC Type (CRC Type)

Select the CRC type. Select this for version APR2016 and JAN2010. This is fixed to Legacy for version FEB2008 and older.
Recommended: CRC is added using the type recommended in version APR2016 or JAN2010.
Legacy: CRC is added using the type recommended in version FEB2008 and older.

Detection Method (Customize Error Factor)

Select the method of detecting error types Successive CAL Pulses and Status and Communication.

- **Successive CAL Pulse Detection Method (Successive Calibration Pulses)**
  Select the method of detecting error type Successive CAL Pulses.
  OFF: Errors are not detected.
  Preferred Option: The calibration pulse of current frame is compared to the calibration pulse of the preceding frame to detect errors.
  Option 2: The calibration pulse of current frame is compared to the calibration pulse of the last valid preceding frame to detect errors. However, if three consecutive errors are detected, the third calibration pulse is considered as valid.

- **Status and Communication Detection Method (Status and Communication)**
  Select the method of detecting error type Status and Communication. Select bit 0 or bit 1 or both. If you select both, errors are detected on the OR condition.
  Bit 0: Bit 0 becoming 1 is detected as an error.
  Bit 1: Bit 1 becoming 1 is detected as an error.

Source (Source)

Source (Source)

Set the trigger source to one of the settings below. The available settings vary depending on the model.
If you select Logic, select the source bit.
CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7)*
* C0 to C7 and D0 to D7 are available on models with the /L32 option.

Level (Level), HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)

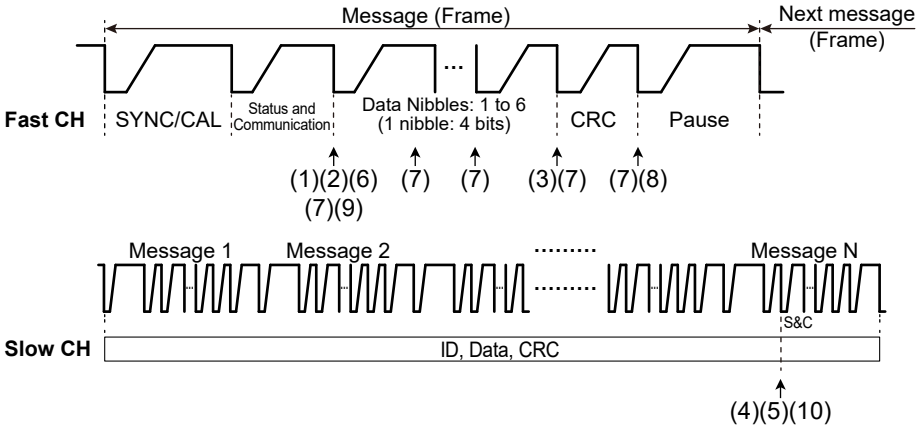
Set these items for the trigger source.
These items are the same as the trigger level, HF rejection, and noise rejection* of edge trigger.
* You can set this only when the trigger source is set to Logic and the 701989 logic probe is connected.
▶ See here.

Hysteresis (Hysteresis)

You can set this only when the trigger source is CH1 to CH8.
This item is the same as that of the CAN bus trigger.
▶ See here.

Trigger Point

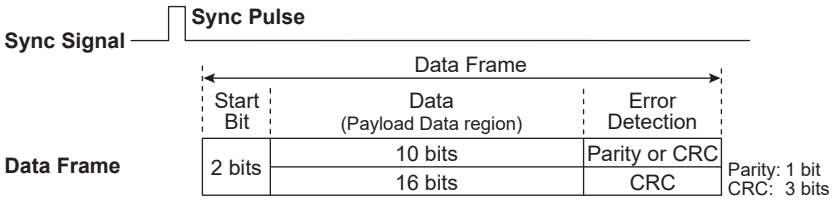
The following figures illustrate the trigger points. For other trigger points, see appendix 6.
▶ See here.



Positions (1) to (10) above are trigger points for the following conditions.
(1) Every Fast CH
(2) Fast CH S&C
(3) Fast CH Data
(4) Every Slow CH
(5) Slow CH ID/Data
(6) Successive CAL Pulses Error, detection method Option 2
(7) Nibble Data Value Error
(8) Fast CH CRC Error
(9) Status and Communication Error
(10) Slow CH CRC Error

PSI5 Airbag Trigger [ENHANCED, option]

The instrument triggers using the sync pulse, start bit, and data pattern of PSI5 Airbag signals as trigger conditions. The following figure shows the PSI5 Airbag signal frame format.



* When the data length of Data is 10 bits, set the error detection method (Error Detection) to Parity or CRC.

Trigger Mode (Mode)

Set the PSI5 Airbag trigger mode to one of the settings below.
Sync: The instrument triggers on sync pulses.
Start Bit: The instrument triggers on the start bit of data frames.
Frame in Slot: The instrument triggers on data frames included in the selected slot.
Data: The instrument triggers on a data pattern or a Data value.
Error: The instrument triggers on errors.

Sync

The instrument triggers on the rising edge of sync pulses. This will not be available if the sync signal (Sync) source, explained later, is None.

Start Bit

The instrument triggers on start bits.

Frame in Slot

The instrument triggers on data frames included in the selected slot. Frame in Slot will not be available if the sync signal source is None.

- **Set the slot number (Slot No.) for specifying the trigger source frame pattern.**
  Select the trigger source slot number. Depending on the number of slots (Number of Slots), explained later, select from the following range.
  - When the number of slots is set to a number from 1 to 6
    1 to N
    where N is the specified number of slots
  - When the number of slots is set to Auto
    1 to 6

Data

The instrument triggers on a data pattern or a Data value.

- **Trigger Condition (Condition Setup)**
  On the Condition Setup screen, set the slot and data trigger conditions.

  Slot

  Select the trigger source slot number. Depending on the number of slots (Number of Slots), explained later, select from the following range. Slot numbers will not be available if the sync signal (Sync) is None.
  - When the number of slots is set to a number from 1 to 6
    1 to N
    where N is the specified number of slots
  - When the number of slots is set to Auto
    1 to 6

  Data
  - **Comparison Condition (Condition)**
    The data trigger condition is met when the relationship between the data pattern or the reference value and the input signal data value matches the specified comparison condition.

True	When the value matches the data pattern
False	When the value does not match the data pattern
Data=a[1]	When the value is equal to the reference value
Data≠a[1]	When the value is not equal to the reference value
a≤Data[1]	When the value is greater than or equal to the reference value
Data≤b[1]	When the value is less than or equal to the reference value
a≤Data≤b[2]	When the value is within the reference range (including the reference values)
Data<a, b<Data[2]	When the value is outside the reference range (excluding the reference values)

    1 Set one reference value.
    2 Set two reference values.

  - **Data Pattern (Hex/Bin)**
    When the comparison condition is True or False, set the data pattern input format to Bin (binary) or Hex (hexadecimal). The data length of the data pattern is set using Data Bits of data frame source (Data), explained later.

  - **Reference Values (a and b)**
    If the comparison condition is set to Data = A, Data ≠ a, a ≤ Data, Data ≤ b, a ≤ Data ≤ b, or “Data < a or b < Data,” set the reference values in hexadecimal (Hex) or decimal (Dec) notation according to the input format.
    The data length of the reference values is set using Data Bits of data frame source (Data), explained later.
    The selectable ranges are as follows:

10-bit Data		16-bit Data	
Hex	**Dec**	**Hex**	**Dec**
200 to 1FF	-512 to 511	8000 to 7FFF	-32768 to 32767

  - **Input Format (Input Format)**
    Set the reference value input format to Hex (hexadecimal) or Dec (decimal).

- If you specify X in the data pattern, the condition is assumed to be met regardless of the corresponding bit status.
- In a data pattern setting, if a binary pattern contains any Xs, the corresponding hexadecimal display will be “$.”
- If the comparison condition is a ≤ Data ≤ b or “Data < a or b < Data,” the two reference values are automatically adjusted so that the lower limit is less than or equal to the upper limit.

Error

The instrument triggers when it detects various types of errors.

Error Type (Error Type OR)

Select the types of errors to detect from the following. The instrument triggers if any of the selected errors is detected.

Frame	The instrument triggers when the number of bits in a data frame is insufficient or excessive.
Manchester	The instrument triggers when the specified clock tolerance is exceeded.
Start Bit	The instrument triggers when the start bit state is not 00.
Parity/CRC	The instrument triggers when it detects a parity error or CRC error.
Frame Number	The instrument triggers when the data frames are insufficient or excessive with respect to the specified number of slots.
Slot Boundary	The instrument triggers when when the data frame exceeds slot boundary or overlaps the sync signal boundary.

Sync Signal (Sync)

Source (Source)

Set the sync signal source to one of the settings below.
CH1 to CH8, None

* If you select None, sync signal will not be detected. Therefore, Trigger mode Sync will not be available. In addition, sync signal noise rejection, explain later, will be set to off.

Data Frame Source (Data)

Source (Source)

Set the data frame source (data source) to one of the following settings below.

- When the sync signal is set to CH1 to CH4
  CH1 to CH4
- When the sync signal is set to CH5 to CH8
  CH5 to CH8
- When the sync signal is set to None
  CH1 to CH8

Bit Rate (Bit Rate)

Set the data transfer rate of the data frame source to one of the following settings below.
125 kbps, 189 kbps, User Define
If you select User Define, set the transfer rate in the range of 10.0 kbps to 1000.0 kbps in 0.1-kbps steps.

Data Length (Data Bits)

Set the length of data area of the data frame (Payload Data Region) to one of the following settings below.
10 bit, 16 bit

The selectable range for data patterns and reference values (a and b) of the aforementioned trigger conditions varies depending on the data length setting.

Error Detection Method (Error Detection)

When the data frame's data length is 10 bits, set the error detection method to one of the following settings below. When the data length is 16 bit, this is fixed to CRC.
Parity, CRC

Clock Tolerance (Clock Tolerance)

Set the clock tolerance of the data frame source.
Selectable range: ±0.5% to ±33.3%
Resolution: 0.1%

Sync Signal Noise Rejection (Sync Noise Rejection)

You can configure the instrument so that current noise generated by sync pulses is not detected (is ignored) for a given time period. This prevents detecting the start bit of data frames by mistake.

- **Rejection Mode (Mode)**
  ON: Noise is rejected.
  OFF: Noise is not rejected.
- **Sync Noise Rejection End (Rejection End)**
  Set the time period from the rising edge of the sync pulse to the end of noise rejection.
  Selectable range: 0.0 µs to 20000.0 µs
  Resolution: 0.1 µs

Level (Level), HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)

Set these for the sync signal and data source.
These items are the same as those of the edge trigger.*

* When the sync signal source is set to None, the trigger level and HF rejection for the sync signal source will not be displayed.
▶ See here.

Number of Slots (Number of Slots)

When the aforementioned sync signal source is not None, a control menu appears, and you can set the number of slots. Set the same number of slots as the number of data frames between the applicable sync pulse and the next sync pulse.
Auto, 1 to 6

If set to Auto, slot numbers are assigned automatically to data frames in order from number 1. The data frame closest to the applicable sync pulse is assigned the number 1, and numbers up to 6 are assigned.

Time Range of Each Slot (Slot)

When the number of slots (Number of Slots) is not Auto, you can set the time range of each slot.

- Start position of slot N (Slot N Start)
  Selectable range: 0.0 µs to 20000.0 µs
  Resolution: 0.1 µs
  However, Slot N Start≤Slot N+1 Start, where N is the slot number (1 to the specified number of slots)
- Slot N_{max} end position (Slot N_{max} End)
  Selectable range: Slot N_{max} −1 Start value to 20000.0 µs
  Resolution: 0.1 µs
  where N_{max} is the specified number of slots

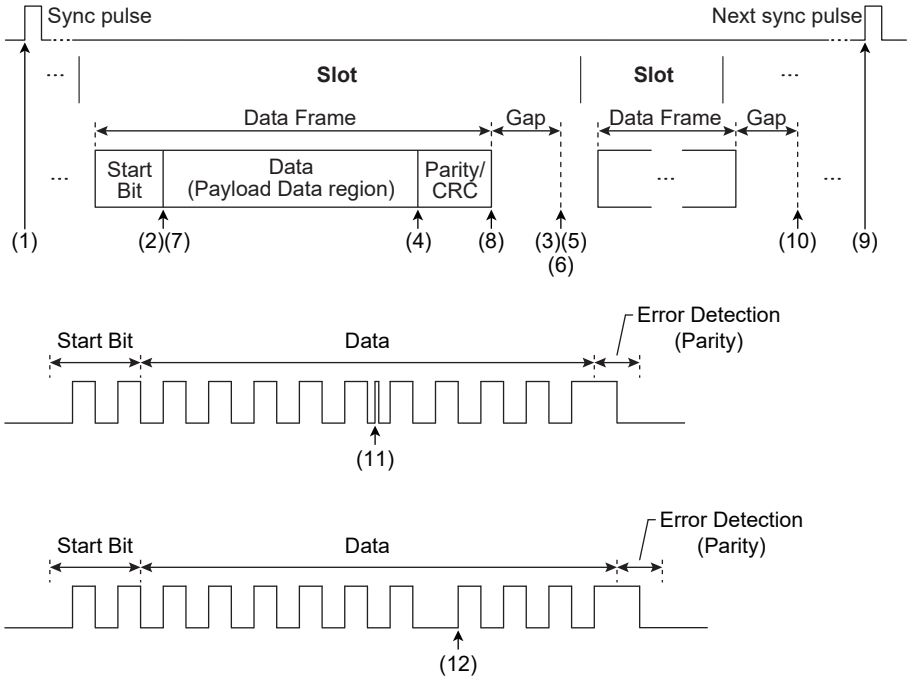
The following table shows the default slot settings depending on the data length and bit rate.

Data length	10 bit		16 bit	
Bit rate	125 kbps	189 kbps	125 kbps	189 kbps
Slot 1 Start (µs)	44.0	44.0	44.0	44.0
Slot 2 Start (µs)	181.3	139.5	257.3	179.3
Slot 3 Start (µs)	328.9	245.5	492.0	328.2
Slot 4 Start (µs)	492.0	362.5	750.1	492.0
Slot 5 Start (µs)	672.1	492.0	1034.1	672.1
Slot 6 Start (µs)	870.0	633.3	1346.4	870.3
Slot 6 End (µs)	1088.3	788.8	1690.0	1088.3

If the number of slots is less than 6, Slot N End = Slot N+1 Start.

Trigger Point

The following figure shows the trigger points.

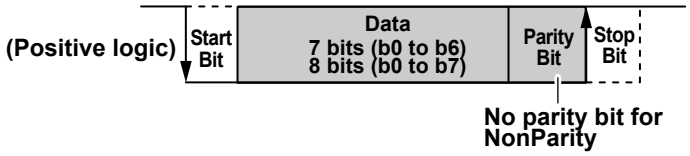


Positions (1) to (12) shown above are trigger points for the following conditions.

(1) Sync
(2) Start Bit
(3) Frame in Slot
(4) Data when a slot is not specified
(5) Data when a slot is specified
(6) Frame Error
(7) Start Bit Error
(8) Parity/CRC Error
(9) Frame Number Error
(10) Slot Boundary Error
(11) Manchester Error, the position where a bit center edge that does not meet the specified tolerance is detected
(12) Manchester Error, the position where a bit center edge that exceeds the specified tolerance is detected

UART Trigger [ENHANCED, option]

The instrument triggers on a UART signal. The following figure shows the UART signal data format for positive logic.



Trigger Mode (Mode)

Select the UART trigger mode from one of the settings below.

Every Data: Triggers on the data stop bit

Error: Triggers on errors

Data: Triggers on a data pattern

Every Data

The instrument triggers on the stop bit positions of all data frames.

Error

The instrument triggers when it detects various types of errors.

- **Error Type (Error Type)**

  Select the types of errors to detect from the following. The instrument triggers if any of the selected errors is detected.

Framing	The instrument triggers when the logical stop bit value is zero.
Parity	When the instrument detects a parity error in a received character, the instrument triggers on the stop bit position. • You can select which parity to check, odd or even. • Errors will not occur if the parity bit is set to none.

Data

The instrument triggers on a specified data pattern.

- **Trigger Condition (Condition Setup)**

  Data Length (Size)

  Set how many consecutive data bytes will be compared.

  Selectable range: 1 to 4 bytes

  Comparison Condition (Condition)

  The instrument triggers when the input signal data value matches the data pattern.

  Input Format (Input Format)

  For the data whose length was specified by Data Size, set the condition using a data pattern or ASCII character codes.

  When using Pattern, set the data pattern using hexadecimal (Hex) or binary (Bin) notation.

  If you use ASCII,

  - Select whether uppercase and lowercase are considered when, as a trigger condition, the input signal data value is compared to the data pattern.
  - Set the data pattern with the keyboard that appears on the screen.
  - The special characters CR, LF, SP, and NUL are shown in single quotation marks. These special characters are counted as one character including the single quotation marks.
  - The entered string, including the character codes for the case, is retained even if the input format is changed to Pattern. It is also retained when the format is changed from Pattern to ASCII.
  - If a character code that does not exist on the keyboard is entered when the input format is Pattern and then the input format is changed to ASCII, a white square is displayed in the corresponding position.

When using binary or hexadecimal, if you set Xs in the data pattern, the corresponding bits will be considered satisfying the condition. If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

Source (Source)

Source (Source)

Set the trigger source to one of the settings below. The available settings vary depending on the model.
If you select Logic, select the source bit.
CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7)*

* C0 to C7 and D0 to D7 are available on models with the /L32 option.

Bit Rate (Bit Rate)

Select the UART signal's transfer rate from one of the settings below.
1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, User Define
If you select User Define, set the transfer rate in the range of 200 bps to 10000000 bps in 0.5-bps steps.

Bit Order (Bit Order)

Set the bit order that is appropriate for the data stream.
When setting the data pattern, set the pattern MSB first regardless of the bit order setting.

MSB	When the data stream starts with the MSB
LSB	When the data stream starts with the LSB

Polarity (Polarity)

Select which bit state will be recognized to be logic 1.

	Positive logic
	Negative logic

Sample Point (Sample Point)

You can set the reference that will be used to determine the signal level in the range of 18.8 to 90.6% in 3.1% steps.
The instrument's UART signal trigger circuit samples the input UART signal using the internal clock and detects the point of level change. Set the sample point as a percentage, with the detected point of change equal to 0% and the point that is bit time after the point of change equal to 100%. The bit time is the inverse of the set bit rate.

▶ See here.

Level (Level), HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)

Set these items for the trigger source.
These items are the same as the trigger level, HF rejection, and noise rejection* of edge trigger.

* You can set this only when the trigger source is set to Logic and the 701989 logic probe is connected.

▶ See here.

Hysteresis (Hysteresis)

You can set this only when the trigger source is CH1 to CH8.
This item is the same as that of the CAN bus trigger.

▶ See here.

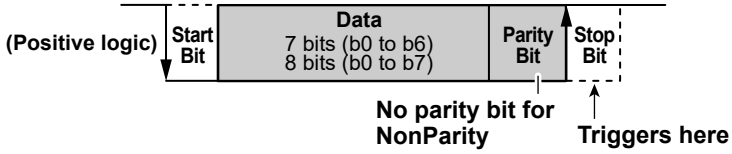
Format (Format)

You can select the data format from one of the settings below.

8bit No Parity	8-bit data (no parity bit)
7bit Parity	7-bit data + parity bit
8bit Parity	8-bit data + parity bit

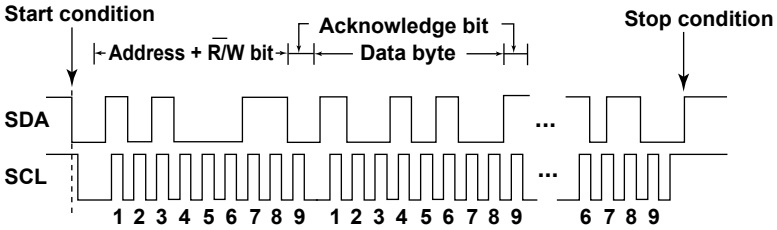
Trigger Point

For all formats, in all modes, the trigger point is the stop bit after the trigger condition is met. If multiple data frames are specified, the trigger point is the stop bit of the last data byte.



I²C Bus Trigger [ENHANCED, option]

The instrument triggers based on the I²C bus signal's start condition or the address pattern or data pattern trigger conditions. The following figure shows the I²C bus signal data format.



Serial Clock (SCL), Serial Data (SDA)

Source (Source)

Set the SCL and SDA source from one of the settings below. The available settings vary depending on the model.

If you select Logic, select the source bit.

CH1 to CH8[1], Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7)[2]

1 When the SCL source is in the range of CH1 to CH4, you can set the SDA source in the range of CH1 to CH4. When the SCL source is in the range of CH5 to CH8, you can set the SDA source in the range of CH5 to CH8. When the SCL source is , you can set the SDA source to Logic.

2 C0 to C7 and D0 to D7 are available on models with the /L32 option.

Level (Level), HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)

Set these items for the SCL and SDA sources.

These items are the same as the trigger level, HF rejection, and noise rejection* of edge trigger.

* You can set this only when the trigger source is set to Logic and the 701989 logic probe is connected.

▶ See here.

Hysteresis (Hysteresis)

You can set this only when the trigger source is CH1 to CH8.

These items are the same as those of the CAN bus trigger.

▶ See here.

Trigger Mode (Mode)

Select I²C bus trigger mode from one of the settings below.

Every Start: Triggers on start or restart condition

Address Data: Triggers on the AND of address pattern and data pattern conditions

NON ACK: Triggers when the acknowledge bit is Nack (SDA is H)

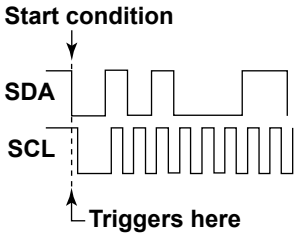
General Call: Triggers on general call addresses

Start Byte: Triggers on the start byte master code

HS Mode: Triggers on the HS Mode master code

Every Start

When a start condition is detected, the instrument triggers on the SDA signal's falling edge.



Address Data

The instrument triggers on the AND of Address and Data conditions.
If you do not select Address or Data, the instrument triggers on the start condition.
If you select only Address, the instrument triggers on the address acknowledge bit position.
If you select Data, the instrument triggers on the acknowledge bit position of the last byte of the applicable data.

If you specify X in the address or data pattern, the condition is assumed to be met regardless of the corresponding bit status.
In a address pattern or data pattern setting, if a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

- **Trigger Condition (Condition Setup)**

  On the Condition Setup screen, set the trigger conditions. The instrument triggers based on the Start (start condition), Address (address pattern), and Data (data pattern) items whose check box is selected.

  Start (Start Condition)

  If the only trigger condition is the start condition, when a start condition is detected, the instrument triggers on the SDA signal's falling edge.

  Address

  - **Type**

    Set the address type to 7bit Address, 7bit + Sub Address, or 10bit Address.

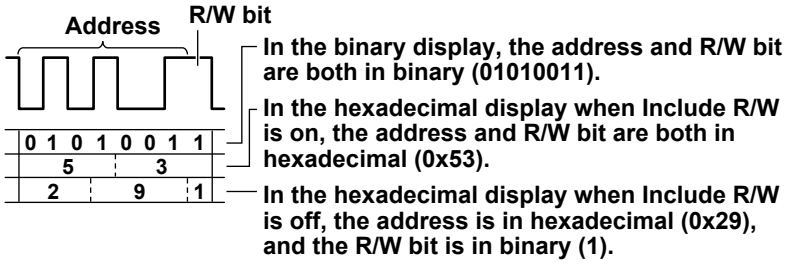
  - **Data Direction Bit Status (Direction)**

    Set the data direction bit (R/W bit) to don't care (X), write (Write), or data request (Read). You can set this when the R/W bit is OFF.

  - **Address Pattern (Hex/Bin)**

    Set the address pattern for the data nibble in hexadecimal (Hex) or binary (Bin) notation. The address trigger condition is met when the specified address pattern matches the input signal address pattern.
    If you set the input format to hexadecimal (Hex), the trigger condition is affected by whether the R/W bit is on or off.

    7-bit Address Example



Data

You can use a data pattern as a trigger condition.

- **Data Length (Size)**
  Set how many consecutive data bytes will be compared.
  Selectable range: 1 to 4 bytes
- **Comparison Start Position (Position)**
  Set the comparison start position. The instrument skips the specified number of bytes and starts comparing from the next data byte. If you do not set the comparison start point, the data trigger condition is met when the input signal data pattern first matches the specified data pattern.
  Selectable range: 0 to 9999 bytes
- **Comparison Condition (Condition)**
  The data trigger condition is met when the relationship between the specified pattern and the input signal pattern meets the specified comparison condition.

True	When the patterns match
False	When the patterns do not match

- **Data Pattern (Hex/Bin)**
  Set the data pattern for the specified data size in hexadecimal (Hex) or binary (Bin) notation.

- **R/W Bit Inclusion (Include R/W)**

Select whether to include or omit the R/W bit when you set the address pattern.

- ON: Include the R/W bit (address + R/W bit: hexadecimal or binary)
- OFF: Omit the R/W bit (address: hexadecimal or binary, R/W bit: set with Direction)

You can set R/W bit inclusion (Include R/W) under the conditions listed below. The setting is universal.

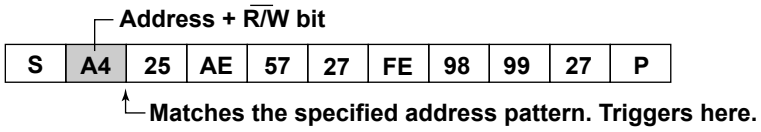
- When the I^2C bus trigger type is Address Data.
- When the I^2C bus signal is being analyzed or searched.

Example (Address Data)

This example displays the data sequence at the byte level (hexadecimal notation) and indicates the trigger position. The following notations are used in the figure.
S: Start condition, P: Stop condition, Shading: Compared pattern

- **Trigger only on the address pattern**

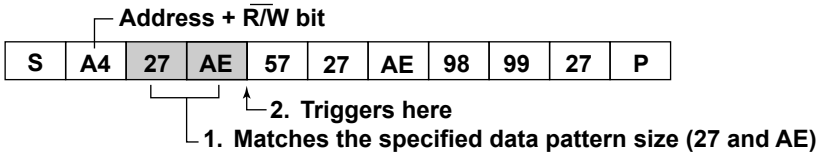
Mode	Address Data
Address	7bit address, A4
Data	Don't care



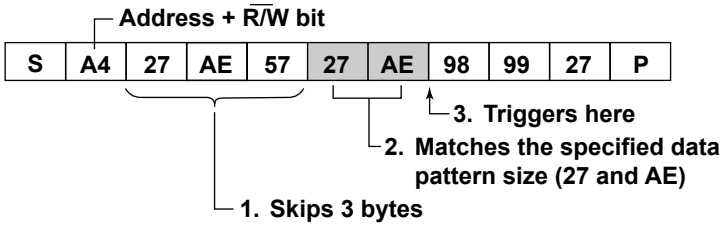
- **Trigger only on the data pattern**

Mode	Address Data
Address	Don't care
Data	Condition: True, Size: 2 bytes, Data pattern: 27 and AE

<When the position is not specified>



<When the position is set to 3>



NON ACK

The instrument triggers when the acknowledge bit is Nack (when the SDA signal is high) at the acknowledge bit position.
You can select whether to use (OFF) or ignore (ON) the acknowledge bits that belong to the start byte (Start Byte), HS mode master code (HS Mode), and read access byte (Read Access).

General Call

When a general call address is detected, the instrument triggers on the acknowledge bit position of the second byte (address).

- **Trigger Condition (Condition Setup)**

  On the Condition Setup screen, set the trigger conditions. The instrument triggers based on the general call and second byte items whose check box is selected.

  General Call

  The instrument triggers on the general call address (0000 0000). This is always set as a trigger condition.

  Second Byte

  You can use the second byte address pattern (the byte after the general call address) as a trigger condition. The second byte trigger condition is met when the input signal pattern matches the specified pattern. You can select the second byte address pattern (Type) from one of the settings below.

0000 0100	When the input signal pattern matches the pattern 0000 0100 (0x04)
0000 0110	When the input signal pattern matches the pattern 0000 0110 (0x06)
Master Address	When the input signal pattern matches the specified pattern, if you select Master Address, you can use the address or data pattern as a trigger condition.

  Address/Data

  When the second byte is set to Master Address, set the Address Data mode trigger condition.

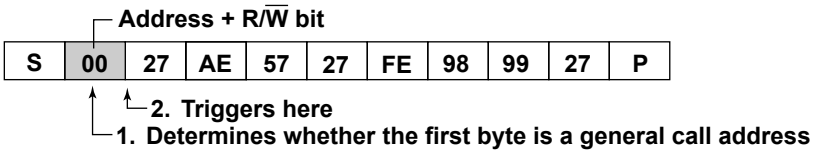
  ▶ See here.

Example (General Call)

This example displays the data sequence at the byte level (hexadecimal notation) and indicates the trigger position. The following notations are used in the figure.
S: Start condition, P: Stop condition, Shading: Compared pattern

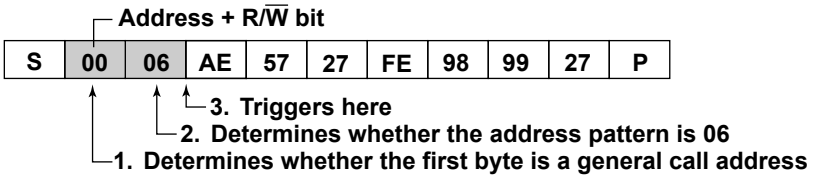
- **Trigger only on the general call address**

Mode	General Call
Second Byte	Not selected



- **Trigger on a pattern whose second byte address is 06**

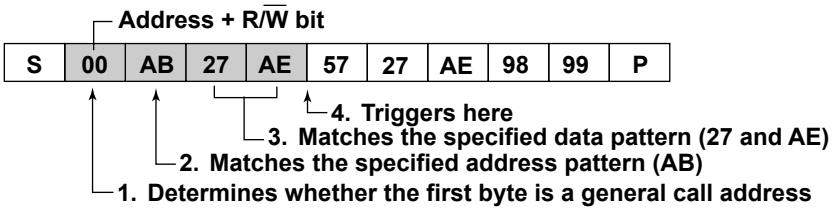
Mode	General Call
Second Byte	0000 0110



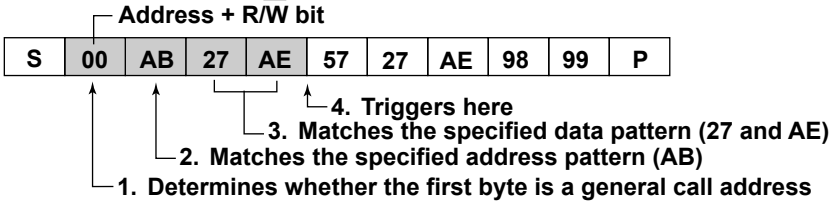
- **Trigger when the second byte address matches the specified pattern**

Mode	General Call
Second Byte	Master Address, Address pattern: 1010 1011 (0xAB)
Data	Condition: True, Size: 2 bytes, Data pattern: 2

<When the position is not specified>



<When the position is set to 3>



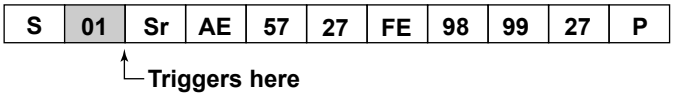
Start Byte

When a start byte master code (pattern: 0000 0001) is detected, the instrument triggers on the acknowledge bit position.

Example (Start Byte)

This example displays the data sequence at the byte level (hexadecimal notation) and indicates the trigger position. The following notations are used in the figure.
S: Start condition, Sr: Restart, P: Stop condition, Shading: Compared pattern

Mode	Start Byte

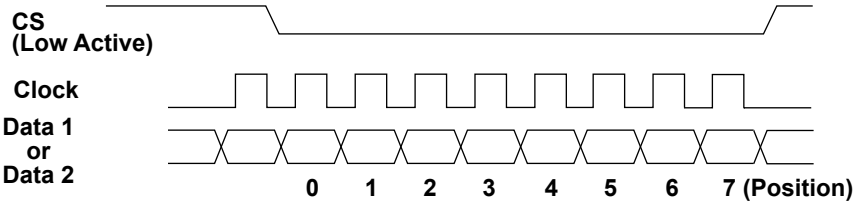


HS Mode

When an HS mode (high speed mode) master code (pattern: 0000 1XXX) is detected, the instrument triggers on the acknowledge bit position.

SPI Bus Trigger [ENHANCED, option]

The instrument triggers based on the conditions of SPI bus signal data patterns. The following figure shows the SPI bus signal timing chart.



Wiring System (Mode)

Select from the following.

3 Wire	The instrument triggers on the data pattern condition of one data line.
4 Wire	The instrument triggers on the data pattern conditions of Data1 and Data2 lines. You can also use one of the two data lines as a trigger condition.

Clock (Clock)

Source (Source)

Set the clock source to one of the settings below. The available settings vary depending on the model.
If you select Logic, select the source bit.
CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7)*
* C0 to C7 and D0 to D7 are available on models with the /L32 options.

Polarity (Polarity)

You can select which clock edge causes the data patterns to be compared.

⎍	On the rising edge
⎎	On the falling edge

Data 1 or 2 (Data1/Data2)

You can use a data pattern as a trigger condition. When the wiring system is 3 Wire, only set Data1. When the wiring system is 4 Wire, set Data1 and Data2.

Source (Source)

Set the Data1 and Data2 sources from one of the settings below. The available settings vary depending on the model.

If you select Logic, select the source bit.

CH1 to CH8[1], Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7)[2]

1 When the clock source is in the range of CH1 to CH4, you can set CH1 to CH4.
When the clock source is in the range of CH5 to CH8, you can set CH5 to CH8.
When the clock source is , you can set Logic.

2 C0 to C7 and D0 to D7 are available on models with the /L32 options.

CS(SS)

Source (Source)

Set the chip select source to one of the settings below. The available settings vary depending on the model.

If you select Logic, select the source bit.

CH1 to CH8[1], Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7)[2]

1 When the clock source is in the range of CH1 to CH4, you can set CH1 to CH4.
When the clock source is in the range of CH5 to CH8, you can set CH5 to CH8.
When the clock source is , you can set Logic.

2 C0 to C7 and D0 to D7 are available on models with the /L32 options.

Active State (Active)

You can select the chip select level for activating the data.

H	When the signal level is high
L	When the signal level is low

Trigger Condition (Condition Setup)

Bit Order (Bit Order)

Set the bit order that is appropriate for the data stream.

When setting the data pattern, set the pattern MSB first regardless of the bit order setting.

MSB	When the data stream starts with the MSB
LSB	When the data stream starts with the LSB

Data Length (Size)

Set how many consecutive data bytes will be compared.

Selectable range: 1 to 8 bytes

Comparison Start Position (Position)

Set the comparison start position. For example, to start comparing from the first data byte after the chip select signal is activated, specify zero.

Selectable range: 0 to 9999 bytes

Comparison Condition (Condition)

The data trigger condition is met when the relationship between the specified pattern and the input signal pattern meets the specified comparison condition.

True	When the patterns match
False	When the patterns do not match

Data Pattern (Hex/Bin)

Set the data pattern for the specified data size in hexadecimal (Hex) or binary (Bin) notation.

If you specify X in the pattern, the condition is assumed to be met regardless of the corresponding bit status. If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

Level (Level), HF Rejection (HF Rejection), Noise Rejection (Noise Rejection)

Set these items for Clock, Data1, Data2, and CS.

These items are the same as the trigger level, HF rejection, and noise rejection* of edge trigger.

* You can set this only when the trigger source is set to Logic and the 701989 logic probe is connected.

▶ See here.

Hysteresis (Hysteresis)

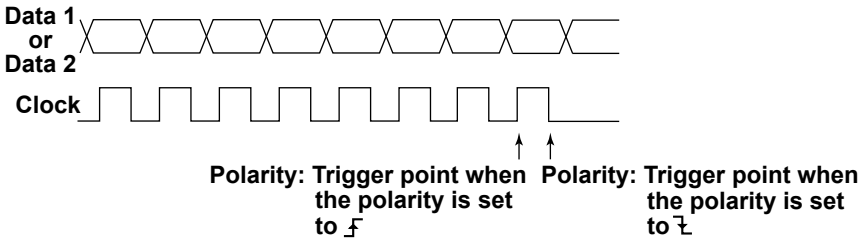
You can set this only when the trigger source is CH1 to CH8.

This item is the same as that of the CAN bus trigger.

▶ See here.

Trigger Point

The trigger point is determined by the clock polarity setting as follows:



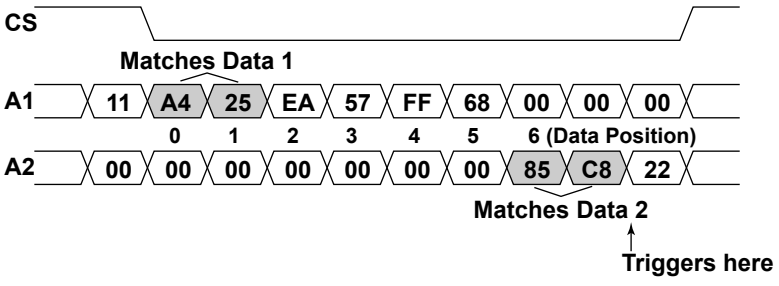
Example

This example displays the data sequence in hexadecimal (Hex) notation and indicates the trigger position.

The Data1 and Data2 pattern references are set to A1 and A2, respectively.

Shading: Pattern to compare

CS	Active: L
Data 1	Condition: True, Position: 0, Size: 2 bytes, Data pattern: A4 and 25
Data 2	Condition: True, Position: 6, Size: 2 bytes, Data pattern: 85 and C8



User-Defined Serial Bus Trigger [User Define, ENHANCED]

The instrument triggers based on the trigger conditions of user-defined serial bus signal data patterns.

Data (Source)

Data Source (Source)

Set the data source to one of the settings below. The available settings vary depending on the model.
CH1 to CH8

Data source state to be recognized as 1 (Active)

Select which signal level, high or low, will be detected as 1.

H	Detects high level as 1
L	Detects low level as 1

Clock ON/OFF

You can select whether or not to sample the data source in sync with the selected clock source.

ON	Samples in sync with the clock source
OFF	Samples according to the bit rate.

Clock (Clock)

Set the clock that will be used to sample the data source.

Clock Source (Source)

Set the clock source to one of the settings below. The available settings vary depending on the model.

Data (Source)	Clock (Clock)
For CH1 to CH4	CH1 to CH4
For CH5 to CH8	CH5 to CH8

Polarity (Polarity)

You can select which clock source edge causes the data source to be sampled.

⎍	On the rising edge
⎎	On the falling edge

Enable (Enable)

When the data source is sampled in sync with the clock source, whether sampling will be performed can be controlled with the enable signal.

Enable Source (Source)

Set enable source to one of the settings below. The available settings vary depending on the model.

Data (Source)	Enable (Source)
For CH1 to CH4	CH1 to CH4, None*
For CH5 to CH8	CH5 to CH8, None*

* None: The data source is constantly sampled using the clock without using enable.

State of the enable source to be recognized as the data source (Active)

Select which signal level, high or low, will be used to test the data source.

H	Detects the data source when the signal level is high
L	Detects the data source when the signal level is low

Latch (Latch)

You can specify the timing at which the data source pattern sampled in sync with the clock source is compared with the specified pattern as a trigger condition.

Latch Source (Source)

Set latch source to one of the settings below. The available settings vary depending on the model.

Data (Source)	Latch (Source)
For CH1 to CH4	CH1 to CH4, None*
For CH5 to CH8	CH5 to CH8, None*

* None: Latch is not used. Comparison is made for each clock.

Polarity (Polarity)

You can select which latch source edge causes the data patterns to be compared.

	On the rising edge
	On the falling edge

Trigger Condition (Condition Setup)

You can use data patterns as trigger conditions. The data pattern trigger condition is met when the sampled data source pattern matches the specified pattern.

Data Length (Data Size)

Set the data pattern bit length.
Selectable range: 1 to 128 bits

Data Pattern (Hex/Bin)

Set the data pattern for the specified data size in hexadecimal (Hex) or binary (Bin) notation.
If you specify X in the pattern, the condition is assumed to be met regardless of the corresponding bit status.
If a binary pattern contains any Xs, the corresponding hexadecimal display will be “$.”

Bit Rate (Bit Rate)

If the clock is set to OFF, the instrument samples the data source at the specified bit rate.
Range: 1 kbps to 50 Mbps (resolution: 1 kbps)

Level (Level), HF Rejection (HF Rejection)

Set these items for data, clock, enable, and latch.
These items are the same as those of the edge trigger.

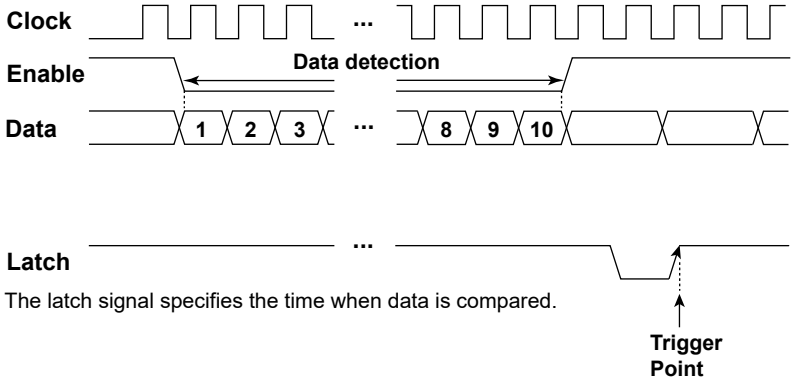
▶ See here.

Hysteresis (Hysteresis)

This item is the same as that of the CAN bus trigger.

▶ See here.

Setup Example



TV Trigger [ENHANCED]

The instrument triggers based on the trigger conditions of a particular field or line in a TV signal.

Broadcasting System (Mode)

Set the broadcasting system to one of the settings below.
NTSC(525/60/2)
PAL(625/50/2)
SDTV(480/60p)
HDTV(1080/60i, 1080/50i, 720/60p, 1080/25p, 1080/24p, 1080/24sF, 1080/60p)
Userdef TV: Specify appropriate settings such as the definition (SD or HD), horizontal sync frequency, and sync guard frequency.

Trigger Source (Source)

Set the trigger source to a channel from CH1 to CH8. The available settings vary depending on the model.

Polarity (Polarity)

Select which polarity the TV signal must be with respect to the trigger level for the instrument to trigger.

Pos	Positive
Neg	Negative

Trigger Level (Level)

Set the trigger level in units of divisions with the value at the start of sync pulses equal to 0 divisions.
Selectable range: 0.1 to 2.0 div
Resolution: 0.1 div
The default setting is 0.5 divisions.

Line Number (Line)

Set the trigger source line number.

- One: The instrument triggers on the start of the selected line number.
- All: The instrument triggers on all lines.

The selectable range for various broadcasting systems is as follows:

Broadcasting System	Range
NTSC	5 to 1054
PAL	2 to 1251
SDTV	8 to 2251
HDTV	2 to 2251
User Define	2 to 2251

Field Number (Field)

Select the field number to detect.

You can only set the field number for NTSC, PAL, or HDTV (1080/60i, 1080/50i, or 1080/24sF).

1	Detects fields whose vertical sync pulse starts at the same time as the start of a line
2	Detects fields whose vertical sync pulse starts 1/2H (where H is the horizontal scanning period) behind the start of a line
X	Detects both

Frame Skip (Frame Skip)

This feature skips frames in cases such as when the color burst is inverted for every frame. You can select how many frames to skip.

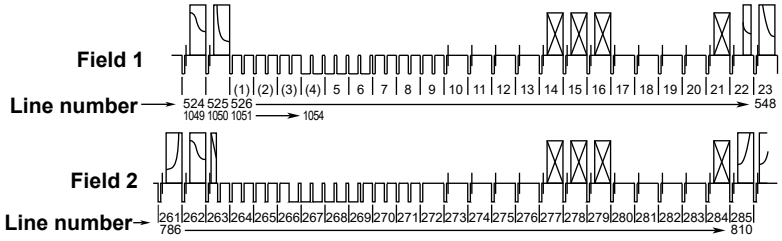
1	The instrument triggers on the specified field of every frame.
2	The instrument skips 1 frame and triggers on the specified field on the subsequent frame. This operation is repeated every 2 frames.
4	The instrument skips 3 frames and triggers on the specified field on the subsequent frame. This operation is repeated every 4 frames.
8	The instrument skips 7 frames and triggers on the specified field on the subsequent frame. This operation is repeated every 8 frames.

HF rejection settings are ignored.

NTSC Example

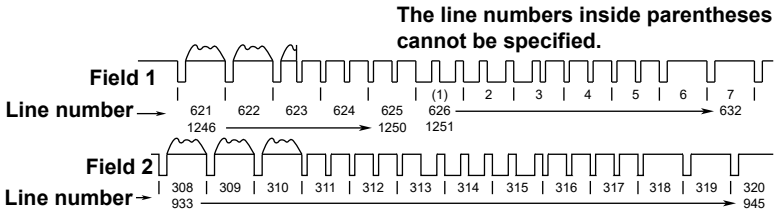
The following line numbers are those when the field number is set to 1
(if the field number is set to 2, the numbers are assigned sequentially by setting 268 to 5).

The line numbers inside parentheses cannot be specified.

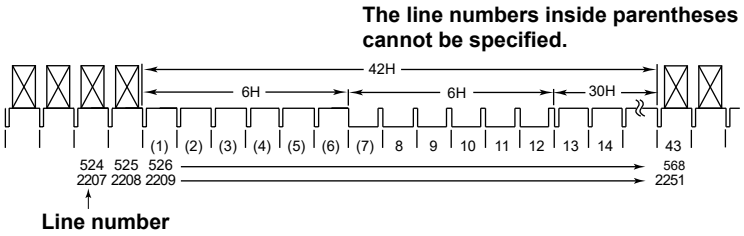


PAL Example

The following line numbers are those when the field number is set to 1
(if the field number is set to 2, the numbers are assigned sequentially by setting 315 to 2).



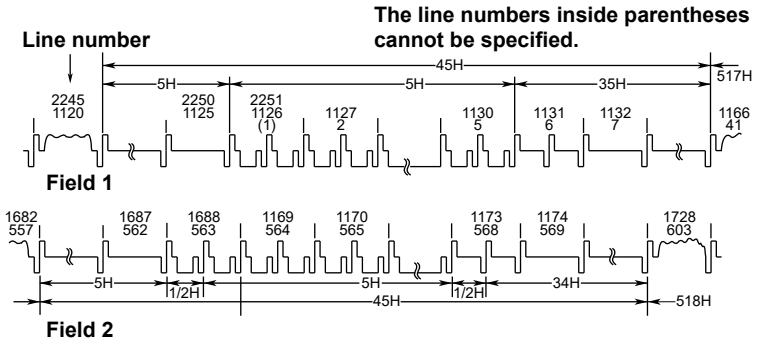
SDTV Example



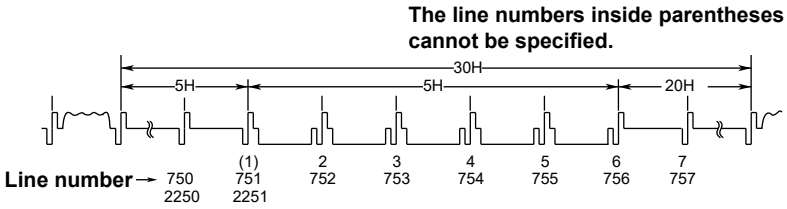
HDTV Example

- **Example for 1080/60i, 1080/50i, or 1080/24sF**

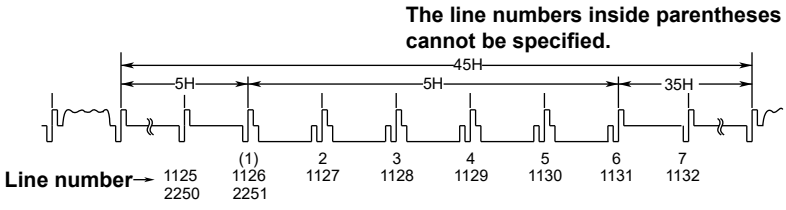
  The following line numbers are those when the field number is set to 1
  (if the field number is set to 2, the numbers are assigned sequentially by setting 565 to 2).



- **720/60p Example**



- **Example for 1080/25p, 1080/24p, or 1080/60p**



User Defined (Userdef TV)

Define appropriate values for definition, horizontal sync frequency, sync guard frequency, etc.

Trigger Source (Source), Polarity (Polarity), Trigger Level (Level)

Line Number (Line), Field Number (Field), Frame Skip (Frame Skip)

These items are the same as when a specific broadcasting system is specified.

▶ See here.

HF Rejection (HF Rejection)

Select whether or not to eliminate high-frequency components (300 kHz or higher) from the trigger source.
300 kHz: Eliminates high-frequency components greater than or equal to 300 kHz
OFF: Does not eliminate high-frequency components

When the broadcasting system is not set to User Define, the HF rejection setting is as follows:
For NTSC, PAL, SDTV: Fixed at 300 kHz
HDTV: Fixed at OFF

Horizontal Sync Frequency (HSync)

Set the horizontal sync frequency. Pressing the RESET key sets the frequency to 31.5 kHz.

Sync Guard Frequency (Sync Guard)

Set the sync guard frequency as a percentage of the horizontal sync frequency.
Pressing the RESET key sets the frequency to 70%/Hsync.

Definition (Definition)

Set the definition to one of the settings below.
SD: Standard (bi-level sync signal)
HD: High definition (tri-level sync signal)

Trigger B [B TRIG]

Trigger B is the trigger you set using the B TRIG key.
The instrument can trigger on the combination of trigger A (condition A) and trigger B (condition B).
The trigger conditions you set using the EDGE or ENHANCED key are the trigger A conditions. The trigger conditions you set using the B TRIG key menu are the trigger B conditions.

Trigger Combination (Combination)

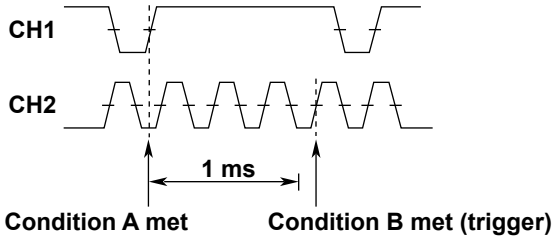
Set how to combine trigger A and B conditions.

- OFF: The instrument triggers only on the trigger A conditions (the trigger B conditions are not used).
- A Delay B: After the trigger A conditions are met and the specified amount of time elapses, the instrument triggers when the trigger B conditions are met.
- A to B(N): After the trigger A conditions are met, the instrument triggers when the trigger B conditions are met N times.

Setup Example

A Delay B Trigger

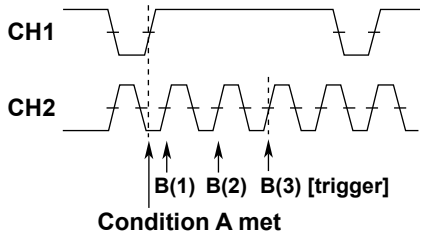
After the trigger A conditions are met and the specified amount of time elapses, the instrument triggers when the trigger B conditions are first met.



Condition A: Edge trigger, CH1 = ↓,
Condition B: Edge trigger, CH2 = ↓, Delay = 1 ms

A to B(N) Trigger

After the trigger A conditions are met, the instrument triggers when the trigger B conditions are met N times.



Condition A: Edge trigger, CH1 = ⤓ ,
Condition B: Edge trigger, CH2 = ⤓ , N = 3

Trigger A (A Trigger)

The trigger A conditions are set using the menu that corresponds to the EDGE or ENHANCED key, whichever is illuminated.

Trigger B (B Trigger)

Configure trigger B (condition B). You can use the following triggers.

Edge trigger, Edge OR trigger, Pattern trigger (no time conditions), Window trigger (no time conditions), Window OR trigger, Serial Bus trigger

- If you set trigger condition A to serial bus trigger, you cannot set trigger condition B to serial bus trigger.
- The trigger level is shared between trigger A and trigger B. If the trigger type of one of the triggers has two levels (upper level and lower level) and that of the other has one level, the center value of the two levels and the single level are shared.

Configuring the Trigger B Conditions

The items that you can set vary depending on the A and B trigger types that you selected.

- **A Delay B Trigger**

  Configure these items for trigger B: trigger type, trigger source, trigger level, delay, and other settings. The trigger type, trigger source, and trigger level settings are the same as those in the EDGE or ENHANCED key menu.

  Delay (Delay)
  Range: 10 ns to 10 s
  Resolution: 2 ns

- **A to B(N) Trigger**

  Configure these items for trigger B: trigger type, trigger source, trigger level, the number of times condition B must be met, and other settings. The trigger type, trigger source, and trigger level settings are the same as those in the EDGE or ENHANCED key menu.

  Number of Times Condition B Must Be Met (N Count)
  Selectable range: 1 to 10^9

5 Executing Actions

A specific action can be executed when trigger conditions are met (this feature is called action-on-trigger) or when the GO/NO-GO determination result is no-go. You can set the number of times to execute the action in terms of the number of waveform acquisitions or the number of determinations.
Logic signals cannot be used as source waveforms for rectangular zone, waveform zone, or polygonal zone in GO/NO-GO determination.

Action Mode (Mode)

Select the action mode from one of the following three settings.

- Action on Trig (trigger): Executes the specified action each time the trigger condition is met
- Go/Nogo AND (GO/NO-GO determination): Executes the specified action each time all of the reference conditions are no-go
- Go/Nogo OR (GO/NO-GO determination): Executes the specified action each time any of the reference conditions are no-go

Action to Execute When Conditions Are Met (Action)

The instrument executes the specified action each time the conditions are met. You can specify any of the four actions below.

Buzzer (Buzzer)

Sounds an alarm.

Print or Save the Screen Image (Print)

Prints the screen image to the printer (Printer (built-in printer), USB (USB printer)) specified by “Print to” in the PRINT menu or stores the screen image data to the specified storage device.

Save Waveform Data (Save Waveform)

Stores the waveform data in binary or ASCII format to the destination (internal storage, USB storage) specified using the FILE menu. Specify the file type using Data Type in the FILE menu.

▶ See here.

Send Mail (Send Mail)

The instrument sends an e-mail to the specified address. Set the email address by pressing UTILITY and then selecting Network > Mail.

▶ See here.

- **E-mail Send Count (Mail Count)**

  Sets the upper email transmission limit. When the number of transmitted emails reaches Mail Count, the instrument stops sending emails.
- **Contents of Emails That the Instrument Sends (Action on Trig)**

  <Subject>: The subject attached to the email. For example: “Action Triggered Report (nth action)”
  [Comment]: Comment
  [Trigger Date and Time]: The time of trigger occurrence
  [Action Count]: The number of actions performed

- **Contents of Emails That the Instrument Sends (Go/Nogo AND, Go/Nogo OR)**

  <Subject>: The subject attached to the email. For example: “GoNogo Triggered Report (Nth Nogo result)”
  [Comment]: Comment
  [Setup Information]: Reference conditions (contents of condition numbers 1 to 8)[1], Logic (AND/OR), Stop Nogo/Action Count ((the number of no-go results/the number of actions)
  [Trigger Date and Time]: The time of trigger occurrence
  [Nogo/Exec Count]: The number Nogo results/the number of judgments performed
  [Nogo Factor]: Information, including measured values, about the conditions that returned no-go results[2]

  1 When the reference range type is OFF, the reference condition (Select) is blank.
  2 Measured values are only sent for GO/NO-GO determination based on waveform parameters.

  Example

  [Comment] Test
  [Setup Information]
  Select1: Rect(C1,Main) (Left:-3.0000E+00,Right:-2.5000E+00,Upper: 500.00E-03,Lower:-500.00E-03,Condition:In)
  Select2: Wave(C1,Main) (Range1:-5.0000E+00,Range2: 5.0000E+00,Condition:In)
  Select3: Polygon(C1,Main) (Condition:In)
  Select4: Measure(Max(C1)) (Upper: 0.0000E+00,Lower: 0.0000E+00,Condition:In)
  Select5: Rect(C5,Main) (Left:-3.0000E+00,Right:-2.5000E+00,Upper: 500.00E-03,Lower:-500.00E-03,Condition:In)
  Select6:
  Select7:
  Select8:
  Logic: OR
  Stop Nogo/Action Count: 1/Inf
  [Trigger Date and Time] 2020/06/01 21:18:51
  [Nogo/Exec Count] 1/1
  [Nogo Factor]
  Select1: Rect(C1,Main)
  Select2: Wave(C1,Main)

Number of Actions (Action Count/Nogo Count)

When the number of waveform acquisitions reaches the specified action count or when the number of no-go results reaches the specified Nogo Count, the instrument stops waveform acquisition.

Action Count

Set the number of waveform acquisitions.
1 to 1000000: The instrument stops the action when it acquires the specified number of waveforms.
Infinite: The instrument repeats the action until waveform acquisition is stopped using the Abort soft key or the RUN/STOP key.

Nogo Count

Set the number of no-go results.
1 to 1000: When the specified number of no-go results is reached, the instrument stops GO/NO-GO determination.
Infinite: The instrument repeats GO/NO-GO determination until waveform acquisition is stopped using the Abort soft key or the RUN/STOP key.

Executing Action-on-Trigger or GO/NO-GO determination (Exec)

Press the Exec soft key. You cannot use the RUN/STOP key for this purpose. During execution, the Exec soft key changes to the Abort soft key. The trigger mode during action-on-trigger or GO/NO-GO determination is set to Normal (this setting is independent from the front-panel MODE key).

Press the Abort soft key to stop action-on-trigger or GO/NO-GO determination.

GO/NO-GO Determination (Go/Nogo AND, Go/Nogo OR)

The instrument determines whether the acquired waveform meets the reference condition (no-go result) or not (go result). When the instrument produces a no-go result, it executes the specified action.

You can specify up to eight reference conditions. You can also apply AND or OR logic to the eight reference conditions.

In the reference conditions, you can include a zone or values obtained from automated measurement of waveform parameters.

The determination result can be transmitted through the rear-panel GO/NO-GO output terminal.

- Go/Nogo AND: Executes the action when all reference conditions 1 to 8 are no-go
- Go/Nogo OR: Executes the action when any of the reference conditions (1 through 8) are no-go

Reference Conditions (No.)

For reference conditions 1 to 8,* set the source waveform, reference range (the zone or the waveform parameter upper and lower limits), and the reference criterion.

* Reference conditions 1 to 4 on 4ch models

Reference Range Type (Mode)

You can set the reference range type to one of the settings below.

- OFF: The source waveform is not used for GO/NO-GO determination.
- RectZone: Rectangular zone.
- WaveZone: Waveform zone.
- PolygonZone: Polygonal zone.
- Parameter: Zone between the upper and lower limits of one waveform parameter.

Source Waveform (Trace)

You can select from one of the settings below. If you select Logic, select the source bit.

CH1 to CH8,* Math1 to Math8,* XY1 to XY4,* FFT1 to FFT4,* Logic

* CH1 to CH4, Math1 to Math4, XY1 to XY2, FFT1 to FFT2 on 4ch models

Selectable Reference Range Types for Various Source Waveforms

	Rect	Wave	Polygon	Parameter
CH1 to CH8	Yes	Yes	Yes	Yes
Math1 to Math8	Yes	Yes	Yes	Yes
XY1 to XY4	Yes	No	Yes	Yes
FFT1 to FFT4	No	No	No	Yes
Logic	No	No	No	Yes

Reference Criterion (Condition)

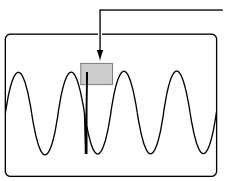
Set whether the source waveform must be in or out of the reference range to produce a no-go result.

- IN: No-go when the source waveform is within the reference range
- OUT: No-go when the source waveform is outside the reference range

Reference conditions 1 through 8 share their settings with history waveform search conditions 1 through 8.

Creating a Rectangular Zone (RectZone)

To create a rectangle, use the jog shuttle or the SET key to set the top, bottom, right, and left boundaries of the rectangle.



Creating a Rectangular Zone (Upper/Lower and Left/Right)

Create a rectangular zone.

- The selectable range for top and bottom boundaries is ±4 divisions from the screen center in 0.01-division steps.
- The selectable range for left and right boundaries is ±5 divisions from the screen center in 0.01-division steps.

Determination Source Window (Range)

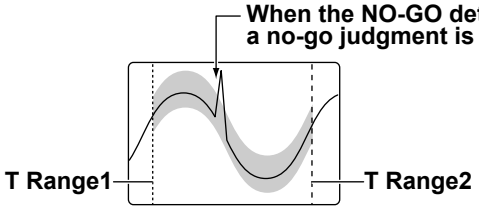
If the source waveform is CH1 to CH8, Math1 to Math8, set the GO/NO-GO determination source window to one of the following options:

- Main: Main window
- Zoom1: Zoom1 window
- Zoom2: Zoom2 window

Creating a Waveform Zone (WaveZone)

Create a zone based on the source waveform. You can also use other waveforms to create the zone.1 You can create up to eight waveform zones. One of them is used for GO/NO-GO determination.

* 4 on 4ch models



Determination Source Window (Range)

Select the GO/NO-GO determination source window. The selection process is the same as with the rectangular zone.

▶ See here.

Selecting the Waveform Zone (Zone No.)

Select the number of the waveform zone (1 to 8)* you want to edit. GO/NO-GO determination is performed using the waveform zone that you select here.

* 1 to 4 on 4ch models. On 8ch models, if the determination source waveform is CH5 to CH8 or Math5 to Math8, you can select 5 to 8.

Editing a Waveform Zone (Edit1 to 8)

Create a vertical or horizontal zone on the entire waveform or on a portion of the waveform.

On 4ch models, you can only set Edit 1 to Edit 4. On 8ch models, if the determination source waveform is CH5 to CH8 or Math5 to Math8, you can set Edit 5 to Edit 8.

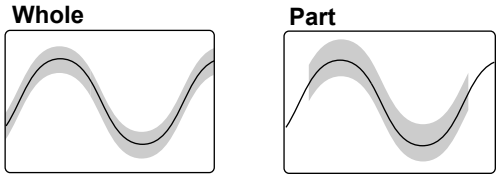
The waveform zones that you create are stored in the internal memory even when the power is turned off. You can save and load waveform zones from the internal storage or an external storage device using the FILE menu.

▶ See here.

Specifying the Editing Range (Edit)

You can specify which portion of the base waveform you want to edit.

- Whole: Edit the entire waveform
- Part: Edit a portion of the waveform



Range (Upper/Lower, Left/Right, T Range1/T Range2)

Set vertical or horizontal ranges.

- Selectable vertical zone range: ±8 divisions from the base waveform
- Selectable horizontal zone range:* ±5 divisions from the screen center

* When you select Whole, use Left and Right to set the zones. When you select Part, use T-Range1 and T-Range2 to set the zones.

Changing the Base Waveform (Trace)

You can select the base waveform for creating the waveform zone from one of the settings below. Change the base waveform when you want to use a waveform other than the GO/NO-GO determination source waveform or when you want to recreate the zone. You cannot select waveforms whose display is turned off.
CH1 to CH8, Math1 to Math8

Starting Over the Editing (Exec)

To start over the editing of the waveform zones, press this soft key. If you press this key, all the zones that you have edited up to that point will be lost.

If you want to continue editing existing zones, do not press this soft key. Even if you press the Exec soft key and clear the zones, the original zones are stored if you have stored them in the past according to the procedure explained in "Confirming the Waveform Zones" on the next page. If you want to go back and edit the original zones, press the Quit soft key to finish editing once, and then press one of the Edit 1 to Edit8* soft keys to enter the edit menu again.

* Edit 1 to Edit 4* on 4ch models

Confirming the Waveform Zone (Store)

Confirms the waveform zone.

Finishing the Editing Operation (Quit)

Finish waveform zone editing. If you do not confirm the edited waveform zone by pressing the Store soft key, the changes that you made are lost.

Determination Period (T Range1 and T Range2)

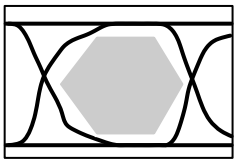
The instrument performs GO/NO-GO determination on the waveform in the area specified by T Range1 and T Range2.
Selectable range: Within ±5 divisions of the time axis

Creating a Polygonal Zone (PolygonZone)

You can use polygonal zones by using polygon images. You can create polygon images by using the Mask Editor Software on a PC. You can create up to eight* polygonal zones and use one of them for GO/NO-GO determination.

You can download the Mask Editor Software from the YOKOGAWA website.

* 4 on 4ch models



Loading a Polygon Image

Using the FILE Menu, load a polygon image into the specified zone (Zone No.1 to 8).

Determination Source Window (Range)

Select the GO/NO-GO determination source window. The selection process is the same as with the rectangular zone.

▶ See here.

Selecting the Polygonal Zone (Zone No.)

Select the zone number that contains the polygon image that you want to use for determination.

Moving the Polygonal Zone (V-Position, H-Position)

You can move the loaded polygon image vertically or horizontally.

Selectable V-Position range: ±4 divisions

Selectable H-Position range: ±5 divisions

Setting the Reference Range Using a Waveform Parameter (Parameter)

Set upper and lower limits on a measured item obtained through the automated measurement of waveform parameters.



Selecting the Measured Item to Use for Determination (Item)

The selectable item varies depending on the determination source waveform (Trace) that you selected.

- CH1 to CH8, Math1 to Math8: All measurement items
- Logic: Freq, Period, Avg Freq, Duty, Pulse Count, Delay
- XY1 to XY4: Integ only
- FFT1 to FFT4: Freq, V

Reference Range (Upper/Lower)

Set the upper and lower limits of the reference range.

Notes about Actions

How the instrument operates when the action setting is Print or Save Waveform

- The instrument operates based on the settings in the Print menu or FILE menu. If the auto naming feature in the FILE menu is off, files are saved using specified names. If it is not off, the files are saved using the specified method.
- If the instrument's internal storage is being accessed from a PC while an action is being executed, the PC may stop detecting the internal storage. If this happens, remove the USB cable connecting the PC to the instrument, wait a few seconds, and reconnect the cable.

Points to Consider When Configuring Action-on-Trigger

- You cannot change settings while the action-on-trigger feature is active.
- Exponential averaging is used.

Notes about GO/NO-GO Determination

- The instrument displays the determination results on the screen (the total number of results and the number of no-go results).
- During GO/NO-GO determination, only the Abort soft key and RUN/STOP are valid.
- The instrument automatically changes the trigger mode to Normal when it executes GO/NO-GO determination.

Points to Consider when Setting the Action Setting to Print

- If Print To is set to Multi on the PRINT menu, you cannot execute the action.

Points to Consider When Setting the Action Setting to Save Waveform

- Do not set the storage device's root folder as the save destination.
- If you set sequential numbering as the automatic naming method (using the FILE menu), as the number of saved files increases, the amount of time required to save a file will also increase. Also, the maximum number of files that can be saved using sequential numbering is 5000. To save more than 5000 files, set the automatic naming function so that files are named by date. However, if the save location is a USB storage device formatted to FAT16 or FAT32, the maximum number of files that can be saved when Numbering is selected is 1000.
- If you use the automatic naming function to save data to files, GO/NO-GO determination will stop if the same file name exists in the same folder. To prevent this from happening, you can either create a new empty folder before you start GO/NO-GO determination, or you can make sure that there are no files in the destination folder.
- Up to 12500 files and folders can be displayed in the file list. If there are more than a total of 12500 files and folders in a given folder, the file list for that folder will display only 12500 files and folders. There is no way to set which files and folders are displayed.

Points to Consider When Setting the Action Setting to Send Mail

- The instrument operates based on the settings that you specified by pressing UTILITY and selecting Network > Mail. You can attach screen images to emails.
- We recommend that you set a limit on the mail transmission number to avoid overloading the mail server. You can set the upper limit of mail transmissions using Mail Count.
- If the specified number of mail transmissions is less than the number of specified actions, mail transmission will stop after the specified number of transmissions. If the specified number of mail transmissions is greater than the number of specified actions, mail transmission will stop after the specified number of actions.

6 Waveform Acquisition

Based on the data that has been stored in the acquisition memory, the instrument performs various operations, such as displaying waveforms on the screen, computing, measuring cursors, and automatically measuring waveform parameters.
This chapter explains how to set the number of data points to store in the acquisition memory (the record length), how to enable or disable the sample data averaging feature, and so on.

Record length (Record Length)

Record length refers to the number of data points that are stored to the acquisition memory for each channel.
Display record length refers to the data points from the data stored in the acquisition memory that are displayed on the screen. Normally, the acquisition-memory record length and display record length are the same, but the time scale may cause them to differ.
When you change the time scale, the sample rate and record length also change.
The instrument allows you to set the record length to a value from 1.25 kpoints to 500 Mpoints (this range varies depending on the installed option).
If you want to observe a long-term phenomenon at a high time resolution (at a high sample rate), set the record length to a high value.
When the record length is long, computation and measurement processing take longer than when the record length is short.
The following limitations on waveform acquisition conditions and the number of waveforms that can be stored in the acquisition memory (the number of history waveforms) apply depending on the specified record length.

Record Length	Number of History Waveforms		
	No options (125 Mpoints)	**/M1S or /M1 option (250 Mpoints)**	**/M2S or /M2 option (500 Mpoints)**
1.25 kpoints	20000	50000	100000
12.5 kpoints	2500	5000	10000
125 kpoints	250	500	1000
1.25 Mpoints	25	50	100
2.5 Mpoints	10	25	50
5 Mpoints	5	10	25
12.5 Mpoints	1	5	10
25 Mpoints	1[1]	1	2
50 Mpoints	1[2]	1[1]	1
125 Mpoints	1[2, 3]	1[2]	1[1]
250 Mpoints	–	1[2, 3]	1[2]
500 Mpoints	–	–	1[2, 3]

1 Waveform acquisition operates in Single mode at this record length regardless of the trigger mode setting.
2 Waveform acquisition operates in Single mode at this record length regardless of the trigger mode setting. You cannot specify Averaging or Interpolation mode.
3 CH2, CH4, CH6, CH8, and Logic (C0 to C7, D0 to D7) waveforms cannot be acquired at this record length. Moreover, Math2 (Ref2), Math4 (Ref4), Math6 (Ref6), and Math8 (Ref8) cannot be used (the available settings very depending on the model).

Acquisition Mode (Mode)

Select from the following.

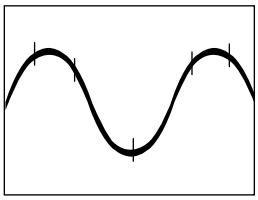
Normal Mode (Normal)

Displays waveforms without processing the sampled data.

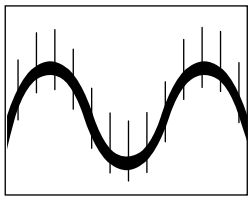
Envelope Mode (Envelope)

The instrument determines the maximum and minimum values among the data sampled at 2.5 GS/s at the time interval that is 2 times of the sampling period (the inverse of the sample rate) of the Normal mode setting and displays the values as pairs to produce the waveform.

This mode is effective when you want to avoid aliasing, because the sample rate is essentially kept high regardless of the time axis setting. It is also effective when you want to detect glitches (narrow pulse signals) or when you want to display the envelope of a modulated signal. This mode can be used when the sample rate is 625 MS/s or less.



Normal mode



Envelope mode

If you set the acquisition mode to Envelope when the sample rate is set to 1.25 GS/s or higher, the instrument actually operates in Normal mode. In envelope mode, [Envelope] appears in the upper right of the screen. If envelope is in use in high resolution mode, [Env:Hi-Res] appears.

Averaging Mode (Average)

In Averaging mode, the instrument acquires waveforms numerous times, averages the same time points relative to the trigger point, and displays averaged waveforms. Averaging mode is useful when you want to remove random noise from waveforms.

You cannot use the history feature in Averaging mode.

The averaging method varies depending on the trigger mode.

- Auto, Auto Level, or Normal mode: Exponential averaging
- Single mode: Linear averaging
- N Single mode: Actually operates in Normal mode.

To average waveforms that have been acquired in N Single mode, set the acquisition mode to Normal, and turn on history feature's averaging.

Attenuation Constant and Average Count (Avg Count)

Sets the attenuation constant for exponential averaging or the average count for linear averaging.
Selectable range: 2 to 1024

Exponential average

$$An = \frac{1}{N}\{(N-1)An-1 + Xn\}$$

An: nth averaged value
Xn: nth measured value
N: Attenuation constant
(2 to 1024 in 2^n steps)

Simple average

$$An = \frac{\sum_{n=1}^{N} Xn}{N}$$

Xn: nth measured value
N: Number of times to average
(2 to 1024 in 2^n steps)

Logic waveforms are not averaged.

Number of Waveform Acquisitions (ACQ Count)

When the acquisition mode is set to Normal (Normal) or Envelope (Envelope), you can set the number of waveform acquisitions. If you select Infinite, the instrument continues waveform acquisition until you stop it using the RUN/STOP key. The default setting is Infinite. You cannot change the number of acquisitions during waveform acquisition. If you want to change it, stop acquisition first.
Selectable range: 1 to 65536, or Infinite

The number of waveforms that have been stored to the acquisition memory appears at the upper right of the screen.

High Resolution Mode (Hi Resolution)

When High Resolution mode is turned on, the number of effective bits per data value is expanded by up to 12 bits through the digital and bandwidth filters (Band Width).

- ON: Enables High Resolution mode
- OFF: Disables High Resolution mode

- When High Resolution mode is turned on, the maximum sample rate of real-time sampling is set to 1.25 GS/s, half the ordinary value.
- High Resolution mode does not apply to logic waveforms.

Sampling Mode (Sampling Mode)

The instrument samples data using a 2.5 GS/s A/D converter, so the maximum sample rate in normal sampling mode (real-time sampling mode) is 2.5 GS/s.

If you decrease the time axis setting when measuring fast phenomena, the sample rate will reach its maximum rate (2.5 GS/s) at a certain point. If you decrease the time axis setting further, the number of displayed points decreases (the display record length decreases).

The instrument has two modes for interpolating between deficient data points. Set the sampling mode when you want to make measurements by setting a sample rate that is higher than the real-time sampling mode's maximum sample rate (2.5 GS/s).

- Interpolation mode: Interpolates between data points using the (sinx)/x function. This mode is effective for single-shot signals.
- Repetitive sampling mode: Interpolates through random sampling. This mode is effective for repeating signals.

Relationship between the Time Scale, Record Length, and Sample Rate

The relationship between the time scale, record length, and sample rate is as follows:

When the record length and the time axis are set so that the sample rate is at the maximum rate, if you decrease the time axis setting further, the record length is reduced.

Sample rate = Record length/(time scale [s/div] × 10 [div])

Real-Time Sampling Mode (Realtime)

When you change the time axis setting, the sample rate changes. You can sample data at a maximum sample rate of 2.5 GS/s (1.25 GS/s when High Resolution mode is on).

In this mode, the instrument can only display waveforms up to the frequency that corresponds to one-half the sample rate, in accordance with the sampling theorem.* Therefore, this mode is suitable for observing waveforms whose frequency is lower than one-half the sample rate.

* If the sample rate is comparatively low with respect to the input signal frequency, the harmonics contained in the signal are lost. When this happens, some of the harmonics will be misread as low-frequency waves due to the effects described by the Nyquist sampling theorem. This phenomenon is called aliasing. You can avoid aliasing by acquiring waveforms with the acquisition mode set to Envelope.

Interpolation Mode (Interpolation)

In Interpolation mode, the instrument interpolates the data sampled at 2.5 GS/s up to 100 times using the (sinx)/x function.

This essentially increases the sample rate to up to 250 GS/s.

The interpolation mode is effective for single-shot signals. If the input signal frequency is high relative to the sample rate (2.5 GS/s here), aliasing may occur.

You can use the history feature in Interpolation mode.

Repetitive Sampling Mode (Repetitive)

In this mode, one waveform is created from several cycles of a repeating signal. This is equivalent to sampling the signal at a higher sample rate than the actual sample rate. The equivalent sample rate is 250 GS/s maximum.

The instrument uses random sampling, which takes advantage of the fact that the time difference between the trigger point and sampled points is random. The instrument realigns the trigger point each time it acquires a waveform.

This mode is effective for repeating signals, and aliasing rarely occurs.

You cannot use the history feature in Repetitive Sampling mode.

- Even if Interpolation or Repetitive Sampling mode is selected, the instrument runs in real-time sampling mode when the sample rate is less than or equal to 2.5 GS/s. When the instrument is running in Interpolation or Repetitive Sampling mode, “IntP” or “Rep” appears at the upper right of the screen.
- When the sample rate is at its maximum rate (250 GS/s) in Interpolation or Repetitive Sampling mode, if you decrease the time axis setting, the display record length is reduced.
- If the trigger mode is set to Single or N Single, the acquisition mode is set to Averaging, and the sampling mode is set to Repetitive Sampling, the instrument actually runs in Interpolation mode.
- If the trigger mode is set to N Single and the sampling mode is set to Repetitive Sampling, the instrument actually runs in Interpolation mode.
- Repetitive Sampling mode can only be used when the record length is 1.25 Mpoints or less. If the trigger source is set to Logic, the instrument runs in Interpolation mode.

Waveform Acquisition (RUN/STOP)

When you execute (RUN) waveform acquisition, the instrument stores waveform data to the acquisition memory and updates the displayed waveforms each time the instrument triggers. The acquisition memory is divided into many areas based on the specified record length, and the maximum number of acquirable waveforms are stored in the memory. You can recall past waveforms that are stored in the memory using the history feature when waveform acquisition is not running.

How the Instrument Operates When the Acquisition Mode Is Set to Averaging

- Averaging stops when you stop acquisition.
- If you execute acquisition again, averaging starts from the beginning.

RUN and STOP Operations during Accumulation

- Accumulation stops when you stop waveform acquisition.
- When you execute acquisition again, the displayed waveforms up to that point are cleared, and accumulation restarts from the beginning.

The RUN/STOP Key Is Disabled:

- When the instrument is in remote mode.
- When the instrument is printing to a printer, when it is being set up automatically, or when it is accessing a storage device.

- If you press HISTORY during waveform acquisition, waveform acquisition stops.
- If you change the waveform acquisition conditions and, waveform acquisition, the past data stored in the acquisition memory is cleared.
- You can use the snapshot feature to retain the displayed waveform on the screen. This feature allows you to update the display without having to stop waveform acquisition.
- To update the displayed waveform once when the trigger condition is met and then stop waveform acquisition, press SINGLE.

Acquiring the Waveform Once (SINGLE)

When you execute waveform acquisition (SINGLE) and trigger conditions are met, the instrument updates the displayed waveform once and stops waveform acquisition. If no triggers occur, the display is not updated.
If no triggers occur, the display is not updated. If TIME/DIV is set to a value that would cause the display to switch to roll mode (100 ms/div to 500 s/div), roll mode is used until a trigger occurs. When the instrument triggers, roll mode will stop when it acquires the record length's post-trigger data. This mode is suitable for the observation of single-shot signals.

7 Display

Types of Windows

This instrument has the following types of windows.

VT waveform display window

- Main window
  Displays normal waveforms, which are not magnified
- Zoom1 window
  Displays zoomed waveforms according to the settings specified using the ZOOM1 key.
- Zoom2 window
  Displays zoomed waveforms according to the settings specified using the ZOOM2 key.

XY window

Displays the XY1 to XY4 waveforms according to the settings specified using the X-Y key.[1]
Can be displayed separately in two windows

FFT window[2]

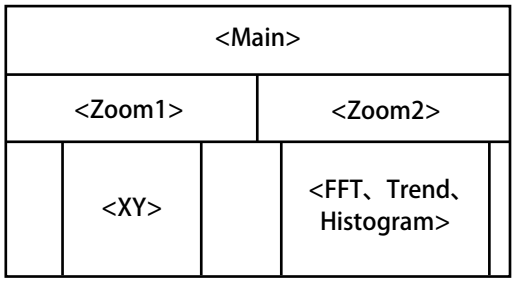
Displays the FFT1 to FFT4 waveforms according to the settings specified using the FFT key.[1]

Trend/Histogram window[2, 3]

Displays Trend1, Trend2, Hist1, and Hist2 according to the statistical processing settings specified using the MEASURE key.

1 XY3 and XY4 waveforms and FFT3 and FFT4 waveforms are available only on 8ch models.
2 The FFT window and the Trend/Histogram window are the same.
3 Two out of Trend1, Trend2, Hist1, and Hist2 can be displayed. Trend1 and Hist1 or Trend2 and Hist2 cannot be displayed simultaneously.

Display Example



Display Format (Format)

You can evenly divide the VT waveform display window so that you can easily view input waveforms and computed waveforms. You can divide the window in the following ways.
Auto,* Single (one area), Dual (two areas), Triad (three areas), Quad (four areas), Hexa (six areas), Octal (eight areas)

* The number of areas is automatically selected based on the number of displayed waveforms.

The number of displayed points per area varies depending on how many areas the window is divided into.
The vertical resolution does not change even if the number of displayed points is different.
The number of displayed points when only the Main window is displayed is as follows:
Single: 640 points, Dual: 320 points, Triad: 208 points, Quad: 160 points, Hexa: 104 points, Octal: 80 points

Waveform Mapping (Mapping)

You can specify how channels are assigned to the divided areas.

- **Auto**
  The waveforms whose display is turned on are assigned in order starting with the top area.
- **Manual**
  You can assign each waveform to the area of your choice.
  You can assign all waveforms regardless of whether their displays are turned on.

Color (Color)

Intensity (Intensity Graticule)

You can set the intensity of the grid (Grid), zoom box (Zoom Box), cursor (Cursor), and marker (Marker).
Selectable range: 0 to 31

Waveform Color (Waveform)

You can select the waveform display color separately for CH1 to CH8,* Logic, State, and Math1 to Math8* from the available 16 colors.
For State, set the color for when the logic signal state display is turned on.

* CH1 to CH4 and Math1 to Math4 on 4ch models

Serial Bus Trend Color (Serial Bus Trend)

The instrument has a function that analyzes and decodes certain serial bus signals and displays the trend of the results. You can select the color of each trend from 16 colors.
For details on the analysis, decoding, and trend display of serial bus signals, see chapter 15, “Analyzing and Searching Serial Bus Signals.” ▶ See here.

Initialization

Intensity and color can be reset to default values.

- To reset the intensity of the grid, zoom box, cursor, or marker to its default value, select the item that you want to reset, and then press RESET.
- To reset the colors of the waveform and serial bus trend, press DEFAULT. However, be careful as pressing DEFAULT will also reset other settings to their factory default values. ▶ See here.

Display Interpolation (Dot Connect)

When the number of data points is within the interpolation zone,* the instrument displays waveforms by interpolating between sampled data points.

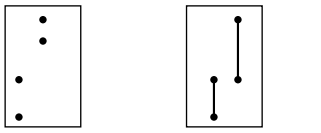
* Interpolation zone refers to the condition in which a given number of data points are not contained in the 10 divisions along the time axis. The number of data points that define the interpolation zone varies depending on the display record length and zoom factor.

You can set the interpolation method to one of the options below.

- **OFF**
  Displays the data using dots without interpolation.
- **Sine Interpolation (Sine)**
  Interpolates a sine curve between two points using the (sinx)/x function. This method is suitable for the observation of sine waves.
- **Linear Interpolation (Line)**
  Linearly interpolates between two points.
- **Pulse Interpolation (Pulse)**
  Interpolates between two points in a staircase pattern.

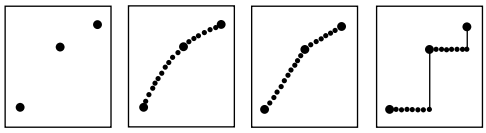
When the Number of Displayed Waveform Data Points Is Not in the Interpolation Zone

If the interpolation method is set to Sine, Line, or Pulse, the dots are connected vertically.



OFF Sine/Line/Pulse

When the Number of Displayed Waveform Data Points Is in the Interpolation Zone



OFF Sine Line Pulse

The interpolation method is set to Pulse when:

- The input signal is a logic signal.
- The acquisition mode is Envelope.
- The sampling mode is Repetitive Sampling.

Grid (Graticule)

Set the window grid to one of the settings below.

- Dot Grid: Displays the grid using broken lines
- Line Grid: Displays the grid using solid lines
- Frame: Displays a grid frame
- Cross Hair: Displays the grid using crosshairs

Fine Grid Display (Fine Grid)

You can set whether or not to display the fine grid.

- ON: Displays the fine grid
- OFF: Does not display the fine grid

Scale Value Display (Scale Value)

You can set whether to display the upper and lower limits (scale values) of each waveform's vertical or horizontal axes.

- ON: Displays the scale values
- OFF: Does not display the scale values

Waveform Intensity (Intensity)

You can set the waveform intensity.

Selectable range: 1 to 64

Accumulation (Accumulate)

When you turn the accumulate feature on, the instrument acquires waveforms at a rate independent of the screen update interval and accumulates them on the screen.
The accumulated waveforms are displayed with gradually decreasing intensity for the specified amount of time. The accumulated display can be used to increase the waveform acquisition rate and retain waveforms of infrequent phenomenon on the screen for a certain amount of time.
If accumulation is turned off, the screen is updated every time a trigger occurs, and waveforms are not accumulated. The waveform acquisition rate never becomes faster than the screen refresh interval of the display, but this is effective when you want to focus on the waveform acquired once.

Waveform Accumulation Expression

Select from the following:

- **Intensity**

  Waveform accumulation frequency is expressed using intensity (brightness) levels. Analog waveforms are displayed using up to 63 levels and logic waveforms up to 3 levels. The intensity range is 1 to 64.
- **Color**

  Waveform accumulation frequency is expressed using different colors. Indicates 15 frequency levels using different colors that range from blue to green to yellow to red to white starting with the lowest frequency. Logic waveforms are displayed using up to three colors.
- **OFF**

  Accumulation is disabled.

Accumulation Time (Accum Time)

Sets the amount of time to retain waveforms on the screen.

Selectable range

100 ms to 100 s, or Infinite (Infinite)

Pressing CLEAR TRACE clears the accumulated waveforms.

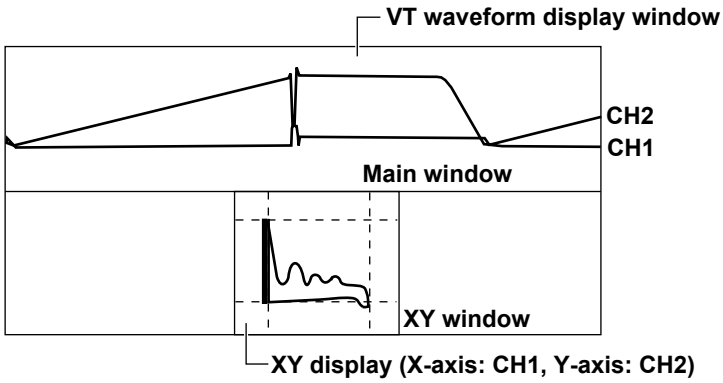
Notes about Waveform Accumulation

- Automated measurement of waveform parameters and GO/NO-GO determination are performed on the most recent waveform.
- If you press RUN/STOP to stop waveform acquisition, accumulation stops. When you restart waveform acquisition, all the waveforms are cleared, and accumulation starts from the beginning.
- If the instrument does not trigger when the trigger mode is set to Normal, the waveform intensity is retained until the next time the instrument triggers.
- If you change the display format when accumulated waveforms are displayed, the instrument operates in the following manner.
  During accumulation: The instrument clears the screen and restarts displaying from the beginning.
  When accumulation is stopped: The instrument clears the waveforms and displays the most recent waveform.

8 Displaying XY Waveforms

You can view the correlation between two input signal levels by assigning the level of a waveform to the X-axis (horizontal axis) and assigning the level of another waveform to the Y-axis (vertical axis). XY waveforms appear in the XY window.
You can perform cursor measurements on and determine the area of the displayed XY waveform. You can view XY waveforms and normal VT waveforms simultaneously.
For example, you can use the XY waveform display to measure the area of safe operation (SOA) of switching elements.
You can set up to four XY waveforms (XY1 to XY4).*

* Up to two waveforms on 4ch models (XY1, XY2)



Turning the XY Waveform Display On and Off (Display)

Sets whether or not to measure and display XY waveforms. If you set this to ON, the XY window appears.

- ON: Displays and measures XY waveforms
- OFF: Does not display or measure XY waveforms

X-Axis and Y-Axis Source Waveforms (X Trace/Y Trace)

Select the waveforms to assign to the X-axes and Y-axes of the XY1, XY2, XY3, and XY4 waveforms. The available settings vary depending on the model.

- Waveforms to assign to XY1 and XY2: CH1 to CH4, Math1 to Math4
- Waveforms to assign to XY3 and XY4: CH5 to CH8, Math5 to Math8

Configuring the Display (Display Setup)

Displaying the VT Waveforms (VT Display)

Sets whether or not to display XY waveforms along with the VT waveforms.

- ON: Displays the VT waveform display window
- OFF: Does not display the VT waveform display window

Split Display (Split)

Set whether to display the four XY waveforms in two windows.

- ON: The four waveforms are displayed in two windows. XY1 to XY4 waveforms whose display is turned on are displayed in order starting with the left XY window, then the right XY window, then the left XY window, and so on.
- OFF: The four waveforms are not displayed in separate windows. XY1 to XY4 waveforms are displayed in the same window.

If you press DISPLAY, ZOOM1, or ZOOM2 when the VT waveform display (VT Display) is OFF, the VT waveform display window turns on.

Display Source Window (Time Range)

Set the display and measurement range source window to one of the settings below.

Main: Main window
Zoom1: Zoom1 window
Zoom2: Zoom2 window

Display Area (T Range1/T Range2)

Sets the start point (T Range1) and the end point (T Range2) of the display and the measurement time period.
Selectable range: ±5 divisions with the center of the target window taken to be 0 divisions.

Measurement Setup (Measure Setup)

You can perform cursor measurements on and determine the area of the displayed XY waveform.

Measurement Mode (Mode)

- Measurement off
- Cursor Measurement (Cursor)
- Performing Area Calculations (Integ)

Cursor Measurement (Cursor)

You can display two cursors on both the X and Y axes and measure with them simultaneously.

- **Vertical cursor**
  You can measure the X-axis values for Cursor1 and Cursor2. You can set the cursors in the range of ±4 divisions in 0.01-division steps.
- **Horizontal cursor**
  You can measure the Y-axis values for Cursor1 and Cursor2. You can set the cursors in the range of ±4 divisions in 0.01-division steps.
- **Measurement Item (Item)**
  The instrument measures the values of the items listed below that you select.
  X1: X axis value at Cursor1
  Y1: Y axis value at Cursor1
  X2: X axis value at Cursor2
  Y2: Y axis value at Cursor2
  ΔX: Difference between the X1 and X2 values
  ΔY: Difference between the Y1 and Y2 values

Performing Area Calculations (Integ)

The total area of the XY waveform is determined. You can set the loop and polarity for each XY waveform.

- **Area determination method (Loop)**
  Sets the method of determining the area to Open (total trapezoidal area) or Close (total triangular area).
- **Direction to be made positive (polarity)**
  Selects which direction to make positive, CW (clockwise) or CCW (counterclockwise).

9 Computed and Reference Waveforms

The instrument can display up to eight computed or reference waveforms (Math/Ref1 to Math/Ref8).*

* Only four (Math/Ref1 to Math/Ref4) on 4ch models

Computation Mode (Mode)

Select the waveforms that will be displayed for Math/Ref1 to Math/Ref8 from one of the settings below. The available settings vary depending on the model.

OFF: Does not display computed or reference waveforms

Math: Displays computed waveforms

Ref: Displays reference waveforms

Even if Ref is selected, it appears as Math1 to Math8 in the various source selection menus.

Computation Source Waveforms (Source1/Source2)

If you set the computation mode to Math, you can select the computation source waveforms for Math/Ref1 to Math/Ref8 from one of the settings below.

Depending on the operator, you may need to select only Source1 or Source1 and Source2. The available settings vary depending on the model.

- Math1 (Math/Ref1): CH1 to CH4
- Math2 (Math/Ref2): CH1 to CH4, Math1*
- Math3 (Math/Ref3): CH1 to CH4, Math1,* Math2*
- Math4 (Math/Ref4): CH1 to CH4, Math1* to Math3*
- Math5 (Math/Ref5): CH5 to CH8
- Math6 (Math/Ref6): CH5 to CH8, Math5*
- Math7 (Math/Ref7): CH5 to CH8, Math5,* Math6*
- Math8 (Math/Ref8): CH5 to CH8, Math5* to Math7*

* If Ref is selected, even if it is displayed as Math1 to Math7 on the source selection menu, the computation source is Ref1 to Ref7. When the computation source waveform (source) includes Math and the Math source is set to OFF, computation is not performed.

Reference Waveforms

If you set the computation mode to Ref, you can display reference waveforms. The following waveforms can be used as reference waveforms.

- Waveforms displayed on the screen: You can load waveforms using the Load from soft key.
- Waveforms saved in the past: You can load waveforms using the load feature of the FILE menu.

Loading the Reference Waveform (Load from)

The reference waveform is set to the waveform displayed on the screen. Select the waveform to load into Ref1 to Ref8 from one of the settings below. Data that exceeds 25 Mpoints is loaded by sampling. The available settings vary depending on the model.

- Ref1 (Math/Ref1): CH1 to CH4, Math2, Math3, Math4
- Ref2 (Math/Ref2): CH1 to CH4, Math1, Math3, Math4
- Ref3 (Math/Ref3): CH1 to CH4, Math1, Math2, Math4
- Ref4 (Math/Ref4): CH1 to CH4, Math1, Math2, Math3
- Ref5 (Math/Ref5): CH5 to CH8, Math6, Math7, Math8
- Ref6 (Math/Ref6): CH5 to CH8, Math5, Math7, Math8
- Ref7 (Math/Ref7): CH5 to CH8, Math5, Math6, Math8
- Ref8 (Math/Ref8): CH5 to CH8, Math5, Math6, Math7

Measurement and Computation Using Reference Waveforms

- If a reference waveform is displayed and you set the measurement source of cursor measurement to Math1 to Math8, you can perform cursor measurement or automated measurement of waveform parameters on the reference waveform.
- If reference waveform Ref1 is displayed and you set the computation source waveform of Math2 to Math1, you can perform computation using reference waveform Ref1. The same holds true for Math1 and Math2 for Math3 and Math1 to Math3 for Math4. Moreover, this relationship applies to Math6 to Math8 computation sources Math5 to Math7.

Vertical Position (Position)

You can move the reference waveform vertical position within ±4 divisions.

- In computation where the time axis is different between the reference waveform and input waveform, the instrument interpolates or compresses the reference waveform data so that the number of data points for both waveforms is the same.
- You cannot change the reference waveform time axis.
- Reference waveforms whose record length is 25 Mpoints or less are backed up when they are loaded. However, if you turn on the instrument while holding down the RESET key, the settings are set to their factory defaults, and the reference waveforms are cleared.
- To load a file that contains waveform data of multiple channels as a reference waveform, use Load to Channels on the menu for loading waveform data from files into channels, and then load a waveform as a reference waveform.

Operators (Operation)

The following operators are available.

- S1+S2: Adds the waveforms assigned to Source1 and Source2
- S1−S2: Subtracts the waveform assigned to Source2 from the waveform assigned to Source1
- S1xS2: Multiplies the waveforms assigned to Source1 and Source2
- Filter(S1): Performs phase shifting, moving average, or noise rejection on the waveform assigned to Source1
- Integ(S1): Integrates the waveform assigned to Source1
- Count: Counts the number of edges of the waveform assigned to Source1 or the number of phase changes between the two waveforms assigned to Source 1 and Source2.
- User Define: User-defined expression (optional)

Addition, Subtraction, and Multiplication (S1+S2, S1−S2, S1xS2)

Performs addition, subtraction, or multiplication on the two waveforms assigned to Source1 and Source2.

IIR Filter, Smoothing (Filter(S1))

Performs phase shifting or moving average on the waveform assigned to Source1 or applies an IIR filter to the waveform.

Selecting the Filter Type (Filter Setup)

Set the filter type to one of the settings below.

- Delay: Displays a phase-shifted waveform
- Moving Avg: Displays a waveform whose noise has been eliminated through moving averaging
- IIR Lowpass/IIR Highpass: Displays a waveform whose noise has been eliminated through an IIR filter

Phase Shifting (Delay)

Displays a waveform that has been phase-shifted by the specified amount of time.

- **Delay (Delay)**
  Set the amount of time to shift the phase.
  Selectable range: Time corresponding to ±5 divisions
  The resolution is 1/sample rate.

The specified delay is retained even if you change the TIME/DIV setting, unless the change causes the specified delay to exceed the amount of time corresponding to ±5 divisions.

Smoothing (Moving Avg)

The instrument averages the waveforms according to the following equation. Set the number of points to use for moving averaging.

$$X_n = \frac{1}{N}\left\{ X_n + 0.5 \times (X_{n-k} + X_{n+k}) + \sum_{i=1}^{k-1} (X_{n-i} + X_{n+i}) \right\}$$

(when weight N is set to 2k)

- **Weighted Points (Weight)**
  Set the number of points to use for moving averaging.
  Selectable range: 2 to 128 in 2^n steps

IIR Filter (IIR Lowpass/IIR Highpass)

Set the filter order and cutoff frequency for the low-pass filter or high-pass filter.

- IIR Lowpass: Rejects high-frequency noise
- IIR Highpass: Rejects low-frequency noise

- **Filter order (Order)**
  Select 1st order or 2nd order. Depending on the filter type and filter order that you select, the phase change varies as follows:

Filter Type	Harmonic Order	Phase Change
Low Pass	1	Phase lag
High Pass	1	Phase lead
High Pass/Low Pass	2	No phase change

- **Cutoff frequency (Cutoff1)**
  You can set the cutoff frequency to a value up to 500 MHz.

- In the filter calculation (IIR filter), because the initial value is indeterminate, correct calculation is not possible immediately after the start of calculation. With a first-order filter the left end of the waveform is not shown, and with a second-order filter, both ends of the waveform are not shown.
- The lower cutoff frequency limit varies depending on the time-axis setting.

Integration (Integ(S1))

Integrates the waveform assigned to Source1.
The instrument integrates with the initial point (Initial Point) set to zero.

Edge Count or Rotary Count (Count)

The instrument counts edges or rotations of the waveforms assigned to Source1 and Source2.

Count Setup (Count Setup)

Count Type (Type)

Select the count type from one of the settings below.

- Edge: Counts the number of edges of one waveform
- Rotary: Counts the number of phase changes between two waveforms

Edge Count (Edge)

With the computation initial point (Initial Point) counted as zero, the instrument counts the number of times the waveform specified as Source1 passes through the detection level.

- **Detection Level (Threshold)**

  Set the level for detecting edges.
  Selectable range: ±10 div

- **Polarity (Slope)**

  Select which waveform slope the instrument will detect edges on.

⨍	Detected when the waveform slope is rising
⨏	Detected when the waveform slope is falling

- **Hysteresis (Hysteresis)**

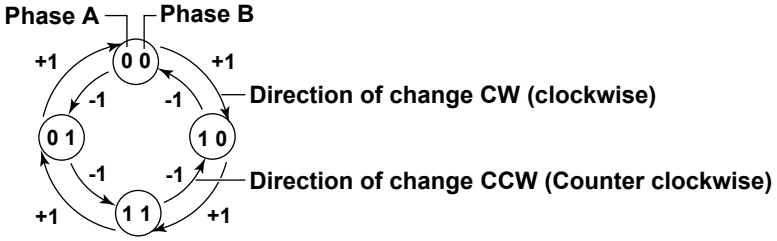
  You can apply a hysteresis to the detection level so that edges are not detected on small changes.
  Selectable range: 0.3 div to 8.0 div
  Resolution: 0.1 div

Rotary Count (Rotary)

The counter is incremented or decremented based on the phase changes in the waveforms assigned to Source1 (phase A) and Source2 (phase B). The state when the waveform is above the specified threshold level is considered to be 1. The state when the waveform is below the threshold level is considered to be 0. Depending on how phase A and phase B change, the counter is incremented or decremented.
The instrument counts the number of phase changes with the initial point (Initial Point) set to zero. In addition, the counter can be reset based on the combination of the edge of the waveform assigned to Source3 (Z) and that of the waveform assigned to phase A or B. The counter can also be reset based on the waveform assigned to phase Z.

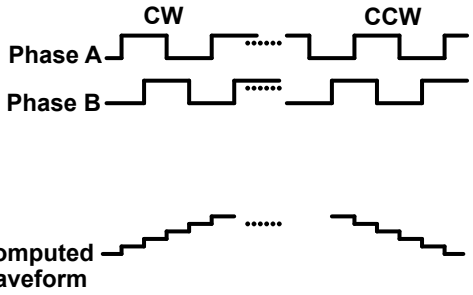
- **Relationship between State Transitions and Counting**

  As shown in the figure below, the instrument counts up or counts down depending on the phase change (change in state between 0 and 1) of phase A and phase B.

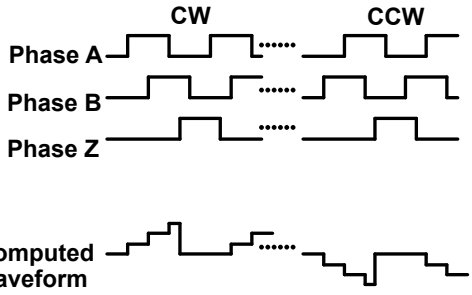


Counting Example

Source3 (phase Z): None



Source3 (phase Z): CH1 to CH8, ⎍



- **Computation Source Waveform (Source1 (A), Source2 (B), Source3 (Z))**

  The options are the same as were described above for the computation source waveform (Source1, Source2). You can select None (no setting) for only Source3 (Z).

  Polarity (Polarity)

  Select the Source3 (Z) polarity. You can set this when Source 3 (Z) is not set to None.

⎍	Resets the counter when the signal level is high
⎎	Resets the counter when the signal level is low

- **Determination Level (Threshold)**

  Set the level for determining changes in the waveform states. Set the level for phase A, phase B, and phase Z.
  Selectable range: ±10 div

- **Hysteresis (Hysteresis)**

  Set a width to the level for determining changes in the waveform states so that the instrument does not perform determination on small fluctuations in the phase.
  Selectable range: 0.3 div to 8.0 div
  Resolution: 0.1 div

- **Count Conditions (Count Condition)**

  Set the timing for counting phase changes in phase A and phase B.

  Multiplication (Multiplication)

  Select the multiplication from the following:
  - 1-time multiplication (x1): Counts on the edge of one location of the waveform assigned to phase A or B
  - 2-times multiplication (x2): Counts on the edge of two locations of the waveform assigned to phase A or B
  - 4-times multiplication (x4): Counts on all edges of the waveform assigned to phase A or B

  CW Timing (CW Timing/CW Timing1/CW Timing2)

  Select the CW timing from the following: You can set this when x1 or x2 is selected.

A↑	Counts on the rising edges of phase A
A↓	Counts on the falling edges of phase A
B↑	Counts on the rising edges of phase B
B↓	Counts on the falling edges of phase B

  CCW Timing (CCW Timing/CCW Timing1/CCW Timing2)

  The CCW timing is determined according to the CW timing (CW Timing/CW Timing1/CW Timing2) setting.

CW Timing	CCW Timing	
A↑	A↓	Counts on the falling edges of phase A
A↓	A↑	Counts on the rising edges of phase A
B↑	B↓	Counts on the falling edges of phase B
B↓	B↑	Counts on the rising edges of phase B

- **Reset Condition (Reset Condition)**

  Set the timing at which the counter will be reset.

  - Z Only: The counter is reset according to the polarity of the waveform assigned to phase Z. The polarity of the waveform assigned to phase Z is set using Polarity (Polarity) of Source3 (Z).
  - Edge on Z: The counter is reset on the edge of the waveform assigned to phase A or B while the polarity of the waveform assigned to phase Z meets the specified condition.

CW Timing (CW Timing)

Select the CW timing from the following: You can set this when Edge on Z is selected.

A↓	The counter is reset on the rising edge of phase A.
A↑	The counter is reset on the falling edge of phase A.
B↓	The counter is reset on the rising edge of phase B.
B↑	The counter is reset on the falling edge of phase B.

CCW Timing (CCW Timing)

The CCW timing is determined according to the CW timing (CW Timing/CW Timing1/CW Timing2) setting.

CW Timing	CCW Timing	
A↓	A↑	Resets on the falling edges of phase A
A↑	A↓	Resets on the rising edges of phase A
B↓	B↑	Resets on the falling edges of phase B
B↑	B↓	Resets on the rising edges of phase B

Initial Point (Initial Point)

Set the initial point when integrating, counting edges, or counting rotations. The instrument integrates and counts by assuming the initial point to be zero.

You can set the initial point numerically or set it to a specific point such as the trigger position or 0 divisions.

Selectable range: –5.00 div to 5.00 div

Resolution: 0.01 div

Setting a Specific Point (Set to)

You can set the initial point to any of the following points.

Trigger Pos (trigger position), −5.00 div, 0 div, Zoom1 (the center of Zoom1), or Zoom2 (the center of Zoom2)

When phase Z is used in a rotary count (Source 3 (Z) is CH1 to CH8), the initial point is fixed at –5.00 divisions and does not appear in the setup menu.

Setting Labels and Units (Label/Unit)

Turning Label Display On and Off (Display)

- ON: Shows labels
- OFF: Hides labels

Label (Name)

You can set computation (Math) or reference (Ref) waveform labels when the label display is turned on. You can use up to eight characters for labels. The labels that you create are displayed on the screen.

Unit (Unit)

If the computation mode is Math, you can assign a unit to computation results.

- **Auto**

  The default unit is used. The unit varies depending on the computation.

Filter, addition, subtraction, multiplication, or division	V, A, VV, AA, VA
integration	Vs, As, VVs, AAs, VAs
Edge count or rotary count	Blank
User-defined computation	EU

- **User Define**

  You can assign a unit (User Unit) using up to four characters.

Scaling (Ranging)

Select the method used to set the vertical display range of computed waveforms. You cannot set the method when the source waveform is Ref1 or Ref8.
When using user-defined computation (optional), the method is set to Auto.

Auto (Auto Scaling)

From the computed waveform, the instrument automatically determines the sensitivity (Sensitivity)[2] and the level[1] at the vertical center (Center) of the screen area.

Manual (Manual Scaling)

Set the sensitivity (Sensitivity)[2] and the level[1] at the vertical center (Center) of the screen area.

1 Voltage for a voltage waveform.
2 Voltage per division for a voltage waveform.



If you change the operator during manual scaling, the instrument changes the display range to the auto display range that corresponds to the new operator. Ranging remains set to Manual.

User-Defined Computation (User Define, Option)

You can define up to eight original expressions.*

* Up to four on 4ch models

Expression (Expression)

Define an expression by combining computation source waveforms and operators.
You can enter up to 128 characters.

Computation Source Waveform

The following waveform data can be used. When the computation source waveform (source) includes Math and the Math source is set to OFF, computation is not performed.

Menu Item	Description
C1 to C8[1]	CH1 to CH8 waveforms
M1[2]	Math1 waveform (can be used in Math2 to Math8)
M2[2]	Math2 waveform (can be used in Math3 to Math8)
M3[2]	Math3 waveform (can be used in Math4 to Math8)
M4[3]	Math4 waveform (can be used in Math5 to Math8)
M5[3]	Math5 waveform (can be used in Math6 to Math8)
M6[3]	Math6 waveform (can be used in Math7 and Math8)
M7[3]	Math7 waveform (can be used in Math8)
Bus1	Can be used only with the DA operator.
Bus2	Can be used only with the DA operator.
Bus3[4]	Can be used only with the DA operator.
Bus4[4]	Can be used only with the DA operator.
T	Amount of time elapsed from the screen's left edge

1 C1 to C4 can be used on 4ch models.
2 The available conditions on 4ch models are as follows:
M1: Can be used in Math2 to Math4
M2: Can be used in Math3 and Math4
M3: Can be used in Math4
3 Can be used on 8ch models.
4 Can be used on models with the /L32 option.

Operators

You can combine the following operators to define expressions.

Menu Item	Example	Description
Basic functions		
+, −, *, /	C1+C2−C3	Basic arithmetic of the input value
ABS	ABS(C1)	Absolute value of the input value
SQRT	SQRT(C2)	Square root of the input value
LOG	LOG(C1)	Logarithm of the input value
LN	LN(C1)	Natural logarithm of the input value
EXP	EXP(C1)	Exponent of the input value
P2	P2(C1)	Square of the input value
−	−(C1)	Inversion of the input value around level 0
Trigonometric functions		
SIN	SIN(C1)	Sine of the input value
ASIN	ASIN(C1)	Arc sine of the input value
COS	COS(C1)	Cosine of the input value
ACOS	ACOS(C1)	Arc cosine of the input value
TAN	TAN(C1)	Tangent of the input value
ATAN	ATAN(C1)	Arc tangent of the input value
PH	PH(C1,C2)	Phase difference between two input values
Differentiation and integration		
DIFF	DIFF(C1)	Derivative of the input waveform
INTEG	INTEG(C1)	Integral of the input waveform
Filter functions		
FILT1	FILT1(C1)	Application of a digital filter to the input waveform
FILT2	FILT2(C1)	Application of a digital filter to the input waveform
HLBT	HLBT(C1)	Hilbert function of the input waveform
MEAN	MEAN(C1,10)	Moving average of the input waveform
DELAY	DELAY(C1,0.001)	Phase shifting of the input waveform
BIN	BIN(CH1,1,−1)	Conversion of the input waveform into binary values
Pulse width functions		
PWHH	PWHH(C1,1,−1)	Pulse width computation of the input waveform from a rising edge to the next rising edge
PWHL	PWHL(C1,1,−1)	Pulse width computation of the input waveform from a rising edge to the next falling edge
PWLH	PWLH(C1,1,−1)	Pulse width computation of the input waveform from a falling edge to the next rising edge
PWLL	PWLL(C1,1,−1)	Pulse width computation of the input waveform from a falling edge to the next falling edge
PWXX	PWXX(C1,1,−1)	Pulse width computation of the input waveform from one rising or falling edge to the next rising or falling edge
FV	FV(C1,1,−1)	Inverse of the computed pulse width PWHH
DUTYH	DUTYH(C1,1,−1)	Duty cycle of the high side of each period of the input waveform
DUTYL	DUTYL(C1,1,−1)	Duty cycle of the low side of each period the input waveform
D/A conversion		
DA	DA(Bus1)	D/A conversion of a logic waveform

Constant

Menu Item	Description
K1 to K4	Constants
0 to 9	–
Exp	Exponent Used to enter a number in scientific notation in expressions (1E+3 = 1000, 2.5E−3 = 0.0025) Displayed as “E” in expressions to distinguish this from the “EXP” operator.
PI	Pi (π)
e	Euler’s constant (Napier’s constant) Base of the natural logarithm (e = 2.71828...) Displayed as “eul” in expressions to distinguish this from the “E” that represents exponents.
fs	Sample rate The value changes according to the instrument’s sample rate and changes in the time axis or record length setting.
1/fs	Number of samples per second Computed based on the instrument sample rate when the computation was executed. The value changes according to the changes in the time axis or record length setting.
Measure	A waveform parameter value can be used. Example: P.Max(C1)
T	Time elapsed from –5 div

Automated Measurement Values of Waveform Parameters (Measure)

You can use the automated measurement values of waveform parameters in expressions.

- “P.” precedes waveform parameters when waveform parameters are displayed in expressions.
- The instrument cannot retrieve waveform parameter values when the measurement source waveform display is off.

D/A conversion can be specified only when the computation source waveform is Bus. The computation result will be the same as the bus display (Hex) value.

Computation Conditions (Setup)

Configure constants (K1 to K4) and the digital filter, and turn computation averaging on or off.

Constant Definitions (Const Setup)

Set a value for K1 to K4.

Selectable range: −10E+30 to 10E+30

Digital Filter Definitions (Filter1/Filter2)

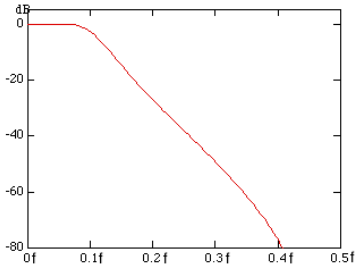
When using FILT1 or FILT2 in user-defined computation, set the digital filter’s filter type, frequency band, and cutoff frequency.

- **Filter Type (Type)**

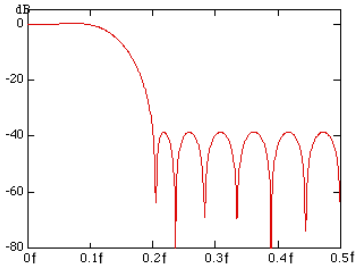
  Select the filter from one of the settings below.

  - IIR: Non-linear phase. Achieves adequate cutoff characteristics even at relatively low orders.
  - FIR: Linear phase. Takes longer than IIR to process.

IIR (low pass; 10% cutoff)



FIR (low pass; 10% cutoff)



- **Frequency Band (Band)**

  You can set the frequency band to one of the settings below.
  - LowPass
  - HighPass
  - BandPass

- **Cutoff frequency (Cutoff1/Cutoff2)**

  Set for Filter1 and Filter2 separately.
  Selectable range: 2.0% to 30.0% of the sampling frequency
  Resolution: 0.2% of the sampling frequency

Averaging on Computation (Average)

Set whether or not to linearly average the user-defined computation data. This setting applies to Math1 to Math8.
- ON: Averages computed data
- OFF: Does not average computed data

- **Average Count (Average Count)**

  Selectable range: 2 to 1024 in 2^n steps

- If you change the computation conditions while averaging on computation is on, the computed data up to that point is cleared.
- Averaging on computation cannot be used if the trigger mode is set to N SINGLE.
- You cannot average computations during waveform acquisition.
- You cannot average computations that are recomputed after waveform acquisition.

Auto Ranging (Auto Ranging)

You can execute auto ranging. Use this feature when the computed waveform amplitude changes greatly and it is difficult to view the waveform.
You can also set the display range by specifying the vertical center (Center) of the display area and the value per division (Sensitivity).

Computation on History Waveforms (Math on History)

This feature performs computation on all history waveforms.
If waveform acquisition is stopped and you press the Math on History soft key, the instrument performs user-defined computation on all of the source channel's history waveforms.

- You cannot execute computation on history waveforms during waveform acquisition.
- While computation on history waveforms is in progress, the "computing" icon and a progress bar appear at the top of the screen. All operations except for that of the Abort soft key are invalid.
- If you set the trigger mode to N Single and start waveform acquisition, the instrument performs user-defined computation on the last waveform after waveform acquisition stops. To perform user-defined computation on all history waveforms, execute computation on history waveforms.
- If you change a setting that would affect the result of user-defined computation, the instrument only recomputes on the selected history waveform.
- If an error occurs in the average display or statistical processing of a history waveform, execute computation on history waveforms.

Examples of Expressions

For each operator, correct expressions and easily mistaken expressions are listed. Incorrect examples are shaded.

DIFF and INTEG (differentiation and integration) Examples

Syntax: DIFF(parameter), INTEG(parameters)

Parameter: Enter a waveform or an expression that contains waveforms.

DIFF(C1/3)	Derivative of the C1/3 waveform
INTEG(INTEG(C3))	Double integral of the C3 waveform
DIFF(DIFF(C4))	Double derivative of the C4 waveform
DIFF(5)	Not allowed because the parameter is a constant
INTEG(K1+10)	Not allowed because the parameter is a constant expression

FILT1 and FILT2 (Digital Filter) Examples

Syntax: FILT1(parameter), FILT2(parameter)

Parameter: Enter a waveform or an expression that contains waveforms.

FILT1(C1+C2)	Digital filtering of the C1+C2 waveform
FILT1(C3+K1)	Digital filtering of the C1+K1 waveform
FILT1(5)	Not allowed because the parameter is a constant
FILT2(K1+10)	Not allowed because the parameter is a constant expression

* The digital filters must be defined.

▶ See here.

MEAN (Moving Average) Examples

Syntax: MEAN(parameter 1, parameter 2)

Parameter 1: Set the source waveform of the moving average. Enter a waveform or an expression that contains waveforms.

Parameter 2: Set the moving average coefficient. Enter a constant or a constant expression.

MEAN(C1,10)	Moving average of waveform C1 with the coefficient set to 10
MEAN(C2+C3,K1)	Moving average of the C2+C3 waveform with the coefficient set to K1
MEAN(5,10)	Not allowed because parameter 1 is not a waveform or an expression that contains waveforms
MEAN(C1,C2)	Not allowed because parameter 2 is not a constant or a constant expression

DELAY (Phase Shift) Examples

Syntax: DELAY(parameter 1, parameter 2)

Parameter 1: Set the waveform to phase-shift. Enter a single-term waveform.

Parameter 2: Set the amount of phase shift. Enter a constant or a constant expression.

DELAY(C1,5E−3)	Phase-shift waveform C1 by 0.005 s
DELAY(C2,P. Period(C2)*2)	Phase-shift waveform C2 by 2 periods of waveform C2
DELAY(C1,C2)	Not allowed because parameter 2 is not a constant or a constant expression
DELAY(C1+C2,5)	Not allowed because parameter 1 is not a single-term waveform

BIN (Conversion into Binary Values) Examples

Syntax: BIN(parameter 1, parameter 2, parameter 3)

Parameter 1: Set the waveform to convert into binary values. Enter a waveform or an expression that contains waveforms.

Parameter 2: Set the upper threshold level. Enter a constant or a constant expression.

Parameter 3: Set the lower threshold level. Enter a constant or a constant expression.

BIN(C1+C2,10+K1/2,10−K1/2)	Convert the C1+C2 waveform into binary values with Upper set to 10+K1/2 and Lower set to 10−K1/2
BIN(C2,P.High(C2),P.Low(C2))	Convert waveform C2 into binary values with Upper set to waveform C2's high value and Lower set to waveform C2's low value
BIN(5,10,2)	Not allowed because parameter 1 is not a waveform or an expression that contains waveforms
BIN(C1,C2,−1)	Not allowed because parameter 2 is not a constant or a constant expression

PWHH to DUTYL (Pulse Width Computation) Examples

Syntax: PWHH(parameter 1, parameter 2, parameter 3)

Parameter 1: Set the waveform to compute the pulse width of. Enter a single-term waveform.

Parameter 2: Set the upper threshold level. Enter a constant or a constant expression.

Parameter 3: Set the lower threshold level. Enter a constant or a constant expression.

PWHH(C1,K1,K2)	Compute the pulse width of waveform C1 with Upper set to K1 and Lower set to K2
DUTYH(C2,P.High(C2),P.Low(C2))	Compute the pulse width of waveform C2 with Upper set to waveform C2's high value and Lower set to waveform C2's low value
PWHH(5,10,2)	Not allowed because parameter 1 is not a waveform
PWHL(C1,C2,−1)	Not allowed because parameter 2 is not a constant or a constant expression
PWLL(C1+C2,1,−1)	Not allowed because parameter 1 is not a single-term waveform

DA (D/A Conversion) Examples

Syntax: DA(parameter 1)

Parameter 1: Set the source waveform for DA computation. Enter Bus. This can be executed only when the LOGIC menu key is illuminated.

DA(Bus1)	D/A conversion of a logic waveform

* When Bus is set to State, D/A conversion is performed on the state result.
When the Logic display is turned off, D/A conversion is not performed as State is not executed.

Examples of Other Operators

Syntax: Operator(parameter)

Parameter: Specify a waveform, a constant, or an expression.

SIN(PI)	Example in which the parameter is set to a constant
COS(C1)	Example in which the parameter is set to a waveform
ABS(C1+C2*2)	Example in which the parameter is set to an expression that consists of waveforms and a constant
SQRT(ABS(C1+C2*2))	Example in which the parameter is set to an expression
SIN(2*PI*T*K1)	Example in which the parameters is set to an expression (that consists of elapsed time T and constants)

Combinations of Operators That Are Not Allowed

You cannot enter Math2 in the expression of Math1. Example:Math1=M2+C3
An expression can only contain up to two FILT1 or FILT2 functions. Example: FILT1(C1)+FILT1(C2)+FILT1(C3)
Computation cannot be performed on a computed pulse width. Example: PWHH(C1, 1, 0)+C2
When converting to binary values or when computing pulse width, the source waveform can only be a single waveform. Example: BIN(C1-C2, 1, -1), PWHH(C1*C2, 0, 0)

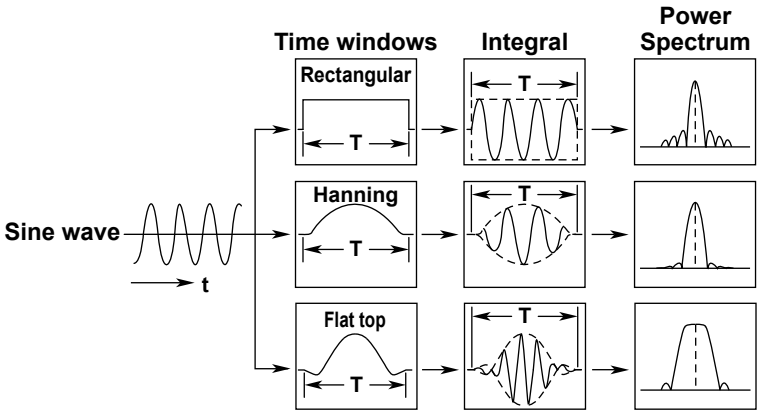


- Averaging cannot be performed on pulse width computation.
- If you want to covert the result of a computation such as C1+C2 to binary values or perform pulse width computation on it, define the Math1 and Math2 expressions in this manner: Math1 = C1+C2 and Math2 = BIN(M1, 0, 0).

10 FFT

The instrument can determine up to four input waveform power spectra (FFT1 to FFT4).* On models with the user-defined feature (option), the instrument can determine the linear spectrum, rms power spectrum, power spectrum, cross spectrum, transfer function, and coherence function.
FFT waveforms appear in the FFT window.

* Up to two waveforms on 4ch models (FFT1, FFT2)



Rectangular: W(t) = u(t) – u(t – T) u(t): **Step function**

Hanning : $W(t) = 0.5 - 0.5\cos(2\pi\frac{t}{T})$

Flat top : $W(t) = \{0.54 - 0.46\cos(2\pi\frac{t}{T})\}\frac{\sin\{2\pi(1-2t/T)\}}{2\pi(1-2t/T)}$

Turning the FFT On or Off (Display)

Set whether or not to perform FFT analysis. If you set this to ON, the FFT window appears.

- ON: Performs FFT analysis
- OFF: Does not perform FFT analysis

Analysis Source Waveform (Trace)

You can select from one of the settings below. The available settings vary depending on the model.
CH1 to CH8, Math1 to Math8

FFT Conditions (FFT Setup)

Configure the time window and how to display FFT waveforms (normal, peak hold, or average).
On models with user-defined computation (option), you can also select the spectrum to analyze. Only PS-LOGMAG is available on models without user-defined computation.

Spectrum Type (Type/Sub Type)

On models with user-defined computation (option), you can also select the spectrum to analyze from the following:

spectrum	Description	Unit (Default value)
LS-MAG	Amplitude of the linear spectrum of the specified waveform	Source unit
LS-LOGMAG	Logarithmic amplitude of the linear spectrum of the specified waveform	dB and source unit
LS-PHASE	Phase of the linear spectrum of the specified waveform	deg
LS-REAL	Real part of the linear spectrum of the specified waveform	Source unit
LS-IMAG	Imaginary part of the linear spectrum of the specified waveform	Source unit
RS-MAG	Rms power spectrum magnitude	Source unit
RS-LOGMAG	Rms power spectrum logarithmic magnitude	dB and source unit
PS-MAG	Amplitude of the power spectrum of the specified waveform	Enumeration of source units
PS-LOGMAG	Logarithmic amplitude of the power spectrum of the specified waveform	dB and source unit
PSD-MAG	Amplitude of the power spectrum density of the specified waveform	Enumeration of source units
PSD-LOGMAG	Logarithmic amplitude of the power spectrum density of the specified waveform	dB and source unit
CS-MAG	Magnitude of the cross spectrum of the specified two waveforms	Enumeration of source units
CS-LOGMAG	Logarithmic amplitude of the cross spectrum of the two specified waveforms	• If the source units are the same: dB and source unit • If the source units are different: dB
CS-PHASE	Phase of the cross spectrum of the two specified waveforms	deg
CS-REAL	Real part of the cross spectrum of the two specified waveforms	Enumeration of source units
CS-IMAG	Imaginary part of the cross spectrum of the two specified waveforms	Enumeration of source units
TF-MAG	Amplitude of the transfer function of the two specified waveforms	None
TF-LOGMAG	Logarithmic amplitude of the transfer function of the two specified waveforms	dB
TF-PHASE	Phase of the transfer function of the two specified waveforms	deg
TF-REAL	Real part of the transfer function of the two specified waveforms	None
TF-IMAG	Imaginary part of the transfer function of the two specified waveforms	None
CH-MAG	Amplitude of the coherence function of the two specified waveforms	None

Source unit:

There is no source unit when the LinearScale unit or Math unit is not set.
When the source unit is up to two characters in length, the source unit is used.
When the source unit is more than two characters in length, "EU" is used.

Time Window (Window)

Set the time window to one of the settings below.

- Rectangle (rectangular window)
- Hanning (Hanning window)
- Flattop (flattop window)

Waveform Display Mode (Mode)

Select how to display FFT waveforms from one of the settings below.

- Normal: Displays FFT waveforms for each acquisition
- Max Hold: For each frequency, the instrument holds the maximum value among the values acquired from the start of analysis up to the current acquisition and displays it.
- Average: For each frequency, the instrument displays the average of the values acquired from the start of analysis up to the current point.

Analysis Source Waveform (Trace2)

When the spectrum type is CS, TF, or CH, you can choose from the following options.
CH1 to CH8, Math1 to Math8

Unit (Unit)

Select the unit type from one of the settings below.

- Auto: The default unit is used. The unit varies depending on the type spectrum.
- dBm: Applies the unit dBm. You can select this unit when the spectrum is PS-LOGMAG and the unit of the analysis source waveform (Trace) is “V.”
- User Define: You can assign a unit (User Unit) using up to four characters.

The unit dBm expresses values in decibels (dB) with 1 mW as the reference. The following equation can be used to derive the spectrum.
dBm = PS-LOGMAG*−10 × log (Z × 0.001)
Z: Impedance, 0.001: Reference value (1 mW)
* For details on the computation, see “FFT Function” in appendix 2.

Impedance (Impedance)

You can set the impedance within the range of 40 Ω to 20000 Ω in 1 Ω steps.

Number of FFT Points (FFT Points)

Select from the following:
1.25 k, 2.5 k, 12.5 k, 25 k, 125 k, 250 k, 1.25 M

Relationship between the Number of FFT Points and Number of Displayed Points (Display Record Length)

Depending on the number of displayed points in the window that you select using the analysis range (Time Range) setting, the actual number of FFT points may be different from the number of FFT points that you selected.

- Number of FFT points < number of display points:
  Display points are decimated to match the number of FFT points. The FFT may not cover the entire display range.
- Number of FFT points > number of display points:
  The number of FFT points is adjusted to an appropriate number less than or equal to the number of displayed points.

Analysis Range (Time Range)

Set the analysis range to any of the following windows below.

- Main: Entire main window
- Zoom1: Entire Zoom1 window
- Zoom2: Entire Zoom2 window

Scale Value (Display Setup)

Set the vertical and horizontal scale values.

Vertical Scale (Vert.Scale)

Select from the following:

- Auto: Sets the vertical scale values automatically
- Manual: For manually setting the center (Center) of the vertical axis and the value per division (Sensitivity)

Horizontal Scale (Horiz.Scale)

Select from the following:

- Auto: Sets the center point and span automatically
- Center/Span: You must set the center point and span manually
- Left/Right: You must set the left and right ends of the scale manually

Displaying the Source Waveform (VT Display)

Select whether or not to display the FFT source waveform.

- ON: Displays the source waveform
- OFF: Does not display the source waveform

Measurement (Measure Setup)

You can use cursors to display the values of FFT waveforms or use the frequency spectrum contained in the signal to display the overall value.

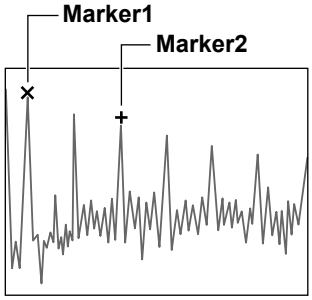
Measurement Mode (Mode)

Select the FFT waveform measurement mode from the following:

- OFF: Measurement is disabled.
- Marker: Using two marker cursors, you can display frequencies, levels, and the difference between the markers.
- Peak: Using the detection level and excursion, you can display frequencies and levels.
- Parameter: Indicates the overall value using the frequency spectrum contained in the signal.

Marker Cursor Measurement (Marker)

The instrument displays the frequencies and levels at the two marker cursors (Marker1 and Marker2). It can also display the difference between the cursors. Marker cursors move on the waveform data points.



- **Measurement Item (Item)**

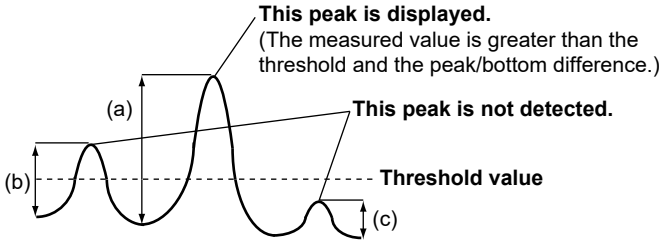
  Set the measurement item to one of the settings below.
  F1: Displays the Marker1 frequency
  F2: Displays the Marker2 frequency
  ΔF: Displays the frequency difference between Marker1 and Marker2
  V1: Displays the Marker1 level
  V2: Displays the Marker2 level
  ΔV: Displays the level difference between Marker1 and Marker2

- **Marker Cursor Positions (Marker1/Marker2)**

  Set the Marker1 and Marker2 positions.
  Selectable range: ±5.00 div

Peak Cursor Measurement (Peak)

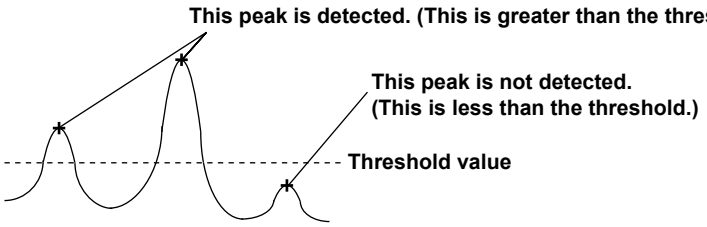
Using the threshold value (Threshold) and the difference between peak and valley (Excursion), the instrument determines the frequency (Frequency) and level (Peak). Only the peaks that meet the threshold and excursion conditions are displayed.



(a) Peak/bottom difference < measured value
(b) Peak/bottom difference > measured value
(c) Peak/bottom difference > measured value

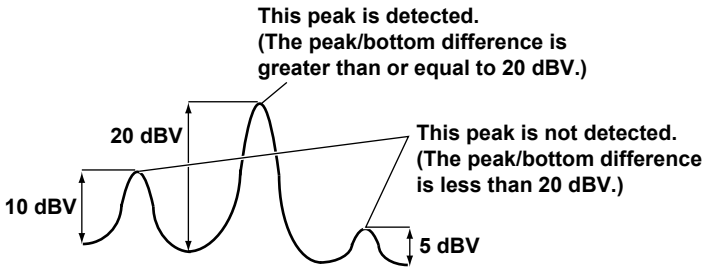
- **Threshold (Threshold)**

  Set the threshold value for detecting peaks. Peaks that are greater than the specified values are measured.



- **Difference between peak and valley (excursion)**

  Peaks whose amount of change from the peak value (the difference between the peak and valley) is greater than the specified value are measured.



Example: Excursion = 20 dBV

- **Measurement Frequency Range (Peak Range1/Peak Range2)**

  Set the start point (Peak Range1) and the end point (Peak Range2) of the measurement frequency range.
  Selectable range: ±5 div

- **List Display (List)**

  The list displays the following items. You can also jump to the maximum level (Jump To Max Peak).

No.	Analysis number. Analysis results can be displayed in the range of 1 to 10.
Frequency	Displays the peak frequency
Peak	Displays the peak level

- **Analysis Number (List No.)**

  The instrument moves to the selected number and displays the frequency and level.

Parameter Measurement (Parameter)

The overall value is indicated using the frequency spectrum contained in the signal. The overall value is the total RMS value determined from the frequency spectrum included in the signal. The overall value is the square root of the summation of the power spectra of all frequencies. Can only be set when the spectrum is set to PS-MAG, PS-LOGMAG, PSD-MAG, or PSD-LOGMAG.

When the spectrum is set to PS-MAG or PSD-MAG

$$\text{Overall value } [V_{rms}] = \sqrt{\frac{(R_0^2 - I_0^2) + \sum_{i=1}^{n}(R_i^2 - I_i^2)}{k}}$$

When the spectrum is set to PS-LOGMAG or PSD-LOGMAG

$$\text{Overall value [dB]} = 20 \times \log \sqrt{\frac{(R_0^2 - I_0^2) + \sum_{i=1}^{n}(R_i^2 - I_i^2)}{k}}$$

k varies as indicated below depending on the selected time window.

Time Window Type	k
Rect (Rectangular window)	1
Hanning (Hanning window)	1.5
FlatTop (Flattop window)	3.19693

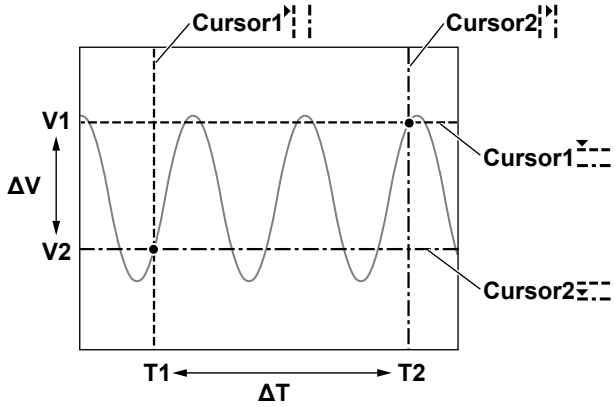
- **Overall Value On/Off (Overall)**

  Set whether or not to display the overall value.

11 Cursor Measurement

You can move cursors on the waveforms displayed on the screen to view the measured values at the points where the cursors intersect the waveforms.

ΔT&ΔV cursor



Turning Cursor Measurement On and Off (Display)

Sets whether or not to make measurements using cursors.

- OFF: Turns cursor measurement off
- ON: Turns cursor measurement on

Cursor Type (Type)

There are five cursor modes.

- ΔT cursors: Two ΔT cursors are used to measure time values.
- ΔV cursors: Two ΔV cursors are used to measure vertical values.
- ΔT&ΔV cursors: Two ΔT cursors and two ΔV cursors are used to measure time-axis and vertical values.
- Marker Cursor (Marker): Four marker cursors that move on the waveform are used to measure waveform values.
- Angle Cursor (Degree): Two angle cursors are used to measure angles.

Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below. The available settings vary depending on the model.

CH1 to CH8, Logic,[1] Math1 to Math8, All[2]

1 If the source waveform is a logic signal (Logic), you can only use the ΔT cursors and angle cursors.

2 “All” specifies all channels. This setting is only available for ΔT cursors and angle cursors.

- Even when a waveform is selected as a measurement source waveform, if the source waveform is not displayed on the screen (the corresponding key is not illuminated), vertical cursor measurements are not performed.
- You cannot perform cursor measurement on snapshot waveforms or accumulated waveforms that have been acquired in the past. You can perform cursor measurement on the most recent accumulated waveform.
- For history waveforms, cursor measurement is performed on the waveform whose record number is selected.

ΔT Cursors (ΔT)

The ΔT cursors are two lines that are perpendicular to the time axis. You can use them to measure the time from the trigger position to each of the ΔT cursors, the time difference between the two cursors, and the inverse of the time difference between the two cursors. Cursor1 is a dashed line, and Cursor2 is a dot-dash line. You can also measure the vertical values at the points where the ΔT cursors intersect the waveforms.

Measurement Items (Item Setup)

You can measure the following time values at the cursor positions.

T1	Time value at Cursor1
T2	Time value at Cursor2
ΔT	Difference between the time values of Cursor1 and Cursor2
1/ΔT	Inverse of the time difference between Cursor1 and Cursor2
V1	Vertical value at the intersection of Cursor1 and the waveform[1]
V2	Vertical value at the intersection of Cursor2 and the waveform[1]
ΔV	Difference in the vertical values at the points where Cursor1 and Cursor2 intersect the waveforms[1, 2, 3]
ΔV/ΔT	(Vertical value)/(Time value) in the table

1 If you set the measurement source waveform to All, values of all the measurement items are measured for CH1 through CH8, Logic, and Math1 to Math8.
2 ΔV of logic signals are not measured.
3 The ΔV formula has been changed from V1 – V2 to V2 – V1 in firmware version 2.50 and later.

Example of Logic Signal Measurement

The instrument displays measured values according to the bit order (Bit Order) settings in the LOGIC menu.

- **Bus1, Bus2, Bus3, Bus4***

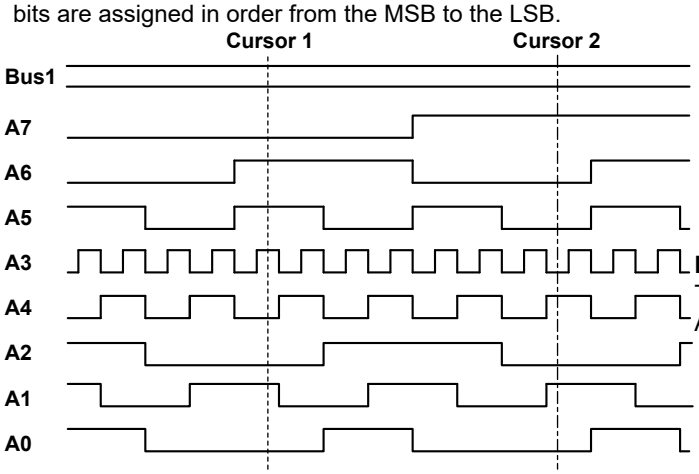
  Bits are read according to the MSB-to-LSB order specified by bus bit assignments (Assignment). Measured values are displayed in hexadecimal (Hex) notation.
  They are displayed only when the bus display in the LOGIC menu is set to on.

- **A (A0 to A7), B (B0 to B7), C (C0 to C7), D (D0 to D7)***

  The measured values of bits (0 or 1) are displayed in order from the top of the screen according to the bit order (Bit Order) setting.

* Bus3, Bus4, C (C0 to C7), and D (D0 to D7) are available on models with the /L32 option.

Bus (Bus) Bit Assignments (Assignment)
Consider the case when the A7, A6, A5, A4, A3, A2, A1, and A0 bits are assigned in order from the MSB to the LSB.



Bit display order (Bit Order)
The display order of A4 and A3 has been changed.

Measured values of Cursor1(V1) and Cursor2(V2)

V1(BUS1)	6A [Hex]	V2(BUS1)	92 [Hex]
V1(L)	72 [Hex]	V2(L)	8A[Hex]

(The order of the measured values above are different from what appears on the screen.)

ΔV Cursors (ΔV)

The ΔV cursors are two lines that are perpendicular to the vertical axis. You can use them to measure vertical values at the cursor positions. You can also measure the level difference between the two cursors. Cursor1 is a dashed line, and Cursor2 is a dot-dash line.

Measurement Items (Item Setup)

You can measure the following vertical values at the cursor positions.

V1	Vertical value at Cursor1
V2	Vertical value at Cursor2
ΔV	Difference in the vertical values at Cursor1 and Cursor2

ΔT&ΔV Cursors (ΔT&ΔV)

ΔT cursors and ΔV cursors are displayed at the same time.

Measurement Items (Item Setup)

You can measure the following time and vertical values at the cursor positions.

Time axis	
T1	Time value at Cursor1II
T2	Time value at Cursor2II
ΔT	Difference between the time values of Cursor1II and Cursor2II
1/ΔT	Inverse of the time difference between Cursor1II and Cursor2II
Vertical axis	
V1	Vertical value at Cursor1
V2	Vertical value at Cursor2
ΔV	Difference in the vertical values at Cursor1 and Cursor2
ΔV/ΔT	(Vertical value)/(Time value) in the table

Marker Cursors (Marker)

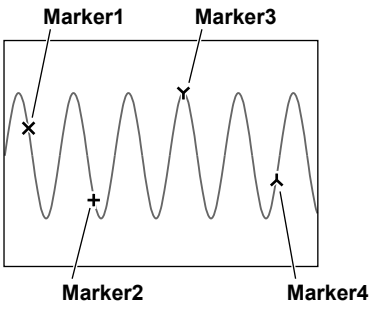
Four markers are displayed on the selected waveform. You can measure the level at each marker, the amount of time from the trigger position to each marker, and the level and time differences between markers.

Marker Display Format (Marker Form)

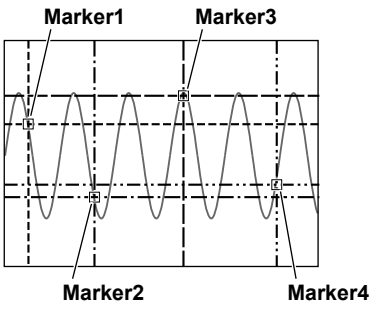
Set the marker display format to one of the settings below.

- Mark: A dot
- Line: A crosshair

Mark



Line



Cursor Source Waveform and Measurement Items (Marker1, Marker2, Marker3, and Marker4)

Set the measurement source waveform and the measurement items for Marker1 to Marker4.
You can assign separate waveforms to Marker1 to Marker4.

Measurement Source Waveform (Trace)

Select from the following:
CH1 to CH8, Math1 to Math8, OFF (disabled)

Measurement Items (Item Setup)

Marker cursors move on the waveform data. You can measure the following values at Marker1.

T1	Time value at Marker1
T1−T2	Difference between the time values of Marker1 and Marker2
T1−T3	Difference between the time values of Marker1 and Marker3
T1−T4	Difference between the time values of Marker1 and Marker4
V1	Vertical value at Marker1
V1−V2	Difference in the vertical values at Marker1 and Marker2
V1−V3	Difference in the vertical values at Marker1 and Marker3
V1−V4	Difference in the vertical values at Marker1 and Marker4

Angle Cursors (Degree)

You can measure time values and convert them to angles. On the time axis, set the zero point (Ref Cursor1 position), which will be the measurement reference, the end point (Ref Cursor2 position), and the reference angle that you want to assign to the difference between Ref Cursor1 and Ref Cursor2. Based on this reference angle, you can measure the angle between two angle cursors (Cursor1 and Cursor2).

Measurement Items (Item Setup)

The instrument measures the angle cursor (Cursor1 and Cursor2) positions as angles.

D1	Angle of Cursor1 from Ref Cursor1
D2	Angle of Cursor2 from Ref Cursor1
ΔD	Angle difference between Cursor1 and Cursor2
V1	Vertical value at the intersection of Cursor1 and the waveform[1]
V2	Vertical value at the intersection of Cursor1 and the waveform[1]
ΔV	Vertical value at the intersection of Cursor1/Cursor2 and the waveform[1, 2]

1 If you set the measurement source waveform to All, values of all the measurement items are measured for CH1 to CH8, Logic, and Math1 to Math8.
2 ΔV of logic signals are not measured.

Reference Setup (Reference Setup)

Set the zero point (Ref Cursor1 position), which will be the measurement reference, the end point (Ref Cursor2 position), and the reference angle.

Reference Angle (Ref Value)

Set the reference angle you want to assign to the range defined by Ref Cursor1 and Ref Cursor2.
Selectable range: 1 to 720

Angle Unit (Unit)

You can set the angle unit using any characters you like.

Reference Cursors (Ref Cursor)

Set the zero point (Ref Cursor1) and the end point (Ref Cursor2).
Selectable range: –5.00 div to 5.00 div

Moving the Cursors (Cursor/Marker)

The cursor type determines the range of cursor movement.

- **ΔV and ΔV in ΔT&ΔV Mode (Cursor1 = and Cursor2 =)**

  You can move these cursors in the range of −4 to +4 divisions from the vertical center of the window in 0.01-division steps. You can set them in 0.01 div steps.

- **ΔT, ΔT in ΔT&ΔV, Degree, Marker Cursors (Cursor1 ll, Cursor2 ll, Marker1 to Marker4)**

  You can move these cursors in the range of −5 to +5 divisions from the horizontal center of the window in 0.01-division steps. You can set them in 0.01 div steps. If a zoom window is displayed and a cursor moves into the zoom window, you can move the cursor by 0.01 divisions of the zoom window at a time.

- **Linking Cursor1 and Cursor2**

  When the cursor type is ΔT, ΔV, ΔT&ΔV, or Degree and you select Cursor1 and Cursor2 at the same time, you can move the cursors while maintaining the same space between them.

Notes about Cursor Measurement

- The measured time values are based on the trigger position.*
  * If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.
- The measured value for data that cannot be measured appears as "***."
- If the display record length is less than a given length (in the interpolation zone), the instrument interpolates between sampled data if Dot Connect is not set to OFF. Therefore, it is possible for there to be no sampled data where the vertical cursor is. Because marker cursors move on the sampled data, you can always read sampled data.

Cursor Jumping (Cursor Jump/T Cursor Jump)

You can make Cursor1, Cursor2, or Marker1 to Marker4 jump to the center of the specified zoom window. The jump options are listed below.

When the cursor is ΔT, the ΔT&ΔV ΔT cursor, or Degree

Cursor1 to Zoom1: Cursor1 jumps to the Zoom1 window. Cursor1 to
Cursor1 to Zoom2: Cursor1 jumps to the Zoom2 window. Cursor1 to
Cursor2 to Zoom1: Cursor2 jumps to the Zoom1 window. Cursor1 to
Cursor2 to Zoom2: Cursor2 jumps to the Zoom2 window. Cursor1 to

For marker cursors

Jump to Zoom1: The selected marker jumps to the Zoom1 window.
Jump to Zoom2: The selected marker jumps to the Zoom2 window.

12 Automated Measurement of Waveform Parameters

For waveforms that are displayed on the screen, various measurement items (waveform parameters), such as maximum and minimum values, can be measured automatically and their statistics can be calculated. The enhanced parameter measurement feature allows you to automatically measure parameters in two areas (defined as area 1 and area 2) and perform various calculations on the automated measurement values of waveform parameters.

Turning Automated Measurement On or Off (Mode)

Enables or disables the automated measurement of waveform parameters.

- ON: Enables automated measurement
- OFF: Disables automated measurement

Source Waveform (Source)

Selects the automated measurement source waveform. The available settings vary depending on the model.

CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7),* Math1 to Math8

* C0 to C7 and D0 to D7 are available on models with the /L32 options.

Measurements cannot be made on a snapshot waveform or an accumulated waveform that is not the most recent waveform.

Source Window (Time Range)

Selects the window on which to perform automated measurement of waveform parameters.

- Main: Main window
- Zoom1: Zoom1 window
- Zoom2: Zoom2 window

Measurement Time Period (T Range1/T Range2)

Sets the start point (T Range1) and the end point (T Range2) of the automated measurement time period.

Selectable range: ±5 divisions from the center of the waveform area

Resolution: 0.01 div

Automated Measurement of Waveform Parameters

The instrument automatically measures the specified measurement items on the source waveform.

Measurement Items (Item Setup)

Sets the measurement items for each source waveform.

Up to a total of 100000 data values can be saved for the entire area and all sources (CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7),* Math1 to Math8). The instrument can display up to 30 measurement items on the screen.

* C0 to C7 and D0 to D7 are available on models with the /L32 options.

The source waveform type determines the measurement items that you can choose.

- **Analog signal (Source): CH1 to CH8, Math1 to Math8**

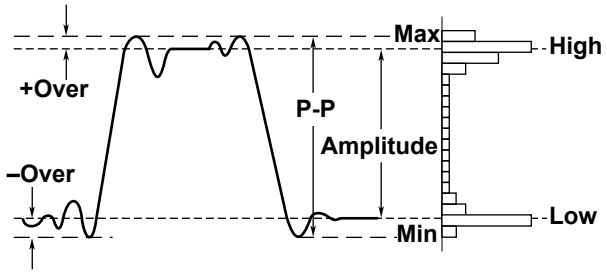
  All voltage and time items
- **Logic signal (Source): Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7)**

  The following time measurement items
  Freq, Period, Avg Freq, Duty, Pulse Count, Delay

- You can increase the number of displayed measurement item values using the number of rows (Max Rows) outside the waveform area in the system settings (System Configuration).
- You can read out the values of measurement items that are not displayed on the screen by using communication features. They can also be saved to files.
- If you execute GO/NO-GO determination based on a waveform parameter, automated measurement turns on.
- If the power measurement mode of the power supply analysis feature (/G03 option) is turned on, you will not be able to set the following measurement items.
  Max, Min, P-P, Rms, Mean, Sdev (AC RMS), Avg Freq

Voltage Measurement Items

V1: Voltage at the point where the trace intersects T Range1
V2: Voltage at the point where the trace intersects T Range2
Max: Maximum voltage [V]
Min: Minimum voltage [V]
P-P: P-P value (Max − Min) [V]
High: High voltage [V]
Low: Low voltage [V]
Amplitude: Amplitude (High − Low) [V]
Rms*: Rms voltage [V] $(1/(\sqrt{N}))(\Sigma(Xn^2))^{1/2}$
Mean*: Mean voltage [V] $(1/N)\ \Sigma Xn$
Sdev (AC RMS)*: Standard deviation [V] $((\Sigma Xn^2 - (\Sigma Xn)^2/N)/N)^{1/2}$
IntegTY+: Area under the positive parts [Vs]
IntegTY: Area under the positive parts − area under the negative parts [Vs]
+Over: Overshoot [%]
(Max − High)/(High − Low)×100
−Over: Undershoot [%]
(Low − Min)/(High − Low)×100

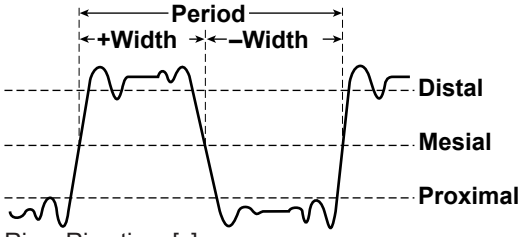


* Xn is the voltage at each sample point, and N is the number of data points in the measurement time period.

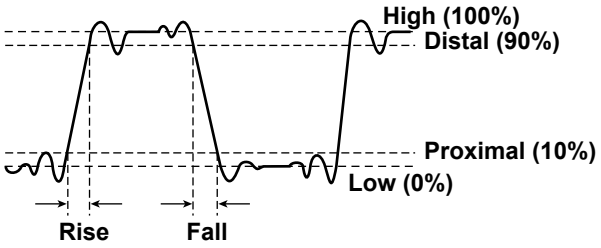
- The unit of measurement that is listed for voltage measurement items changes to amperes when current is measured. If you have specified a unit when measuring in linear-scaling mode, the instrument displays the measured values using the specified unit.
- You can determine the area of XY waveforms by using the analysis features available in the X-Y menu.

Time Measurement Items

ΔT: Time difference between T Range1 and T Range2
Freq: Frequency [Hz]
Period: Period [s]
+Width: Time span when the waveform is above the mesial reference line [s]
−Width: Time span when the waveform is below the mesial reference line [s]
Duty: Duty cycle (+Width/Period × 100) [%]



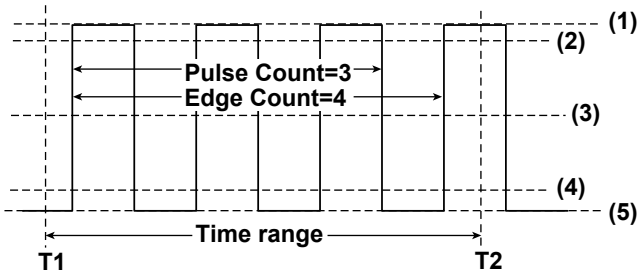
Rise: Rise time [s]
Fall: Fall time [s]



Delay: Delay between waveforms [s]

* Freq, Period, +Width, −Width, Rise, Fall, and Duty parameters are measured on the first period of the waveform.

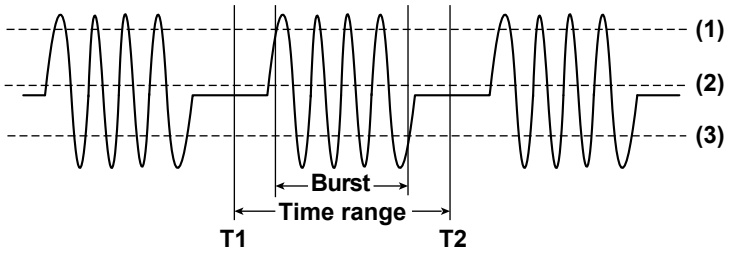
Pulse Count: Pulse count [no unit]
Edge Count: Edge count [no unit]
Avg Freq: Average frequency in the time range [Hz]
Avg Period: Average period in the time range [s]



(1) High
(2) Distal
(3) Mesial
(4) Proximal
(5) Low

Burst: Burst period [s]

Set the measurement time period (Time Range) to a value appropriate for the burst period you want to measure.



(1)Distal
(2)Mesial
(3)Proximal

Measurement of Delay between Waveforms (Delay Setup)

Measures the time difference from the reference waveform (Reference) edge or the trigger position* to the source waveform (Source) edge.

* If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

- Reference: Selects the reference waveform (CH1 to CH8, Math1 to Math8, Logic,* Trigger Position)
  * If you select Logic, select the source bit.
- Polarity: Selects the slope (rising or falling) of the edge you want to detect
- Count: Sets which edge counted from the start point (T Range1) of the time range to use as a detected point (reference point or measured point). The selectable range is 1 to 99.
- Unit: Sets the unit for displaying the delay between waveforms to Time or Degree when Reference is not set to Trigger Position.

Time

Displays the delay between waveforms in time.

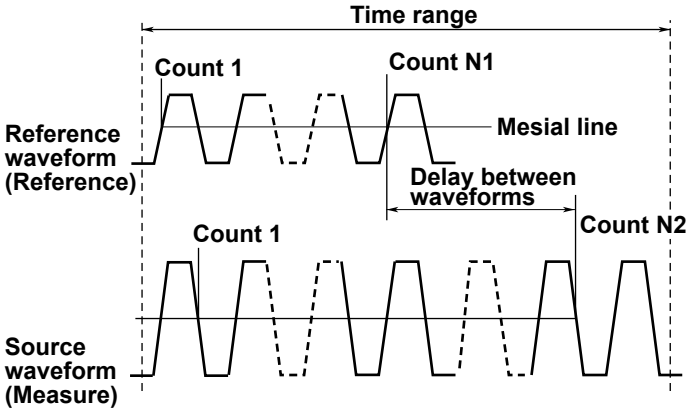
Degree

Displays the delay between waveforms as an angle.

Conversion formula: angle = delay (s)/period (s) × 360 (deg) where the period is the period of the reference waveform.

Example

(When Reference is not set to Trigger Position)



Reference waveform settings
- Polarity : ⤴ (rising)
- Count : N1 (an integer between 1 and 99)

Source waveform settings
- Polarity : ⤵ (falling)
- Count : N2 (an integer between 1 and 99)

Cycle Mode (Cycle Mode)

The time range for automated measurement is set to the period, not the time range specified by T Range1 and T Range2. You can set how the instrument determines the time range to one of the settings below.

1 Cycle: Sets the time range to the first period after T Range1

N Cycle: Sets the time range to the left end of the first period that is between T Range1 and T Range2 to the right end of the Nth period

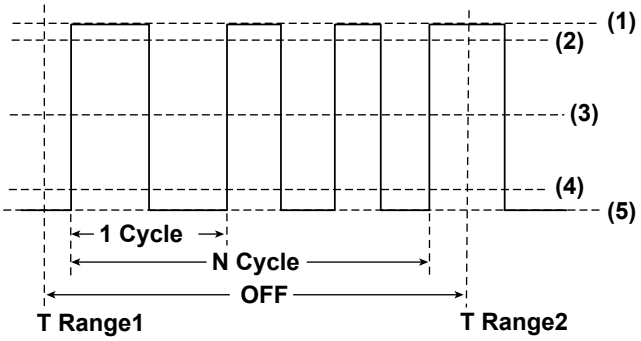
OFF: Sets the time range to the duration between T Range1 and T Range2 (the same as normal automated measurement)

* The method of determining the period is the same as the method for determining the Period measurement item.

In cycle mode, the following items can be measured.

Max: Maximum voltage [V]
Min: Minimum voltage [V]
P-P: P-P value (Max − Min) [V]
High: High voltage [V]
Low: Low voltage [V]
Amplitude: Amplitude (High – Low) [V]
Rms*: Rms voltage [V] $(1/(\sqrt{N}))(\Sigma(Xn^2))^{1/2}$
Mean*: Mean voltage [V] $(1/N)\ \Sigma Xn$
Sdev (AC RMS)*: Standard deviation [V] $((\Sigma Xn^2 - (\Sigma Xn)^2/N)/N)^{1/2}$
IntegTY+: Area under the positive parts [Vs]
IntegTY: Area under the positive parts − area under the negative parts [Vs]
+Over: Overshoot [%] (Max − High)/(High − Low)×100
−Over: Undershoot [%] (Low − Min)/(High − Low)×100

Time range for each cycle mode



(1) High
(2) Distal
(3) Mesial
(4) Proximal
(5) Low

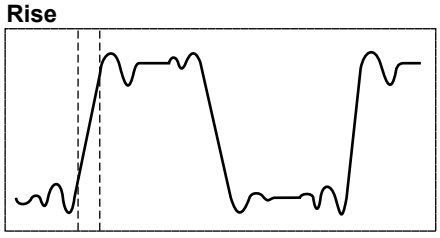
* Xn is the voltage at each sample point, and N is the number of data points in the measurement time period.

Measurement Location Indicator (Indicator)

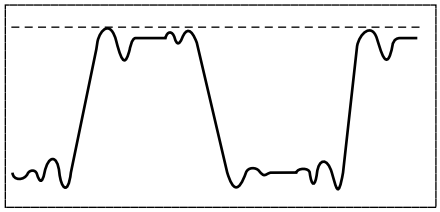
Indicates the measured location of a specified item using cursors. The measurement locations of the following items can be indicated.

Max, Min, P-P, High, Low, Amplitude, Rms, Mean, Sdev (AC RMS), +Over, −Over, V1, V2, IntegTY+, IntegTY
Avg Freq, Avg Period, Burst, Freq, Period, +Width, −Width, Duty, Rise, Fall, Delay

Rise



Max



If the statistical processing mode is set to Cycle or History, the measurement location cannot be displayed.

Reference Level for Automated Measurement (Ref Levels)

Sets the reference level that is used to measure various parameter values such as High, Low, Hi-Low, Rise, and Fall for each source waveform.

Reference Level Setting Unit (Mode)

Selects the unit used to set the reference level (Distal/Mesial/Proximal).

- **%**

  Assuming the High and Low values to be 100% and 0%, respectively, you can set the distal, mesial, and proximal values to any percentage.
- **Unit**

  You can set the distal, mesial, and proximal values to any voltage.

Distal, Mesial, and Proximal (Distal/Mesial/Proximal)

You can set the distal, mesial, and proximal values. If you set the reference level mode to Unit, specify values that are within the range of the voltage source waveform.

▶ See here.

High/Low level

Selects how the instrument determines the 100% (High) and 0% (Low) levels of the measurement source.

- **Auto**

  Sets the high value to the high amplitude level and the low value to the low amplitude level based on the voltage level frequency of the source waveform in the time range taking into account the effects from ringing, spikes, etc. This method is suitable for measuring square waves and pulse waves.
- **Max-Min**

  Sets high and low values to the maximum and minimum values in the time range. This method is suitable for measuring sinusoidal and saw waves. It is not suitable for waveforms that have ringing and spikes.
- **Histogram**

  Sets the levels of the two highest frequencies on a histogram to high and low. This method is suitable for waveforms whose maximum frequency of a given level is extremely high compared to frequencies of other levels, such as in a rectangular waveform.

Statistics (Statistics)

Display the following five statistics on the automated measurement values of waveform parameters. Statistics can be calculated on up to nine automatically measured items.

- Maximum (Max)
- Minimum (Min)
- Mean (Mean)
- Standard deviation (σ)
- The number of measured values used to calculate statistics (Count)

The following types of statistical processing are available.

- Normal statistical processing (Continuous)
- Statistical processing for each period (Cycle)
- Statistical processing of history waveforms (History)

If 10 or more automatically measured items are selected, the instrument displays the first 9 items in ascending order by channel number and in the order that the items appear in the automated measurement item selection menu (Max, Min, ..., +Over, −Over, ..., Freq, Period, ..., and Delay).
Example:
When CH1: Max, Min, High, Low, CH2: Max, Min, High, CH3: Max, Min, High are selected, the following items are displayed: CH1: Max, Min, High, Low, CH2: Max, Min, High, CH3: Max, and Min

You can view or load the statistics of other items in the following way.

- Increase the number of rows (Max Rows) outside the waveform area in the system settings (System Configuration) to show the items on the screen.
- Load the items into a PC using the communication feature.
- Save the statistical items as automated measurement values of waveform parameters, and load the data into a PC.

Statistical Processing Mode (Mode)

Set the statistical processing mode to one of the settings below.

- OFF: Disables statistical processing
- Continuous: Normal statistical processing
- Cycle: Statistical processing of measured values for each period (cyclic statistical processing)
- History: Statistical processing of history waveforms

Normal Statistical Processing (Continuous)

While acquiring waveforms, the instrument calculates the statistics of the waveforms that it has acquired so far. The number of measured values used to calculate statistics (Count) is equal to the number of waveforms that have been acquired up to that point.
If you stop waveform acquisition and restart it, or if you add another automatically measured item during waveform acquisition, the Count value is reset to 1.

Restart (Restart)

Resets the statistics calculated up to that point. You can only use this feature when the mode is set to Continuous.

Statistical Processing Setting When the Trigger Level Changes (TrigLevelChange)

When the mode is set to Continuous, select whether statistical processing should be reset when the trigger level is changed during waveform acquisition.

- Restart: Count is reset to 1, and statistical processing restarts.
- Ignore: Statistical processing continues without being reset.

Cyclic Statistical Processing (Cycle)

In cyclic statistical processing, the instrument divides the displayed waveform by the period that it automatically determines through calculation, and calculates statistics of the measured values in each period. The method of determining the period is the same as the method for determining the Period measurement item.
This mode is effective for items, such as Rms or Avg, that may result in errors depending on the time range setting.

Cycle Trace (Cycle Trace)

Selects the source waveform used to determine the period.

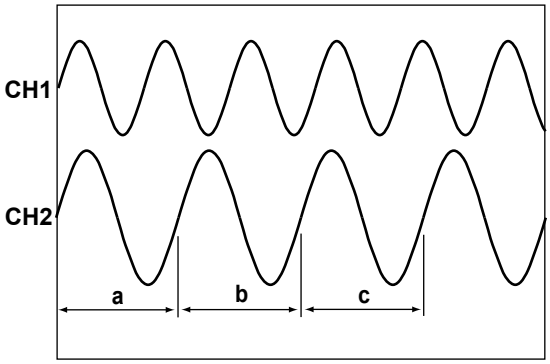
- **Own**

  The period is determined for each source waveform.

- **CH1 to CH8, Logic, Math1 to Math8**

  The period is determined for the selected waveform, and that period is used on all source waveforms. If you select Logic, select the source bit.

Example in Which Cycle Trace Is Set to CH2



Measures the items in ranges a, b, and c, and calculates statistics on the items in the order a, b, and c.
The items of other channels are also measured in ranges a, b, and c. If you select Own, the items are measured automatically over each waveform's period.

Executing Statistical Processing (Exec)

Executes statistical processing. You can use this command when the statistical processing mode is set to Cycle or History.

- The number of cycles being used for the cyclic statistical processing is displayed in the statistical display's Count column.
- The number of cycles that can be used in cyclic statistical processing varies depending on the number of measured items that the instrument is calculating the statistics of.

  100000/(the number of measured items that the instrument is calculating the statistics of)
- Cyclic statistical processing is performed only on the main window.
- The following measurement items cannot be selected when the cycle trace and the measurement source waveform are the same or when the cycle trace is set to Own.

  Avg Freq (average frequency), Avg Period (average period), Pulse Count (pulse count), Edge Count (edge count), Delta T, Delay

Statistical Processing of History Waveforms (History)

The instrument automatically measures items on the selected range of the history waveform and calculates statistics. The instrument calculates statistics from the oldest waveform. The statistics of the waveforms displayed in Time Stamp are calculated.

Executing Statistical Processing (Exec)

Executes statistical processing. You can use this command when the statistical processing mode is set to Cycle or History.

List Display (List)

Displays a list of calculated statistics. You can display this list when the statistical processing mode is set to Cycle or History.

- **Search Mode (Search Mode)**

  Searches for the specified item and highlights the detected line.
  OFF (disable), Statistics Max (maximum value), Statistics Min (minimum value), a≤Data (a value greater than or equal to the specified value), Data≤b (a value less than or equal to the specified value), a≤Data≤b (a value between two specified values)

- **Jump To (Jump To)**

  Jumps to and highlights the specified destination.
  - When Search Mode is set to OFF
    Statistics Max (maximum value), Statistics Min (minimum value), Oldest, or Latest
  - When Search Mode is set to OFF
    You can specify any of the search results.
    If multiple maximum and minimum values are available, the data with the newest number is highlighted.
    Previous (previous data), Next (next data), Oldest, or Latest

- **Sort (Sort)**

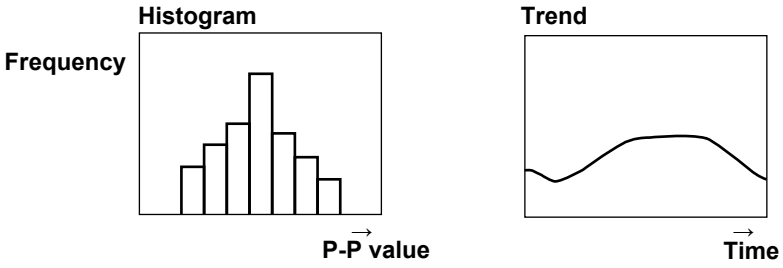
  Sorts the list in the specified order.
  Forward (from the oldest) or Reverse (from the latest)

- You can use the jog shuttle or tap to specify the highlighted measured value.
- In cyclic statistical processing, you can highlight a measured value to display one period of the corresponding waveform on the zoom display.
- In statistical processing of history data, you can highlight a measured value to display the corresponding waveform.

Trend Display and Histogram Display (Trend/Histogram)

You can display up to two trends or histograms of the specified measurement items. You can also display values using the measurement feature. Mean, standard deviation, and other statistics can be displayed on the histogram display.

Display Example (Item = P-P)



Displaying Trends and Histograms (Display)

Set whether or not to display trends or histograms. If you select ON, you can set the type of graph to display and the source. Trends and histograms are displayed in the Trend/Histogram window.

- **Turning Graph Display On and Off (Display)**
  - OFF: Does not displays trends or histograms
  - ON: Displays trends or histograms

- **Type of Graph to Display (Mode)**

  You can set the type of graph you want to display to one of the settings below.
  - Trend: Trend of the calculated statistics
  - Histogram: Histogram of the calculated statistics

- **Display Source (Item)**

  You can select the source waveform and the automatically measured item (you can only select one item) that will be shown in the trend or histogram display.
  The measurement items that are turned on in the Item Setup screen for the automated measurement of waveform parameters appear in the list.

- **Configuring the Display (Display Setup)**

  You can turn on and off the VT waveform display (shared with the trend and histogram display) and specify how to set the display scale (trend display only).
  - Auto Scale Execution (Auto Scale Exec)
    Executes auto scaling of the trend display Upper, Lower, and H-Span are set as follows:
    Upper/Lower: Set so that the difference between the maximum and minimum values of the waveform parameter is 80% of the waveform area.
    H-Span: Set so that all of the waveform parameter values that were measured before Auto Scale was executed are displayed.
  - Vertical Scale Values (Upper/Lower)
    Set the vertical scale values of the trend display.
  - Horizontal Scale Values (H-Span)
    Set the horizontal scale values of the trend display. You can set this when the mode is set to Continuous or History.
  - Horizontal Scale Target (H-Span)
    Select the window for setting the horizontal scale of the trend display. You can set this when the mode is set to Cycle.
  - Turning the VT Waveform Display Window On or Off (VT Display)
    Set whether to display the VT waveform along with the trend or histogram display.
    OFF: Does not display the VT waveform display window
    ON: Displays the VT waveform display window

If the statistical processing mode is set to Continuous and you execute Auto Scale, H-Span is set to 100 if the number of waveform parameters that had been measured is less than or equal to 100.

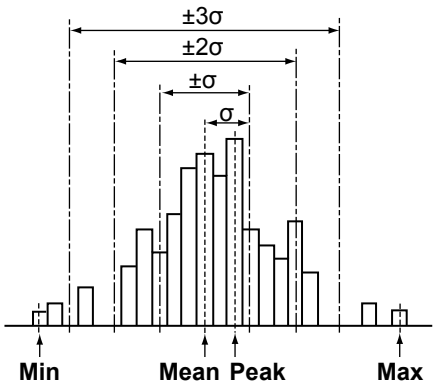
- **Measurement (Measure Setup)**

  On histograms, you can measure parameters such as peak values and maximum values and measure values using cursors.

  - Measurement Mode (Measurement Mode)
    OFF: Disables measurement.
    Param: Measures the value of the selected parameter.
  - Cursor Positions (Cursor1/Cursor2)
    Measurement items C1, C2, and ΔC are used to measure the Cursor1 value, the Cursor2 value, and the difference between the two cursor values.
  - Measurement Item (Item)
    The instrument measures the values of the items listed below that you select.

Peak	Peak value
Max	Maximum value
Min	Minimum value
Mean	Mean value
σ	Standard deviation of the histogram
Median	Median*
Integ±σ	Percentage of values that fall within ±σ (%)
Integ±2σ	Percentage of values that fall within ±2σ (%)
Integ±3σ	Percentage of values that fall within ±3σ (%)
C1	Cursor1 value
C2	Cursor2 value
ΔC	Difference between Cursor1 and Cursor2

* Re-sorts the sampled points from the minimum to the maximum value and determines the value at [total number of samples/2] from the maximum point.



Enhanced Parameter Measurement (Enhanced)

The enhanced parameter measurement feature allows you to perform automated measurement of the waveform parameters of two areas. It also allows you to perform calculations using the automated measurement values of waveform parameters.

You cannot use the enhanced parameter measurement feature when the statistical processing mode is set to Cycle.

Setting Area2 (Item Setup (Area2))

You can configure measurement items and other settings of the second area (Area2). The method to set the range is the same as that for the automated measurement of waveform parameters.

▶ See here.

Source Window (Time Range (Area2))

Selects the source window for Area2. The method to set the range is the same as that for the automated measurement of waveform parameters.

▶ See here.

Measurement Time Period (T Range1/T Range2)

Set the measurement range of Area2. The method to set the range is the same as that for the automated measurement of waveform parameters.

▶ See here.

Calculation Using Waveform Parameters (Calc Setup)

You can define four calculations (Calc1 through Calc4) that use the automated measurement values of waveform parameters.

Name (Name)

You can specify a name of up to eight characters in length for the computation that you have defined. The specified name is displayed on the screen.

Expression (Expression)

Be sure to include a waveform parameter in the expressions. The available operators and how to use them are described below.

Menu Item	Example	Description
+, −, *, /	Max(C1)−Min(C1)	Basic arithmetic of the input value
ABS	ABS(High(C1))	Absolute value of the input value
SQRT	SQRT(Volt1(C1))	Square root of the input value
LOG	LOG(Max(C2))	Logarithm of the input value
LN	LN(Min(C2))	Natural logarithm of the input value
EXP	EXP(Volt2(C1))	Exponent of the input value
P2	P2(Min(C1))	Square of the input value
SIN	SIN(Low(C1))	Sine of the input value
ASIN	ASIN(High(C2))	Arc sine of the input value
COS	COS(Max(C1))	Cosine of the input value
ACOS	ACOS(Min(C1))	Arc cosine of the input value
TAN	TAN(Volt1(C2))	Tangent of the input value
ATAN	ATAN(Volt2(C1))	Arc tangent of the input value
0 to 9	−	−
Exp		Exponent. Used to enter a number in scientific notation in expressions. (1E+3=1000, 2.5E–3=0.0025) Displayed as “E” in expressions to distinguish this from the “EXP” operator.
PI		Pi (π)
e		Euler’s number, base of the natural logarithm (e = 2.71828…) Displayed as “eul” in expressions to distinguish this from the “E” that represents exponents.

fs		Sample rate. The instrument's sample rate when the computation was executed. The value changes according to the changes in the T/div or record length setting.
Measure Item	Max(C1)	Selects a waveform parameter.
A2	PP(C1,A2)	Specifies the calculation source area. If you want to calculate on Area2, add ",A2" after the calculation source channel.

Unit (Unit)

You can set the unit, which is used when the computed results are displayed, using up to four characters.

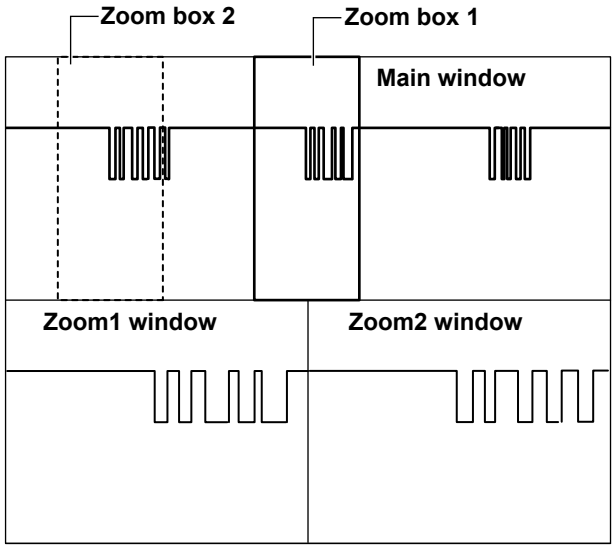
Notes about Automated Measurement of Waveform Parameters

- When an item is impossible to measure its measured value is displayed as '*****'.
- The instrument may not measure correctly if the waveform amplitude is small.
- To stop automated measurement, select OFF by pressing MEASURE > Mode soft key. Measurement stops immediately.
- **Notes about Statistical Processing**
  If the statistical processing mode is set to Cycle or History, all keys and soft keys except the Abort soft key are invalid during statistical processing. In Continuous mode, the RUN/STOP key and TrigLevelChange Soft key are valid.

13 Zooming in on Waveforms

You can magnify the displayed waveforms vertically or horizontally.
The zoomed waveforms of two locations can be displayed simultaneously (the dual zoom feature). You can also specify which channel you want to zoom in on. You cannot zoom if the number of displayed points on the screen is less than or equal to 10.

Example of the Dual Zoom Display



If the main window (which displays normal waveforms) and the Zoom1 or Zoom2 window are displayed at the same time, a zoom box appears in the Main window so that you can check the zoom position.

Turning the Zoom Windows On or Off (Display)

Sets whether or not to display zoom windows.

- OFF: Does not display the zoom windows
- ON: Displays the zoom windows

The ZOOM1 and ZOOM2 keys illuminate when the zoom feature is on. The ZOOM knob controls the waveforms in the window whose corresponding key is illuminated more brightly.

Display Format (Format)

Selects how to divide the zoom windows. Select from one of the settings below.

- Main: Same format as the Main window
- Single: No divisions
- Dual: Two divisions
- Triad: Three divisions
- Quad: Four divisions
- Hexa: Six divisions
- Octal: 8 divisions

Displaying the Main Window (Main)

Selects which area to display the main window in.

- OFF: Does not display the main window
- On (20%): Displays the main window in the top 20% area of the screen
- On (50%): Displays the main window in the top half (50%) of the screen

Auto Scrolling (Auto Scroll)

Automatically moves the zoom position in the specified direction. You can view the zoom waveform and stop scrolling at the appropriate position.

⏮	Zooms in on the left edge of the Main window
◀	Starts scrolling to the left
■	Stop auto scrolling
▶	Starts scrolling to the right
⏭	Zooms in on the right edge of the Main window

Scroll Speed (Speed)

Six different auto scroll speeds are available.

- Down: Decreases the scroll speed by one level.
- Up: Increases the scroll speed by one level.

Zoom Source Waveforms (Trace)

Select the zoom source waveforms from the options listed below. You can select multiple waveforms.
The available settings vary depending on the model.
All, CH1 to CH8, Logic, Math1 to Math8

If you select a waveform whose display is turned off in the main window, the zoom waveform does not appear.

Zoom Factor (ZOOM knob)

You can set separate horizontal zoom factors for ZOOM1 and ZOOM2. The zoom window time axis settings change automatically based on the specified zoom factor.
Use the ZOOM knob to set the zoom factor.

Selectable Range

From twice the TIME/DIV setting of the main window up to the ratio at which the number of data points in the zoom window is 2.5

- The ZOOM knob has a push switch. If you push the knob, the FINE indicator illuminates, and you can set the zoom factor with higher resolution.
- The horizontal zoom factor applies to all waveforms that are displayed in the zoom window.

Zoom Position (Z1 Position, Z2 Position)

Taking the horizontal center of the main window to be 0 divisions, set the center position of the zoom boxes in the range of −5 to +5 divisions. In the Main window, the zoom box with solid lines is Zoom1, and the zoom box with dashed lines is Zoom2.
Waveforms are magnified around Z1 Position and Z2 Position.

Zoom Link

If the Zoom1 and Zoom2 windows are both displayed, you can select whether or not to maintain the distance between the two zoom boxes when you set the zoom position.

Z1 Position/Z2 Position	The jog shuttle sets the zoom box 1 position.
Z1 Position/Z2 Position	The jog shuttle sets the zoom box 2 position.
Z1 Position/Z2 Position	The jog shuttle sets the zoom box 1 and 2 positions while maintaining the same distance between the two zoom boxes.

Vertical Zoom (Vertical Zoom)

Zoom Source Waveforms (Trace)

Set the zoom source waveform to one of the waveforms below.
The available settings vary depending on the model.
CH1 to CH8, Math1 to Math8

Zoom Position (V-Position)

Taking the vertical center of the main window to be 0 divisions, set the vertical center position of the zoom boxes in the range of −4 to 4 divisions. In the Main window, the zoom box with solid lines is Zoom1, and the zoom box with dashed lines is Zoom2.

Zoom Factor (V-Mag)

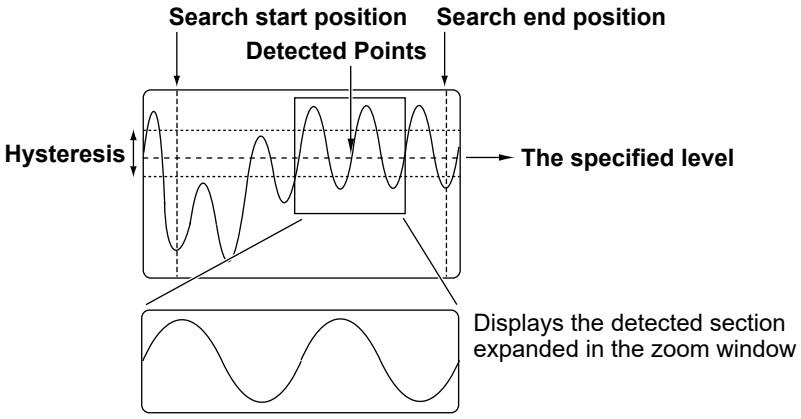
You can set separate vertical zoom factors for ZOOM1 and ZOOM2. The zoom window vertical axis settings change automatically based on the specified zoom factors.
Use the jog shuttle to set the zoom factors.
Selectable range: Up to 10 times

Initializing the Vertical Zoom (Reset)

You can reset the vertical zoom position and zoom factor.
If you want to initialize settings for a particular waveform, use the V-Pos/V-Mag soft key to select the zoom position or zoom factor, and press RESET on the front panel.
If you want to initialize the zoom positions and zoom factors of all waveforms, press the Reset soft key in the Vertical Zoom menu.

14 Searching Waveforms

You can search the displayed waveforms for locations that match the specified conditions. You can zoom-in on the detected locations. You can search the waveforms within the specified search range over up to 50000 points.



Search Source Waveform

Select from the following. The available settings vary depending on the model. If you select Logic, select the source bit.

CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7),* Math1 to Math8

* C0 to C7 and D0 to D7 are available on models with the /L32 options.

- If you select a channel that a reference waveform has been loaded into, you can search the reference waveform. ▶ See here.
- If you set the source to a channel (CH1 to CH8) that a waveform has been loaded into, you can search the loaded waveform.

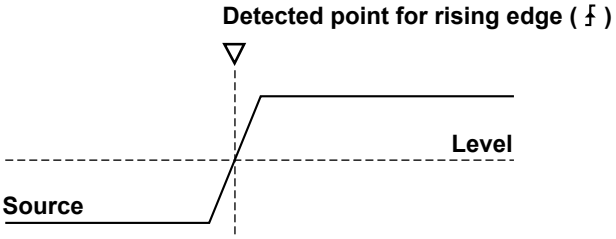
Search Type (Type)

Set the search method to one of the settings below. The search method of each search type is the same as the method of the corresponding trigger type.

Edge Search

Search for positions where the rising or falling slope of the specified waveform passes through the specified level.

Search Example



Pattern Search

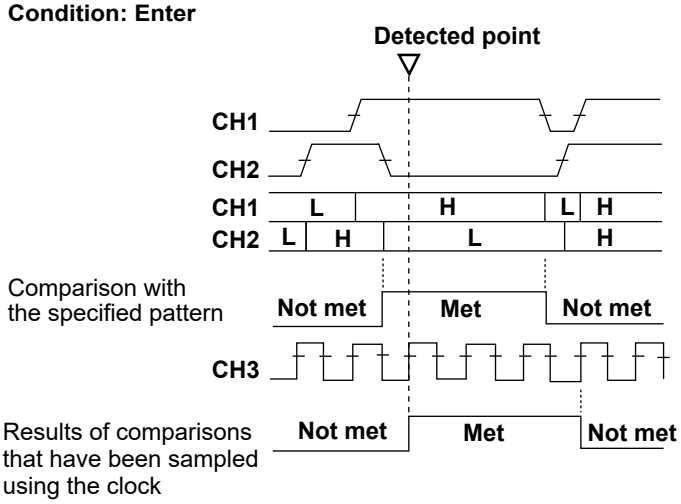
Set the search source pattern and whether a clock source is available. The instrument searches for positions that meet the specified conditions.

When a Clock Source Is Specified

Search Example 1

The results of comparing the combination (Logic) of the search source signal pattern (Pattern) and the specified pattern are sampled on the edges of the clock source, and the instrument searches for the point of change in the comparison results (Enter or Exit of the search condition (Condition)).

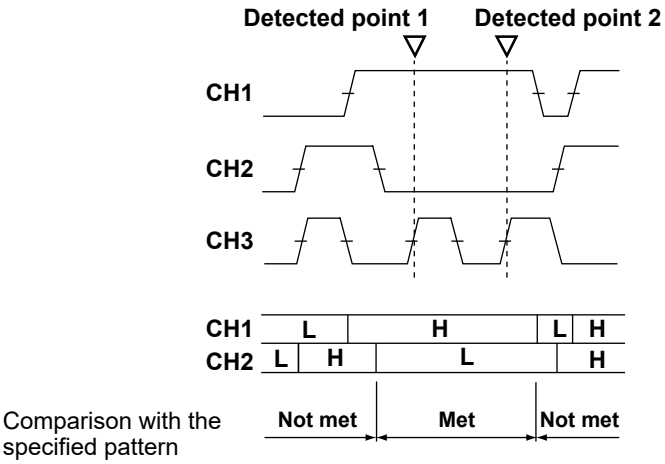
Clock: CH3, ↓
Pattern: CH1 = H, CH2 = L, other channels = X, Logic = AND
Condition: Enter



Search Example 2

When the result of comparing the combination (Logic) of the search source signal pattern (Pattern) and the specified pattern is true or false as specified by the achievement condition (Condition), the instrument searches for the edge of the clock source.

Clock: CH3, ↓
Pattern: CH1 = H, CH2 = L, other channels = X, Logic = AND
Condition: Ture

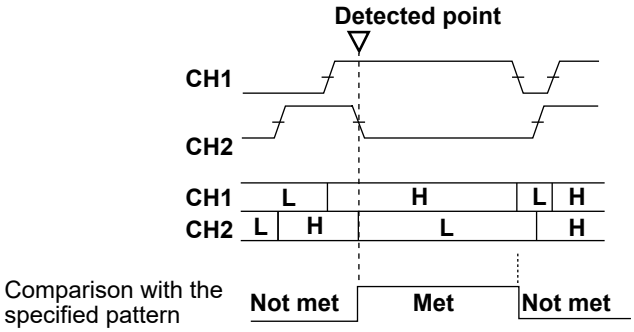


When a Clock Source Is Not Specified

Search Example 1

The instrument searches for the point of change in the results (Enter or Exit of the achievement condition (Condition)) of comparing the combination (Logic) of the search source signal pattern (Pattern) and the specified pattern.

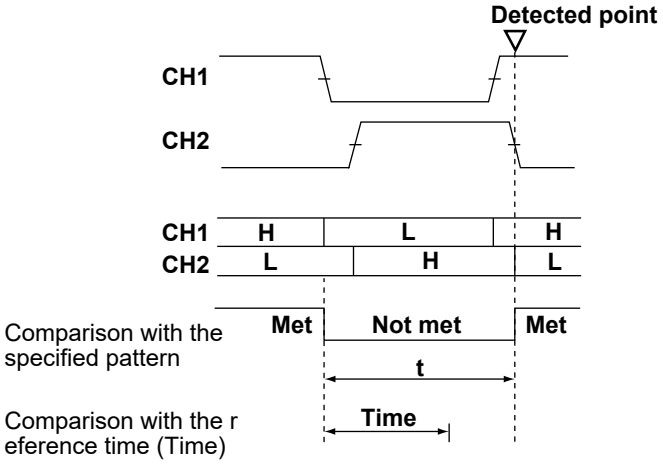
Clock: None
Pattern: CH1 = H, CH2 = L, other channels = X, Logic = AND
Condition: Enter



Search Example 2

The instrument searches for the end point of the achievement time (t) when the relationship between the duration the result (Enter or Exit of the achievement condition (Condition)) of comparing the combination (Logic) of the search source signal pattern (Pattern) and the reference time meets the specified time condition (Time Qualification). When the time condition is set to timeout, the instrument searches for the timeout point.

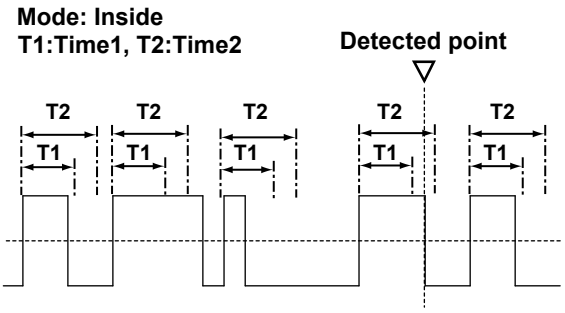
Clock: None
Pattern: CH1 = H, CH2 = L, other channels = X, Logic = AND
Condition: False
Time Qualification: More than(t>Time)



Pulse Width Search

The instrument searches for the position where the pulse width of the specified waveform meets the specified reference time.

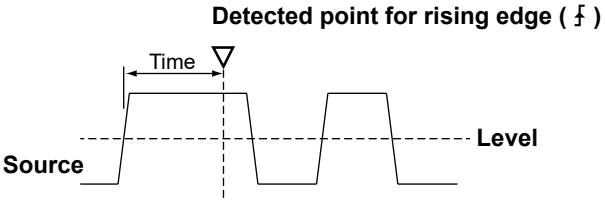
Search Example



Timeout Search

The instrument searches for the timeout position from the point where the rising or falling slope of the specified waveform passes through the specified level.

Search Example



Search Conditions (Condition Setup)

Set the search source waveform, detection level, and other search conditions. The items that you need to set vary depending on the search type that you select.

Edge Search

Search Source Waveform (Source)

Select from the following. The available settings vary depending on the model. If you select Logic, select the source bit.

CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7),* Math1 to Math8

* C0 to C7 and D0 to D7 are available on models with the /L32 options.

Slope (Slope)

You can select which slope edge to detect in the search source waveform.

⨍	Rising slope
⨏	Falling slope
⨍⨏	Rising or falling slope

Level (Level)

When the search source waveform is CH1 to CH8 or Math1 to Math8, set the level used to detect the search source waveform's rising or falling edge.

Selectable range: ±10 div

Resolution: 0.01 div

Hysteresis (Hysteresis)

When the search source waveform is CH1 to CH8 or Math1 to Math8, you can set a width (hysteresis) to the edge detection level so that the instrument does not detect edges on level changes within the specified width.
Selectable range: 0.3 div to 8.0 div
Resolution: 0.1 div

Pattern Search

Clock Source (Clock)

You can select from one of the settings below. The available settings vary depending on the model. If you select Logic, select the source bit.
CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7),* Math1 to Math8, None (not to specify the clock source)

* C0 to C7 and D0 to D7 are available on models with the /L32 options.

Clock Source Slope

Select the clock source slope.

⨍	When the source changes from a level below the specified level to a level above the specified level (rising)
⨏	When the source changes from a level above the specified level to a level below the specified level (falling)
⨎	When a rising or falling edge is detected

You cannot set a pattern to a signal that is set as the clock source.

Search Conditions (Condition)

- **Search Source Pattern (Pattern)**
  Set the search source (CH1 to CH8, A0 to A7, B0 to B7, C0 to C7,* D0 to D7,* Math1 to Math8, excluding the clock source) pattern.
  * C0 to C7 and D0 to D7 are available on models with the /L32 options.
  This item is the same as that of the trigger source pattern (Pattern) of the pattern trigger.
  ▶ See here.

- **Combination (Logic), Achievement Condition (Condition), Time Condition (Time Qualification)**
  These items are the same as those of the pattern trigger.
  ▶ See here.

- **Reference Times (Time or Time1 and Time2)**
  Selectable range: 1 ns to 10 s

- **Level (Level) and Hysteresis (Hys)**
  Set the level and hysteresis used to detect the search source waveform state.
  These items are the same as those of the edge search.
  ▶ See here.

Pulse Width Search

Search Source Waveform (Source)

Select from the following. The available settings vary depending on the model. If you select Logic, select the source bit.

CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7),* Math1 to Math8

* C0 to C7 and D0 to D7 are available on models with the /L32 options.

Reference time (Time)

Selectable range: 1 ns to 10 s

Polarity (Polarity), Time Condition (Time Qualification)

This item is the same as that of the Pulse Width trigger.

▶ See here.

Level (Level) and Hysteresis (Hys)

Set the level and hysteresis used to detect the search source waveform state.

These items are the same as those of the edge search.

▶ See here.

Timeout Search

Search Source Waveform (Source)

Select from the following. The available settings vary depending on the model. If you select Logic, select the source bit.

CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7),* Math1 to Math8

* C0 to C7 and D0 to D7 are available on models with the /L32 options.

Timeout Period (Time)

Range: 1 ns to 10 s

Polarity (Polarity)

Select which polarity will cause the comparison with the timeout period. The search source polarity is based on the level.

	Pos (positive polarity)
	Neg (negative polarity)

Level (Level) and Hysteresis (Hys)

Set the level and hysteresis used to detect the search source waveform state.

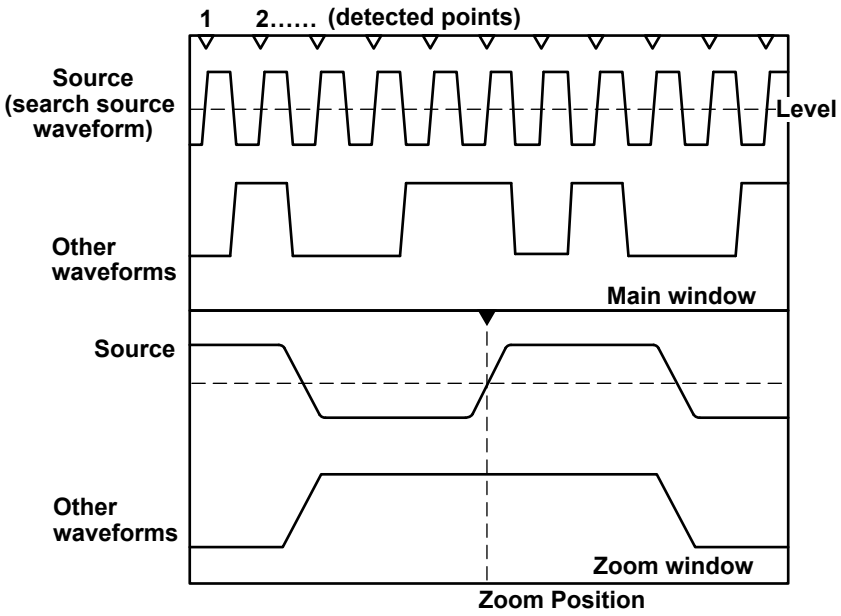
These items are the same as those of the edge search.

▶ See here.

Displaying Detected Waveforms (Display Setup)

Displays the detected point of the detected point number specified by (Pattern No.) in the center of the zoom window.

When the pattern number is set to 2



Mark (Mark)

Select whether or not to display marks on the detected points. When this feature is turned on, detected point marks appear at the top section of the main Window.

- OFF: Does not display the marks
- ON: Displays the marks

Specifying the Zoom Window (Result Window)

Select the Zoom1 or Zoom2 window to display an expanded view of the detected points.
You only need to make this selection when both the Zoom1 and Zoom2 displays are turned on.

If Zoom1 and Zoom2 displays are both off and you press SEARCH, the Zoom1 display turns on.

Zoom Position (Z1 Position, Z2 Position)

You can change the zoom position in the zoom window that is specified using Result Window in the menu accessible with the Display Setup soft key.

Search Skip (Skip Mode)

After a search condition is met, you can skip the detection of search conditions for the specified amount of time or the specified number of counts.

Set the skip method to one of the settings below.

- OFF: Searches for all points that meet the search conditions
- Holdoff: Skips the detection of search conditions for the specified amount of time
  (You can set the amount of time to a value from 0.1 ns to 1.00000 s (6 significant digits) in 0.1-ns steps.)
- Decimation: Skips the detection of search conditions for the specified number of counts
  (The selectable range is 1 to 9999.)

You can specify search skip for edge searches, pulse width searches and timeout searches.

Search Range (Start/End Point)

Set the search start and stop points (Start Point/End Point) in the range shown below.

Selectable range: −5 div to +5 div

Detected Point number (Pattern No.)

Specify the number of the detected point to display in the zoom window.

Detected points are numbered in order. The first detected point is zero.

The maximum detected point number is 50000.

Executing a Search (Search)

The instrument searches for positions where the specified search conditions are met. Then, the instrument displays the waveform expanded in the zoom window with the detected point that corresponds to the number you specify at the center.

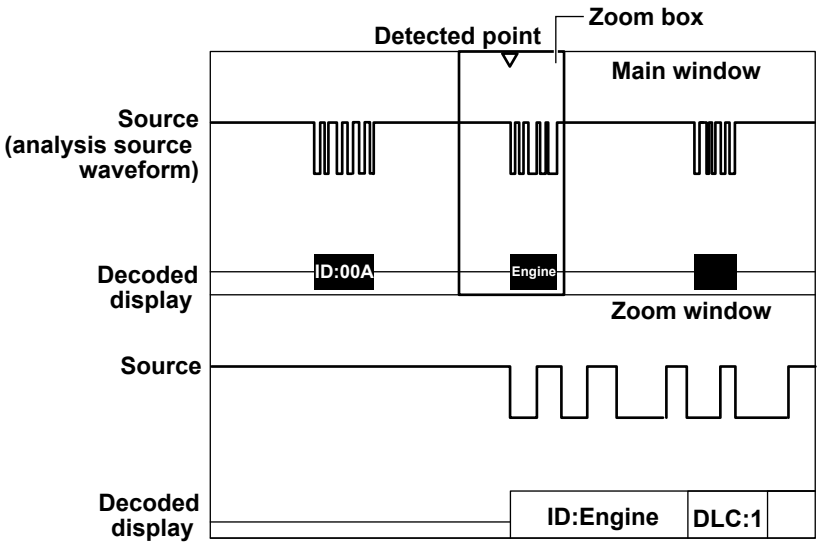
Detected Points

The detected points are the same as the trigger points.

- You cannot search while waveform acquisition is in progress (RUN).
- You cannot search accumulated waveforms.

15 Analyzing and Searching Serial Bus Signals

The instrument can decode frames, fields, and other information from the waveform displayed on the screen. Then, it can display the decoded results along with the waveform on the screen or display a list of detailed decoded results.
If you set search conditions and perform searches, the waveform can be displayed expanded, with the detected frame's or field's first data byte at the center of the window.
The instrument can perform waveform analysis and searching on up to four serial bus signals (Serial Bus1(S1), Serial Bus2(S2), Serial Bus3(S3), and Serial Bus4(S4)). The instrument can search up to 50000 points on the selected serial bus signal.



Turning the Analysis and Search Feature On or Off (Display)

Set whether or not to perform serial bus signal analysis and searching. If you turn this feature on, the instrument displays the decoded field values at the bottom of the screen.

- OFF: Does not perform serial bus signal analysis and searching
- ON: Performs serial bus signal analysis and searching

Number of Analyzable and Searchable Frames or Data Bytes

The maximum number of analyzable and searchable frames or data bytes varies depending on the serial bus type as follows:

FlexRay	5000 frames
CXPI	10000 frames
CAN FD	Up to 50000 frames
CAN/LIN/SENT	100000 frames
UART/I^2C/SPI/User Define	300000 bytes
PSI5 Airbag	400000 bytes

Analysis and Search Source Waveform

You can analyze and search any of the following channel waveforms. The selectable channels vary depending on the model.

CH1 to CH8, Logic,* Math1 to Math8

* You can select Logic only for SENT, UART, I^2C, and SPI serial bus signals. If you select Logic, select the source bit (A0 to A7, B0 to B7, C0 to C7, D0 to D7). C0 to C7 and D0 to D7 are available on models with the /L32 option.

- If you select a channel that a reference waveform has been loaded into, you can analyze and search through the reference waveform.▶ See here.
- If you set the source to a channel (CH1 to CH8) that a waveform has been loaded into, you can analyze and search through the loaded waveform.
- Set the time scale and record length so that the sample rate displayed in the upper right of the screen is at least 10 times the signal bit rate. The instrument may not be able to analyze or search if the sample rate is low.

Serial Bus Signal Type (Type)

Select the serial bus signal type to analyze and search from one of the settings below. FlexRay, CAN, CAN FD, LIN, CXPI, SENT, PSI5 Airbag, UART, I^2C, and SPI are options.

- FlexRay: FlexRay bus signal
- CAN: CAN bus signal
- CAN FD: CAN FD bus signal
- LIN: LIN bus signal
- CXPI: CXPI bus signal
- SENT: SENT signal
- PSI5 Airbag: PSI5 Airbag signal
- UART: UART signal
- I2C: I^2C bus signal
- SPI: SPI bus signal
- User Define: User-defined serial bus signal

Bus Setup (Setup)

Configure the settings necessary for serial bus signal analysis. The settings vary depending on the bus type.

Auto Setup (Auto Setup)

If you specify the serial bus type and source, the instrument can automatically set the bit rate and source level. You can select the source from the waveforms displayed on the screen or additional waveforms obtained after executing auto setup. You can also set a trigger for the assigned source. The auto setup feature will not work properly on some input signals.

You can cancel auto setup by pressing the Abort soft key.

Search Setup (Search)

Set the serial bus signal search conditions. The conditions that you set vary depending on the search source signal.

Specifying the Zoom Window (Result Window)

Select the Zoom1 or Zoom2 window to display an expanded view of the detected points.
You only need to make this selection when both the Zoom1 and Zoom2 displays are turned on.

If the Zoom1 and Zoom2 displays are both off and you press SERIAL BUS (SHIFT+SEARCH) and then set Display to ON, the Zoom1 display turns on.

Detected Point Number (Pattern No.)

Specify the number of the detected point (the location where the search condition was met) you want to display in the zoom window.
Detected points are numbered in order. The first detected point is zero.
The maximum detected point number is 50000.

Zoom Position (Z1 Position, Z2 Position)

You can change the zoom position in the zoom window that is specified using Result Window in the menu accessible with the Search soft key. You can also link the analysis number (List No.) and zoom position settings.
▶ See here.

Decoded Display (Decode)

The instrument decodes each field value and displays the decoded result using different colors for each field at the bottom of the screen.

Decode Display Format (Format)

The following table shows the available decode display formats.

Decode Format		Hex	Dec	Bin	ASCII	Symbol
Serial bus	FlexRay	Yes	No	Yes	No	No
	CAN	Yes	No	Yes	No	Yes*
	CAN FD	Yes	No	Yes	No	Yes*
	LIN	Yes	No	Yes	No	No
	CXPI	Yes	No	Yes	No	No
	SENT	Yes	Yes	No	No	No
	PSI5 Airbag	Yes	Yes	Yes	No	No
	UART	Yes	No	Yes	Yes	No
	I^2C	Yes	No	Yes	Yes	No
	SPI	Yes	No	Yes	Yes	No
	User Define	Yes	No	Yes	Yes	No

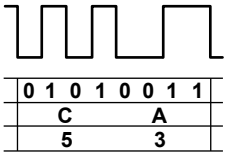
* You can display the decoded results using symbols by converting a CANdb file (.dbc) to a physical value/symbol definition file (.sbl) using the free YOKOGAWA conversion software “Symbol Editor” and by loading the file into the instrument.

Display Example

When Bin display is used, a bit order that is appropriate for the displayed waveforms is used regardless of the bit order setting.

The bit order setting varies depending on the bus type.

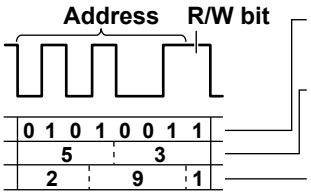
CRC of FlexRay, CAN, CAN FD, I^2C, SENT (except when the data type is User), PSI5 Airbag	MSB
Data of LIN, CXPI, PSI5 Airbag	LSB
UART, SPI, SENT (when the data type is User)	LSB or MSB



Binary display
Hexadecimal display (bit order: LSB)
Hexadecimal display (bit order: MSB)

When I^2C bus signals are being analyzed, the display of the decoded address pattern is affected by whether the R/W bit is on or off.

7-bit Address Example



In the binary display, the address and R/W bit are both in binary (01010011).

In the hexadecimal display when Include R/W is on, the address and R/W bit are both in hexadecimal (0x53).

In the hexadecimal display when Include R/W is off, the address is in hexadecimal (0x29), and the R/W bit is in binary (1).

Label (Label)

Set the decode display label using up to 8 characters. The label that you create is displayed on the screen.
The label does not change even if you execute auto setup on the analysis menu of each serial bus signal.

Display Position (Position)

Select where to display the decoded results from the following:

- Auto: The decoded results are displayed at the bottom of the screen.
- Manual: The decoded results are displayed at the specified location. You can set the position by using the jog shuttle.

This is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The setting changes from Auto to Manual when you drag the decoded results.

Target Channel/Target Data (Select)

Select the channel or data that you want to set the label and display position of. Select SENT or SPI.

List Display (List)

You can display a list of decoded results. You can list the decoded results of four serial bus signals. You can also display the waveform of a specified analysis number in the zoom window.
Listing is not possible when the source is a user-defined serial bus signal.

Turning Zoom Linking On and Off (Zoom Link)

When Zoom Link is set to ON, the analysis number and zoom position settings are linked. When Zoom Link is set to OFF, the analysis number and zoom position settings are not linked. The default setting is ON.

List Size (List Size)

Select the list size and display position from one of the settings below.

- Full Screen: Displays the list in full-screen mode
- Half(Upper): Displays the list in the top half of the screen
- Half(Lower): Displays the list in the bottom half of the screen

Detailed Display (Detail)

If the bus type is UART(When Grouping is on), I^2C, or SPI, the instrument displays all of the data for the specified analysis number in hexadecimal notation and ASCII codes. If you show the detailed display, you can view the data from the 17th byte.

Analysis Number (List No.)

The line on the list that corresponds to the number you select is highlighted. When Zoom Link is set to ON, the zoom window displays the waveform expanded with the start of the frame that corresponds to the selected analysis number at the center of the window.

Trend Display (Trend)

You can display the trend of decoded SENT and PSI5 Airbag signal data. For each analysis of serial bus signals (Serial Bus1 (S1), Serial Bus2 (S2), Serial Bus3 (S3), Serial Bus4 (S4)), up to four trends can be displayed.

Saving the Analysis Results

You can save the analysis results (the data list of the decoded results) in CSV format to a storage device. The extension is .csv.

For details on saving the serial bus analysis results, see “Serial Bus Analysis Results (Serial Bus)” in chapter 20, “Saving and Loading Data.”▶ See here.

You cannot save the results of analyzing a user-defined serial bus signal (User Define).

Analyzing and Searching FlexRay Bus Signals (Option)

Analysis Source Frame

You can analyze the following frames and patterns.
Frame Start, Error, ID/Data

For the frame format, see "FlexRay Bus Trigger" in chapter 4, "Triggering."

Bus Setup (Setup)

Source (Source)

Set the analysis source to one of the settings below. The available settings vary depending on the model.
CH1 to CH8, Math1 to Math8

Bit Rate (Bit Rate)

Select the FlexRay bus signal's data transfer rate from one of the settings below.
2.5 Mbps, 5 Mbps, 10 Mbps

Bus Channel (Channel)

Select A or B.

Level and Hysteresis (Level/Hysteresis)

These items are the same as those of the edge search.
▶ See here.

Auto Setup (Auto Setup)

Auto setup is performed on the assigned source.
The bit rate, bus channel, level, and hysteresis are set automatically based on the target waveform. The instrument triggers when the Trigger Settings check box is selected.
You cannot execute auto setup if the source is set to Math1 to Math8.

Source Waveform (Source Waveform)

Select the waveform to be used as the setup condition for auto setup from the following.

- **New Waveform to Acquire (New waveform to acquire)**
  When auto setup is executed, waveforms are acquired automatically. Auto setup is performed on the acquired waveforms.
- **Waveform Currently Displayed (Waveform currently displayed)**
  This is available when waveform acquisition is stopped. Auto setup is performed based on the waveforms displayed on the screen. When history waveforms are displayed, auto setup is performed based on the waveform selected for highlighting (Select No.). This is not available when waveform acquisition is in progress.

Trigger Settings (Trigger Settings)

The trigger is set to the FlexRay bus signal's start-of-frame position.
If you clear the check box, the trigger is not set even when auto setup is performed.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows:

Indicator	Yellow (Yellow)
Frame ID	Light green (Light Green)
Payload	Pink (Pink)
Header CRC	Light blue (Light Blue)
Cycle Count	Orange (Orange)
Data	Cyan (Cyan)
CRC	Light blue (Light Blue)
BSS	Gray (Gray) fill
Error	Red (Red) BSS Error, FES Error: Displays the words “BSS Error” or “FES Error” in the field in which the error occurred using black characters on red background. Header CRC Error, CRC Error: Displays the characters of the field in which an error occurred using black characters on red background.

List Display (List)

The list displays the following items.

No.	Analysis number. Negative numbers are assigned to frames before the and positive numbers are assigned to frames after the trigger position.* The instrument can display the analysis results for up to 5000 frames in the range of −5000 to 5000. Pressing the RESET key highlights frame number zero.
Time(ms)	Displays the time from the trigger position* to the start of the frame in milliseconds.
S/D	Displays the frame type. S: Static Frame, D: Dynamic Frame
IND	Displays the states of the four header segment indicators in the following order using bit patterns. Payload preamble indicator, Null frame indicator, Sync frame indicator, Startup frame indicator
ID	Displays the 11-bit frame ID in decimal notation.
Len	Displays the data length of the payload segment in decimal notation.
CC	Displays the cycle-count value in decimal notation.
Data	Displays Data 0 to Data n of the payload segment (n = byte 0 to 253) in hexadecimal notation.
Information	Displays the following error information. If multiple errors are detected in one frame, the instrument displays the error with the highest precedence. The errors are listed below in order of precedence with the highest precedence error first. BSS Error: BSS not detected, FES Error: FES not detected, Header CRCError: Incorrect header CRC, CRC Error: incorrect CRC

* If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

Search Setup (Search)

Search Type (Mode)

Select the FlexRay bus signal search type from one of the settings below.

- Frame Start: Searches for the starting position of the frame
- Error: Searches for errors
- ID/Data: Searches for the position where the AND condition of the ID bit pattern and Data pattern is met

If you select Error, set the error type; if you select ID/Data, set the search conditions.

Error Type (Error Type OR)

If the search type is set to Error, you can select the error types to search for from one of the settings below.

Header CRC	Header CRC error
CRC	Frame CRC error
BSS	BSS error (BSS falling edge not at the specified location)
FES	FES error (FES rising edge not at the specified location)

Search Conditions (Condition Setup)

If you set the search type to ID/Data, you can set the Indicator, ID, Cycle Count, and Data1 search conditions. The method to set search conditions is the same as that for the trigger conditions of the FlexRay bus trigger.

▶ See here.

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the frame corresponding to the specified detected point number (Pattern No) expanded in the zoom window.

Detected Points

The detected points are the same as the trigger points.

▶ See here.

Jumping to the Specified Field (Field Jump)

You can move the zoom position to the start of the following fields in the frame corresponding to the specified detected point number.

ID, Payload Length, Header CRC, Cycle Count, CRC

Analyzing and Searching CAN Bus Signals (Option)

Analysis Source Frame

The following frames can be analyzed.
Remote, data, error, and overload frames

For the CAN frame format, see "CAN Bus Trigger" in chapter 4, "Triggering."

Bus Setup (Setup)

Source (Source)

Set the analysis source to one of the settings below. The available settings vary depending on the model.
CH1 to CH8, Math1 to Math8

Bit Rate (Bit Rate)

Select the CAN bus signal's data transfer rate from one of the settings below.
33.3 kbps, 83.3 kbps, 125 kbps, 250 kbps, 500 kbps, 1 Mbps, User Define
If you select User Define, set the transfer rate in the range of 10 kbps to 1 Mbps in 0.1-kbps steps.

Recessive Level (Recessive)

Select the recessive level from one of the settings below. In either setting, the logical value of the recessive level is 1, and the logical value of the dominant level is 0.

H	The recessive level is greater than the dominant level.
L	The recessive level is less than the dominant level.

Sample Point (Sample Point)

Set the reference that will be used to determine the bus level (recessive or dominant) in the range of 18.8 to 90.6% in 3.1% steps.

Level (Level) and Hysteresis (Hys)

These items are the same as those of the edge search.

▶ See here.

Auto Setup (Auto Setup)

Auto setup is performed on the assigned source.
The bit rate, recessive level, sample point, level, and hysteresis are set automatically based on the target waveform. The instrument triggers when the Trigger Settings check box is selected.
You cannot execute auto setup if the source is set to Math1 to Math8.

Source Waveform (Source Waveform)

Select the waveform to be used as the setup condition for auto setup from the following.

- **New Waveform to Acquire (New waveform to acquire)**
  When auto setup is executed, waveforms are acquired automatically. Auto setup is performed on the acquired waveforms.
- **Waveform Currently Displayed (Waveform currently displayed)**
  This is available when waveform acquisition is stopped. Auto setup is performed based on the waveforms displayed on the screen. When history waveforms are displayed, auto setup is performed based on the waveform selected for highlighting (Select No.). This is not available when waveform acquisition is in progress.

Trigger Settings (Trigger Settings)

The trigger is set to the CAN bus signal's start-of-frame (SOF) position.
If you clear the check box, the trigger is not set even when auto setup is performed.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows:

Arbitration	Light green (Light Green)
Control	Pink (Pink)
Data	Cyan (Cyan)
CRC	Light blue (Light Blue)
Error bit, field in which the error occurred, frame, error frame	Red (Red)
Overload frame	Green (Green)
Frame background	Gray (Gray)
Stuff bits	Gray (Gray) fill

List Display (List)

The list displays the following items.

No.	Analysis number. Negative numbers are assigned to frames before the and positive numbers are assigned to frames after the trigger position.* The instrument can display the analysis results for up to 100000 frames in the range of −99999 to 99999. Pressing the RESET key highlights frame number zero.
Time(ms)	Displays the time from the trigger position* to the start of the frame in milliseconds.
Frame	Displays the frame type. The instrument can analyze the following four frame types: data frame (Data), remote frame (Remote), error frame (Error), and overload frame (Over load).
ID	Displays the 11-bit standard format ID value or the 29-bit extended format ID value in hexadecimal notation. If decode (Decode) is set to Symbol, the ID is displayed with the message name.
DLC	Displays the number of significant bytes in hexadecimal notation.
Data	Displays the data in hexadecimal notation when the frame type is data frame. If decode (Decode) is set to Symbol, Data is displayed with physical values.
CRC	Displays the sequence in hexadecimal notation. This is displayed when the frame type is data frame or remote frame.
Ack	Displays “Y” when an ACK bit is detected and “N” otherwise.
Information	Displays the following error information. If multiple errors are detected in one piece of data, the instrument displays a single error in the following order of precedence. Stuff Error, CRC Error

* If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

Time Reference (Time Ref)

The difference from the trigger position or the beginning of the previous frame is displayed.
Trigger Position: The difference from the trigger position to the beginning of the frame is displayed.
Previous Row: The difference from the the beginning of the previous frame is displayed.

Filtering the List Display (Filter)

A filter is applied using the specified frame format and ID bit pattern. The list can be filtered to display only the values of matching IDs.

- Frame format (Frame Format)
  Set the frame format to standard (Standard) or extended (Extend).
- Bit pattern (Hex)
  Set the 11-bit standard format ID bit pattern or the 29-bit extended format ID bit pattern in hexadecimal (Hex) notation.

Search Setup (Search)

Search Type (Mode)

Select the CAN bus signal search type from one of the settings below.

- SOF: Searches for the start-of-frame position
- Error: Searches for errors
- ID/Data: Searches for the position where the AND condition of the ID bit pattern and Data pattern is met

If you set the type to Error or ID/Data, set the search conditions.
The method to set search conditions is the same as that for the trigger conditions of the CAN bus trigger.

▶ See here.

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the frame corresponding to the specified detected point number (Pattern No) expanded in the zoom window.

Detected Points

The detected points are the same as the trigger points.

▶ See here.

Jumping to the Specified Field (Field Jump)

You can move the zoom position to the start of the following fields in the frame corresponding to the specified detected point number.
SOF, ID, Control Field, Data Field, CRC, ACK

Analyzing and Searching CAN FD Bus Signals (Option)

Analysis Source Frame

The following frames can be analyzed.
Remote, data, error, and overload frames

For the CAN FD frame format, see “CAN FD Bus Trigger” in chapter 4, “Triggering.”

Bus Setup (Setup)

Source (Source)

This item is the same as that of the CAN bus.

▶ See here.

Bit Rate (Bit Rate)

Select the CAN FD bus signal’s arbitration phase data transfer rate from one of the settings below.
250 kbps, 500 kbps, 1 Mbps, User Define
If you select User Define, set the transfer rate in the range of 20 kbps to 1 Mbps in 0.1-kbps steps.

Sample Point (Sample Point)

Set the reference that will be used to determine the bus level (recessive or dominant) of the CAN FD bus signal’s arbitration phase in the range of 18.8 to 90.6% in 0.1% steps.

Data Bit Rate (Data BitRate)

Select the CAN FD bus signal's data phase data transfer rate from one of the settings below.
500 kbps, 1 Mbps, 2 Mbps, 4 Mbps, 5 Mbps, 8 Mbps, User Define
If you select User Define, set the transfer rate in the range of 250 kbps to 10 Mbps in 0.1-kbps steps.
The data bit rate can be set as high as 16 times the arbitration phase bit rate.

Sample Point of the Data Phase (Sample Point)

Set the reference that will be used to determine the bus level (recessive or dominant) of the CAN FD bus signal's data phase in the range of 18.8 to 90.6% in 0.1% steps.

If the data bit rate exceeds 16 times the bit rate, the rates are automatically adjusted according to the last set value so that the relationship "data bit rate ≤ bit × 16" is maintained.

Recessive Level (Recessive)

This item is the same as that of the CAN bus.

▶ See here.

CAN FD Standard (FD Standard)

Select the compliant standard for the CAN FD bus signal to be applied. This setting is linked to FD Standard of the trigger menu.
ISO: ISO 11898-1: Analyzed as a 2015-compliant CAN FD bus signal.
non-ISO:ISO 11898-1: Analyzed as a CAN FD bus signal compliant to a standard before 2015.

Level (Level) and Hysteresis (Hys)

These items are the same as those of the edge search.

▶ See here.

Auto Setup (Auto Setup)

Set the CAN FD standard for the specified source and then execute auto setup.
The bit rate, recessive level, sample point, level, and hysteresis are set automatically based on the target waveform. The instrument triggers when the Trigger Settings check box is selected.
You cannot execute auto setup if the source is set to Math1 to Math8.

Source Waveform (Source Waveform)

Select the waveform to be used as the setup condition for auto setup from the following.

- **New Waveform to Acquire (New waveform to acquire)**
  When auto setup is executed, waveforms are acquired automatically. Auto setup is performed on the acquired waveforms.
- **Waveform Currently Displayed (Waveform currently displayed)**
  This is available when waveform acquisition is stopped. Auto setup is performed based on the waveforms displayed on the screen. When history waveforms are displayed, auto setup is performed based on the waveform selected for highlighting (Select No.). This is not available when waveform acquisition is in progress.

Trigger Settings (Trigger Settings)

The trigger is set to the CAN or CAN FD bus signal's start-of-frame (SOF) position.
If you clear the check box, the trigger is not set even when auto setup is performed.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows:

Arbitration	Light green (Light Green)
Control[1]	Pink (Pink)
Data	Cyan (Cyan)
Stuff Count[2]	Light blue (Light Blue)
CRC	Light blue (Light Blue)
Error bit, field in which the error occurred,3 frame, error frame	Red (Red)
Overload frame	Green (Green)
Frame background	Gray (Gray)
Stuff bits	Gray (Gray) fill
ESI bit and frame when the ESI bit is recessive[3]	Orange (Orange)
FDF bit and frame when the FDF bit is recessive[3]	Dark blue (Dark Blue)
Frame when the FDF bit is dominant[3]	Light blue (Light Blue)

1 If the FDF bit is recessive and display space is available, FD is displayed in front of DLC.

2 This appears when the CAN FD standard (FD Standard) is set to ISO.

3 The order of precedence when these frames overlap is the frame in which the error occurred, frame when the ESI bit is recessive, the frame when the FDF bit is dominant, and the frame when the FDF bit is recessive.

List Display (List - Show List)

The list displays the following items.

No.	Analysis number. Negative numbers are assigned to frames before the and positive numbers are assigned to frames after the trigger position.* The instrument can display the analysis results for up to 50000 frames in the range of −49999 to 49999. Pressing the RESET key highlights frame number zero.
Time(ms)	Displays the time from the trigger position* to the start of the frame in milliseconds.
Frame	Displays the frame type. The instrument can analyze the following four frame types: data frame (Data), remote frame (Remote), error frame (Error), and overload frame (Over load). If the FDF bit is recessive, FD is displayed in front of Data.
ID	Displays the 11-bit standard format ID value or the 29-bit extended format ID value in hexadecimal notation. If decode (Decode) is set to Symbol, the ID is displayed with the message name.
DLC	Displays the number of significant bytes in hexadecimal notation.
Data	Displays the data in hexadecimal notation when the frame type is data frame. If decode (Decode) is set to Symbol, Data is displayed with physical values. If the number of bytes is 9 or higher, every 8 bytes of data is displayed in its own line.
SC	Displays the 4-bit value of the stuff bit count and parity in hexadecimal notation. This appears when the CAN FD standard (FD Standard) is set to ISO.
CRC	Displays the sequence in hexadecimal notation. This is displayed when the frame type is data frame or remote frame.
Ack	Displays “Y” when an ACK bit is detected and “N” otherwise.
Information	Displays the following error information. If multiple errors are detected in one piece of data, the instrument displays a single error in the following order of precedence. Stuff Error, Fixed Stuff Error, CRC Error If the CAN FD standard (FD Standard) is set to ISO, the CRC error is displayed as follows according to the error type. CRC Error (SC): Stuff Count error, CRC Error (Seq): CRC Sequence error, CRC Error (SC,Seq): Both Stuff Count and CRC Sequence error In addition to error information, if the ESI bit is recessive (error passive), “ESI(Error Passive)” is displayed.

* If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

Time Reference (Time Ref)

The difference from the trigger position or the beginning of the previous frame is displayed.
Trigger Position: The difference from the trigger position to the beginning of the frame is displayed.
Previous Row: The difference from the the beginning of the previous frame is displayed.

Filtering the List Display (Filter)

A filter is applied using the specified frame format and ID bit pattern. The list can be filtered to display only the values of matching IDs.

- Frame format (Frame Format)
  Set the frame format to standard (Standard) or extended (Extend).
- Bit pattern (Hex)
  Set the 11-bit standard format ID bit pattern or the 29-bit extended format ID bit pattern in hexadecimal (Hex) notation.

Search Setup (Search)

Search Type (Mode)

Select the CAN FD bus signal search type from one of the settings below.

- SOF: Searches for the start-of-frame position
- Error: Searches for errors
- ID/Data: Searches for the position where the AND condition of the ID bit pattern and Data pattern is met
- FDF: Searches for an FDF bit state
- ESI (Error Passive): Searches for when the ESI bit is recessive (error passive)

If you set the type to Error, ID/Data, or FDF, set the search conditions.
The method to set search conditions is the same as that for the trigger conditions of the CAN FD bus trigger.
▶ See here.

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the frame corresponding to the specified detected point number (Pattern No) expanded in the zoom window.

Detected Points

The detected points are the same as the trigger points.
▶ See here.

Jumping to the Specified Field (Field Jump)

You can move the zoom position to the start of the following fields in the frame corresponding to the specified detected point number.
SOF, ID, Control Field, Data Field, CRC, ACK

Analyzing and Searching LIN Bus Signals (Option)

Analysis Source Field

You can analyze the following fields and patterns.
Break, Synch, ID, Data, Checksum

For the LIN frame format, see "LIN Bus Trigger" in chapter 4, "Triggering."

Bus Setup (Setup)

Source (Source)

Set the analysis source to one of the settings below. The available settings vary depending on the model.
CH1 to CH8, Math1 to Math8

Bit Rate (Bit Rate)

Select the LIN bus signal's data transfer rate from one of the settings below.
1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, User Define
If you select User Define, set the transfer rate in the range of 1000 bps to 20000 bps in 10-bps steps.

Revision (Revision)

Set the revision to one of the settings below.

- LIN 1.3: Only uses classic checksums, which only include the data field.
- LIN 2.0: Only uses enhanced checksums that include the protection ID. However, classic checksums are used for ID = 60 (0x3c) to 63 (0x3f).
- Both: Uses both the enhanced check sum and the classic checksum.

Sample Point (Sample Point)

You can set the reference that will be used to determine the bus level in the range of 18.8 to 90.6% in 3.1% steps.

Level (Level) and Hysteresis (Hys)

These items are the same as those of the edge search.

▶ See here.

Auto Setup (Auto Setup)

Auto setup is performed on the assigned source.
The bit rate, revision, sample point, level, and hysteresis are set automatically based on the target waveform.
The instrument triggers when the Trigger Settings check box is selected.
You cannot execute auto setup if the source is set to Math1 to Math8.

Source Waveform (Source Waveform)

Select the waveform to be used as the setup condition for auto setup from the following.

- **New Waveform to Acquire (New waveform to acquire)**
  When auto setup is executed, waveforms are acquired automatically. Auto setup is performed on the acquired waveforms.
- **Waveform Currently Displayed (Waveform currently displayed)**
  This is available when waveform acquisition is stopped. Auto setup is performed based on the waveforms displayed on the screen. When history waveforms are displayed, auto setup is performed based on the waveform selected for highlighting (Select No.). This is not available when waveform acquisition is in progress.

Trigger Settings (Trigger Settings)

The trigger is set to the LIN bus signal's Break Synch.
If you clear the check box, the trigger is not set even when auto setup is performed.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows:

Break	Orange (Orange)
Synch	Pink (Pink)
ID	Light green (Light Green)
Data	Cyan (Cyan)
Checksum	Light blue (Light Blue)
WakeUp	Green (Green)
Start Bit	Gray (Gray) fill
Stop Bit	Gray (Gray) fill
Error	Red (Red) Timeout Error: Displays a thick red line in the area where an error has occurred. Framing Error: Displays the words “Framing Error” in the field in which an error occurred using black characters on red background. The instrument displays this error with higher precedence than checksum, synch, and parity errors. Checksum Error, Synch Error, Parity Error: Displays the characters of the synch, ID, or checksum field in which an error occurred using black characters on red background.

List Display (List)

The list displays the following items.

No.	Analysis number. Negative numbers are assigned to frames before the and positive numbers are assigned to frames after the trigger position.* The instrument can display the analysis results for up to 100000 frames in the range of −99999 to 99999. Pressing the RESET key highlights frame number zero.
Time(ms)	Displays the time from the trigger position* to the start of the frame in milliseconds.
ID	Displays the ID value in hexadecimal notation.
ID−Field	Displays the ID value including the 2-bit parity in hexadecimal notation.
Data	Displays the data in hexadecimal notation.
Checksum	Displays the checksum value in hexadecimal notation.
Information	Detects and displays the following signals and errors. If a WakeUp signal is detected, the instrument displays “WakeUp.” If multiple errors are detected in one frame, the instrument displays the error with the highest precedence. The errors are listed below in order of precedence with the highest precedence error first. Timeout-Error, Framing-Error, Checksum-Error, Synch-Field-Error, ID-Parity-Error

* If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

Search Setup (Search)

Search Type (Mode)

Select the LIN bus signal search type from one of the settings below.

- Break Synch: Searches for break and synch fields
- Error: Searches for errors
- ID/Data: Searches for both the ID bit pattern and Data pattern (AND)

The method of setting Break Synch and ID/Data is the same as that of setting the LIN bus trigger conditions. However, you cannot specify the break length as a search condition.

▶ See here.

Error Type (Error Type OR)

If you set the search mode to Error, select the error types to search for from the following settings.

Parity	The instrument calculates the parity of the protected identifier field. If the result does not satisfy the following equations, the instrument detects the protected identifier field's stop bit position. Even Parity Check: ID0 xor ID1 xor ID2 xor ID4 xor P0 = 0 P0 = ID0 xor ID1 xor ID2 xor ID4 ODD Parity Check: ID1 xor ID3 xor ID4 xor ID5 xor P1 = 1 P1 = ¬(ID1 xor ID3 xor ID4 xor ID5)
CheckSum	Revision LIN 1.3 (classic checksum): If the calculated result of all data fields and the checksum is not 0xFF, the instrument detects the checksum field's stop bit position. Revision LIN 2.0 (enhanced checksum): If the total value[1] of the protected identifier field, all data fields, and the checksum is not 0xFF, the instrument detects the checksum field's stop bit position. However, if the protected identifier field ID is from 60 (0x3c) to 63 (0x3f), the instrument triggers based on the calculated result of the classic checksum.
Sync	If the synch field is not 0x55, the instrument detects the synch field's stop bit position.
Timeout	The instrument detects the following three errors. Slave Not Responding Error: After a break detection, if the frame is not finished before the time determined by the following equation elapses, the instrument detects it. $1.4\times(T_{Header}[2] + T_{Response}[3])$ Header Timeout Error: After a break detection, if the header is not finished before the time determined by the following equation elapses, the instrument detects it. $1.4\times T_{Header}[2]$ Response Timeout Error: After a break detection, if the response is not finished before the time determined by the following equation elapses, the instrument detects it. $1.4\times T_{Response}[3]$
Framing	When the Field, Data, or Checksum stop bit is at low level, the instrument detects it. The instrument may detect a break and synch field in the middle of a frame.

1 If the value exceeds 255, it is carried over.
2 Nominal header length T_{Header} = 34 × Tbit[4]
3 Nominal response length $T_{Response}$ = 10×(N + 1)× Tbit[4] (N: data length)
4 Nominal time needed to transmit one bit defined in the physical layer.

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the frame corresponding to the specified detected point number (Pattern No) expanded in the zoom window.

Detected Points

The detected points are the same as the trigger points.

▶ See here.

Jumping to the Specified Field (Field Jump)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the frame corresponding to the specified detected point number (Pattern No.) expanded in the zoom window.

Break, Synch, ID, Data, CheckSum

Analyzing and Searching CXPI Bus Signals (Option)

Analysis Source

Normal frames, long frames (burst frames), sleep frames, wakeup pulses, wakeup state, sleep state

For the CXPI frame format, see "CXPI Bus Trigger" in chapter 4, "Triggering."

Bus Setup (Setup)

Source (Source)

Set the analysis source to one of the settings below. The available settings vary depending on the model.
CH1 to CH8, Math1 to Math8

Bit Rate (Bit Rate)

Select the CXPI bus signal's data transfer rate from one of the settings below.
4800 bps, 9600 bps, 19200 bps, User Define
If you select User Define, set the transfer rate in the range of 4000 bps to 50000 bps in 10-bps steps.

T Sample (T Sample)

Set the sum value, T Sample, for determining the logical value of the current bit.
The value in which T Sample is added to the low width of logical value 1 detected with the last bit is used as the threshold to determine the value as follows:

- Logical value 1 when the low width of the current bit is less than or equal to the threshold
- Logical value 0 when the low width of the current bit is greater than the threshold

Selectable range: 0.010 Tbit to 0.300 Tbit
Resolution: 0.001 Tbit

* Tbit is the time width of a bit calculated from the bit rate.

Clock Tolerance (Clock Tolerance)

Set the tolerance of the clock width calculated from the bit rate.
Range: ±0.5% to ±5.0%
Resolution: 0.1%

Counter Error Detection (Counter Error Detection)

Set whether to detect counter errors.

- ON: Counter errors are detected.
- OFF: Counter errors are not detected.

Level (Level) and Hysteresis (Hys)

These items are the same as those of the edge search.

▶ See here.

Auto Setup (Auto Setup)

Auto setup is performed on the assigned source.
The bit rate, level, and hysteresis are set automatically based on the target waveform. The instrument triggers when the Trigger Settings check box is selected.
You cannot execute auto setup if the source is set to Math1 to Math8.

Source Waveform (Source Waveform)

Select the waveform to be used as the setup condition for auto setup from the following.

- **New Waveform to Acquire (New waveform to acquire)**
  When auto setup is executed, waveforms are acquired automatically. Auto setup is performed on the acquired waveforms.
- **Waveform Currently Displayed (Waveform currently displayed)**
  This is available when waveform acquisition is stopped. Auto setup is performed based on the waveforms displayed on the screen. When history waveforms are displayed, auto setup is performed based on the waveform selected for highlighting (Select No.). This is not available when waveform acquisition is in progress.

Trigger Settings (Trigger Settings)

The trigger is set to the CXPI bus signal's start-of-frame (SOF) position.
If you clear the check box, the trigger is not set even when auto setup is performed.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows:

PTYPE	Pink (Pink)
ID	Light green (Light Green)
DLC, extension DLC*	Pink (Pink)
CT	Orange (Orange)
NM(Sleep.ind/ Wakeup.ind)	Yellow (Yellow)
Data	Cyan (Cyan)
CRC	Light blue (Light Blue)
Parity	Yellow (Yellow)
Start Bit	Gray (Gray) fill
Stop Bit	Gray (Gray) fill
IBS	Gray (Gray) fill
Wakeup pulse	Green (Green)
Error	Red (Red) Parity Error, CRC Error, Counter (CT) Error: Characters in the parity, CRC, or CT field in which an error occurred are displayed in black on a red background. Data Length Error: When the data length is less than DLC, characters in the DLC field is displayed in black on a red background. When the data length is greater than DLC, characters in the exceeded field is displayed in black on a red background. Framing Error: "Framing Error" is displayed in black on a red background in the field after the error occurrence. IBS Error: "IBS Error" is displayed in black on a red background in the IBS field. Clock Error: "• • •" is displayed in black on a red background in the field that the error occurred in.

* Extension DLC applies to long frames.

List Display (List - Show List)

The list displays the following items.

No.	Analysis number. Negative numbers are assigned to frames before the and positive numbers are assigned to frames after the trigger position.* The instrument can display the analysis results for up to 10000 frames in the range of −9999 to 9999. Pressing the RESET key highlights frame number zero.
Time(ms)	Displays the time from the trigger position* to the start of the frame in milliseconds.
ID	Displays the ID value in hexadecimal notation. If there is a PTYPE Field, “P” is displayed in front of the ID value.
DLC	Displays the DLC value in decimal notation. For long frames, the character “L” is followed by the extension DLC value in decimal notation.
W/S	Displays the wakeup indicator and then the sleep indicator in binary notation.
CT	Displays the counter value in decimal notation.
Data	Displays the data in hexadecimal notation. 12 bytes of data is displayed in each row.
CRC	Displays the CRC value in hexadecimal notation.
Information	Displays the following information. Wakeup, Wakeup Pulse, Sleep, Sleep Frame, errors If multiple errors are detected in a frame, up to two errors are displayed in the following order. PTYPE-Parity Error, ID-Parity Error, CRC Error, Data Length Error, Framing Error, IBS Error, Clock Error, Counter Error

* If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

Search Setup (Search)

Search Type (Mode)

Select the CXPI bus signal search type from one of the settings below.

- SOF: Searches for the start-of-frame position
- Error: Searches for errors
- PTYPE: Searches for PTYPE
- ID/Data: Searches for the position where the AND condition of the ID bit pattern, frame information, and data pattern is met
- Wakeup/Sleep: Searches for wakeup pulses, wakeup states, sleep frames, and sleep states

If you set the type to PTYPE, ID/Data, or Wakeup/Sleep, set the search conditions.

The method to set search conditions is the same as that for the trigger conditions of the CXPI bus trigger. However, for ID/Data, the instrument searches for normal, long, and sleep frames.

▶ See here.

Error Type (Error Type OR)

If the search type is set to Error, you can select the error types to search for from one of the settings below.

Parity	When a parity error is detected
CRC	When a CRC error is detected
Data Length	When the DLC value and the number of data pieces in the data field (data length) do not match
Framing	When the logical value of the stop bit of a field or the stop bit of data is 0
IBS	When the number of IBS bits is 10 or more
Counter	When a counter error is detected (can be set as a search item when the counter error detection is set to ON)
Clock	When the clock width exceeds the specified tolerance

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the specified detected point number (Pattern No) expanded in the zoom window.

Detected Points

The detected points are the same as the trigger points.

▶ See here.

Analyzing and Searching SENT Signals (Option)

Analysis Source

Fast channel and slow channel of SENT signals

For the SENT frame format, see “SENT Trigger” in chapter 4, “Triggering.”

Bus Setup (Setup)

Source (Source)

Set the analysis source to one of the settings below. The available settings vary depending on the model.
If you select Logic, select the source bit.
CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7),* Math1 to Math8

* C0 to C7 and D0 to D7 are available on models with the /L32 option.

Format (Format)

These items are the same as those of the SENT signal trigger.

▶ See here.

Display Channel (Display)

Select the channel to be decoded and listed from one of the settings below.

- Both: Both fast channel and slow channel are displayed.
- Fast CH: Fast channel is displayed.
- Slow CH: Slow channel is displayed.

Fast Channel Data Type (Fast CH_Data Type)

Select the fast channel data display method from one of the settings below.
Nibble: Set a 4 to 24 bit data pattern in unit of nibbles (4 bits).
User: Set the data sizes of Data1 to Data4 in the range of 0 to 24 bits.

- Select whether or not to display Data1 to Data4.
- The total number of bits for Data1 to Data4 is up to 24. If you try to exceed the total number of bits, the data size of other pieces of Data is reduced. If as a result of executing auto setup (explained later), the number of data nibbles in the input SENT signal is less than six, the total number of bits that can be specified is up to (the number of data bits) × 4.
- Set the nibble order (Order) to Big or Little.

Slow CH Type (Slow CH Type)

Select the slow channel message type from one of the settings below. This is selectable when the format version (explained earlier) is APR2016 or JAN2010.

- Short: Short message
- Enhanced: Enhanced message

Level and Hysteresis (Level/Hysteresis)

These items are the same as those of the edge search.

▶ See here.

Auto Setup (Auto Setup)

Auto setup is performed on the assigned source.
The format, level, and hysteresis are set automatically based on the target waveform. The instrument triggers when the Trigger Settings check box is selected.
You cannot execute auto setup when:

- The sources is set to Math1 to Math8.
- The state display applied to the logic bits set in the source is ON.

Source Waveform (Source Waveform)

Select the waveform to be used as the setup condition for auto setup from the following.

- **New Waveform to Acquire (New waveform to acquire)**
  When auto setup is executed, waveforms are acquired automatically. Auto setup is performed on the acquired waveforms.
- **Waveform Currently Displayed (Waveform currently displayed)**
  This is available when waveform acquisition is stopped. Auto setup is performed based on the waveforms displayed on the screen. When history waveforms are displayed, auto setup is performed based on the waveform selected for highlighting (Select No.). This is not available when waveform acquisition is in progress.

Trigger Settings (Trigger Settings)

The trigger is set to the end of the Fast CH's SYNC/CAL.
If you clear the check box, the trigger is not set even when auto setup is performed.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows:

Fast CH

SYNC/CAL	Pink (Pink)
S&C	Yellow (Yellow)
Data	Cyan (Cyan)
CRC	Light blue (Light Blue)
Pause	Orange (Orange)
Error	Red (Red) Depending on the error type, the red area is applied as follows: Successive CAL Pulses: SYNC/CAL field Nibble Number: Entire frame Nibble Data Value: Nibble of the relevant data Fast CH CRC:CRC Field Status and Communication(S&C):S&C Field

Slow CH

ID	Light green (Light Green)
Data	Cyan (Cyan)
CRC	Light blue (Light Blue)
Error	Red (Red) Depending on the error type, the red area is applied as follows: Error present in the corresponding fast channel: Frame borders Slow CH CRC: CRC background and frame borders

List Display (List/Trend - List)

The list displays the following items.

Fast CH

No.	Analysis number. Negative numbers are assigned to frames before the and positive numbers are assigned to frames after the trigger position.* The instrument can display the analysis results for up to 100000 frames in the range of −99999 to 99999. Pressing the RESET key highlights frame number zero.
Time(ms)	Displays the time from the trigger position* to the start of the frame in milliseconds.
Sync(µs)	Displays the time period of the SYNC/CAL field.
Tick(µs)	Displays the time period of a clock tick.
S&C	Displays the S&C field value in binary notation.
Data	Displays data in hexadecimal or decimal notation.
CRC	Displays the CRC value in hexadecimal or decimal notation.
Length(tick)	Displays the frame length.
Information	Displays the following error information. If multiple errors are detected in a frame, the instrument displays a single error in the following order of precedence. Successive CAL Pulses, Nibble Number, Nibble Data Value, Fast CH CRC, Status and Communication(S&C)
Slow CH	This item is displayed when the display channel (Display) is set to Both. It displays the slow channel information. The corresponding fast channel is enclosed with <START> and <END> tags.

* If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

Slow CH

No.	Analysis number. Negative numbers are assigned to frames before the and positive numbers are assigned to frames after the trigger position.* The instrument can display the analysis results for up to 100000 frames in the range of −99999 to 99999. Pressing the RESET key highlights frame number zero.
Time(ms)	Displays the time from the trigger position* to the start of the frame in milliseconds.
ID	Displays message ID in hexadecimal or decimal notation.
Data	Displays data in hexadecimal or decimal notation.
CRC	Displays the CRC value in hexadecimal or decimal notation.
Information	Displays the following error information. If multiple errors are detected in a frame, the instrument displays a single error in the following order of precedence. Fast CH Error, CRC Error

* If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

Trend Display (List/Trend - Trend)

Up to four trends (Trend1 to Trend4) of decoded data can be displayed. You can also display the data values using the cursor measurement function.

Trend Display (Display)

Set whether or not to display the trend. The trend is displayed in the Trend window. The trend is not displayed for data of messages that contain errors. Such areas become blank.

- ON: The trend is displayed.
- OFF: The trend is not displayed.

Display Source (Source)

Select the channel to display the trend of from one of the settings below.

- Fast CH: The trend of the fast channel is displayed.
- Slow CH: The trend of the slow channel is displayed.

User Data(User Data)

When the display source is fast channel, select the user data you want to display the trend of. Set the size and order of user data using the fast channel data type menu in the bus setup menu. ▶ See here.

Selectable range: 1 to 4
(2 to 4 when the version is APR2016 and multiplexing is set to on)

Slow CH ID(Slow CH ID)

When the display source is slow channel, set the message ID of the data you want to display the trend of. The selectable range of ID varies depending on the type selected in the slow channel message type menu (▶ See here.).

Message type	Short		Enhanced	
Decode format	Hex	Dec	Hex	Dec
Range	0 to F	0 to 15	00 to FF	0 to 255

Configuring the Display (Display Setup)

Set the trend display scale, and turn the display of VT waveforms on or off.

- **Auto Scale Execution (Auto Scale Exec)**
  Executes auto scaling. The upper and lower limits are set so that the difference between the maximum data value and minimum data value in the window selected with H-Range covers 80% of the vertical scale of the Trend window.

- **Source Window (Range)**
  Select the range to display the trend of from the following windows.
  Main: Main window
  Zoom1: Zoom1 window
  Zoom2: Zoom2 window

- **Turning the VT Waveform Display Window On or Off (VT Display)**
  Select whether to display the VT waveform along with the trend display.
  ON: Displays the VT waveform display window
  OFF: Does not display the VT waveform display window

- **Vertical Scale Values (Upper/Lower)**
  Set the vertical scale values of the trend display.

Cursor Measurement (Cursor)

You can perform cursor measurement on the trend.

ON: Cursor1 and Cursor2 values are measured.

OFF: Cursor measurement is not performed.

T1	Time value of Cursor1 (time from the trigger position*)
T2	Time value of Cursor2 (time from the trigger position*)
ΔT	Difference between the time values of Cursor1 and Cursor2
V1(TRx)	Data value at the intersection of Cursor1 and trend (Trend) x
V2(TRx)	Data value at the intersection of Cursor2 and trend (Trend) x
ΔV(TRx)	Difference between the data values at the intersection of Cursor1 and trend (Trend) x and the intersection of Cursor2 and trend (Trend)

* If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

x: 1 to 4

Search Setup (Search)

Search Type (Mode)

Select the SENT signal search type from one of the settings below.

- Every Fast CH: Searches for fast channel messages
- Fast CH S&C: Searches for the status and communication bit pattern
- Fast CH Data: Searches for the position where the AND condition of the fast channel data is met
- Every Slow CH: Searches for slow channel messages
- Slow CH ID/Data: Searches for the position where the AND condition of the slow channel ID and data is met
- Error: Searches for errors

The method to set search conditions is the same as that for the trigger conditions of the SENT trigger. Set the ID and data using the format selected in the decode menu.

▶ See here.

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the specified detected point number (Pattern No) expanded in the zoom window.

Detected Points

For the positions of detected points, see appendix 6.

▶ See here.

Analyzing and Searching PSI5 Airbag Signals (Option)

Analysis Source

Data frame is analyzed.

For the PSI5 Airbag frame format, see "PSI5 Airbag Trigger" in chapter 4, "Triggering."

Bus Setup (Setup)

Sync Signal (Sync)

Set the sync signal source to one of the settings below.
CH1 to CH8, Math1 to Math8, None

* If you select None, sync signal is not detected. Therefore, sync noise rejection, explained later, is set to OFF.

Level (Level) and Hysteresis (Hys)

You can set the edge detection level and hysteresis for the sync signal. These items are the same as those of the edge search.

▶ See here.

Data Frame (Data)

- **Source (Source)**
  Set the data frame source (data source) to one of the following settings below.
  - When the sync signal is set to CH1 to CH4 or Math1 to Math4
    CH1 to CH4, Math1 to Math4
  - When the sync signal is set to CH5 to CH8 or Math5 to Math8
    CH5 to CH8, Math5 to Math8
  - When the sync signal is set to None
    CH1 to CH8, Math1 to Math8

- **Bit Rate (Bit Rate)**
  Set the data transfer rate of the data frame source to one of the following settings below.
  125 kbps, 189 kbps, User Define
  If you select User Define, set the transfer rate in the range of 10.0 kbps to 1000.0 kbps in 0.1-kbps steps.

- **Data Length (Data Bits)**
  Set the length of data area of the data frame (Payload Data Region) to one of the following settings below.
  10 bit, 16 bit

- **Error Detection Method (Error Detection)**
  If the data length is 10 bits, set the error detection method to one of the following settings below. When the data length is 16 bit, this is fixed to CRC.
  Parity, CRC

- **Sync Signal Noise Rejection (Sync Noise Rejection)**
  You can configure the instrument so that current noise generated by sync pulses is not detected (is ignored) for a given time period. This prevents detecting the start bit of data frames by mistake.

  Rejection Mode (Mode)
  ON: Noise is rejected.
  OFF: Noise is not rejected.

  Sync Noise Rejection End (Rejection End)
  Set the time period from the rising edge of the sync pulse to the end of noise rejection.
  Selectable range: 0.0 µs to 20000.0 µs
  Resolution: 0.1 µs

- **Clock Tolerance (Clock Tolerance)**
  Set the clock tolerance of the data frame source.
  Selectable range: ±0.5% to ±33.3%
  Resolution: 0.1%

- **Level (Level) and Hysteresis (Hys)**
  You can set the edge detection level and hysteresis for the data frame sources. These items are the same as those of the edge search.
  ▶ See here.

Auto Setup (Auto Setup)

Executes auto setup based on the specified sync signal and data frame source.
The bit rate, data length, error detection method, sync signal noise rejection, clock tolerance, number of slots, level, and hysteresis are set automatically based on the target waveform. The instrument triggers when the Trigger Settings check box is selected.
You cannot execute auto setup if the source is set to Math1 to Math8.

Source Waveform (Source Waveform)

Select the waveform to be used as the setup condition for auto setup from the following.

- **New Waveform to Acquire (New waveform to acquire)**
  When auto setup is executed, waveforms are acquired automatically. Auto setup is performed on the acquired waveforms.
- **Waveform Currently Displayed (Waveform currently displayed)**
  This is available when waveform acquisition is stopped. Auto setup is performed based on the waveforms displayed on the screen. When history waveforms are displayed, auto setup is performed based on the waveform selected for highlighting (Select No.). This is not available when waveform acquisition is in progress.

Trigger Settings (Trigger Settings)

Set the trigger as follows:
- When the sync signal (Sync) source is CH1 to CH8, the instrument triggers on the rising edge of the sync pulse.
- When the sync signal source is None, the instrument triggers on the start bit of data frames.

If you clear the check box, the trigger is not set even when auto setup is performed.

Number of Slots (Number of Slots)

When the aforementioned sync signal source is not None, a control menu appears, and you can set the number of slots. Set the same number of slots as the number of data frames between the applicable sync pulse and the next sync pulse.

Auto, 1 to 6

If set to Auto, slot numbers are assigned automatically to data frames in order from number 1. The data frame closest to the applicable sync pulse is assigned the number 1, and numbers up to 6 are assigned. You can view the slot numbers on the list display.

If you set the number of slots different from the number of data frames between the applicable sync pulse and the next sync pulse, Sync on the decode display (explained later) will be red. Under Information of the list display, error type Slot Boundary Error or Frame Number Error is displayed.

Time Range of Each Slot (Slot)

When the number of slots (Number of Slots) is not Auto, you can set the time range of each slot.

- Start position of slot N (Slot N Start)
  Selectable range: 0.0 µs to 20000.0 µs
  Resolution: 0.1 µs
  However, Slot N Start≤Slot N+1 Start, where N is the slot number (1 to the specified number of slots)
- Slot N_{max} end position (Slot N_{max} End)
  Selectable range: Slot N_{max} −1 Start value to 20000.0µs
  Resolution: 0.1 µs
  where N_{max} is the specified number of slots

The following table shows the default slot settings depending on the data length and bit rate.

Data length	10 bit		16 bit	
Bit rate	125 kbps	189 kbps	125 kbps	189 kbps
Slot 1 Start (µs)	44.0	44.0	44.0	44.0
Slot 2 Start (µs)	181.3	139.5	257.3	179.3
Slot 3 Start (µs)	328.9	245.5	492.0	328.2
Slot 4 Start (µs)	492.0	362.5	750.1	492.0
Slot 5 Start (µs)	672.1	492.0	1034.1	672.1
Slot 6 Start (µs)	870.0	633.3	1346.4	870.3
Slot 6 End (µs)	1088.3	788.8	1690.0	1088.3

If the number of slots is less than 6, Slot N End = Slot N+1 Start.

If the start (Start) position or end (End) position of a specified slot overlaps with a data frame, Sync on the decode display (explained in the next section) will be red. Under Information of the list display, error type Slot Boundary Error is displayed.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows:

Sync	Light gray (Light Gray) It will appear in red in the following situations. When the number of slots (Number of Slots) is different from the number of data frames or when the start (Start) position or end (End) position of a slot overlaps with a data frame.
Start Bit	Pink (Pink) fill
Data	Cyan (Cyan)
Parity/CRC	Light blue (Light Blue)
Error	Red (Red) The field frame with the error is displayed in red, and a red block is displayed within the frame.

List Display (List/Trend - Show List)

The list displays the following items.

No.	Analysis number. Negative numbers are assigned to sync pulses or data frames before the trigger position, and positive numbers are assigned to sync pulses or data frames after the trigger position. The instrument can display the analysis results for a total of up to 400000 sync pulses and data frames in the range of –399999 to 399999. Pressing the RESET key highlights sync pulse or data frame number zero.
Time(ms)	Displays the time from the trigger position to the start of the sync pulse or that of the data frame in milliseconds.
from Sync(µs)	Displays the time from the start of the previous sync pulse to the start of the applicable sync pulse or that of the data frame in microseconds. This will be blank if the aforementioned sync signal (Sync) source is None.
Slot No.	For sync pulses, the word “Sync” is displayed. For data frames, the corresponding slot number is displayed. This will be blank if the aforementioned sync signal (Sync) source is None.
Data	Displays data in hexadecimal or decimal notation.
Parity/CRC	Displays the parity or CRC value in hexadecimal notation.
Information	Displays the following error information. If multiple errors are detected in a frame, the instrument displays up to three errors in the following order of precedence. Frame Error, Manchester Error, Start Bit Error, Parity/CRC Error, Frame Number Error, Slot Boundary Error

Trend Display (List/Trend - Trend)

Up to four trends (Trend1 to Trend4) of decoded data can be displayed. You can also display the data values using the cursor measurement function.

Trend Display (Display)

Set whether or not to display the trend. The trend is displayed in the Trend window. The trend is not displayed for data that contains errors.* Such areas become blank.

- ON: The trend is displayed.
- OFF: The trend is not displayed.

* There are six error types. If the error type is frame number, the trend is displayed.

Display Source (Source)

When the aforementioned sync signal (Sync) source is not None, a control menu appears, and you can select the slots to display the trend of. Depending on the aforementioned number of slots (Number of Slots), select from the following range.

- When the number of slots is set to a number from 1 to 6
  Slot 1 to Slot N
  where N is the specified number of slots
- When the number of slots is set to Auto
  Slot 1 to Slot 6

If there is no data frame in the selected slot, the trend is not displayed.

Configuring the Display (Display Setup)

Set the trend display scale, and turn the display of VT waveforms on or off.

- **Auto Scale Exec**
  Executes auto scaling. The upper and lower limits are set so that the difference between the maximum data value and minimum data value in the window selected with H-Range covers 80% of the vertical scale of the Trend window.

- **H-Range**
  Select the range to display the trend of from the following windows.
  Main: Main window
  Zoom1: Zoom1 window
  Zoom2: Zoom2 window

- **VT Display**
  Select whether to display the VT waveform along with the trend display.
  ON: Displays the VT waveform display window
  OFF: Does not display the VT waveform display window

- **Upper/Lower**
  Set the vertical scale values of the trend display.

- **Cursor Measurement (Cursor)**
  You can perform cursor measurement on the trend.
  ON: Cursor1 and Cursor2 values are measured.
  OFF: Cursor measurement is not performed.

T1	Time value of Cursor1 (time from the trigger position)
T2	Time value of Cursor2 (time from the trigger position)
ΔT	Difference between the time values of Cursor1 and Cursor2
V1(TRx)	Data value at the intersection of Cursor1 and trend (Trend) x
V2(TRx)	Data value at the intersection of Cursor2 and trend (Trend) x
ΔV(TRx)	Difference between the data values at the intersection of Cursor1 and trend (Trend) x and the intersection of Cursor2 and trend (Trend)

x: 1 to 4

Search Setup (Search)

Search Type (Mode)

Select the PSI5 Airbag signal search type from one of the settings below.

- Sync: Searches for sync pulses. This will not be available if the aforementioned sync signal (Sync) source is None.
- Start Bit: Searches for the start bit of data frames
- Frame in Slot: Searches for data frames included in the specified slot. This will not be available if the sync signal source is None.
- Data: Searches for a data pattern or a data value. You can also specify a slot.
- Error: Searches for errors.

The method to set search conditions is the same as that for the trigger conditions of the PSI5 airbag trigger.

▶ See here.

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the specified detected point number (Pattern No) expanded in the zoom window.

Detected Points

The detected points are the same as the trigger points.

▶ See here.

Analyzing and Searching UART Signals (Option)

Analysis Source

Data: Searches for data patterns

For the UART data format, see “UART Trigger” in chapter 4, “Triggering.”

Bus Setup (Setup)

Source (Source)

Set the analysis source to one of the settings below. The available settings vary depending on the model.
If you select Logic, select the source bit.
CH1 to CH8, Logic (A0 to A7, B0 to B7, C0 to C7, D0 to D7),* Math1 to Math8

* C0 to C7 and D0 to D7 are available on models with the /L32 option.

Bit Rate (Bit Rate)

Select the UART signal’s data transfer rate from one of the settings below.
1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, User Define
If you select User Define, set the transfer rate in the range of 200 bps to 10000000 bps in 0.5-bps steps.

Bit Order (Bit Order) and Polarity (Polarity)

These items are the same as those of the UART signal.

▶ See here.

Sample Point (Sample Point)

You can set the reference that will be used to determine the signal level in the range of 18.8 to 90.6% in 3.1% steps.

Data Format (Format)

Select from the following.

- 8 bit No Parity: 8-bit data (no parity bit)
- 7bit Parity: 7-bit data + parity bit
- 8bit Parity: 8-bit data + parity bit

Parity (Parity)

Set the parity bit to even (Even) or odd (Odd).

Grouping (Grouping)

Select whether or not to group data when displaying the list of decoded results. When you turn grouping on, data whose time is shorter than the specified byte space (Byte Space) is decoded and displayed in a single group.

- ON: Groups the list of decoded results
- OFF: Does not group the list of decoded results

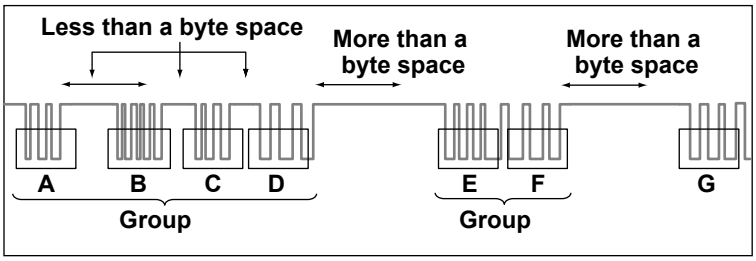
- **Byte Space (Byte Space)**

  When you turn grouping on, data whose time is shorter than the specified byte space (Byte Space) is decoded and listed in a single group. If you set the byte space to Min, data is listed in 1-byte groups.

  Range

  The selectable range is from the time length that corresponds to the number of bits in the UART signal data format plus 2 bits to 500 ms, or Min.
  The “2 bits” that are added are the start and stop bits.
  For example, if the data format is 8 bits with a parity bit, the time length is as follows:
  Data (8) + parity bit (1) + start bit (1) + stop bit (1) = Time length for 11 bits

  Resolution: 1 µs
  Default value: Time length that corresponds to the number of bits in the UART signal data format and 2 bits



Level (Level) and Hysteresis (Hys)

These items are the same as those of the edge search.

▶ See here.

Auto Setup (Auto Setup)

Auto setup is performed on the assigned source.

The bit rate, sample point, level, and hysteresis are set automatically based on the target waveform. The instrument triggers when the Trigger Settings check box is selected.

You cannot execute auto setup when:

- The sources is set to Math1 to Math8.
- The state display applied to the logic bits set in the source is ON.

Source Waveform (Source Waveform)

Select the waveform to be used as the setup condition for auto setup from the following.

- **New Waveform to Acquire (New waveform to acquire)**
  When auto setup is executed, waveforms are acquired automatically. Auto setup is performed on the acquired waveforms.
- **Waveform Currently Displayed (Waveform currently displayed)**
  This is available when waveform acquisition is stopped. Auto setup is performed based on the waveforms displayed on the screen. When history waveforms are displayed, auto setup is performed based on the waveform selected for highlighting (Select No.). This is not available when waveform acquisition is in progress.

Trigger Settings (Trigger Settings)

The trigger is set to the UART signal's Stop Bit.

If you clear the check box, the trigger is not set even when auto setup is performed.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows:

Data	Cyan (Cyan)
Parity	Yellow (Yellow)
Start Bit	Gray (Gray) fill
Stop Bit	Gray (Gray) fill
Error	Red (Red) Framing Error: Displays the words "Framing Error" in the field in which an error occurred using black characters on red background. It is displayed with higher precedence than a parity error. Parity Error: Displays the characters of the field in which an error occurred using black characters on red background.

List Display (List)

The list displays the following items.

When Grouping Is Set to ON

No.	Analysis number. Negative numbers are assigned to frames before the and positive numbers are assigned to frames after the trigger position.* The instrument can display the analysis results for up to 300000 frames in the range of −299999 to 299999. Pressing the RESET key highlights data number zero.
Time(ms)	Displays the time from the trigger position* to the start of the byte in milliseconds.
Data	Displays the first 16 bytes of data for each group in hexadecimal notation and ASCII codes. You can press the Detail soft key to view all of the data of the specified group (analysis number).
Information	Displays the following error information. If multiple errors are detected in one piece of data, the instrument only displays the framing error indication. Framing Error, Parity Error

* If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

When Grouping Is Set to OFF

Address	Displays the address relative to the first data address.
Hex	Displays the data in hexadecimal notation. An asterisk or an “X” is attached to the data if a framing error or a parity error is detected, respectively.
Ascii	Displays the data using ASCII codes.

Search Setup (Search)

Search Type (Mode)

Select the UART signal search type from one of the settings below.

- Every Data: Searches for data stop bits
- Error: Searches for errors
- Data: Searches for data patterns

The method to set search conditions is the same as that for the trigger conditions of the UART trigger.

▶ See here.

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the specified detected point number (Pattern No) expanded in the zoom window.

Detected Points

The detected points are the same as the trigger points.

▶ See here.

Analyzing and Searching I²C Bus Signals (Option)

For the I²C data format, see "I²C Bus Trigger" in chapter 4, "Triggering."

Bus Setup (Setup)

Serial Clock (SCL), Serial Data (SDA)

Set the SCL and SDA sources to one of the settings below. The available settings vary depending on the model.

Serial clock (SCL)	Serial data (SDA)
For CH1 to CH4, Math1 to Math4	CH1 to CH4, Math1 to Math4
For CH5 to CH8, Math5 to Math8	CH5 to CH8, Math5 to Math8
For Logic*	Logic*

* If you select Logic, select the source bit (A0 to A7, B0 to B7, C0 to C7, D0 to D7). C0 to C7 and D0 to D7 are available on models with the /L32 option.

Level (Level) and Hysteresis (Hys)

These items are the same as those of the edge search.

▶ See here.

Auto Setup (Auto Setup)

Executes auto setup based on the specified SCL and SDA sources.
The level and hysteresis are set automatically based on the target waveform. The instrument triggers when the Trigger Settings check box is selected.
You cannot execute auto setup when:

- SCL or SDA source is set to Math1 to Math8.
- The state display applied to the logic bits set in SCL or SDA is ON.

Source Waveform (Source Waveform)

Select the waveform to be used as the setup condition for auto setup from the following.

- **New Waveform to Acquire (New waveform to acquire)**
  When auto setup is executed, waveforms are acquired automatically. Auto setup is performed on the acquired waveforms.
- **Waveform Currently Displayed (Waveform currently displayed)**
  This is available when waveform acquisition is stopped. Auto setup is performed based on the waveforms displayed on the screen. When history waveforms are displayed, auto setup is performed based on the waveform selected for highlighting (Select No.). This is not available when waveform acquisition is in progress.

Trigger Settings (Trigger Settings)

The trigger is set to the I²C bus signal's Start (start condition).
If you clear the check box, the trigger is not set even when auto setup is performed.

R/W Bit Inclusion (Include R/W)

When you set the address pattern input format to hexadecimal, you can choose to include or omit the R/W bit when you set the address pattern.

- ON: Include the R/W bit (address + R/W bit: hexadecimal)
- OFF: Omit the R/W bit (address: hexadecimal, R/W bit: binary)

▶ See here.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows:

Start/Restart Condition	Light gray (Light Gray)
Adr	Light green (Light Green)
Data	Cyan (Cyan)
R/W	Pink (Pink)
Ack	Yellow (Yellow)
General Call	Green (Green)
Start Byte	Orange (Orange)
HS Mode	Orange (Orange)
Stop Condition	Light gray (Light Gray)

You can select whether to show or hide Start/Restart Condition and Stop Condition.

▶ See here.

List Display (List)

The list displays the following items.

No.	Analysis number. Negative numbers are assigned to frames before the and positive numbers are assigned to frames after the trigger position.[1] The instrument can display the analysis results for up to 300000 frames in the range of −299999 to 299999. Pressing the RESET key highlights data number zero.
Time(ms)	Displays the time from the trigger position[1] to the start of the byte in milliseconds.
1st[2]	Displays the first byte address in hexadecimal notation.
2nd[2]	Displays the second byte address in hexadecimal notation.
R/W	Displays the signal type. R: Read, W: Write
Data	Displays the data in hexadecimal notation. The first 16 bytes are displayed. You can press the Detail soft key to view all of the data of the specified analysis numbers.
ACK	If an Acknowledge bit is detected, the instrument displays an asterisk by the Data column.
Information	Displays the data type. general call, Start byte, Hs-mode, 10-bit, 7-bit, CBus

1 If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.

2 You can use the R/W bit inclusion setting (Include R/W) to choose whether or not to include the R/W bit in the displayed address.

Search Setup (Search)

Search Type (Mode)

I^2C bus signal search type from one of the settings below and set the search conditions.

- Every Start: Searches for start and restart conditions
- Address Data: Searches for address patterns and data patterns (AND condition)
- NON ACK: Searches for NACK (SDA is H) acknowledge bits.
- General Call: Searches for general call addresses
- Start Byte: Searches for the master codes of start bytes
- HS Mode: Searches for the master codes of HS modes

The method to set search conditions is the same as that for the trigger conditions of the I^2C bus trigger.

▶ See here.

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the specified detected point number (Pattern No) expanded in the zoom window.

Detected Points

The detected points are the same as the trigger points.

▶ See here.

Analyzing and Searching SPI Bus Signals (Option)

For the SPI time chart, see “SPI Bus Trigger” in chapter 4, “Triggering.”

Bus Setup (Setup)

Wiring system (Mode)

This item is the same as that of the SPI bus signal.

▶ See here.

Setting the Data Format (Data Setup)

Data Type (Type)

Select from the following:

Byte: Select this to set the bit order.

User: Select this to set the bit order, field size, and effective bit range.

Bit Order (Bit Order)

This item is the same as that of the SPI bus signal.

▶ See here.

Field Size (Field Size)

You can set the field size to a value between 4 and 64 bits. The instrument decodes using the specified bit unit.

Effective Bit Range (Enable MSB/LSB)

You can specify the effective bit range (0 to 63) of the field size. The instrument searches the data in the effective bit range.

Clock (Clock), Data1 (Data1), Data2 (Data2), and Chip Select (CS (SS))

Set the clock, Data1, Data2, and chip select sources from the available waveforms below. The available settings vary depending on the model.

Clock (Clock)	Data 1 (Data1), Data 2 (Data2), chip select (CS(SS))
For CH1 to CH4, Math1 to Math4	CH1 to CH4, Math1 to Math4, None (don't care)[1]
For CH5 to CH8, Math5 to Math8	CH5 to CH8, Math5 to Math8, None (don't care)[1]
For Logic[2]	Logic,[2] None (don't care)[1]

1 Only selectable for the chip select source. If you select None, set grouping to ON or OFF and the idle time (Idle Time).
2 If you select Logic, select the source bit (A0 to A7, B0 to B7, C0 to C7, D0 to D7).
C0 to C7 and D0 to D7 are available on models with the /L32 option.

Clock Idle Time and Grouping (Idle time/Grouping)
When Grouping is set to ON, the decoded results are displayed starting from the first rising or falling clock edge after the specified idle time. When Grouping is set to OFF, the data is decoded from the left of the screen, regardless of the idle time setting.
You can turn grouping on and off and set the idle time when CS (SS) is set to None (don't care).

Clock Polarity (Polarity) and Chip Select Active State (Active)

These items are the same as those of the SPI Bus trigger.
▶ See here.

Level (Level) and Hysteresis (Hys)

These items are the same as those of the edge search.
▶ See here.

Auto Setup (Auto Setup)

Executes auto setup based on the specified wiring system and the clock, Data1, Data2, and chip select sources. The level and hysteresis are set automatically based on the target waveform. The instrument triggers when the Trigger Settings check box is selected.
You cannot execute auto setup when:

- Any of the sources (i.e., clock, Data1, Data2, or chip select) is set to Math1 to Math8.
- The state display applied to any of the logic bits set in Clock, Data 1, Data 2 or Chip Select is ON.
- The chip select source is set to None (Don't care).

Source Waveform (Source Waveform)

Select the waveform to be used as the setup condition for auto setup from the following.

- **New Waveform to Acquire (New waveform to acquire)**
  When auto setup is executed, waveforms are acquired automatically. Auto setup is performed on the acquired waveforms.
- **Waveform Currently Displayed (Waveform currently displayed)**
  This is available when waveform acquisition is stopped. Auto setup is performed based on the waveforms displayed on the screen. When history waveforms are displayed, auto setup is performed based on the waveform selected for highlighting (Select No.). This is not available when waveform acquisition is in progress.

Trigger Settings (Trigger Settings)

The trigger is set to the SPI signal's first data byte.
If you clear the check box, the trigger is not set even when auto setup is performed.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows:

Data	Cyan (Cyan)
Group background	Gray (Gray)

List Display (List)

The list displays the following items.

No.	Analysis number. Negative numbers are assigned to frames before the and positive numbers are assigned to frames after the trigger position (reference point).1 The instrument can display the analysis results for up to 300000 frames in the range of −299999 to 299999. Pressing the RESET key highlights data number zero.
Time(ms)	Displays the time from the trigger position[1] to the start of the byte in milliseconds.
Data1[2]	Displays Data1 in hexadecimal notation.
Data2[2]	Displays Data2 in hexadecimal notation (only for when the wiring system is 4 Wire).

1 If delay cancel (Delay Cancel) is set to OFF, they are based on the trigger point.
2 The first 16 bytes are displayed. You can press the Detail soft key to view all of the data of the specified analysis numbers.

Search Setup (Search)

When the wiring system is 3 Wire, the instrument searches Data1 for the specified condition (data pattern).
When the wiring system is 4 Wire, the instrument searches Data1 and Data2 for the specified condition (data pattern).

Search Conditions (Condition Setup)

These conditions are the same as the SPI bus trigger conditions.

▶ See here.

However, if the field size or effective bit range is set to a value other than the default value in the data format setting (Data Setup), the search conditions will change as follows:

- Setting of the data length (Size) will not be available.
- The setting range of the comparison start position (Position) will be 0 to 9999 fields.
- The number of bits in the data pattern (Hex/Bin) will be the number of bits (1 to 64 bits) in the data range set in the effective bit range.

Note that the default value of the field size is 8, and the default value of the effective bit range is 7 for MSB and 0 for LSB.

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the specified detected point number (Pattern No) expanded in the zoom window.

Detected Points

The detected points are the same as the trigger points.

▶ See here.

Analyzing and Searching User-Defined Serial Bus Signals (User Define)

Bus Setup (Setup)

You must set the following items to analyze user-defined serial bus signals.

Source (Source)

Set the analysis source to one of the settings below. The available settings vary depending on the model.
CH1 to CH8, Math1 to Math8

Set the selected source's active state (Active), and level (Level).
This item is the same as the trigger of a user-defined serial bus signal.

▶ See here.

Level (Level) and Hysteresis (Hysteresis)

These items are the same as those of the edge search.

▶ See here.

Clock (Clock)

You can select whether or not to sample the data source in sync with the clock source.

- ON: Samples the data source in sync with the clock source
- OFF: Samples the data source according to the bit rate.

If you select ON, set the clock source (Clock), enable source (Enable), and latch source (Latch).
This item is the same as the trigger of a user-defined serial bus signal.

▶ See here.

Bit Rate (Bit Rate)

The instrument samples the data source at the specified bit rate. Set the bit rate when the clock is OFF.

Range	1000 bps to 50 Mbps
Setting resolution	0.001 kbps (for 1.000 kbps to 99.999 kbps) 0.01 kbps (for 100.00 kbps to 999.99 kbps) 0.1 kbps (for 1 Mbps to 9999.9 kbps) 1 kbps (for 10 Mbps to 50 Mbps)

Decoding Start Point (Start Point)

Set the decoding start point.

Decoded Display (Decode)

The colors that are used for the fields in the decoded display are as follows: The decoded display can only be used when the clock is not used.
Data: Cyan (Cyan)

Search Setup (Search)

Search Conditions (Condition Setup)

The method of setting search conditions is the same as that of setting the user-defined serial bus signal trigger conditions.

▶ See here.

Executing a Search (Search)

The instrument searches for locations where the specified search conditions are met. Then, the instrument displays the specified detected point number (Pattern No) expanded in the zoom window.

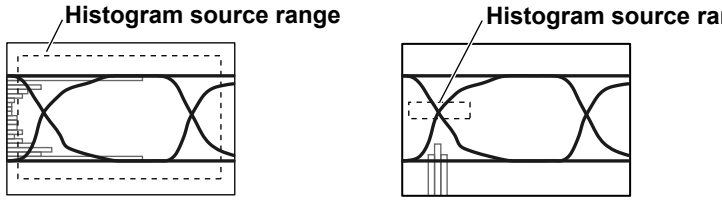
Detected Points

The detected points are the same as the trigger points.

▶ See here.

16 Waveform Histogram Display

The instrument can count the frequency of data occurrence in a specified area and display in a histogram. You can select whether to count the voltage data frequency or the time data frequency.
You can measure the mean, standard deviation, maximum value, minimum value, peak value, median, etc.
You can set up to two histogram source waveforms (Histogram1, Histogram2).



Histogram on the voltage axis **Histogram on the time axis**

Turning the Histograms On or Off (Display)

Sets whether or not to display histograms for Histogram1 and Histogram2.

- OFF: Hides the histograms
- ON: Displays the histograms

Source Waveform (Trace)

Select the source waveform from the waveforms below. The available settings vary depending on the model.
CH1 to CH8, Math1 to Math8

Source Axis (Type)

Selects the data axis that you want to count the frequency for.

- Vertical: Vertical axis
- Horizontal: Time axis

Range Setup (Range Setup)

Source Window (Range)

Selects the window that you want to count the frequency in.

- Main: Main window
- Zoom1: Zoom1 window
- Zoom2: Zoom2 window

Upper and Lower Range Limits (Upper/Lower)

Sets the upper and lower limits within which frequencies are counted in the range of ±4 divisions.

Left and Right Range Values (Left/Right)

Sets the left and right boundaries within which frequencies are counted in the range of ±4 divisions.

Histogram Frequency

The frequency of values is counted until the waveform display is updated. The frequency is reset when the waveform display is updated.

Measurement (Measure Setup)

Mode (Mode)

OFF: Disables measurement.

Param: Measures the value of the selected parameter and performs cursor measurement.

Displaying Cursor Values (Cursor1/Cursor2)

Measurement items C1, C2, and ΔC are used to measure the Cursor1 value, the Cursor2 value, and the difference between the two cursor values. The selectable range varies depending on the source axis as follows:

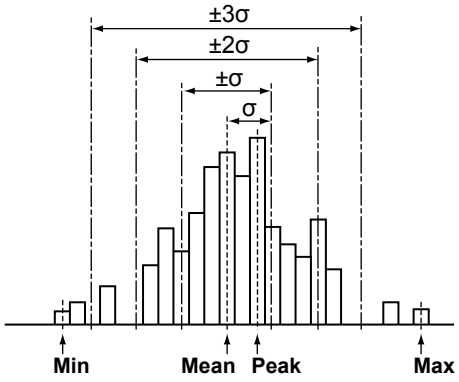
- If the source axis is vertical (Cursor1 =, Cursor2 =): In the range of ±4 divisions of the vertical axis
- If the source axis is horizontal (Cursor1 II, Cursor2 II): In the range of ±4 divisions of the time axis

Histogram Parameter (Item)

The instrument measures the values of the items listed below that you select.

Peak	Peak value
Max	Maximum value
Min	Minimum value
Mean	Mean value
σ	Standard deviation of the histogram
Median	Median*
Integ±σ	Percentage of values that fall within ±σ (%)
Integ±2σ	Percentage of values that fall within ±2σ (%)
Integ±3σ	Percentage of values that fall within ±3σ (%)
C1	Cursor1 value
C2	Cursor2 value
ΔC	Difference between Cursor1 and Cursor2

* Re-sorts the sampled points from the minimum to the maximum value and determines the value at [total number of samples/2] from the maximum point.



17 Power Supply Analysis Feature (Power Analysis and Power Measurement, Option)

Overview of the Power Supply Analysis Feature

The power supply analysis feature consists of (1) analysis features such as switching loss analysis, safe operating area analysis, harmonic analysis, and Joule integral and (2) power measurement features for voltage, current, power, watt-hours and ampere-hours.

Power Analysis (Power Analysis)

Type (Type)

Select the power supply analysis type from one of the settings below.

- OFF: Disables power supply analysis
- SW Loss: Switching loss analysis
- SOA: Safe operating area analysis
- Harmonics: Harmonic analysis
- I^2t: Joule integral

Power Measurement (Power Measurement)

Power of up to four circuits (Power Measurement1 to Power Measurement4) can be measured simultaneously. For details, see “Power Measurement (Power Measurement),” provided later.

Deskewing the Transfer Time Difference between Analysis Source Signals

To correctly measure power supply analysis items from the voltage and current, you must apply the voltage and current signals to the instrument’s signal input terminals with no transfer time difference between the signals. However, transfer time difference may occur between the two signals depending on the probe that you are using. The instrument allows you to automatically or manually deskew the transfer time difference between the two signals and then measure analysis items and power measurement items. To use this feature, you need to connect a deskew signal source along with the probe beforehand.
We recommend that you use the following YOKOGAWA products when you deskew the signals.

Deskew signal source	701936
Passive probe	701937
Differential probe	701927, 701978, 702921, 702922
Current probe	701928, 701929, 701930, 701931, 701932, 701933

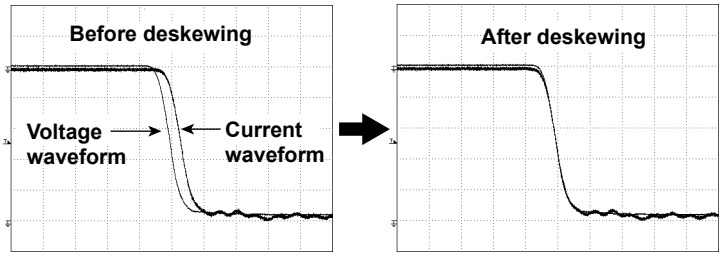
Notes about Auto Deskewing

- Use the 701936 as the deskew signal source.
- Use a current probe whose attenuation is 10 A:1 V. When you use the 701936 deskew signal source, you can also use current probes whose attenuation is 100 A:1 V.
- There is a unique interval between the voltage and current output waveforms of the 701936 deskew signal source. This interval is a result of the electrical length and impedance of the signal output section. Because in auto deskew the unique value is corrected automatically, after auto deskew is performed, the voltage and current waveform values are off by the amount of the unique value. For information about the unique value and about manual skew correction, see the 701936 deskew signal source user’s manual.



You need power supplies to use the deskew signal source and current and differential probes without the YOKOGAWA probe interface (differential probes can run on batteries). If the instrument is not equipped with the probe power option (/P4 or /P8), you need to use the probe power supply (701934), which is sold separately.

Example of Deskewing



Switching Loss Analysis (SW Loss)

You can measure the device's total loss (power loss) and switching loss (power loss during switching).
If you select SW Loss, you can calculate statistics and display power waveforms and measured values.

You can display a total of up to 30 switching loss measurement items and automatically measured waveform parameter items. If measured switching loss values are not displayed, reduce the number of automatically measured waveform parameter items.

▶ See here.

Probe Setup (Probe Setup)

Selecting Channels (Input Channels)

Select CH1 and CH2 or CH3 and CH4. You cannot change these pairs.
To measure power supply analysis items, apply the voltage signal to CH1 or CH3 and the current signal to CH2 or CH4.

Probe Attenuation Ratio and Voltage-to-Current Conversion Ratio (Probe CH1/CH2 or Probe CH3/CH4)

Select one of the probe attenuation ratios (CH1 or CH3) and one of the voltage-to-current conversion ratios (CH2 or CH4) listed below.

- CH1, CH3
  0.001:1, 0.002:1, 0.005:1, 0.01:1, 0.02:1, 0.05:1, 0.1:1, 0.2:1, 0.5:1, 1:1, 2:1, 5:1, 10:1, 20:1, 50:1, 100:1, 200:1, 500:1, 1000:1, 2000:1
- CH2, CH4
  0.001 A: 1 V, 0.002 A: 1 V, 0.005 A: 1 V, 0.01 A: 1 V, 0.02 A: 1 V, 0.05 A: 1 V, 0.1 A: 1 V, 0.2 A: 1 V, 0.5 A: 1 V, 1 A: 1 V, 2 A: 1 V, 5 A: 1 V, 10 A: 1 V, 20 A: 1 V, 50 A: 1 V, 100 A: 1 V, 200 A: 1 V, 500 A: 1 V, 1000 A: 1 V, 2000 A: 1 V

Changing the probe attenuation ratio or voltage-to-current conversion ratio here will change the same ratio in the CH key probe settings.

Deskewing Manually (Deskew CH1/CH2 or Deskew CH3/CH4)

You can set values for deskewing the transfer time difference between signals on each channel.

Auto Deskew Reference Waveform (Ref Trace)

Sets the reference waveform for auto deskewing. The instrument deskews the input signals by using the specified waveform as its reference.

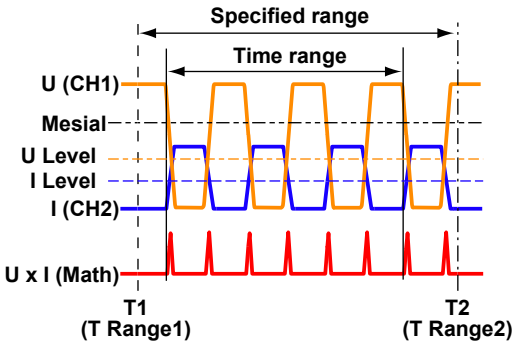
Auto Deskewing (Auto Deskew)

Executes auto deskewing.

You can also manually deskew the input signals by using the jog shuttle.

Measurement Setup (Measure Setup)

Loss over multiple cycles can be measured within the period specified by the T Range1 and T Range2 cursors. The number of cycles is calculated based on the intersection of the mesial level and voltage waveform, the intersection of the U Level and voltage waveform, and the intersection of the I Level and current waveform. The total loss that is corrected depending on the type of loss (described later) can also be measured.



If the specified period does not contain one cycle of waveform, the measured value is displayed as "*****."

Type of Loss (Conduction Calc)

Select the type of loss from one of the settings below.

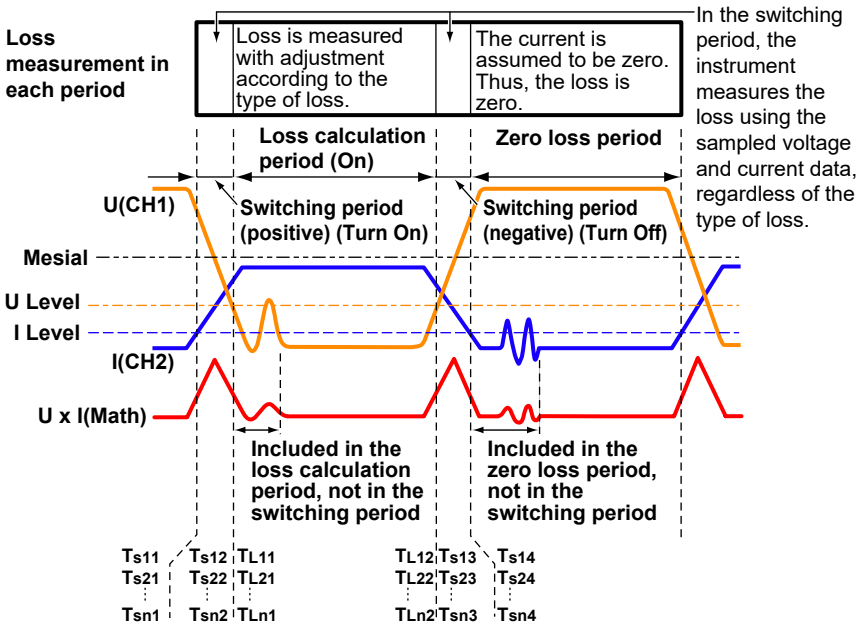
U x I: The loss over the loss calculation period is measured using the voltage and current waveforms.

RDS(on) x I^2: The loss over the loss calculation period is measured on the basis of the device's on-resistance, RDS(on).

VCE(sat) x I: The loss over the loss calculation period is measured on the basis of the device's collector-emitter saturation voltage, Vce(SAT).

The total loss (Total) is measured according to the following equation using the loss over the loss calculation period measured based on the type of loss.

Total loss = Loss in the loss calculation period + loss in the switching period



- Loss calculation period: The period from the point where the voltage waveform goes below the U:Level immediately after the waveform goes below the mesial level to the point where the waveform goes above the U:Level immediately before the waveform goes above the mesial level.

  If there are n voltage waveform cycles between the T Range1 and T Range2 cursors

  When the type of loss is U x I,

  Loss in the loss calculation period

  $$= \int_{TL11}^{TL12} u(t)\cdot i(t)\,dt + \int_{TL21}^{TL22} u(t)\cdot i(t)\,dt \cdots + \int_{TLn1}^{TLn2} u(t)\cdot i(t)\,dt$$

  When the type of loss is RDS(on) x I2,

  Loss in the loss calculation period

  $$= RDS(on)\left\{ \int_{TL11}^{TL12} i(t)^2\,dt + \int_{TL21}^{TL22} i(t)^2\,dt \cdots + \int_{TLn1}^{TLn2} i(t)^2\,dt \right\}$$

  When the type of loss is VCE(sat) x I,

  Loss in the loss calculation period

  $$= Vce(SAT)\left\{ \int_{TL11}^{TL12} i(t)\,dt + \int_{TL21}^{TL22} i(t)\,dt \cdots + \int_{TLn1}^{TLn2} i(t)\,dt \right\}$$

  RDS(on): On-resistance
  Vce(SAT): Collector-emitter saturation voltage
  u(t): Sampled voltage data
  i(t): Sampled current data
  T_{L11}, T_{L12}, T_{L21}, $T_{L22}\cdots T_{Ln1}$, T_{Ln2}: Time values in the loss calculation period

- Zero loss period: The period from the point where the current waveform first goes below the I:Level after the waveform passes the middle point of the loss calculation period to the point where the waveform first goes above the I:Level after the waveform passes the middle point between the relevant loss calculation period and the next loss calculation period. The instrument assumes that the current and loss are zero.
- Switching period: The period other than the loss calculation period or zero loss period described above. Positive switching period is the period in which the current waveform is rising; negative switching period is that in which the current waveform is falling.

  If there are n voltage waveform cycles between the T Range1 and T Range2 cursors, there are 2n switching periods.

  Loss in the switching period

  $$= \int_{Ts11}^{Ts12} u(t)\cdot i(t)\,dt + \int_{Ts13}^{Ts14} u(t)\cdot i(t)\,dt + \int_{Ts21}^{Ts22} u(t)\cdot i(t)\,dt + \int_{Ts23}^{Ts24} u(t)\cdot i(t)\,dt \cdots + \int_{Tsn1}^{Tsn2} u(t)\cdot i(t)\,dt + \int_{Tsn3}^{Tsn4} u(t)\cdot i(t)\,dt$$

  u(t): Sampled voltage data
  i(t): Sampled current data
  T_{s11}, T_{s12}, T_{s13}, T_{s14}, T_{s21}, T_{s22}, T_{s23}, $T_{s24}\cdots T_{sn1}$, T_{sn2}, T_{sn3}, T_{sn4}:
  Time values in the switching period

Level Setup (Level Setup)

Sets the voltage level (U:Level) and current level (I:Level) that are used to determine the loss period and cycle as well as the RDS(on) or VCE(sat) values used to measure the loss over the loss calculation period.

Set the voltage level (U:Level) and current level (I:Level) within the amplitude range of the source waveforms.

Reference Levels (Ref Levels)

Sets the reference levels (distal, mesial, and proximal) used to determine the loss as percentages or as voltage values. This feature is the same as the reference level of the automated measurement of waveform parameters.

▶ See here.

- Set the mesial value to a value greater than U Level. If the mesial value is set to a value that is less than U Level, the measured values will be displayed as "*****."
- If you set the reference levels using percentages, the distal, mesial, and proximal voltage values are determined depending on the waveform.
- If you want to set reference levels that do not change based on the waveform, set the levels as voltage values.
- Changing the reference level settings here will also change the reference level settings for the automated measurement of waveform parameters.

Measurement Items (Item Setup)

You can select which items to measure from the list below.

- Loss (Wp):
  Turn On (loss over the switching period (positive)), On (loss over the loss calculation period), Turn Off (loss over the switching period (negative)), Total (loss over the switching period (positive and negative), sum of the losses in the loss calculation period)
  The definition of the loss over the loss calculation period is different depending on the type of loss.
  ▶ See here.
- Loss per unit time (P): Turn On, On, Turn Off, Total
  Turn On, On, Turn Off, and Total of the loss per unit time (P) correspond to those of the above loss (Wp).
  The loss per unit time is determined by dividing the loss by time Tc. ▶ See here.
- Cycle Count (Cycle Count)
  Cycle count in the period specified by the T Range1 and T Range2 cursors ▶ See here.

The maximum number of measurement items that can be displayed is 30 including the automatically measured waveform parameters. If the measured switching loss values are not displayed, reduce the number of automatically measured waveform parameters.▶ See here.

Unit Setting (Unit)
Select the unit to use when displaying the measured values of Turn On, On, Turn Off, and Total of loss (Wp).
Wh: Watt-hours
J: Joules

The relationship between watt-hours and joules is as follows: Wh=J/3600

Turning the Measurement Location Indicator On and Off (Indicator)

Indicates with cursors the switching period (Turn On, Turn Off), the loss calculation period (On), and the measurement location on the time axis at the end of the cycle.

- ON: Cursors are displayed on the screen.
- OFF: Cursors are not displayed.

▶ See here.

Statistics (Statistics)

Statistics are displayed for the automated measurement values of waveform parameters. This item is the same as that of the automated measurement of waveform parameters.

▶ See here.

Source Window (Time Range)

Specify the range over which to measure the loss by selecting one of the following windows.
Main: Main window
Zoom1: Zoom1 window
Zoom2: Zoom2 window

Measurement Time Period (T Range1/T Range2)

The measurement time period is the range that can be extracted as a cycle within the range specified by T Range1 and T Range2.

Displaying Measured Results

When measurement results are displayed on the screen, symbols that indicate the measurement item and measurement channel are shown in front of the measured values as shown below.

Example
PTotal(C1)
PTotal: Sum of active power
C1: Voltage channel

Power Waveform Display (Power(Math1))

ON: The power waveform is displayed.
OFF: The power waveform is not displayed.

The instrument computes the power value by multiplying the actual measured values for voltage and current. The power waveform display is not affected by the specified U:Level or I:Level, even when cycle mode is on.

Scaling (Ranging (Math1))

Specify the vertical display range of the power waveform.

Auto (Auto Scaling)

The vertical display range is determined automatically based on the computed results.

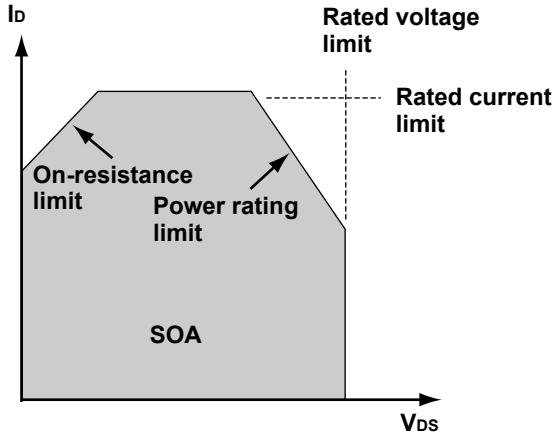
Manual (Manual Scaling)

Set the display range by specifying the center power value (Center) on the vertical axis and the power per division (Sensitivity).

Safe Operating Area Analysis (SOA)

Operating area characteristics of power devices and other devices can be evaluated by plotting the voltage input channel on the x-axis (horizontal axis) and the current input channel on the y-axis (vertical axis). You can check whether the operation of a power device is within the safety operation area (SOA) (enclosed area) indicated in the following figure.

Selecting SOA automatically sets the instrument to XY display mode.



Probe Setup (Probe Setup)

The channel selection, probe attenuation, voltage-to-current conversion ratio, and deskew settings are the same as those for the switching loss analysis (SW Loss) feature.

▶ See here.

Turning the VT Waveform Display On or Off (VT Display)

The SOA is displayed in the XY window. Use this setting to choose whether or not to display VT waveforms with the XY waveforms.

OFF: The VT waveform display window does not appear.

ON: The VT waveform display window appears.

Cursor Measurement (Cursor)

You can display two cursors on both the X and Y axes and measure with them simultaneously.

The cursor setting range and measurement range are the same as those described in "Cursor Measurement (Cursor)" in chapter 8, "Displaying XY Waveforms."

▶ See here.

Analysis Range (T Range1, T Range2)

Sets the start point (T Range1) and the end point (T Range2) of the analysis range.

Selectable range: ±5 divisions with the center of the target window taken to be 0 divisions.

Harmonic Analysis (Harmonics)

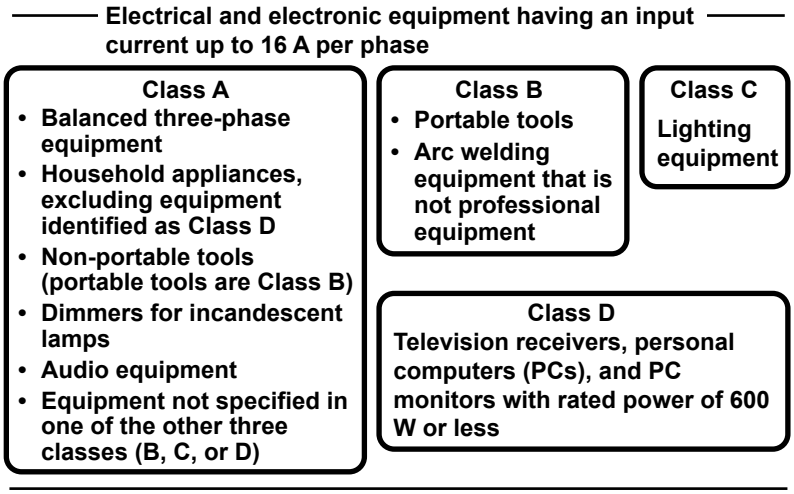
You can measure and analyze harmonics.
The harmonics display appears when you select Harmonics.

Harmonics

Harmonics are sine waves whose frequencies are integer multiples of the fundamental wave (normally a 50- or 60-Hz utility frequency sine wave). The input currents that flow through the power rectification circuits, phase control circuits, and other circuits used in various kinds of electrical equipment generate harmonic currents and voltages in power lines. When the fundamental wave and harmonic waves are combined, waveforms become distorted, and interference sometimes occurs in equipment connected to the power line.
The instrument can analyze the harmonics generated by the applicable devices specified in the IEC standards according to their device class (A to D).[1, 2] To take measurements accurately in accordance with IEC standards, we recommend that you use a WT5000 precision power analyzer and harmonic measurement software, both provided by YOKOGAWA. However, the harmonic analysis features on the DLM series are a good way of measuring general characteristics.

1 IEC 61000-3-2 Edition 4.0
EN 61000-3-2(2006)
IEC 61000-4-7 Edition 2.1

2 “Applicable devices” refers to electrical and electronic devices that are connected to low voltage power distribution systems and that receive 16 A or less of current per cycle. The figure below provides a broad description of the applicable devices. However, while the instrument can perform harmonic analysis on single-phase devices, it cannot perform analysis on three-phase devices.



Fundamental Wave

The sine wave with the longest period among different sine waves derived from the periodic complex wave or the sine wave with the fundamental frequency among complex wave components.

Fundamental Frequency

In a periodic complex wave, this is the frequency corresponding to the longest period (the frequency of the fundamental wave).

Harmonic Order (harmonic order)

The ratio of the harmonic frequency to the fundamental frequency, expressed as an integer.
The instrument can analyze harmonic components up to the 40th harmonic.

Harmonic Component (harmonic component)

The components of waveforms whose frequency is an integer multiple of two or more of the fundamental frequency.

Interharmonics (interharmonics)

If the input signal is 50 Hz in IEC harmonic measurement, a Fourier transform is taken on 10 periods of the input signal to derive frequency components in 5-Hz resolution. As a result, the area between two harmonics is divided into 10 frequency components. Interharmonics is the term used to refer to these intermediate frequency components.
If the input signal is 60 Hz, a Fourier transform is taken on 12 periods of the input signal to derive frequency components in 5-Hz resolution. As a result, the area between two harmonics is divided into 12 frequency components.

Measurement Conditions

To analyze harmonics, use the following measurement conditions.

Trigger Mode

To continuously analyze harmonics while acquiring waveforms, set the trigger mode to Normal.

▶ See here.

Time Window

Rectangle (rectangular window)

▶ See here.

Number of Waveforms and Number of Waveform Data Points

To perform analysis in accordance with harmonic current emission standards, you must configure the instrument so that the number of data points and the number of periods meet the following conditions.

- Number of data points
  9000 points or more in 200 ms of data
- Period
  50-Hz power supply (45 Hz to 55 Hz): 10 periods of data
  60-Hz power supply (55 Hz to 65 Hz): 12 periods of data

Probe Setup (Probe Setup)

The channel selection, probe attenuation, voltage-to-current conversion ratio, and deskew settings are the same as those for the switching loss analysis (SW Loss) feature.

▶ See here.

Analysis Start Point (Start Point)

Set the analysis start point.

Power Supply Voltage of the EUT (System Volt)

Set the power supply voltage of the device that you want to perform harmonic analysis on. The instrument uses the power supply voltage to determine the harmonic limits set by the harmonic current emission standard and uses the limits as references (see below for more information). The default setting is 230 V.
Selectable range: 90 V to 440 V
Resolution: 1 V
The harmonic current emission standard lists the limits for each harmonic when the (single-phase) power supply voltage is 220 V, 230 V, or 240 V. The limits for other power supply voltages must be determined through conversion. When the power supply voltage is outside of the range of 220 to 240 V, the instrument's power supply analysis feature uses the following equation to determine the limits for each class.

Converted limit = Limit for each class × 230/Equipment power supply voltage

Setting the Applicable Class (Class Setup)

Configure class-related settings.

Class (Class)

Sets the applicable class to A, B, C, or D.

- **Necessary Class C Settings**
  EUT's active power (Over 25 watts)
  Select whether the EUT's active power exceeds 25 W (True) or not (False). For class C, the reference values change depending on the EUT's active power.

  EUT's fundamental current (Fund Current)
  Set the fundamental current when the EUT's load is at its maximum. To set the maximum current that is measured on the instrument, perform harmonic analysis with the maximum load, and then use the Max value that appears under the Order 1 column in the list. For class C, evaluation is performed based on the ratio of harmonic components to the EUT's maximum fundamental current.

  Power Factor (λ)
  If the EUT's active (input) power exceeds 25 W (True), set the power factor that is observed when the EUT's load is at its maximum. You can acquire and use the currently measured power factor of the EUT (Get λ). For class C, if the EUT's active (input) power exceeds 25 W, the circuit power factor observed when the EUT's load is at its maximum is used to evaluate the ratio of the third harmonic component to the fundamental current.
  The default setting is 0.80000.
  Selectable range: 0.01 to 1.000
  Resolution: 0.001
- **Necessary Class D Settings**
  EUT's active power (Power)
  Set the EUT's active power. For class D, the harmonic current per watt (power ratio limit) is also used in the evaluation.

Harmonic Grouping (Grouping)

There are three types of IEC harmonic groupings. The method for calculating the magnitude of the harmonic rms values is different for each grouping.

Grouping Type (Type)

- No grouping (OFF)
  Only components whose frequencies are integer multiples of the fundamental wave are considered harmonics. Interharmonic components are not included.
- Grouping Type 1 (Type1)
  A harmonic subgroup is treated as a component of the subgroup's harmonic. A harmonic subgroup includes a given harmonic and its two adjacent interharmonics. Therefore, if the input signal includes a harmonic subgroup, harmonic values will be greater than they are when grouping is turned off.
- Grouping Type 2 (Type2)
  A harmonic group is treated as a component of the group's harmonic. A harmonic group includes a given harmonic and all of its adjacent interharmonics. Therefore, if the input signal includes a harmonic group, harmonic values will be greater than they are when grouping is turned off.

Applicable Standard (IEC 61000-4-7)

Ed.2.0: IEC 61000-4-7 Ed.2.0.
Ed.2.1: IEC 61000-4-7 Ed.2.1. Only the second harmonic. Intermediate harmonic components less than the second harmonic are not included.

Configuring the Display (Display Setup)

Turn the display of VT waveforms on or off and set the bar graph display method.

VT Waveform Display Window (VT Display)

OFF: Does not display the VT waveform display window
ON: Displays the VT waveform display window

Bar Graph Display (Scale)

You can display a bar graph of the computed values and the standard limits of each harmonic up to the 40th harmonic. You can set the scale to Linear or Log (logarithmic).

List Display (List)

You can display a list of the computed values and the standard limits of each harmonic up to the 40th harmonic. The contents of the list vary according to the class.

- When the class is A, B, or D
  The list contains harmonic orders, their values and limits in amps, and information.
- When the class is C
  The list contains harmonic orders, their values in amps, their limits (the standard limit ratio × the fundamental current value in amps), their values as percentages (computed harmonic value in amps ÷ fundamental current value in amps), their limits as percentages (ratio of the harmonic to the fundamental current), and information.

The list also displays total harmonic distortion as percentages and rms values in amps. k denotes a harmonic order.

- **Total harmonic distortion (THD) [%]**

$$\frac{\sqrt{\sum_{k=2}^{40} I(k)^2}}{I(1)}$$

- **RMS value (RMS) [A]**

$$\sqrt{\sum_{k=1}^{40} I(k)^2}$$

List Size (List Size)

Select the list size and display position from one of the settings below.
Full Screen: Displays the list in full-screen mode
Half(Upper): Displays the list in the top half of the screen
Half(Lower): Displays the list in the bottom half of the screen

Saving the List (Save List)

You can save the data of the analysis results of each harmonic and standard limits in CSV format to a storage device. The extension is .csv.

Analysis Number (List No.)

The line corresponding to the number you select is highlighted.

- The instrument can perform harmonic analysis on single-phase devices but not on three-phase devices.
- IEC 61000-4-7 specifies that the measured data be smoothed using a first-order filter for 1.5 seconds, but the harmonics analysis results on the instrument are instantaneous values. Therefore, the results do not fully comply with the standard. To take make proper measurements in accordance with the standard, you need to use a YOKOGAWA WT3000 series digital power meter and its harmonic measurement software (761921).
- You can save the analysis results and the standard limits of each harmonic component to a CSV file. You cannot save the harmonic waveform data.
- You can save the original waveform data that you used for harmonic analysis. If you save the waveform data, you can load it onto an instrument with the power supply analysis feature (/G03 option) and perform harmonic analysis.
- You cannot perform harmonic analysis if 10 periods (for 45 Hz to 55 Hz) or 12 periods (for 55 Hz to 65 Hz) of a waveform correspond to less than 200 ms or if the number of data points is less than 9000 points. If this occurs, “--------” appears in the Measure (A) and Measure (%) columns in the list. “--------” also appears for harmonic limits (Limit(A)) that are not specified for a particular class.

Measuring Inrush Current by Computing the Joule Integral (I^2t)

Measure the Joule integral (I^2t) of the inrush current. This feature is useful when you are evaluating and comparing items such as device fuses.

When you select I^2t, you can display measured values and a waveform of the Joule integral and compute statistics.

Joule integral $I^2t\ [A^2s] = \int_0^T i(t)^2\ dt$

T: Measurement time period
i(t): Sampled current data

Probe Setup (Probe Setup)

The channel selection, probe attenuation, voltage-to-current conversion ratio, and deskew settings are the same as those for the switching loss analysis (SW Loss) feature.

▶ See here.

Measurement Setup (Measure Setup)

Measurement Item (Item)

OFF: The Joule integral measured values are not displayed.
I^2t: The Joule integral measured values are displayed.

You can display a total of up to 30 Joule integral measurement items and automatically measured waveform parameter items. If measured Joule integral values are not displayed, reduce the number of automatically measured waveform parameter items.

▶ See here.

Source Window (Time Range)

Specify the range over which to measure the Joule integral by selecting one of the following windows.
Main: Entire main window
Zoom1: Entire Zoom1 window
Zoom2: Entire Zoom2 window

Measurement Time Period (T Range1/T Range2)

Set the measurement time period in the source window.

The measurement range when power analysis I^2t is specified is shared with the measurement range that is specified for the normal automated measurement of waveform parameters (Area1).

Displaying Measured Results

When measurement results are displayed on the screen, symbols that indicate the measurement item and measurement channel are shown in front of the measured values as shown below.

Example
I^2t(C2)
I^2t: Joule integral
C2: Current channel

Joule Integral (I^2t) Waveform Display (I^2t(Math1))

ON: The Joule integral (I^2t) waveform is displayed. Computation settings (MATH/REF) become invalid.
OFF: The Joule integral (I^2t) waveform is not displayed. Computation settings (MATH/REF) are valid.

All Ranging (Auto Ranging)

You can execute auto ranging. Use this feature when the waveform amplitude changes greatly and the waveform is difficult to view.
You can also set the display range by specifying the vertical center I^2t value (Center) of the display area and the I^2t value per division (Sensitivity).

In Joule integral measurement, you can compute statistics in three different modes: Continuous, Cycle, and History.

Power Measurement (Power Measurement)

Power of up to four circuits (Power Measurement1 to Power Measurement4) can be measured simultaneously.

* 4ch models have up to two circuits (Power Measurement1, Power Measurement2).

Turning Power Measurement ON or OFF (Mode)

Set whether to make power measurements.

- ON: Power measurement is enabled.
- OFF: Power measurement is disabled.

- Power supply analysis and power measurement of the power supply analysis feature cannot be executed simultaneously. If any of the power measurement items, Power Measurement1 to Power Measurement4, is set to ON, the power supply analysis is set to OFF. If power supply analysis is set to something other than OFF, all power measurements are set to OFF.
- For input channels that are assigned to power measurement and whose mode is set to ON, the following waveform parameters cannot be set: Max, Min, P-P, Rms, Mean, Sdev (AC RMS), Avg Freq. This is because these parameters overlap with those of the power measurement parameters, and the power measurement parameters are used in their place. ▶ See here.
- If any of the power measurement modes is set to ON, cycle mode of automated measurement of waveform parameters is set to OFF.

Probe Settings (Probe Setup)

The pairs of voltage and current input channels are fixed. Refer to the table below and apply the appropriate voltage and current signals. You cannot change these pairs.

Power Measurement	Voltage Input Channel	Current Input Channel
Power Measurement1	CH1	CH2
Power Measurement2	CH3	CH4
Power Measurement3	CH5	CH6
Power Measurement4	CH7	CH8

Probe Attenuation Ratio and Voltage-to-Current Conversion Ratio (Probe CH1/CH2, Probe CH3/CH4, Probe CH5/CH6, and Probe CH7/CH8)

Select the probe attenuation (CH1, CH3, CH5, and CH7) and voltage-to-current conversion ratio (CH2, CH4, CH6, and CH8).

- CH1, CH3, CH5, CH7
  0.001:1, 0.002:1, 0.005:1, 0.01:1, 0.02:1, 0.05:1, 0.1:1, 0.2:1, 0.5:1, 1:1, 2:1, 5:1, 10:1, 20:1, 50:1, 100:1, 200:1, 500:1, 1000:1, 2000:1
- CH2, CH4, CH6, CH8
  0.001 A:1 V, 0.002 A:1 V, 0.005 A:1 V, 0.01 A:1 V, 0.02 A:1 V, 0.05 A:1 V, 0.1 A:1 V, 0.2 A:1 V, 0.5 A:1 V, 1 A:1 V, 2 A:1 V, 5 A:1 V, 10 A:1 V, 20 A:1 V, 50 A:1 V, 100 A:1 V, 200 A:1 V, 500 A:1 V, 1000 A:1 V, 2000 A:1 V

Changing the probe attenuation ratio or voltage-to-current conversion ratio here will change the same ratio in the CH key probe settings.

Deskewing Manually (Deskew CH1/CH2, Deskew CH3/CH4, Deskew CH5/CH6, and Deskew CH7/CH8)

You can set values for deskewing the transfer time difference between signals on each channel.

Reference Waveform (Ref Trace)

Sets the reference waveform for auto deskewing. The instrument deskews the input signals by using the specified waveform as its reference.

Auto Deskewing (Auto Deskew)

Executes auto deskewing.

You can also manually deskew the input signals by using the jog shuttle.

Measurement Setup (Measure Setup)

Like automated measurement of waveform parameters, items related to power can be measured automatically. Set the measurement item for each input channel.

Input channels and Measurement Items (Item Setup)

- **Measurement Items of Voltage Input Channels CH1, CH3, CH5, and CH7**

  Voltage: U+pk, U−pk, Up-p, Urms, Udc, Uac, Umn, Urmn
  Average frequency: Avg Freq
  Power: S, P, Q
  Impedance: Z
  Power factor: λ
  Watt hours: Wp, Wp+, Wp−, Abs.Wp
  For details on each item is determined, see appendix 5.
  ▶ See here.

  Unit (UNIT)
  Select the unit to use when displaying the measured values for Wp, Wp+, Wp−, and Abs.Wp.
  Wh: Watt-hours
  J: Joules

The relationship between watt-hours and joules is as follows: Wh=J/3600

- **Measurement Items of Current Input Channels CH2, CH4, CH6, and CH8**

  Current: I+pk, I−pk, Ip-p, Irms, Idc, Iac, Imn, Irmn
  Average frequency: Avg Freq
  Ampere hours: q, q+, q−, Abs.q
  For details on each item is determined, see appendix 5.
  ▶ See here.

  - The maximum number of measurement items that can be displayed is 30 including the automatically measured waveform parameters. If the measured power values are not displayed, reduce the number of automatically measured waveform parameters. ▶ See here.
  - For input channels that are assigned to power measurement and whose mode is set to ON, the following waveform parameters cannot be set: Max, Min, P-P, Rms, Mean, Sdev (AC RMS), Avg Freq. This is because these parameters overlap with those of the power measurement parameters, and the power measurement parameters are used in their place.
    If you select any of the power measurement item U+pk, U−pk, Up-p, Urms, Udc, Uac, Avg Freq, I+pk, I−pk, Ip-p, Irms, Idc, Iac, and Avg Freq check boxes, the corresponding input channel waveform parameter Max, Min, P-P, Rms, Mean, Sdev (AC RMS), or Avg Freq check boxes will be selected.

Reference Levels (Ref Levels)

To determine the average frequency (Avg Freq), set the reference levels (distal, mesial, proximal) for each of the input channels as percentages or voltages. This feature is the same as the reference level of the automated measurement of waveform parameters.
▶ See here.

- If you set the reference levels using percentages, the distal, mesial, and proximal voltage values are determined depending on the waveform.
- If you want to set reference levels that do not change based on the waveform, set the levels as voltage values.
- Changing the reference level settings here will also change the reference level settings for the automated measurement of waveform parameters.

Measurement Location Indicator (Indicator)

Indicates the measured location of a specified item using cursors. You can select one item from the power measurement items whose check boxes are selected.

Cycle Mode (Cycle Mode)

OFF: Sets the measurement time range between T Range1 and T Range2.
N Cycle: Sets the time range to the left end of the first period that is between T Range1 and T Range2 to the right end of the Nth period

Calculations That Use Automated Measurement Values (Calc Setup)

You can define four calculations (Calc1 through Calc4) that use the measured power values. This feature is the same as the calculation of the automated measurement of waveform parameters. However, the measurement items that you can select from the Measure menu of the displayed expression dialog box are power measurement items.
▶ See here.

Statistics (Statistics)

Display the following five statistics on the automated measurement values of waveform parameters.

- Maximum (Max)
- Minimum (Min)
- Mean (Mean)
- Standard deviation (σ)
- The number of measured values used to calculate statistics (Count)

This item is the same as that of the automated measurement of waveform parameters.

▶ See here.

Source Window (Time Range)

Specify the range over which to measure the power by selecting one of the following windows.

Main: Main window

Zoom1: Zoom1 window

Zoom2: Zoom2 window

Measurement Time Period (T Range1/T Range2)

Set the measurement time period in the source window.

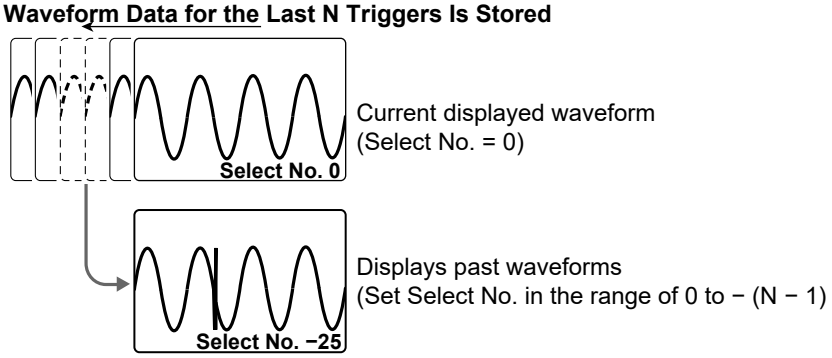
18 Displaying and Searching History Waveforms

Acquisition memory stores waveforms that are displayed on the screen and waveform data that have been acquired in the past. The history feature allows you to display or search past waveforms (history waveforms). You can perform the following operations on history waveforms:

- **Display**

  You can display any single waveform or display all waveforms without gradation (and highlight only the specified waveform). You can also assign colors or intensities based on the frequency of occurrence of waveforms. You can list the timestamps (the trigger times) of all history waveforms.

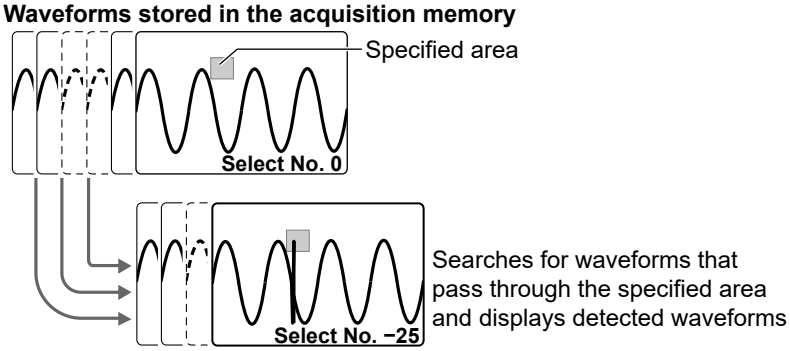
  Waveform Data for the Last N Triggers Is Stored



- **Search**

  You can search for waveforms that meet the specified conditions, display the detected history waveforms, and list the timestamps of the waveforms.

  Waveforms stored in the acquisition memory



- **Average**

  You can linearly average history waveforms in a specified range and display the averaged waveform.

- **Calculation, Cursor Measurement, Automated Measurement, Statistical Processing, and FFT**

  You can perform calculations, cursor measurement, automated measurement of waveform parameters, or FFT analysis on the history waveform that you specified with Select No. You can also calculate statistics of automatically measured values on all history waveforms.

- **Displaying and Analyzing XY Waveforms**

  You can display XY waveforms and perform analysis on the history waveform you specified with Select No. If the display mode is set to All, XY waveforms of all history waveforms are displayed.

- If you restart waveform acquisition by using the RUN/STOP key, all history waveforms that had been stored up to that point are cleared. However, if the trigger mode is set to Single (using the SINGLE key), the waveform that had been stored using the SINGLE key remains as a history waveform unless you change the waveform acquisition conditions.
- If you change the waveform acquisition conditions, all history waveforms that had been stored in the memory are cleared.
- If you change user-defined computation settings while using the history feature, recomputation is not performed on the history waveforms. To recompute, execute Math on History.

Display Mode (Mode)

Selects how history waveforms are displayed.

- One: Displays only the waveform selected by Select No. (highlighted waveform)
- All: Overlays all selected waveforms in the range from Start No. to End No. All waveforms except the waveform specified by Select No. (highlighted waveform) are displayed in an intermediate color.
- Accumulate: Overlays all selected waveforms in the range from Start No. to End No. The frequency of data occurrence is represented by intensity (Intensity) levels or color (Color) levels.

Average (Average)

Highlights the waveform obtained by taking a linear average of the history waveforms in the range specified by Start No. and End No. When the display mode is set All, all history waveforms that had been averaged are overlaid using an intermediate color.

Highlighting (Select No.)

The latest history waveform is assigned the record number zero, and older waveforms are assigned numbers in descending order (−1, −2, −3, and so on).
The waveform that correspond to the record number you specify here are highlighted.
Selectable range: 0 to −(the number of waveform acquisitions − 1)

You can use the jog shuttle to highlight history waveforms at high speeds. While you control the jog shuttle, history waveforms in the range corresponding to the speed of progression are collectively highlighted. Repeating this process, you can ultimately highlight all waveforms. When you stop controlling the jog shuttle, only the waveform of the record number indicated in Select No. will be highlighted.

Maximum Number of Waveform Acquisitions

(Maximum number of history waveforms that can be stored in the acquisition memory)

The number of history waveforms that can be stored varies depending on the selected record length and the installed memory options as follows:

Record Length	Number of History Waveforms		
	No options (125 Mpoints)	/M1S or /M1 option (250 Mpoints)	/M2S or /M2 option (500 Mpoints)
1.25 kpoints	20000	50000	100000
12.5 kpoints	2500	5000	10000
125 kpoints	250	500	1000
1.25 Mpoints	25	50	100
2.5 Mpoints	10	25	50
5 Mpoints	5	10	25
12.5 Mpoints	1	5	10
25 Mpoints	1[1]	1	2
50 Mpoints	1[1]	1[1]	1
125 Mpoints	1[1, 2]	1[1]	1[1]
250 Mpoints	−	1[1, 2]	1[1]
500 Mpoints	−	−	1[1, 2]

1 Waveform acquisition operates in Single mode at this record length regardless of the trigger mode setting.
2 CH2, CH4, CH6, and CH8 waveforms cannot be acquired at this record length. Moreover, Math2 (Ref2), Math4 (Ref4), Math6 (Ref6), and Math8 (Ref8) cannot be used (the available settings very depending on the model).

Target Range (Start/End No.)

Using record numbers, set the range of history waveforms to display. Set the target range for the history waveform display, list of timestamps, history waveform searching, and replay. If you specify History Statistics in the statistical processing of waveform parameters or if you select History All for File Save, processing is performed in this target range.
Selectable range: 0 to −(the number of waveform acquisitions − 1)

List of Timestamps (List)

Lists the history waveforms' record numbers, trigger timestamps, and time differences from the previous data triggers. The trigger timestamp resolution varies depending on the sample rate.

Searching the List

You can move to the following record number.

- Delta Min: Record number whose time difference between data triggers is lowest
- Delta Max: Record number whose time difference between data triggers is highest
- Oldest: The oldest record number
- Latest: The most recent record number

Searching History Waveforms (Search)

Search Logic (Mode)

Select the search logic. If you select AND, history waveforms that meet the logical product of search conditions 1 to 8 (described later) will be searched for. If you select OR, those that meet the logical sum will be searched for. Search conditions are 1 to 4 on 4ch models.

- Simple: Searches for history waveforms that enter a rectangular zone
- AND: Searches for history waveforms that meet all search conditions
- OR: Searches for history waveforms that meet any of the search conditions

Search Conditions (No.)

For search conditions 1 to 8,* set the source waveform, search range (the zone or the waveform parameter upper and lower limits), and the search criterion.

* Search conditions are 1 to 4 on 4ch models.

Search conditions 1 to 8 are shared with the reference conditions of GO/NO-GO determination.
On 4ch models, search conditions 1 to 4 are shared with the reference conditions of GO/NO-GO determination.

Search Range Mode (Mode)

You can set the method of setting the search range to one of the settings below.

- RectZone: Rectangular zone.
- WaveZone: Waveform zone.
- PolygonZone: Polygonal zone.
- Parameter: Sets upper and lower limits for one measured waveform parameter

The methods for setting zones and the upper and lower limits of waveform parameters are the same as with GO/NO-GO determination (action).

▶ See here.

Source Waveform (Trace)

You can set the source waveform to one of the waveforms below. If you select Logic, select the source bit.
CH1 to CH8,[1] Math1 to Math8,[1] XY1 to XY4,[1, 2] FFT1 to FFT4,[1, 3] Logic[3]

1 CH1 to CH4, Math1 to Math4, XY1 to XY2, FFT1 to FFT2 on 4ch models
2 Waveform zones cannot be specified for XY waveforms.
3 Only waveform parameters can be specified for Logic and FFT.

Search Criterion (Condition)

Sets whether the source waveform must be in or out of the search range to be detected.

- IN: The source waveform is detected when it is in the search range.
- OUT: The source waveform is detected when it is out of the search range.

Executing a Search (Exec)

The instrument searches using the specified search conditions.
Searched waveforms are also applicable for history waveform display, list of timestamps, and history waveform searching. If you specify History Statistics in the statistical processing of waveform parameters or if you select History All for File Save, processing is performed on this search result.
You can further narrow the search by changing the search conditions and searching again.

Search Result Reset (Reset)

The search result is reset, and the history target range is reset to all history waveforms from Start No. to End No. The search result is also reset if you replay after searching.

Replay (Replay)

Displays the specified waveform first and then the older or newer data in order from the waveforms in the range from Start No. to End No. If you replay after searching history waveforms, the search result is reset, and all waveforms from Start No. to End No. are displayed and replayed.

Record Number Display and Replay (Record No.)

The following replay features are available.

Oldest ⏮	Display the oldest history waveform
◀	Replays waveforms toward older waveforms
■	Stop replay
▶	Replays waveforms toward newer waveforms
⏭ Latest	Display the latest history waveform

Record number to start replaying (Select No.)

Specifies the record number to start replaying.
Selectable range: 0 to −(the number of waveform acquisitions − 1)

Replay Speed (Speed)

There are seven replay speed levels: x1/60, x1/30, x1/10, x1/3, x1, x3, and x10.

- Down: Decreases the replay speed by one level.
- Up: Increases the replay speed by one level.

Notes on Using the History Feature

Notes about Configuring the History Feature

- When the acquisition mode is set to Average and the sampling mode is set to Repetitive, you cannot use the history feature.
- When the display is in roll-mode, you cannot use the history feature.
- If you stop waveform acquisition, the instrument only displays waveforms that have been acquired completely.

Notes about Recalling Data Using the History Feature

- Waveform acquisition stops when you display the HISTORY menu. You cannot display history waveforms while waveform acquisition is in progress.
- You can start waveform acquisition when the HISTORY menu is displayed. However, you cannot change the history feature settings while waveform acquisition is in progress.
- The settings are restricted so that the following relationship is retained: Last record (End) ≤ Select No. ≤ First record (Start).
- When you load waveform data from the specified storage device, history waveforms up to that point are cleared. The loaded waveform data is placed in record number zero. If you load a file containing multiple waveforms, the latest waveform is placed in zero, and earlier waveforms are placed in order to record numbers 1, 2, and so on.
- Computation and automated measurement of waveform parameters are performed on the waveform of the record number specified by Select No. You can analyze old data as long as you do not overwrite the acquisition memory contents by restarting waveform acquisition. If Average is set to ON, analysis is performed on the averaged waveform.
- History waveforms are cleared when you turn the power off.

19 Printing and Saving Screen Captures

Destination Type (Print To)

You can save screen captures and print them on the following types of printers.

Built-in Printer (BuiltIn)

The optional built-in printer if it is installed.

▶ See here.

USB Printer (USB)

The printer connected to this instrument through USB. USB2.0 compatible.

▶ See here.

Network Printer (Network)

A printer on the network that the instrument is connected to. You must configure the network printer in advance.

▶ See here.

File (File)

You can save screen captures to files in PNG, BMP, and JPEG formats.

▶ See here.

Multiple Destinations (Multi)

You can perform the following operations at the same time.

- Print and save screen captures to multiple destinations
- Save waveform data to the output destination specified using the file list.

▶ See here.

Printing on the Built-in Printer (BuiltIn) (Option)

Print Mode (Mode)

On models with the optional built-in printer, you can print screen captures using one of two available modes. The screen capture is the same as that described in “Saving Screen Captures to Files (File).”

Hardcopy (with menu) (Hardcopy(with Menu))

The entire instrument screen is printed.

Hardcopy (without menu) (Hardcopy(without Menu))

The waveform area of the instrument screen is printed. The menu is not printed.
When the results of cursor measurements and automated measurement of waveform parameters are displayed, they are output below the waveform area.

Additional Information (Information)

You can print the instrument settings that were used at the time the waveform was acquired.

Printing on a USB Printer (USB)

You can print screen captures on a printer connected to one of the USB ports.

USB Ports

This instrument has two standard type A USB ports on the front panel and a standard type B USB port on the rear panel. Connect the printer to one of the standard type A ports.

Front panel **Rear panel**



Type A **Type B**

Pin No.	Signal Name
1	VBUS: +5V
2	D−:−Data
3	D+: +Data
4	GND: Ground

Compatible Printers

You can use HP USB ink jet printers that comply with USB Printer Class Ver.1.0.

- Do not connect an incompatible USB printer.
- For USB printers that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

Connection Procedure

Connect a USB printer to the instrument using a USB cable. You can connect or remove the USB cable regardless of whether the instrument's power switch is on or off (hot-plugging is supported). If you connect a printer when the power switch is on, the printer becomes available for use after the instrument identifies the printer.

- Do not connect multiple printers to the USB ports.
- While the printer is printing, do not turn OFF the printer or remove the USB cable.
- Do not connect or remove USB cables from the time when the instrument is turned on until key operation becomes available (approximately 20 to 30 seconds).

Print Mode (Mode)

You can print the screen image in one of two modes. The screen capture is the same as that described in "Saving Screen Captures to Files (File)."

Hardcopy (with menu) (Hardcopy(with Menu))

The entire instrument screen is printed.

Hardcopy (without menu) (Hardcopy(without Menu))

The waveform area of the instrument screen is printed. The menu is not printed.
When the results of cursor measurements and automated measurement of waveform parameters are displayed, they are output below the waveform area.

Printer Type (Format)

You can only use HP inkjet printers (HP InkJet).

Color (Color)

- ON: Prints using the same colors as the screen, excluding the background color. The grid is printed in black.
- OFF: Prints screen captures in the same way as when the instrument prints on the built-in printer.

Waveform Gradation (Waveform Gradation)

Select this option when the color setting is ON.

- ON: The gradation of the waveform is the same as that of the waveform displayed on the screen.
- OFF: The printing color of the waveform is monochrome.

- The comment may not be printed properly on some printers. Use a USB printer that has been tested for compatibility.
- The instrument may not be able to detect out-of-paper or other errors on the USB printer. If an error occurs, press PRINT again to stop the printout.

Printing on a Network Printer (Network)

A printer on the network that the instrument is connected to. You must configure the network printer in advance.

▶ See here.

Print Mode (Mode)

You can print the screen image in one of two modes. The screen capture is the same as that described in "Saving Screen Captures to Files (File)."

Hardcopy (with menu) (Hardcopy(with Menu))

The entire instrument screen is printed.

Hardcopy (without menu) (Hardcopy(without Menu))

The waveform area of the instrument screen is printed. The menu is not printed. When the results of cursor measurements and automated measurement of waveform parameters are displayed, they are output below the waveform area.

Printer Type (Format)

The following printers can be used with the instrument.

- HP InkJet: HP inkjet printers
- HP Laser: HP laser printers

Color (Color)

- ON: Prints using the same colors as the screen, excluding the background color. The grid is printed in black.
- OFF: Prints screen captures in the same way as when the instrument prints on the built-in printer.

Waveform Gradation (Waveform Gradation)

Select this option when the color setting is ON.

- ON: The gradation of the waveform is the same as that of the waveform displayed on the screen.
- OFF: The printing color of the waveform is monochrome.

Saving Screen Captures to Files (File)

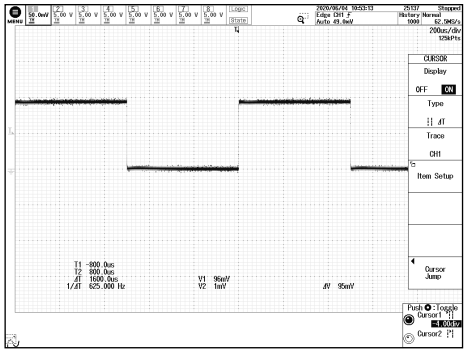
You can save screen captures to files in PNG, BMP, and JPEG formats.

Save Mode (Mode)

Hardcopy (with menu) (Hardcopy(with Menu))

The entire instrument screen is saved.

Example: When color data is ON (Gray)

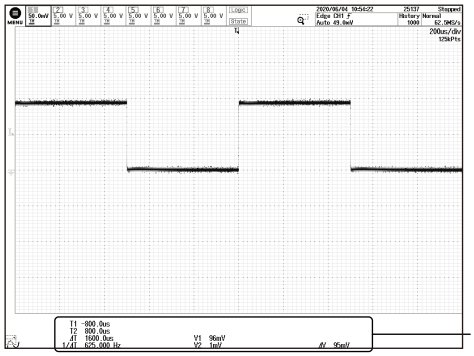


Hardcopy (without menu) (Hardcopy(without Menu))

The waveform area of the instrument screen is saved. The menu area is not saved.

When the results of cursor measurements and automated measurement of waveform parameters are displayed, they are output below the waveform area.

Example: When color data is ON (Gray)

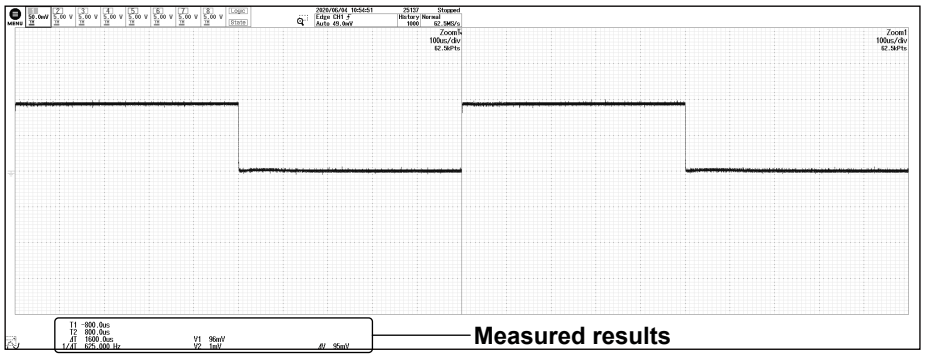


Wide (Wide)

As in hardcopy (without menu) mode, the screen is saved with the waveform's time axis magnified by a factor of 2.

When the results of cursor measurements and automated measurement of waveform parameters are displayed, they are output below the waveform area.

Example: When color data is ON (Gray)



Data Format (Format)

- PNG: The extension is .png. The file size is approximately 50 KB when you save a black and white screen capture and approximately 200 KB when you save a color screen capture.
- BMP: The extension is .bmp. The file size is approximately 100 KB when you save a black and white screen capture and approximately 1.6 MB when you save a color screen capture.
- JPEG: The extension is .jpg. The file size is approximately 300 KB.

The file sizes listed here are for reference. Actual file sizes will vary depending on the image that is saved.

Color Data (Color)

- OFF: Saves data in black and white.
- ON: Saves data using 65536 colors.
- ON(Rev): Saves data using 65536 colors. The image background will be white.
- ON (Gray): Saves data using 32 grayscale levels.

Background Transparent or Opaque (Background)

For PNG format, you can save the waveform display area with a transparent background. This feature is convenient when you want to compare waveforms by overlaying screen captures on the PC.

- Normal: Saves data without changing the background (opaque).
- Transparent: Saves data by making the background transparent.

Including Setting Information (Information)

Setting information such as channels, triggers, and waveform acquisition can be included in waveform screen captures.

- OFF: Setting information is not included.
- ON: Setting information is included.

Waveform Gradation (Waveform Gradation)

Select this option when the color data setting is ON (Rev.).

- ON: The gradation of the waveform is the same as that of the waveform displayed on the screen.
- OFF: The printing color of the waveform is monochrome.

Save Destination (File List)

Like the file feature, the instrument lists the files on the specified drive.

▶ See here.

File Name (File Name)

This is the same as the file feature. You can save files with automatically generated names using sequence numbers or dates, or save the files with specific file names.

▶ See here.

Printing and Saving Screen Captures to Multiple Destinations (Multi)

You can print and save screen-capture and waveform data to multiple output destinations at the same time.
The instrument outputs screen-capture and waveform data according to the PRINT menu or FILE menu settings.

- Save screen captures to files (File)
  ▶ See here.
- Print screen captures on the built-in printer (BuiltIn)
  ▶ See here.
- Print screen captures on a network printer (Network)
  ▶ See here.
- Print screen captures on a USB printer (USB)
  ▶ See here.
- Save waveform data (Waveform)
  ▶ See here.

- When saving screen captures and waveform data simultaneously, the saved destination setting is shared. Both are saved to the save destination selected last in the file list.
- When you are executing action-on-trigger or GO/NO-GO determination, if the output destination type (Print To) is set to Multi, you cannot print or save screen captures.

20 Saving and Loading Data

You can save the following types of data to the internal storage, a USB storage device, or a network drive.

- Waveform data
- Setup data
- Screen capture data
- Waveform zone data
- Snapshot waveform data
- Automated measurement data
- Serial bus analysis results
- FFT waveform data
- Histogram data
- List of Timestamps data

You can load the following types of data from a storage device into the instrument's internal storage.

- Waveform data
- Setup data
- Waveform zone and polygonal zone data
- Snapshot waveform data
- Physical value/symbol definition files

You can also rename and copy files and set or clear protection on files.

Storage Device You Can Save and Load From

This instrument can access the following three types of storage devices for saving and loading data.

Internal storage (Flash_Mem)

The internal storage of this instrument. For the memory size, see section 6.7 in the Getting Started Guide (IM DLM5058-03EN).

USB Storage Device (USB/USB1)

A USB storage device that is connected to the instrument's USB port. USB2.0 mass storage devices compatible with USB Mass Storage Class Ver. 1.1 can be connected to the instrument.

Network Drive (Network)

A storage device on the network. If a Ethernet port is available, you can connect the instrument to an Ethernet network and use a network drive.

▶ See here.

- Only connect a compatible USB keyboard, mouse, printer, or storage device to the USB port for peripherals.
- Do not connect and disconnect multiple USB devices repetitively. Provide at least a 10-second interval between removal and connection.
- Do not connect or remove USB cables from the time when the instrument is turned on until key operation becomes available (approximately 20 to 30 seconds).
- You can use USB storage devices that are compatible with USB Mass Storage Class version 1.1.
- The instrument can handle up to two storage devices. If the connected medium is partitioned, the instrument treats each partition as a separate storage device. As such, the instrument can handle up to two partitions.

Saving Data (Save)

The instrument saves data to the specified storage device.

Waveform data, setup data, other types of data

Saving Waveform Data (Waveform)

You can save the waveform data that the instrument has measured to a file in binary or ASCII format or to a file in ASCII format with time information.

Save Destination (File List)

Specify the data save destination.

File name (File Name)

Set the file name. You can also use the auto naming feature to automatically assign file names.

Auto Naming (Auto Naming)

- OFF

  The auto naming feature is disabled. The name that you specify using the File Name setting is used.
- Numbering

  The instrument automatically adds a three-digit number from 000 to 999 or a four-digit number from 1000 to 4999 after the common name specified using the File Name setting and saves the file.

  If the file save location is the internal storage,* a net drive, or a USB storage device formatted to exFAT, a three-digit number from 000 to 999 or a four-digit number from 1000 to 4999 is added. If the save location is a USB storage device formatted to FAT16 or FAT32, a three-digit number from 000 to 999 is added.

  If there are already numbered files in the save location, the instrument searches for the file with the highest file name number and numbers the file with that number plus one.

  Example

  If files test000.wdf, test001.wdf, and test071.wdf are present, test072.wdf is created.

  If files test000.wdf and test4001.wdf are present, test4002.wdf is created.

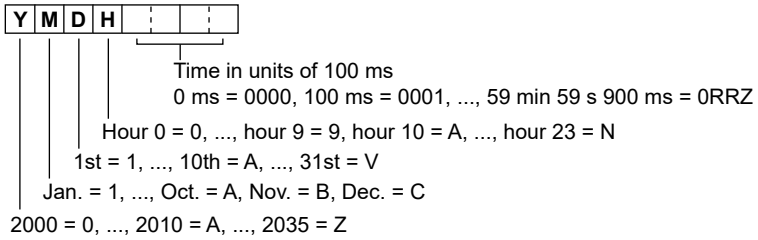
  However, if the file name number is four digits from 0000 to 0999, it is ignored.

  Example

  If files test000.wdf, test0001.wdf, and test0071.wdf are present, test001.wdf is created.

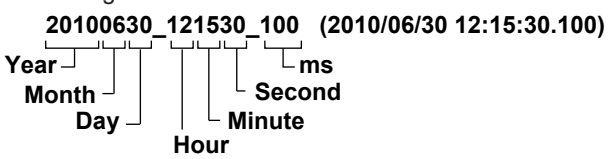
  * If the factory firmware version is earlier than 2.00 on a standard model (without the /C8 option), it is applied after formatting by pressing the Utility key > System Configuration soft key > Format soft key.
- Date

  An 8-character file name produced based on the date and time using base 36 numbers (0 to 9 and A to Z). See the figure below. The file name specified using the File Name setting is not used.



- Date2

  The file name is the date and time (down to ms) when the file is saved. The file name specified using the File Name setting is not used.



File name (File Name)

You can set the common file name that is used when the auto naming feature is turned off or when the auto naming feature is set to Numbering. The maximum number of characters that you can use for file names and folder names is 64 characters. The following restrictions apply.

- Of those characters on the keyboard that appears on the screen, the characters that can be used are 0-9, A-Z, a-z, _, −, =, (,), {, }, [,], #, $, %, &, ~, !, `, and @. @ cannot be entered consecutively.
- The following exact strings cannot be used due to MS-DOS limitations:
  AUX, CON, PRN, NUL, CLOCK, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, COM9
- Make sure that the full file path (absolute path from the root folder) is less than or equal to 255 characters in length. If this is exceeded, an error will occur when you perform file operations (save, copy, rename, create folder, etc.).
  When an operation is being performed on a folder, the full path is up to the name of the folder. When an operation is being performed on a file, the full path is up to the name of the file.

If you set auto naming to Date or Date2 (date and time), the characters that you entered for the file name will not be used. File names will only consist of the Date or Date2 information.

Comment (Comment)

You can add a comment that consists of up to 128 characters when you save a file. You do not have to enter a comment.
All characters, including spaces, can be used in comments.

Data Type (Data Type)

Set the data type to binary, ASCII, or ASCII with time information.

Binary (Binary)

The data stored to the acquisition memory is saved to a file in binary format.
You can load the data into the instrument, display the waveform of the data, and view the values that it contains. You can use the YOKOGAWA's Xviewer software application to analyze waveforms on your PC. For more details, contact your nearest YOKOGAWA dealer. You can download a trial version from the YOKOGAWA website.

- Data size ≈ Record length (Mpoint) × 2 (bytes/point) × the number of traces (from 1 to 8)
- The extension is .wdf.

ASCII

The sampled data stored in the acquisition memory is converted using the specified range and saved to a file in ASCII format.
You can use the file to analyze waveforms on your PC. You cannot load this type of data into the instrument.

- If the record length is less than or equal to 1.25 Mpoints, all of the waveform data can be saved. If the record length is more than 1.25 Mpoints, the data is compressed and saved.
- Data size ≈ Record length (Mpoint) × 10 (bytes/point) × the number of traces (from 1 to 8)
- The extension is .csv.

ASCII with Time Information (ASCII with TimeInfo.)

The time information is attached to the data stored in the acquisition memory, and this data is converted using the specified range and saved to a file in ASCII format.

- Data size ≈ Record length (Mpoint) × {10 (bytes/point) × the number of traces (from 1 to 8)+ 16 (bytes/point)}
- The extension is .csv.

Waveform to Save (Trace)

You can save all of the displayed waveforms (All) or select a specific waveform to save. The waveforms that you can save are CH1 to CH8, Logic, and Math1 to Math8. The vertical-axis, horizontal-axis, and trigger settings are also saved along with the waveforms.

If you select all waveforms, only the waveforms that are displayed out of CH1 to CH8, Logic, and Math1 to Math8 are saved.

History Range (History)

Of the waveforms that are selected to be saved, set which range of history waveforms to save.

- One: The single waveform that is specified with Select No. on the HISTORY menu* will be saved.
- All: All history waveforms within the range bounded by Start No. and End No. on the HISTORY menu* will be saved. If you search for history waveforms, and then select All, only the detected waveforms will be saved.

  * The menu that appears when HISTORY is pressed

History Range One and All Settings

The history range is fixed to One or All depending on the display mode (Mode) and the type of data to be saved (Data Type) on the HISTORY menu.

Display Mode (Mode) on the HISTORY Menu		One	All	Accumulate
Type of data to be saved (Data Type)	Binary	One or All	One or All	Fixed to All
	ASCII	Fixed to One	Fixed to One	Fixed to One
	ASCII with TimeInfo.	Fixed to One	Fixed to One	Fixed to One

If Average on the HISTORY menu is on, only a single set of averaged waveform data will be saved regardless of the display mode specified on the HISTORY menu, the type of data to be saved, and the history range.

▶ See here.

Window to Be Saved (Range)

Select the window to be saved from the following:

- Main: Main window
- Zoom1: Zoom1 window
- Zoom2: Zoom2 window

Data Compression (Compression)

If the window to be saved is set to Main, you can save the waveform data by compressing or sampling it. If you want to save waveform data whose record length exceeds is 1.25 Mpoints to a file in ASCII format, the data must be compressed.

OFF

All the data in the specified range is saved without compression or sampling. Binary files can be loaded into the instrument. Data in ASCII format or Data with time information in ASCII format cannot be loaded.

Saving Data through Compression (p-p)

The waveform data is P-P compressed so that the number of data points is equal to the specified number and then saved. Data that has been compressed and saved cannot be loaded into the instrument regardless of the format (data in ASCII format, data with time information in ASCII format, or data in binary format).

Saving Data through Sampling (Decim)

The data is sampled (decimated) so that the number of data points is equal to the specified number and then saved. Data that has been sampled and saved cannot be loaded into the instrument regardless of the format (data in ASCII format, data with time information in ASCII format, or data in binary format).

- The accumulate setting is always off while waveform data is loaded.
- Compressed and sampled waveform data in binary format can be loaded into the instrument as a reference waveform. For details, see the explanation under "Loading Data."
- If you change the extension of the saved data file, by using a PC or some other device, the instrument will no longer be able to load it.
- Up to 12500 files and folders can be displayed in the file list. If there are more than a total of 12500 files and folders in a given folder, the file list for that folder will display only 12500 files and folders. There is no way to set which files and folders are displayed.
- If the window to be saved is set to Zoom1 or Zoom2, data compression is not possible. Therefore, waveform data whose number of data points on the window to be saved exceeds1.25 Mpoints cannot be saved to a file in ASCII format.

Saving Setup Data (Setup)

You can save setup data to a file or to three different internal memory locations.

Saving Setup Data to a File

Like waveform data, you can save setup data to a specified storage device.
You can specify file names and enter comments in the same way as with waveform data.

▶ See here.

Saving Setup Data to Internal Memory

You can save up to three sets of setup data to internal memory areas #1 to #3. It is convenient to save setup data that you use frequently.

- **#1 to #3**

  Setup data numbers. To save or load setup data, you can simply specify one of these numbers.

- **Detail Settings (Detail)**

  You can add comments to setup data for identification and protect setup data from overwriting. The detail setting screen also displays the date and time when the setup data is saved.

Saving Other Types of Data (Others)

You can save screen image data, waveform zone data, snapshot waveform data, automated measurement values of waveform parameters, serial bus analysis results, FFT computation results (FFT waveform data), histogram data, and list of timestamps.
For details on the serial bus analysis results, see “Serial Bus Analysis Results (Others - Serial Bus (FlexRay/CAN/CAN FD/LIN/CXPI))” and “Serial Bus Analysis Results (Others - Serial Bus (SENT/PSI5 Airbag/UART/I^{2}C/SPI)),” later in this manual.

You can specify file names in the same way as with waveform data.

▶ See here.

Screen Captures (Screen Image)

You can save the displayed screen image to a file in PNG, BMP, or JPEG.

Data Format (Format)

- PNG: The extension is .png. The file size is approximately 50 KB when you save a black and white screen capture and approximately 200 KB when you save a color screen capture.
- BMP: The extension is .bmp. The file size is approximately 100 KB when you save a black and white screen capture and approximately 1.6 MB when you save a color screen capture.
- JPEG: The extension is .jpg. The file size is approximately 300 KB.

- The file sizes listed here are for reference. Actual file sizes will vary depending on the image that is saved.
- You can also save screen captures using the menu that you can access by pressing SHIFT+PRINT. The screen captures that you can save using the FILE menu explained here are the same as those that you can save by selecting Normal (without Menu) in the SHIFT+PRINT menu. If you want to save screen captures including the setup menu or if you want to save images whose time axis is magnified two times, use different options in the menu that you can access by pressing SHIFT+PRINT.

▶ See here.

Color (Color)

- OFF: Saves data in black and white.
- ON: Saves data using 65536 colors.
- ON(Rev): Saves data using 65536 colors. The image background will be white.
- Gray: Outputs data using 32 grayscale levels.

Background (Background)

For PNG format, you can save the waveform display area with a transparent background. This feature is convenient when you want to compare waveforms by overlaying screen captures on the PC.

- Normal: Saves data without changing the background (opaque).
- Transparent: Saves data by making the background transparent.

Including Setting Information (Information)

Setting information such as channels, triggers, and waveform acquisition can be included in waveform screen captures.

- OFF: Setting information is not included.
- ON: Setting information is included.

Waveform Gradation (Waveform Gradation)

Select this option when the color data setting is ON (Rev.).

- ON: The gradation of the waveform is the same as that of the waveform displayed on the screen.
- OFF: The printing color of the waveform is monochrome.

Waveform Zone (Wave Zone)

You can save waveform zones (Zone No.1 to 8) that are used in GO/NO-GO determination and history waveform searching.

▶ See here.

Zone1 to Zone8 can be saved to separate files.
The waveform zone file name extension is .zwf. The data can be loaded into the instrument.

Snapshot Waveform Data (Snap)

You can save the waveform data captured in a snapshot.
The extension is .snp. The data can be loaded into the instrument.

Automated Measurement Values of Waveform Parameters (Measure)

Save the results of automatic waveform parameter measurement to a file in CSV format. The extension is .csv. CSV files are text files that contain data separated by commas. They are used to convert data between spreadsheet and database applications.

The maximum number of previous values that you can save is equal to 100000 ÷ number of items that are turned on.

Data size in bytes = Number of measured items × 15 × number of history waveforms

Output Example

Analysis Type WaveParameter
Model Name DLM5000
Model Version *.**

	Rms(C1)	Mean(C1)	Sdev(C1)	ITY(C1)	Dly(C1)	Calc1(A2)
	V	V	V	Vs	s	
:Max	7.12E-01	5.05E-03	7.12E-01	5.05E-05	1.13E-03	1.13E+00
:Min	7.10E-01	-4.44E-03	7.10E-01	-4.44E-05	-8.99E-04	1.08E+00
:Mean	7.11E-01	1.07E-03	7.11E-01	1.07E-05	3.44E-04	1.10E+00
:Sigma	2.47E-04	2.04E-03	2.48E-04	2.04E-05	9.68E-04	8.23E-03
:Cnt	134	134	134	134	134	134
7021	7.11E-01	2.29E-03	7.11E-01	2.29E-05	1.11E-03	1.10E+00
7031	7.11E-01	1.43E-03	7.11E-01	1.43E-05	1.11E-03	1.11E+00
7040	7.11E-01	3.51E-03	7.11E-01	3.51E-05	1.11E-03	1.10E+00
7050	7.11E-01	1.73E-03	7.11E-01	1.73E-05	1.11E-03	1.11E+00
7059	7.11E-01	1.80E-03	7.11E-01	1.80E-05	-8.86E-04	1.11E+00
7069	7.11E-01	1.15E-03	7.11E-01	1.15E-05	1.11E-03	1.10E+00
7078	7.11E-01	1.45E-04	7.11E-01	1.45E-06	-8.82E-04	1.12E+00
7088	7.11E-01	2.98E-03	7.11E-01	2.98E-05	1.11E-03	1.10E+00
7098	7.11E-01	3.27E-03	7.11E-01	3.27E-05	-8.92E-04	1.09E+00
7107	7.11E-01	3.12E-03	7.11E-01	3.12E-05	-8.83E-04	1.12E+00

FFT Computation Results (FFT)

You can save the results of computation that was specified using FFT1 to FFT4 in CSV format. The extension is .csv. Up to 250 Kpoints of data can be saved.

Frequency Information (Freq Info.)

- OFF: The results are saved without frequency information.
  Data size in bytes = The number of data points × 15
- ON: All data is saved with frequency information.
  Data size in bytes = The number of data points × 30

▶ See here.

Output Example

(When Freq Info. is set to OFF)

Analysis Type FFT
Model Name DLM5000
Model Version *.**
Data Points 6251
HResolution 5.00E+00
HUnit Hz
-3.10E+01
-5.43E+01
-4.16E+01
-6.69E+01
-4.80E+01
-5.26E+01
-6.39E+01
-5.11E+01
-5.17E+01
-5.87E+01

(When Freq Info. is set to OFF)

Analysis Type FFT
Model Name DLM5000
Model Version *.**
Data Points 6251
HResolution 1.00E+02
HUnit Hz
0.00E+00 -5.48E+01
1.00E+02 -7.27E+01
2.00E+02 -5.84E+01
3.00E+02 -7.79E+01
4.00E+02 -6.12E+01
5.00E+02 -6.14E+01
6.00E+02 -6.02E+01
7.00E+02 -6.58E+01
8.00E+02 -6.18E+01
9.00E+02 -6.53E+01

Histogram (Histogram)

You can save the histogram of the waveform or the waveform parameter that was specified using Hist1 or Hist2.

▶ See here.

List of Timestamps (History List)

You can save the list of history waveform information—record number, trigger time, and the difference between the trigger times of the history waveform and its previous history waveform—in CSV format. The extension is .csv.

Data size in bytes = The number of history waveforms × 72

▶ See here.

Output Example

Data Type	HistoryList	
Model Name	DLM5000	
Model Version		*.**
Start No.		0
End No.		-99
No.	Trig'd Time	Delta
0	16:12:08.407 320	0.006 000
-1	16:12:08.401 320	0.008 000
-2	16:12:08.393 320	0.006 000
-3	16:12:08.387 320	0.006 000
-4	16:12:08.381 318	0.015 002
-5	16:12:08.366 318	0.006 000
-6	16:12:08.360 318	0.006 000
-7	16:12:08.354 318	0.006 000
-8	16:12:08.348 318	0.006 000
-9	16:12:08.342 318	0.036 000
-10	16:12:08.306 320	0.005 998

Serial Bus Analysis Results (Others - Serial Bus (FlexRay/CAN/CAN FD/LIN/CXPI))

You can save analysis results for the buses that you specified with the Serial Bus1, Serial Bus2, Serial Bus3 and Serial Bus4 settings.

For details on SENT, PSI5 Airbag, UART, I^2C, and SPI analysis results, see “Serial Bus Analysis Results (Others - Serial Bus (SENT/PSI5 Airbag/UART/I^2C/SPI)).”

History Range (History)

The analysis results are saved according to the settings made on the HISTORY menu and the analysis result save menu. For details on the feature, see “Setting the History Range” for when saving waveform data. You can select the history range for saving analysis results from the same options that are available as when you save waveform data in binary format.

▶ See here.

You cannot save the results of analyzing a user-defined serial bus signal (User Define).

FlexRay

You can save analysis results of FlexRay bus signals to a file in CSV format. The extension is .csv. Analysis results of up to 5000 frames can be saved.

Data size* = (The number of frames in analysis results + 4) × 60 bytes

* The data size is for reference. It is not strictly warranted. Use this as reference for saving data.

Output Example

Analysis Type	SerialBus(FlexRay)							
Model Name	DLM5000							
Model Version	*.**							
No.	Time(ms)	S/D	IND	ID	Len	CC	Data	Information
-7	-0.358624	S	1111	4	4	5	01 02 03 04 05 06 07 08	
-6	-0.307424	S	0000	5	4	5	00 00 00 00 00 00 00 00	
-5	-0.256224	D	1111	6	5	5	C8 C9 CA CB CC CD CE CF D0 D1	
-4	-0.205008	D	1111	7	2	5	FF FF FF FF	
-3	-0.153808	D	1111	8	6	5	01 01 01 01 02 02 02 02 03 03 03 03	
-2	-0.102608	S	0011	1	4	6	01 01 01 01 01 01 01 01	
-1	-0.051408	S	0011	2	4	6	02 02 02 02 02 02 02 02	
0	-0.000208	S	0010	3	4	6	03 03 03 03 03 03 03 03	
1	0.050992	S	1111	4	4	6	01 02 03 04 05 06 07 08	
2	0.102192	S	0000	5	4	6	00 00 00 00 00 00 00 00	
3	0.153392	D	1111	6	5	6	C8 C9 CA CB CC CD CE CF D0 D1	
4	0.204584	D	1111	7	2	6	FF FF FF FF	
5	0.255784	D	1111	8	6	6	01 01 01 01 02 02 02 02 03 03 03 03	
6	0.307184		0000					FES Error
7	0.358184	S	0011	2	4	7	02 02 02 02 02 02 02 02	

Cycle count
Data1 in hexadecimal
Payload length in decimal
ID in decimal
Error information
BSS Error
CRC Error
HCRC Error
FES Error
Indicator information in binary
Frame type
Amount of time from the trigger position to the start of frame
Analysis number

CAN, CAN FD

You can save analysis results of CAN or CAN FD bus signals to a file in CSV format. The extension is .csv.
Analysis results of up to 100000 frames (50000 frames for CAN FD) can be saved.

Data size*

CAN: (The number of frames in analysis results + 4) × 125 bytes

CAN FD: (The number of frames in analysis results + 4) × 300 bytes

* The data size is for reference. It is not strictly warranted. Use this as reference for saving data.

CAN Output Example

DLC in hexadecimal

Data in hexadecimal

CRC sequence in hexadecimal

Analysis Type	SerialBus(CAN)							
Model Name	DLM5000							
Model Version	*.**							
No.	Time(ms)	Frame	ID[1]	DLC	Data	CRC	Ack	Information
-8	-17.5848	Data	00A	2	1	0		
-7	-17.2968	Error						
-6	-15.0728	Data	00A	2	01 02	4A24	Y	
-5	-12.5608	Data	12	1	FE	2263	Y	
-4	-10.1204	Data	100	3	FF 01 A4	6C6E	Y	
-3	-7.5364	Data	00A	2	01 02	4A24	Y	
-2	-5.0244	Data	12	1	FE	2263	Y	
-1	-2.5844	Data	100	3	FF 01 A4	6C6E	Y	
0	-0.0004	Data	00A	2	01 02	4A24	Y	
1	2.5116	Data	12	1	FE	2263	Y	
2	4.9516	Data	100	3	FF 01 A4	6C6E	Y	
3	7.5356	Data	00A	2	01 02	4A24	Y	

ID in hexadecimal

ACK slot state
Y: ACK present
N: ACK not present

Frame type

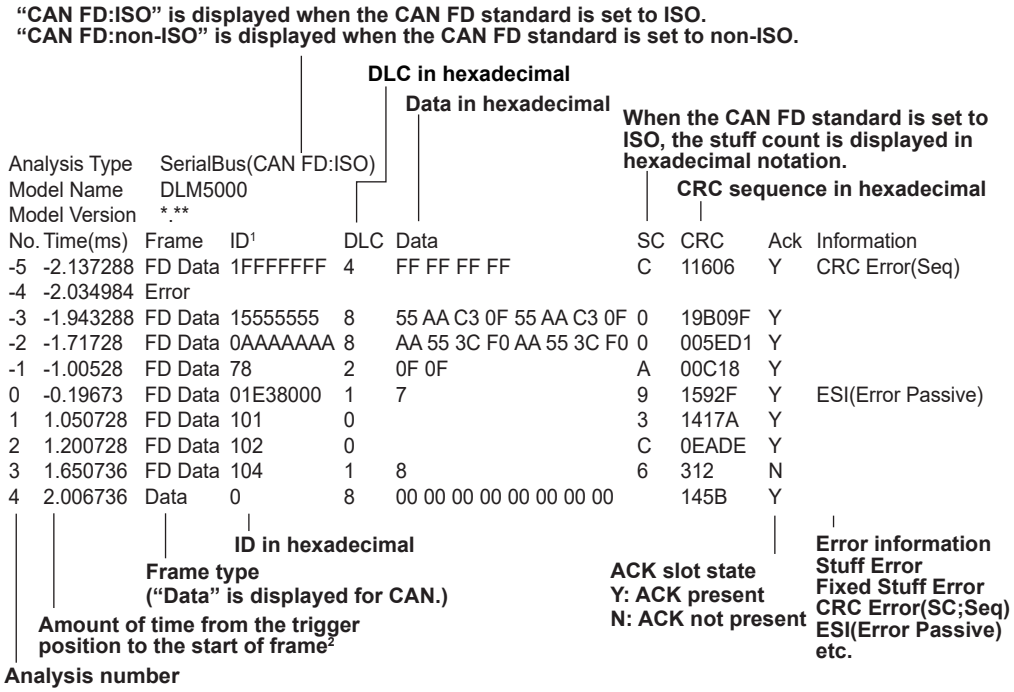
Amount of time from the trigger position to the start of frame[2]

Analysis number

1 ID (Filter) is displayed when a list display filter (Filter) is applied.

2 The instrument may display the time difference from the previous row for the analysis result.

CAN FD Output Example



1 ID (Filter) is displayed when a list display filter (Filter) is applied.

2 The instrument may display the time difference from the previous row for the analysis result.

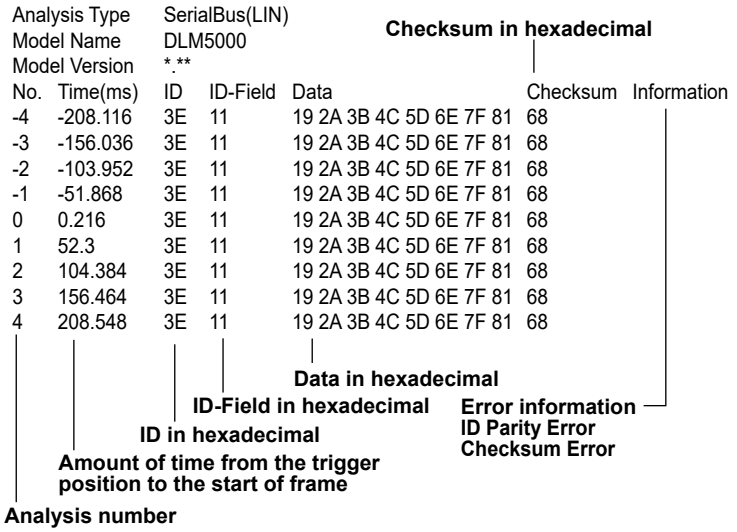
LIN

You can save analysis results of LIN bus signals to a file in CSV format. The extension is .csv. Analysis results of up to 100000 frames can be saved.

Data size* = (The number of frames in analysis results + 4) × 125 bytes

* The data size is for reference. It is not strictly warranted. Use this as reference for saving data.

Output Example



CXPI

You can save analysis results of CXPI bus signals to a file in CSV format. The extension is .csv. Analysis results of up to 10000 frames can be saved.

Data size* = (The number of frames in analysis + 4) × 900 bytes

* The data size is for reference. It is not strictly warranted. Use this as reference for saving data.

Output Example

Analysis Type SerialBus(CXPI)
Model Name DLM5000
Model Version *.**

No.	Time(ms)	ID	DLC	W/S	CT	Data	CRC	Information
-3	-52.4732	3	L16	0	0	00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF	2B30	
-2	-32.4704	4	12	0	0	40 41 42 43 44 45 46 47 48 49 4A 4B	D0	
-1	-12.4676	5	12	0	0	50 51 52 53 54 55 56 57 58 59 5A 5B	E0	
0	-0.4864	P20	2	0	0	01 FF	A1	
1	7.5356	6	12	0	1	60 61 62 63 64 65 66 67 68 69 6A 6B	7D	
2	27.5384	7	12	0	1	70 71 72 73 74 75 76 77 78 79 7A 7B	4D	
3	47.5412	8						ID-Parity Error
4	67.544	9	12	0	0	90 91 92 93 94 95 96 97 98 99 9A 9B	F4	CRC Error
5	87.5468	0A	12	0	1	A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 AA AB	96	Data Length Error
6	107.5496	0B	12	0	1	B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 BA BB		Framing Error
7	127.5524	0C						IBS Error

Data in hexadecimal
CRC in hexadecimal
Error information
CT in decimal
W/S indicator in binary
DLC in decimal
ID in hexadecimal
Amount of time from the trigger position to the start of frame
Analysis number

PTYPE Parity Error
ID Parity Error
CRC Error
Data Length Error
Framing Error
IBS Error
Clock Error
Counter Error

Serial Bus Analysis Results (Others - Serial Bus (SENT/PSI5 Airbag/UART/I^{2}C/SPI))

You can save analysis results for the buses that you specified with the Serial Bus1, Serial Bus2, Serial Bus3 and Serial Bus4 settings.

For details on FlexRay, CAN, CAN FD, LIN, and CXPI analysis results, see “Serial Bus Analysis Results (Others - Serial Bus (FlexRay/CAN/CAN FD/LIN/CXPI)).”

History Range (History)

The analysis results are saved according to the settings made on the HISTORY menu and the analysis result save menu. For details on the feature, see “Setting the History Range” for when saving waveform data. You can select the history range for saving analysis results from the same options that are available as when you save waveform data in binary format.

▶ See here.

You cannot save the results of analyzing a user-defined serial bus signal (User Define).

SENT

You can save analysis results of SENT signals to a file in CSV format. The extension is .csv. Analysis results of up to 100000 frames can be saved.

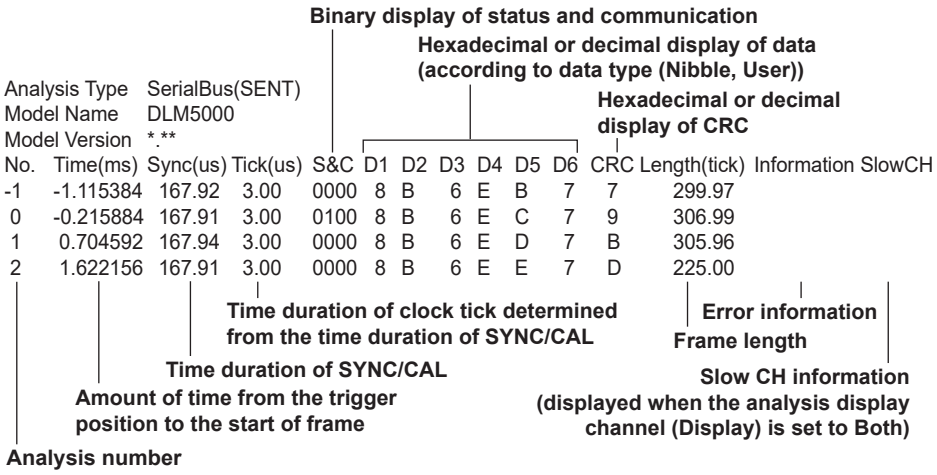
Data size*

Fast CH or Both list: (The number of frames in analysis results + 4) × 100 bytes

Slow CH list: (The number of frames in analysis results + 4) × 30 bytes

* The data size is for reference. It is not strictly warranted. Use this as reference for saving data.

Output example of a Fast CH or Both List



Output example of a Slow CH List

Analysis Type	SerialBus(SENT)				
Model Name	DLM5000				
Model Version	*.**				
No.	Time(ms)	ID	Data	CRC	Information
-3	-45.94672	6	3	0D	
-2	-30.6392	1	205	0B	
-1	-15.31336	2	900	28	
0	-0.01192	88	201	20	
1	15.48904	1	206	1A	
2	31.01336	2	930	30	

Hexadecimal or decimal display of CRC
Error information
Hexadecimal or decimal display of data
Hexadecimal or decimal display of ID
Amount of time from the trigger position to the start of frame
Analysis number

PSI5 Airbag

You can save analysis results of PSI5 Airbag signals to a file in CSV format. The extension is .csv. Analysis results of up to 400000 frames can be saved.

Data size* = (The number of frames in analysis results + 4) × 30 bytes

* The data size is for reference. It is not strictly guaranteed. Use this as reference for saving data.

Output Example

Analysis Type	SerialBus(PSI5 Airbag)					
Model Name	DLM5000					
Model Version	*.**					
No.	Time(ms)	from Sync(us)	Slot No.	Data	Parity/CRC	Information
-4	-0.49844		Sync			
-3	-0.440456	57.98	1	383	1	
-2	-0.300864	197.58	2	3ED	0	
-1	-0.145344	353.1	3	301	1	
0	0.000056	498.5	Sync			
1	0.058032	57.98	1	384	0	
2	0.197592	197.54	2	3E7	0	
3	0.353104	353.05	3	302	1	
4	0.498472	498.42	Sync			

Parity or CRC value in hexadecimal notation
Error information
Frame Error
Manchester Error
Start Bit Error
Parity/CRC Error
Frame Number Error
Slot Boundary Error
Hexadecimal or decimal display of data
For sync pulses, the word “Sync”
For data frames, the slot number
If sync signal is X, blank
Time from the start of the previous sync pulse to the start of the data frame or time from the start of the previous sync pulse to the start of the applicable sync pulse
If sync signal (Sync) is X or for the first sync signal, blank
Time from the trigger position to the start of sync pulses or time from the trigger position to the start of data frames
Analysis number

UART

You can save analysis results of UART signals to a file in CSV format. The extension is .csv. Analysis results of up to 300000 bytes can be saved.

Data size* = (The number of frames in analysis results + 4) × 40 bytes

* The data size is for reference. It is not strictly warranted. Use this as reference for saving data.

Output Example (when grouping is set to ON)

```
Analysis Type     SerialBus(UART)
Model Name        DLM5000
Model Version     *.**
No.   Time(ms)    Data(HEX)                          Data(ASCII)      Information
-4    -209.948    00 80 40 C0 20 04 84 44  ...       ..@. ..D.$..L.,..B."
-3    -157.864    00 80 40 C0 20 04 84 44  ...       ..@. ..D.$..L.,..B."
-2    -105.78     00 80 40 C0 20 04 84 44  ...       ..@. ..D.$..L.,..B."
-1    -53.696     00 80 40 C0 20 04 84 44  ...       ..@. ..D.$..L.,..B."
0     -1.612      00 80 40 C0 20 04 84 44  ...       ..@. ..D.$..L.,..B."
1     50.468      00 80 40 C0 20 04 84 44  ...       ..@. ..D.$..L.,..B."
2     102.552     00 80 40 C0 20 04 84 44  ...       ..@. ..D.$..L.,..B."
3     154.636     00 80 40 C0 20 04 84 44  ...       ..@. ..D.$..L.,..B."
4     206.72      00 80 40 C0 20 04 84 44  ...       ..@. ..D.$..L.,..B."
```

Data1 in hexadecimal

Data1 in ASCII

Amount of time from the start point

Error information
Framing Error
Parity Error

Analysis number

I²C

You can save analysis results of I²C bus signals to a file in CSV format. The extension is .csv. Analysis results of up to 300000 bytes can be saved.

Data size* = (The number of bytes in the analysis results / 2 + 4) × 125 bytes

* The data size is for reference. It is not strictly warranted. Use this as reference for saving data.

Output Example

Analysis result in hexadecimal

```
Analysis Type     SerialBus(I2C)
Model Name        DLM5000
Model Version     *.**
No.   Time(ms)    1st    2nd    R/W    Data      Information
-4    -208.116    AA*           W      AE* 8B*
-3    -156.036    75*           R      BC* EF
-2    -103.952    38*           W      53* A9*
-1    -51.868     9D*           R      10* 4B
```

Read/Write bit state
(W stands for write; R stands for data request.)

Address type

Amount of time from the trigger position

Analysis number

*** ACK present**

SPI

You can save analysis results of SPI bus signals to a file in CSV format. The extension is .csv. Analysis results of up to 300000 bytes can be saved.

Data size* = (The number of bytes in the analysis results × 2 + 4) × 125 bytes

* The data size is for reference. It is not strictly warranted. Use this as reference for saving data.

Output Example

```
Analysis            Type   SerialBus(SPI)
Model Name          DLM5000
Model Version       *.**
No.   Time(ms)      Data
-6    -0.65304      Data1 00 00 00 00 00 7F FF FF FF FF FF FF F8 00
-5    -0.63704      Data1 FF E0 00 3F FF FF FF FF FF FF FC 00 07 FF ......
-4    -0.60504      Data1 FF E0 00 00 00 7F FF 00 00 00 03 FF FF FF ......
-3    -0.25304      Data1 00 1F FF C0 00 7F FF 00 01 FF FF FF FF FF
-2    -0.23704      Data1 FF FF FF C0 00 00 00 00 00 00 03 FF F8 00 ......
-1    -0.20504      Data1 00 1F FF FF FF 80 00 FF FE 00 03 FF F8 00 ......
0     0.14696       Data1 00 00 00 3F FF FF FF FF FE 00 03 FF FF FF
1     0.16296       Data1 00 1F FF FF FF FF FF FF FF FC 00 07 FF ......
2     0.19496       Data1 FF FF FF C0 00 00 00 00 01 FF FC 00 00 00 ......
3     0.54696       Data1 00 1F FF FF FF 80 00 FF FF FF FF FF F8 00
```

Data1 in hexadecimal

Amount of time from the start point

Analysis number

Loading Data (Load)

You can load waveform data, setup data, waveform zones, polygonal zones, and snapshot waveforms that have been saved by the instrument.
You can also view information about the saved data files using file information (File Property).

Loading Waveform Data (Waveform)

You can load waveform data, including Math1 to Math8 waveforms. Waveform data in binary format (files with .wdf extension) can be loaded.

File Properties (File Property)

You can display the file name (Name), data size (Size), save date (Date), attributes (Attr) and other file properties regarding the selected file.

Loading into Reference Waveforms (Load to Ref(Math))

You can load the waveform data of the specified file as a reference waveform. Setup data is not loaded.
Reference waveforms are used to compare current waveforms to waveforms saved in the past and to perform computation.

- You can display reference waveforms by setting the computation mode on the MATH/REF key menu to Ref1 to Ref8.
- If the number of data points exceeds the specified record length, the instrument samples the data so that the number of points is equal to the specified record length and displays the sampled data.

Load Destination (Ref)

Select where to load the waveform data of the specified file from the following. The available settings vary depending on the model.
Ref1 to Ref8

Loading Waveform Data into Channels (Load to Channels)

You can load the waveform data of the specified file along with the setup data into the acquisition memory. All the data in the file is loaded.
This command is used to view or analyze waveform data that has been stored in the past on the instrument.

- You can display computed waveforms by setting the computation mode on the MATH/REF key menu to Math1 to Math8.
- Because setup data is also loaded, the instrument settings change when you load waveform data.
- Loaded data is cleared when you start measurement.



- You may not be able to load waveform data if the memory size of the model that you used to save the waveform data with and that of the model that you are trying to load data into are different. If the waveform data record length is less than or equal to 1.25 Mpoints, the instrument loads the data.
- To load a file saved from the waveform data of multiple channels as a reference waveform, use Load to Channels to load the waveform into channels, and then load the waveform as a computation reference waveform.
- The waveforms that have been acquired at the maximum record length and the waveform data that has been acquired at the maximum record length and saved to files cannot be loaded as a reference waveform.

Loading Setup Data (Setup)

You can load setup data. There are two methods you can use to load setup data. One method is to load setup data that has been saved to a file. The other method is to load setup data that is saved in the internal memory.

Viewing the Setup Data File Information (File Property)

You can view information about the setup data that has been saved to the internal storage or to a USB storage device.

Loading Setup Data That Has Been Saved to a File (Load Setup File)

You can load a .set file that contains setup data that you have saved.

Loading Setup Data That Has Been Save to an Internal Memory Location (#1 to #3)

You can load setup data that has been saved to internal memory locations #1 to #3.

Detailed Information (Detail)

You can view the date and time when setup data was saved to internal memory areas #1 to #3 and the comments attached to the data.
You can change comments, or enable or disable file protection.

Loading Other Types of Data (Others)

You can load waveform zones, polygonal zones, snapshot waveforms, and serial bus signal symbols.

Waveform and Polygonal Zones (Wave-Zone/Polygon-Zone)

You can load waveform zones that you created on the instrument into internal storage locations Zone No. #1 to #8. You can load zones that have been saved to .zwf files using this instrument and polygonal zones that have been saved to .msk files using the dedicated software application.
These zones are used for GO/NO-GO determination and other purposes.

Snapshot Waveforms (Snap)

You can load .snp files that contain snapshot waveforms that you have saved.
The snapshot waveforms that you load are displayed in white on the screen.

Symbol Data (Symbol)

Character strings based on definitions in a CANdb file can be used to express bit patterns. You can load physical value/symbol definition files (.sbl extension) that you have edited using the Symbol Editor tool.
The bit patterns can be used as CAN bus signal trigger conditions or as analysis or search conditions.

- **Files with .sbl Extensions**
  CANdb files (.dbc extension) must be converted into physical value/symbol definition files (.sbl extension) using the free YOKOGAWA conversion software “Symbol Editor” before they can be loaded and used as trigger conditions or as analysis or search conditions on the instrument.
  You can obtain the free software from the YOKOGAWA website (http://www.yokogawa.com/tm/).
  CANdb files (.dbc) are signal definition database files created using the CANdb or CANdb++ software produced by Vector Informatik.

File Operations (Utility)

You can create folders on the storage device, delete and copy files, change file names, and so on.

File List (File List)

Display Format

Selects whether to display a list of files or to display thumbnails.

Sorting the List

You can sort the file list by file name, data size, date, etc.

Filtering the Files to Display

You can limit the type of files that appear in the list by selecting an extension.

File path

The instrument displays various storage device as follows:

- Flash_Mem: Internal storage
- USB: The first detected USB storage device that is connected to the instrument's USB port (type A) for connecting peripheral devices.
- USB1: The USB storage device that is connected to the instrument's USB port (type A) for connecting peripheral devices (the second connected device).
- Network: Network storage device

Selecting Multiple Files or Folders (Select)

Selects or unselects all of the files or folders in the list.
You can also only select or unselect the highlighted files or folders.

Making Folders (Directories) (New folder)

You can make folders.

▶ See here.

Copying and Moving Files and Folders (Copy, Move)

You can copy or move selected files and folders to other storage media or folders.

Renaming Files and Folders (Rename)

You can rename a selected file or folder.

Protecting Files (Protect)

You can change the attribute of the selected file. This is the same feature as turning the protection on and off.

Deleting Files and Folders (Delete)

You can delete selected files and folders.

File Properties (File Property)

You can display the file name (Name), data size (Size), save date (Date), attributes (Attr) and other file properties regarding the selected file.

File Protection (Protect ON/OFF)

You can change file properties to protect the selected file. File properties are displayed in the Attr column of the file information.

Protection	File Attribute	Description
ON	r	The selected file is protected. The file can be read from. Writing is not allowed. Deleting is also not allowed.
OFF	r/w	The selected file is not protected. The file has read and write access.

Selecting Files (All Set, All Reset, and Set/Reset)

Selects or unselects all of the files or folders in the list.
You can also only select or unselect the highlighted files or folders.

- You can format the internal storage (Flash_Mem) by pressing UTILITY and then using Storage Format on the System Configuration menu.
  ▶ See here.
- You can abort (Abort) file deleting. However, files that are already being processed are not applicable.

21 Ethernet Communication (Network)

You can configure TCP/IP parameters and use the Ethernet interface to perform the following tasks.

TCP/IP

TCP/IP settings for connecting to an Ethernet network.
Set the IP address, subnet mask, and default gateway.

▶ See here.

FTP Server (FTP/Web Server)

You can connect the instrument as an FTP server to a network.
You can connect to the instrument from a PC on the same network and retrieve waveform data.

▶ See here.

Web Server (FTP/Web Server)

You can connect the instrument as a Web server to a network.
You can connect to the instrument from a PC on the same network and monitor the instrument display from the PC.

▶ See here.

Mail (Mail)

The action-on-trigger or GO/NO-GO action can be set to mail transmission.

▶ See here.

Network Drive (Net Drive)

You can save waveform data and setup data to a network drive.

▶ See here.

Network Printer (Net Print)

You can specify a network printer for printing screen captures.

▶ See here.

SNTP

The instrument clock can be set using SNTP. The instrument can be configured to automatically adjust its clock when it is turned on.

▶ See here.

To connect a PC to the instrument, use a hub or router, and connect to a network. Do not connect a PC directly to the instrument.

TCP/IP(TCP/IP)

Configure the settings that the instrument needs to connect to a network.

DHCP

DHCP is a protocol that temporarily allocates settings that a PC needs to connect to the Internet.
To connect to a network that has a DHCP server, turn the DHCP setting on. When DHCP is turned on, the IP address can be automatically obtained when the instrument is connected to a network. (You do not have to set it manually.)
If you set DHCP to OFF, set the appropriate IP address, subnet mask, and default gateway for your network.

DNS

DNS is a system used to associate Internet host names and domain names with IP addresses. Given AAA.BBBBB.com, AAA is the host name and BBBBB.com is the domain name.
You can use host names and domain names to access the network instead of using IP addresses, which are just numbers. The instrument allows you to specify the host by name, instead of by IP address.
Set the domain name and the DNS server address (0.0.0.0 by default). For details, consult your network administrator.

DNS Servers (DNS Server1/DNS Server2)

You can specify up to two DNS server addresses: primary and secondary. If querying fails with the primary DNS server, the secondary DNS server is automatically used to find the mapping of the host name and domain name to the IP address.

Domain Suffixes (Domain Suffix1/Domain Suffix2)

The domain suffix is a piece of information that is automatically added when a query is made to a DNS server using only a portion of the domain name. For example, if BBBBB.co.jp is registered as a domain suffix and a query is made using “AAA,” the name “AAA.BBBBB.co.jp” is searched.
You can specify up to two domain suffixes: Domain Suffix1 and Domain Suffix 2.
You can use up to 30 characters. The characters that you can use are 0 to 9, A−Z, a−z, and dashes.

TCP/IP settings are applied when you press Set or when you turn on the instrument the next time.

FTP Server (FTP/Web Server)

You can connect the instrument as an FTP server to a network.
Set the user name, password, and timeout that will be used by devices on the network to access the instrument. Also, set the access timeout value.

FTP Server On and Off (FTP Server)

ON: The FTP server feature is enabled.
OFF: The FTP server feature is disabled.

User Name (User Name)

Set the user name that will be used to access the instrument from a PC. The characters that you can use are all the ASCII characters on the keyboard. You can use up to 30 characters. If you set the user name to “anonymous,” you can connect to the instrument without entering a password.

Password (Password)

Set the password that will be used to access the instrument from a PC. The characters that you can use are all the ASCII characters on the keyboard. You can use up to 15 characters.

Timeout (Timeout)

If a connection cannot be established between the instrument and the PC within the amount of time specified here, the instrument aborts the connection process.
Selectable range: 0 s to 3600 s

Connecting to the Network (Set)

The specified settings are enabled, and the instrument is connected to the network as an FDP server.

FTP Server Overview

When the instrument is connected to the network as an FTP server, the following features become available.

FTP Server Feature

From a PC, you can view a list of files that are stored in the instrument storage device (the internal memory or a storage device that is connected to it) and retrieve files.

Compatible PCs

A PC running the English or Japanese version of Windows 10 (32 bit or 64 bit) or Windows 11

Web Server (FTP/Web Server)

You can connect the instrument as an Web server to a network.
Set the user name and password that will be used by devices on the network to access the instrument. Also, set the access timeout value.

Web Server On and Off (Web Server)

ON: The Web server feature is enabled.
OFF: The Web server feature is disabled.

User Name (User Name)

Set the user name that will be used to access the instrument from a PC. The characters that you can use are all the ASCII characters on the keyboard. You can use up to 30 characters. If you set the user name to “anonymous,” you can connect to the instrument without entering a password.

Password (Password)

Set the password that will be used to access the instrument from a PC. The characters that you can use are all the ASCII characters on the keyboard. You can use up to 15 characters.

Connecting to the Network (Set)

The specified settings are enabled, and the instrument is connected to the network as an FDP server.

The timeout setting is valid only for the FTP server function. It does not apply to the Web server function.

Web Server Overview

When this instrument is connected to the network as an Web server, you can display the screen of this instrument on the PC and control this instrument through the Ethernet network.

Side navigation

The following items are available.

Home (Home)

Information about the instrument is displayed.

Remote View (Remote View)

The instrument’s screen and operation panel are displayed on a browser on your PC. Remote control is not possible on this screen. The following operations can be performed on the display screen.

- s/frame: Set the display screen update interval to OFF, 500 ms, 1 s, 3 s, or 5 s. However, updating may be delayed from the specified update interval depending on the communication status and the load status of the instrument.
- Update: Updates the display screen.
- Save: Save the image of the instrument screen to a PNG file in the PC.
- Full Screen: Open the instrument screen in a new tab (1024×768 size).
- Draw: Open the instrument screen in a new tab. You can paint and insert text.
- Fit to display: Set the display screen size.

Remote control (Remote Control)

The screen and control panel of the instrument can be displayed on a PC browser for remote control on the screen. Some of the instrument’s operations are not supported. Nor can you turn on or off the instrument. Perform s/frame, Update, Save, Full Screen, Draw, and Fit to display operations, as with the remote display explained earlier.

File download (File download)

Download files stored in the internal storage of this instrument or files stored in a USB device connected to this instrument to a PC. The maximum size per file is 2 GB. A Download button is displayed for files that can be downloaded.

Link (Link)

Access our website.

Browsers that have been tested

- Microsoft Edge
- Google Chrome
- Safari

Mail (Mail)

You can send trigger times and other information in emails to a specific email address as an action in the action-on-trigger or GO/NO-GO determination feature.

Mail Server (Mail Server)

Specify the IP address of the mail server on the network that the instrument will use. In a network with a DNS server, you can specify the host name and domain name instead of the IP address.

Mail Address (Mail Address)

You can specify multiple email recipient addresses. Separate each address with a comma.

Comment (Comment)

If necessary, you can enter a comment in the first line of e-mails.

Attaching Image Files (Attached Image File)

You can attach a capture of the screen that is displayed at the time the email is sent.

File format: PNG
File name: DLM_image[time].png
(Example: DLM Image202002171158.png is a screen capture taken at 17:11:58 on December 2, 2020.)
Resolution: XGA (1024×768 dots)
Approximate File Size
Normal screen: Approx. 50 KB
Maximum: Approx. 1.6 MB (when the screen contains many colors)

Timeout (Timeout (sec))

If the instrument cannot send an email for the amount of time specified here, it disconnects from the mail server.
Selectable range: 1 s to 60 s

User Authentication

Before you send an e-mail, POP3 user authentication is performed.

- **User Authentication On and Off (POP3 before SMTP)**

  ON: Authentication is performed before e-mails are sent.
  OFF: Authentication is not performed before e-mails are sent.

- **Encryption type (Type)**

  U/P: The authentication data is sent in plain text.
  APOP: The authentication data is encrypted before it is sent.

- **Server Name (POP3 Server)**
  Set the POP3 server host name or IP address using up to 30 characters. The characters that you can use are all the ASCII characters on the keyboard.
- **User Name (User Name)**
  Set the user name that is required for accessing the POP3 server from the instrument using up to 30 characters. The characters that you can use are all the ASCII characters on the keyboard.
- **Password (Password)**
  Set the password that is required for accessing the POP3 server from the instrument using up to 30 characters. The characters that you can use are all the ASCII characters on the keyboard.

The instrument supports plaintext (U/P) and encrypted (APOP) POP3 user authentication.*
* APOP uses the MD5 algorithm (Message-Digest Algorithm 5 by RSA Data Security, Inc.).

Sending a Test Mail (Send Test Mail)
You can send a test mail to check whether emails can be sent properly.

Network Drive (Net Drive)
You can save waveform data and setup data to a network drive.

FTP Server (FTP Server)
Specify the IP address of the FTP server (network drive) for saving waveform and setup data. In a network with a DNS server, you can specify the host name and domain name instead of the IP address.

User Name (User Name)
Set the user name (login name) for logging in to the network drive. The characters that you can use are all the ASCII characters on the keyboard. You can use up to 14 characters.

Password (Password)
Specify the password that corresponds to the login name. The characters that you can use are all the ASCII characters on the keyboard. You can use up to 14 characters.

Passive Mode (Passive)
Turn FTP passive mode on or off.
In passive mode, the FTP client sets the port number for data transfer. Enable passive mode when you have set an external FTP server as a network drive or when you are accessing an FTP server through a firewall.

Timeout (Timeout (sec))
If the instrument cannot transfer files for a certain amount of time, it disconnects from the FTP server.
Selectable range: 0 s to 60 s

Connecting to the Network Drive (Connect/Disconnect)
When you press the Connect button, the instrument connects to the specified network drive, and the drive appears in the file list (File List). When you press the disconnect button, the network drive is disconnected and removed from the file list (File List).

Network Printer (Net Print)

You can print screen captures on a network printer.
The instrument can print to the following printers.

- HP inkjet printers (HP InkJet)
- HP Laser printers (HP Laser)

LPR Servers (LPR Server)

Specify the IP address of the printer server that the instrument will connect to. In a network with a DNS server, you can specify the host name and domain name instead of the IP address.

LPR is a protocol used to print over a TCP/IP network.

LPR Name (LPR Name)

The name of the shared printer that the instrument will connect to.

Timeout (Timeout (sec))

If the instrument cannot print for a certain amount of time, it disconnects from the network printer.
Selectable range: 0 s to 60 s

SNTP(SNTP)

The instrument clock can be set using Simple Network Time Protocol (SNTP). The instrument can be configured to automatically adjust its clock when it is turned on.

SNTP Server (SNTP Server)

Specify the IP address of the SNTP server that the instrument will use. In a network with a DNS server, you can specify the host name and domain name instead of the IP address.

Timeout (Timeout (sec))

If the instrument cannot connect to the SNTP server for a certain amount of time, it aborts the operation.
Selectable range: 1 s to 60 s

Executing Time Adjustment (Set)

The instrument clock is synchronized to the SNTP server clock.

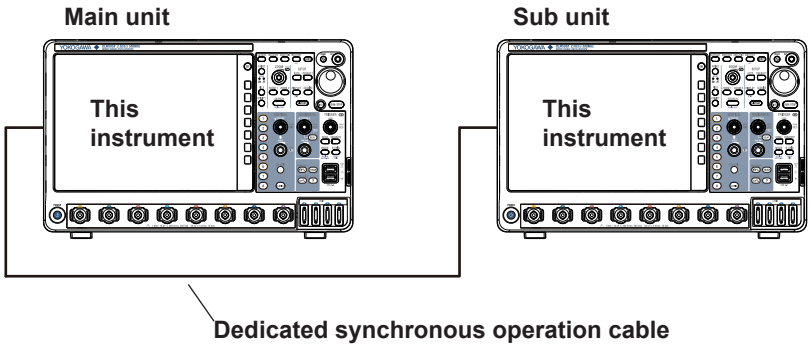
Automatic Adjustment (Adjust at Power On)

You can configure the instrument so that its clock is automatically synchronized to the SNTP server clock when the instrument is turned on when it is connected to the network.

- If the time difference from GMT (Greenwich Mean Time) is set in the date/time setting, the instrument will make appropriate adjustments to the time information received from the SNTP server.
  ▶ See here.
- If you do not want the instrument to synchronize with an SNTP server, do not set the SNTP server IP address.

22 Synchronized Operation (DLMsync, Option)

You can synchronize the operation of two DLM5000s by connecting them with a dedicated synchronous operation cable.
In synchronous operation, one of the connected instruments becomes the main unit and the other becomes the sub unit.
For instructions on how to connect the instruments with a dedicated synchronous operation cable, see section 4.5 in the *Getting Started Guide*, IM DLM5058-03EN.



Synchronous operation is possible between an 8ch model and a 4ch model and between two 4ch models. The 4ch model can be the main unit.

Synchronous Operation (DLMsync)

Starting Synchronous Operation (Connect)

Starts the connection between the instruments connected with the dedicated synchronous operation cable.

- The instrument that you press the Connect soft key on becomes the main unit.
- When a connection is established, the soft key on the main unit changes to Disconnect (Disconnect), and synchronous operation starts.

Ending Synchronous Operation

During synchronous operation, the soft key on the main unit shows Disconnect (Disconnect).

- Execute Disconnect on the main unit. The synchronous operation ends, and the soft key on the main unit and sub unit changes to Connect (Connect).
- To resume synchronous operation, execute the synchronous operation start procedure explained earlier.

- To perform synchronous operation, the /SYN option is required on both the main unit and sub unit. Also, check that the firmware versions on the main unit and sub unit are the same.
- During synchronous operation, M (main unit) or S (sub unit) is displayed at the top of the screen.
- If you turn off the instrument during synchronous operation, synchronous operation is not resumed the next time you start instrument.
- If a synchronous operation error (error number 916) occurs during synchronous operation, the operation will stop, and you may not be able to change the settings or start measurements. To resume synchronous operation safely, stop the synchronous operation and execute the synchronous operation start procedure as explained earlier.
- During synchronous operation, triggers are generated only from the trigger output terminal of the main unit. They are not generated from the sub unit.
- The trigger times on the synchronized sub unit are based on the main unit time.
- The IEEE 1588 time synchronization feature on the synchronized sub unit is disabled during synchronous operation.

Correcting the Sampling Skew between Units (Deskew)

When synchronous operation is performed between two DLM5000s, a sampling reference clock signal is sent from the main unit to the sub unit through a connection cable. This causes a propagation delay, which in turn causes the sampling timing of the sub unit to fall behind.
You can correct this sampling timing error by deskewing (Deskew).
Selectable range: 15.0 ns to 35.0 ns (0.05 ns resolution)

Auto Deskewing (Auto Deskew)

The sampling timing error between units can be corrected automatically by applying a same signal to CH1 of the main unit and CH1 of the sub unit through probes with the same specifications and executing an auto deskew (Auto Deskew).
The recommended auto-deskew input signal is as follows:

Amplitude: 100 mV or more (when using a 10:1 probe)
Frequency: 100 kHz to 10 MHz
Rise time or fall time: 2 ns or less

If you execute an auto deskew with an input signal that does not meet the above conditions, the accuracy of deskewing may degrade or deskewing may fail.
Further, an error will occur if the CH1 input coupling or probe setting is different between the units, if different signals are applied to CH1 on each unit, or if the input signal deviates significantly from the recommended conditions.

Notes on Synchronous Operation

Operations during Synchronous Operation

During synchronous operation, there are features that can be controlled from either the main unit or sub unit and features that can be controlled only from the main unit. In addition, whether synchronization is achieved with the connected instrument varies by feature.
The following table shows the instruments that can be controlled during synchronous operation and whether synchronization is achieved with the connected instrument.

Feature	Chapter	Instrument That Can Be Controlled during Synchronous Operation	Whether Synchronization Is Achieved with the Connected Instrument
Vertical scale	Chapters 1 and 2	Main unit and sub unit	Not synchronized. [1]
Horizontal scale (time scale)	Chapter 3	Main unit and sub unit	Synchronized.
Triggering	Chapter 4	Main unit only	Only the trigger mode (Trigger Mode) is synchronized.
Actions	Chapter 5	Cannot be controlled.	Not synchronized.
Waveform Acquisition	Chapter 6	The following features can be controlled from the main unit and sub unit. Waveform acquisition (RUN and STOP), single waveform acquisition (SINGLE) Other features can only be controlled from the main unit.	Synchronized.
Display	Chapter 7	The following features can be controlled from the main unit and sub unit. Display format (Format), waveform mapping (Mapping), color (Color) Other features can only be controlled from the main unit.	Only the following features are synchronized. Display interpolation (Dot Connect), grid (Graticule), fine grid display (Fine Grid), scale value display (Scale Value), waveform intensity (Intensity), accumulation (Accumulate), accumulation time (Accum Time)
Displaying XY waveforms	Chapter 8	Main unit and sub unit	Not synchronized.

Feature	Chapter	Instrument That Can Be Controlled during Synchronous Operation	Whether Synchronization Is Achieved with the Connected Instrument
Computed and reference waveforms	Chapter 9	Main unit and sub unit	Not synchronized.
FFT	Chapter 10	Main unit and sub unit	Not synchronized.
Cursor measurement	Chapter 11	Main unit and sub unit	Only the ΔT cursor is synchronized.
Automated measurement of waveform parameters	Chapter 12	Statistical processing features other than the trend/histogram display can only be controlled from the main unit. Other features can be controlled from the main unit and sub unit.	Only the following features are synchronized. [2] Measurement source window (Time Range), measurement time period (T Range1/T Range2), features other than trend/histogram display of statistical processing (Trend/Histogram)
Zooming in on or out of waveforms	Chapter 13	Main unit and sub unit [3]	Only the following features are synchronized. Turning the zoom windows or off (Display), initializing the vertical zoom (Reset), zoom factor (ZOOM knob), zoom position (Z1 Position, Z2 Position)
Waveform searching	Chapter 14	Main unit only	Only the detected point number (Pattern No.) is synchronized. [4]
Analyzing and searching serial bus signals	Chapter 15	Main unit and sub unit	Only the following features are synchronized. Zoom window specification (Result Window), detected point number (Pattern No.), zoom positions (Z1 Position/Z2 Position)
Waveform histogram display	Chapter 16	Main unit and sub unit	Not synchronized.
Power supply analysis and power measurement	Chapter 17	Features other than the trend/histogram display of statistical processing can only be controlled from the main unit. Other features can be controlled from the main unit and sub unit.	Only the following features are synchronized. [2, 5] Features other than the trend/histogram display of statistical processing, measurement source window (Time Range), measurement time period (T Range1/T Range2)
History waveform display and searching	Chapter 18	Main unit only	The following features are not synchronized. List of timestamps (List), history waveform search (Search)[4] Other features are synchronized.
Printing and saving screen captures	Chapter 19	The following features can be controlled from the main unit and sub unit. Save destination (File List), PRINT key Other features can only be controlled from the main unit.	Only the PRINT key is synchronized. [6, 7]
Saving data	Chapter 20	The following features can only be controlled from the main unit. Saving waveform data (Waveform), saving setup data (Setup), screen capture (Screen Image), snapshot waveform data (Snap), automated measurement values of waveform parameters (Measure), list of timestamps (History List)	Only the following features are synchronized. [6] Saving waveform data (Waveform),[8] saving setup data (Setup), screen capture (Screen Image), snapshot waveform data (Snap), automated measurement values of waveform parameters (Measure)
Loading data	Chapter 20	The following features can only be controlled from the main unit. Loading into channels (Load to Channels), loading setup data (Setup), snapshot waveform (Snap)	Only the following features are synchronized. Loading into channels (Load to Channels), loading setup data (Setup), snapshot waveform (Snap)
Ethernet Communication	Chapter 21	Main unit and sub unit	Not synchronized.

Feature	Chapter	Instrument That Can Be Controlled during Synchronous Operation	Whether Synchronization Is Achieved with the Connected Instrument
Synchronous Operation	Chapter 22	Synchronous operation can be started and stopped only from the main unit. Other features can be controlled from the main unit and sub unit.	Only the following features are synchronized. Correction of the sampling skew between units (Deskew), execution of auto deskew (Auto Deskew)
Auto setup (AUTO SETUP)	Chapter 23	Main unit and sub unit	Synchronized.
Default Settings (DEFAULT SETUP)	Chapter 23	Main unit and sub unit	Synchronized.
Snapshot	Chapter 23	Main unit and sub unit	Synchronized. [9]
Clear trace	Chapter 23	Main unit and sub unit	Synchronized.
Calibration	Chapter 23	Main unit only	Synchronized.
System setup	Chapter 23	Only the formatting of the internal storage (Storage) can be controlled from the main unit and sub unit. Other features can only be controlled from the main unit.	Only the formatting of the internal storage (Storage) is synchronized. Other features are synchronized.
Overview	Chapter 23	Main unit and sub unit	Not synchronized.
Self-test	Chapter 23	Main unit only	Not synchronized.
Displaying Help	—	Main unit and sub unit	Not synchronized.

1 The vertical scale settings and analog signal input channel (CH1 to CH8) settings are not synchronized. However, if you change the settings, setup restarts on the connected instrument.
2 When cyclic statistical processing or statistical processing of history waveforms is executed on the main unit, the statistical processing results are shared between the main unit and sub unit.
3 Auto scroll cannot be controlled.
4 When a search is executed on the main unit, the search results are shared between the main unit and sub unit.
5 Probe attenuation, voltage-to-current conversion ratio (Probe), deskew, and auto deskew are not synchronized. However, if you change the settings, setup restarts on the connected instrument.
6 The data of two units is saved in a single file. The file is saved in the main unit.
7 The main unit and sub unit screens are printed. When printing on the built-in printer, the print destination is the main unit.
8 When the data format set to binary (Binary), the waveform to save (Trace) is fixed to All. Data cannot be saved if there is no waveform to be saved in either the main unit or sub unit.
9 The synchronized waveform may not be snapped when waveform acquisition is in progress.

Options

If instruments with different options are connected, they will operate as follows.

Option	Behavior during Synchronous Operation
Memory	Of the standard model (no options), /M1S or /M1 option (25 M/125 M/250 Mpoint), /M2S or /M2 option (50 M/250 M/500 Mpoint), the memory is aligned with the model with the least memory.
Internal storage	Can be used only on models with the /C8 option.
User-defined computation	Can be used only on models with the /G02 option.
Power supply analysis feature	Can be used only on models with the /G03 option.
Serial bus trigger and analysis	Can be used only on models with the /F01, /F02, /F03, /F04, /F05, or /F06 option.

23 Other Features

Auto Setup (AUTO SETUP)

The auto setup feature automatically sets the SCALE, TIME/DIV, trigger level, and other settings to the most suitable values for the input signals.
This feature is useful when you are not sure what type of signal will be applied to the instrument. The auto setup feature will not work properly on some input signals.

Center Position after the Execution of Auto Setup

The center position after you execute auto setup will be 0 V.

Source Channels

CH1 to CH8 (CH1 to CH4 on 4ch models)
Logic waveforms are displayed with the same settings that were used before you executed auto setup.

Waveforms Displayed before the Execution of Auto Setup

Waveforms that were displayed before you execute auto setup will be cleared.

Signals That Auto Setup Can Be Applied To

You can use auto setup for the following types of input signals.

- Simple, repeating signals whose frequency is 50 Hz or higher
- Absolute input voltage: Signals whose maximum value is at least approx. 20 mV (at 1:1 setting)

- The auto setup feature may not work properly for signals that include a DC component or high-frequency components.
- The auto setup menu for analyzing serial bus signals is located in the setup menu of each serial bus analysis.
  ▶ See here.

Undoing Auto Setup (Undo)

You can revert to the settings that were used immediately before you executed auto setup.

Default Settings (DEFAULT SETUP)

You can reset the instrument settings to their factory default values. This feature is useful when you want to cancel all the settings that you have entered or when you want to redo measurement from scratch. Default setup refers to the act of resetting the instrument settings to their factory default values.

Items That Cannot Be Reset

The following settings cannot be reset.

- Date and time settings
- Communication settings
- Language setting (English or Japanese)
- Measured value font size setting
- Transparent display on and off, transparency level
- Touch panel feature on and off

Undoing Default Setup (Undo)

If you perform default setup by mistake, you can undo it by pressing the Undo soft key. However, you cannot undo the reset operation if you clear the Undo menu item by switching to a different setup menu or pressing the ESC key.

To Reset All Settings to Their Default Values

While holding down the RESET key, turn the power switch on. All settings except the date and time settings (display on/off setting will be reset) and the setup data stored in internal memory will be reset to their factory default values.

Snapshot (SNAP SHOT)

Retains the currently displayed waveforms on the screen. Snapshot waveforms are displayed in white and moves behind the normal waveforms. This feature allows you to update the display without having to stop waveform acquisition. It is a useful feature when you want to compare waveforms.

You can save and load snapshot waveforms. However, you cannot perform the following operations on snapshot waveforms.

Cursor measurement, automated measurement of waveform parameters, zoom, or computation

Clear Trace (CLEAR TRACE)

Clears all the waveforms that are displayed on the screen.
If you change the display format or perform other similar operations, the instrument redisplays the channel waveforms, computed waveforms, and loaded waveforms that were displayed before you executed the clear trace operation.
If you execute a clear trace operation during waveform acquisition, the instrument restarts waveform acquisition (from the first acquisition). All history waveforms that have been stored up to that point are cleared. Snapshot and clear trace features are disabled.
If Continuous Statistics is in progress in statistical processing of waveform parameters, the result is cleared, and statistical processing is restarted.

Snapshot and clear trace features are disabled:

- When the instrument is printing, when it is executing auto setup, or when it is accessing a storage device.
- When GO/NO-GO determination is in progress, when action-on-trigger is in progress, or when searching is in progress.

Calibration (Calibration)

Executing Calibration (Cal Exec)

You can calibrate the vertical axis ground level and gain. Execute calibration when you want to make accurate measurements.
Calibration is automatically performed for the settings listed above when the power switch is ON.

Notes about Calibration

- Allow the instrument to warm up for at least 30 minutes before you execute calibration. If you execute calibration immediately after power-on, the calibrated values may drift due to temperature changes or other environmental changes.
- Execute calibration in a stable temperature environment ranging from 5°C to 40°C (23 ± 5°C recommended).
- Do not apply signals when calibrating. Calibration may not be executed properly when input signals are being applied to the instrument.

Auto Calibration (Auto Cal)

Auto calibration is executed when you perform one of the following operations and any of the time periods listed below has elapsed since the power was turned on.
90 seconds, 3 minutes, 10 minutes, 30 minutes, 1 hour, and each following hour

- Change the time scale (time/div) during waveform acquisition (when the RUN/STOP key is illuminated)
- Start waveform acquisition after stopping waveform acquisition (so that the RUN/STOP key is not illuminated)

If calibration is executed while signals are being applied to the instrument, we recommend that you stop signal application and recalibrate the instrument.

Remote Control (Remote Control)

Communication interface for controlling this Instrument from a PC. For details, see the communication interface user's manual, IM DLM5058-17EN.

Types of Communication Interfaces (Device)

USB, GP-IB, and Network are the available communication interfaces.

- Only use the selected communication interface. If you send commands simultaneously from another communication interface that has not been selected, the instrument will not execute the commands properly.
- The instrument is in Remote mode while it is communicating with a PC. All keys except SHIFT + CLEAR TRACE are disabled in Remote mode.

USB

Connects the instrument to a PC using USB.

USB Communication (USB Function)

You can specify the communication features that are used when you connect the instrument to a PC through USB.

- **USBTMC**
  You can use USB TMC (Test and Measurement Class) to control the instrument from a PC.
  To connect the instrument to a PC through the USB port, carry out the following procedure.
  - Install the YOKOGAWA USB driver in your PC.
  - Do not use USB drivers (or software) supplied by other companies.
- **Mass Storage (Mass Storage)**
  You can access the instrument from a Windows 10 or Windows 11 PC and read data from the instrument's internal storage.
  - You cannot delete data or write data to the instrument's internal storage.
  - You cannot format or defragment the instrument's internal storage.
  - You cannot access the storage device connected to the USB ports of the instrument.
  - You do not have to install a USB driver on your PC.
  - If you operate the files from the instrument, the instrument will temporarily disconnect the connection from the PC so that the status of the device recognized by the PC can be refreshed.

For information about how to obtain the YOKOGAWA USB driver, contact your nearest YOKOGAWA dealer. You can also access the YOKOGAWA USB driver download website and download the driver (http://www.yokogawa.com/ymi/).

GP-IB

Connects the instrument to a PC using GP-IB.

Address (Address)

- You can select a value between 0 and 30.
- Each device that is connected in a GP-IB system has its own unique address. This address is used to distinguish between different devices. Therefore, you must assign a unique address to the instrument when connecting it to a PC or other device.

When the controller is communicating with the instrument or with other devices through GP-IB, do not change the address.

Notes about Connections

- Multiple cables can be used to connect multiple devices. However, no more than 15 devices, including the controller, can be connected on a single bus.
- When connecting multiple devices, you must assign a unique address to each device.
- Use cables that are 2 m or shorter in length to connect devices.
- Make sure the total length of all cables does not exceed 20 m.
- When devices are communicating, have at least two-thirds of the devices on the bus turned on.
- To connect multiple devices, use a star or daisy-chain configuration. Loop and parallel configurations are not allowed.

Network (Network)

Connects this Instrument to a PC using Ethernet.

VXI-11(VXI-11)

Select whether to allow access to the instrument using VXI-11.

- ON: Allows access
- OFF: Denies access

Socket Interface (Socket)

Select whether to allow access to the instrument using the socket interface.

- ON: Allows access
- OFF: Denies access

Timeout (Timeout)

If a connection cannot be established between the instrument and the PC within the amount of time specified here, the instrument aborts the connection process.

Selectable range: 1 s to 3600 s, Infinite

You must set TCP/IP parameters to connect this Instrument to an Ethernet network.

▶ See here.

Notes about Connections

- To connect the instrument to a PC, be sure to use straight cables and to connect through a hub or router. Proper operation is not guaranteed for a one-to-one connection using a crossover cable.
- Use a network cable appropriate for the data rate of your network.

System Configuration (System Configuration)

You can specify the following settings.

- Date and time on the instrument
- IEEE 1588 time synchronization feature
- Language (menu, message, USB keyboard)
- Measurement display (font size, number of rows outside the waveform area)
- Internal storage format
- Backlight adjustment (auto off, brightness)
- Transparent mode (ON/OFF, level adjustment)
- Offset cancel
- Delay cancel
- Trigger output
- USB communication feature
- Click sound on/off

Date and Time (Date/Time)

The instrument date and time.

Turning the Display On and Off (Display)

Sets whether or not to display the date and time on the instrument screen.

Display Format (Format)

Select the display format from one of the following options.

- Year/month (number)/day
- Day/month (number)/year
- Day-month (English abbreviation)-year (last two digits)
- Day month (English abbreviation) year

Date and Time (Date/Time)

Sets the date and time.

Time Difference from Greenwich Mean Time (Time Diff. GMT)

Set the time difference between the region where you are using the instrument and Greenwich Mean Time.

Selectable range: Set the time difference in the range of −12 hours 00 minutes to 13 hours 00 minutes.

For example, Japan standard time is ahead of GMT by 9 hours. In this case, set Time Hour to 9 and Minute to 0.

Checking the Standard Time

Using one of the methods below, check the standard time of the region where you are using the instrument.

- Check the Date, Time, Language, and Regional Options on your PC.
- Check the website at the following URL: http://www.worldtimeserver.com/



- This instrument does not support Daylight Saving Time. To set the time to Daylight Saving Time, reset the time difference from Greenwich Mean Time.
- Date and time settings are backed up using an internal lithium battery. They are retained even if the power is turned off.
  This instrument has leap-year information.
- The setting of the time difference from Greenwich Mean Time is shared with the IEEE 1588 time synchronization feature.

IEEE 1588 Time Synchronization Feature (IEEE 1588)

IEEE 1588 is a standard protocol for precise time synchronization in local area networks (LANs).
This instrument operates as a IEEE 1588 slave device and can synchronize the time and sampling clock by receiving Precision Time Protocol (PTP) packets from a master device.
For details on the packet format and protocol, see the IEEE 1588 specifications.

Turning the IEEE 1588 Time Synchronization Feature On and off (Mode)

You can select whether to use time synchronization based on IEEE 1588 PTP packets (ON/OFF).

Before enabling the IEEE 1588 time synchronization feature, set the network layer and domain number described below.

Network Layer (Network Layer)

Set the packet type to receive to Layer2 (Ethernet) or Layer3 (UDP/IPv4).

Domain Number (Domain Number)

Set the domain number of the synchronization target device.
Selectable range: 0 to 255

IEEE 1588 Information Monitor (Information)

You can monitor information related to IEEE 1588 time synchronization.

- Master Clock ID
  Displays the master clock ID (64-bit identifier).
  Display format: 16 characters (hexadecimal)
- Local Clock ID
  Displays the local clock ID (64-bit identifier).
  Display format: 16 characters (hexadecimal)
- Port State
  Display the port status.

OFF	The IEEE 1588 time synchronization feature is off.
IINITIALIZING, FAULTY, DISABLED, LISTENING, UNCALIBRATED, SLAVE	States defined in IEEE 1588-2008

- Offset From Master
  Displays the offset from the master device.

Sampling Clock States

When the IEEE 1588 time synchronization feature is on, the sampling clock synchronizes to the IEEE 1588 master. The sampling clock state is indicated with an icon at the top of the screen.

 : Not communicating with the master. The sampling clock is running based on the internal oscillator.
 : Starting to synchronize with the master and adjusting the time and sampling clock.
 : Established synchronization with the master and the time and sampling clock are stable. To measure using the IEEE 1588 time synchronization feature, start measuring after this icon is displayed.

When the IEEE 1588 time synchronization feature is off, the sampling clock runs based on the internal oscillator. No icons are displayed at the top of the screen.

- The time indicated by Offset From Master is based on values calculated from the packet timestamps, so it is an approximate value.
- Perform measurements after the master and sampling clock have become synchronized.
- To reset the IEEE 1588 state or the sampling clock state, turn the IEEE 1588 time synchronization feature off and then back on.
- Usually, the sampling clock stabilizes about 2 minutes after Port State transitions to SLAVE. However, if the communication status with the master is poor or if the master clock is of low quality, the sampling clock may not be stable even when Port State is SLAVE.

Language (Language)

Sets the language that is used in the setup menu and messages.
The available languages vary depending on the model.

USB Keyboard Language (USB Keyboard)

Sets the USB keyboard language to English. The USB keyboard can be used to enter file names, comments, etc.

Measurement Display (Measure Parameter)

You can set the size of text and the number of rows for displaying automated measurement values of waveform parameters and cursor measurement values.

Text Size (Font Size)

You can set the size of text for displaying automated measurement values of waveform parameters and cursor measurements.

- Small: Small font size
- Large: Large font size

Number of Displayed Rows outside the Waveform Area (Max Rows)

Set the number of rows outside the waveform area for displaying automated measurement values of waveform parameters and cursor measurement values.
Selectable range: 4 to 30

Internal Storage Format (Storage)

You can format the instrument's internal storage (Flash_Mem).

Format (Format)

Formats the instrument's internal storage (Flash_Mem).

If you format the internal storage, all saved data is erased.

Adjusting the Backlight (Display)

You can turn off the LCD backlight and adjust its brightness. You can prolong the backlight service life by decreasing the backlight brightness or by turning off the backlight when you do not need to view the screen.

Adjusting the Brightness (Brightness)

You can adjust the brightness in the range of 1 (darkest) to 10 (brightest).

Enable or Disable Auto-off (Auto OFF)

- OFF: The auto-off feature is disabled.
- ON: The backlight turns off automatically when there are no key operations for a given time period. The backlight turns back on when you press any key.

Auto-off Time (Timeout)

Set the time until the backlight turns off after the last panel key operation for when the auto-off feature is turned on.
Selectable range: 1 to 60 minutes

Turn Off (Turn OFF)

You can turn off the backlight. When the backlight is off, you can turn it back on by pressing a key.

Transparent Display (Menu Transparency)

Operation screens (setup menus and dialog boxes) can be displayed transparently. This allows you to view the waveforms displayed behind menus and dialog boxes.

Turning Transparent Display On and Off (Mode)

- OFF: Transparent display is disabled.
- ON: Transparent display is enabled.

Transparency Level (Level)

You can adjust the transparency level in the range of 1 (lowest) to 5 (highest).

Offset Cancel (Offset Cancel)

You can select whether to apply the offset that you specified for observing analog signals to the various measured values.
For details, see “Offset (Offset)” in chapter 1, “Vertical Axis (Analog Signal).”

Delay Cancel (Delay Cancel)

You can select whether to apply the specified trigger delay to time measurement values.
For details, see “Trigger Delay (DELAY)” in chapter 4, “Trigger.”

Trigger Output (TRIG OUT)

You can set the output logic for the signal transmitted from the trigger output terminal and the output reset timing.

Output Logic (Polarity)

Positive: Output with positive logic. When a trigger occurs, the output level changes from low to high.
Negative: Output with negative logic. When a trigger occurs, the output level changes from high to low.

Reset Timing (Reset Timing)

You can set the timing at which the output will be reset. When reset, the output level returns to the level before the trigger occurred.

ACQ End: The set output logic level is held from the time the trigger occurs until the end of waveform acquisition. The time that the set output logic level is held corresponds to the post time and internal processing time.

Next ACQ Start: The set output logic level is held from the time the trigger occurs until the next waveform acquisition starts. The level of the output logic will not change unless waveform acquisition is started.

USB Communication (USB Function)

You can specify the communication features that are used when you connect the instrument to a PC through USB. This is the same feature as the USB communication feature of remote control.

Turning On or Off the Click Sound (Click Sound)

You can turn on or off the click sound that is generated when you operate the jog shuttle.

Overview (Overview)

You can view a list of instrument information and settings.

System Information (System Overview)

You can view the instrument model, memory size, and installed options.

Setup Information (Setup Information1, Setup Information2)

You can view a list of current settings.

Additional Option License (Option Installation)

You can add the following options after purchase. Install the options after you have purchased the license keys for them.

Available Options

/SYN	Synchronous operation
/G02	User-defined computation
/G03	Power supply analysis feature
/F01	UART + I^2C + SPI trigger and analysis
/F02	CAN + CAN FD + LIN trigger and analysis
/F03	FlexRay trigger and analysis
/F04	SENT trigger and analysis
/F05	CXPI trigger and analysis
/F06	PSI5 trigger and analysis

The SUFFIX (suffix code) inscribed in the name plate on the instrument's case indicates the installed options at the time of factory shipment. After you add options through additional option licenses, check the options on the instrument's overview screen.

Self-Test (Self Test)

You can test the keyboard and memory operations.

Test Type (Type)

You can perform the following tests.

Memory Test (Memory)
Tests whether or not the internal CPU board RAM and ROM are operating properly. If they are operating properly, “Success” appears. If an error occurs, “Fail” appears.

Keyboard Test (Keyboard)
Tests whether the front panel keys and knobs are operating correctly and whether the soft keyboard accepts input properly.

- The front panel keys are operating properly if the background color of the names of the keys that you press turns white or green.
- Knobs are operating properly if you turn them slowly, press them, or move them up, down, left, and right depending on the type of knob and the background color of the names or arrows changes to white or green.
- The soft keyboard is operating properly if you can enter the specified characters.

Printer Test (Printer)
Tests whether or not the optional built-in printer is operating properly. The built-in printer is operating properly if the print density is correct. If an error occurs, the print density will not be correct.

Synchronous Operation Feature Test (DLMsync)
Tests whether or not the option’s synchronous operation feature is operating properly. Connect the two DLM5000s with a connection cable, and start (Connect) the synchronous operation. Stop acquiring waveforms, and then execute the test on the main unit.

- Accuracy is a service test item. Under normal circumstances, you do not need to perform these tests.
- The DLMsync soft key menu is displayed only when the /SYN option is installed.

Executing a Test (Test Exec)

The selected self-test starts.

If an Error Occurs during a Self-Test

If an error occurs even after you carry out the following procedure, contact your nearest YOKOGAWA dealer.

- Execute the self-test again several times.
- Check that the paper is set properly in the built-in printer and that paper is not jammed.
- Connect the connection cable securely to the synchronous operation I/O connector, and check that it is locked in place.
- In the case of a synchronous operation feature test, check that M is displayed at the top of the screen on the main unit.

Touch Panel (TOUCH)

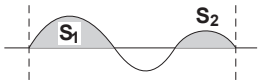
You can turn the touch panel feature on and off. When the touch panel feature is on, the indicator illuminates. For the operating procedure, see the Getting Started Guide, IM DLM5058-03EN.

Appendix

Appendix 1 How to Calculate the Area of a Waveform

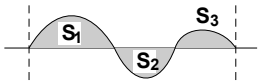
IntegTY+

Area under the positive parts: S1 + S2



IntegTY

Area under the positive parts – area under the negative parts: S1 + S3 − S2

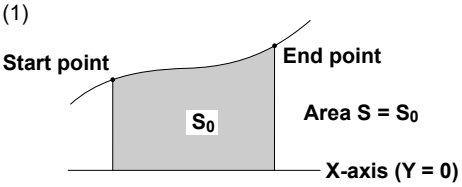


Integ for XY Display

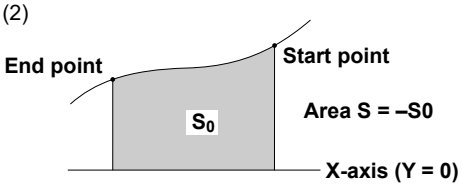
Open

When Each Y Data Point Corresponds to a Single X Data Point

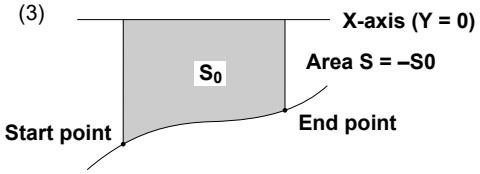
(1)



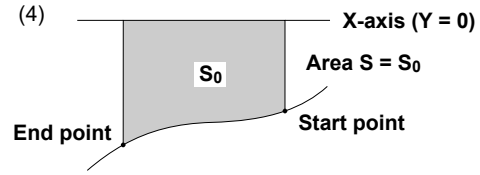
(2)



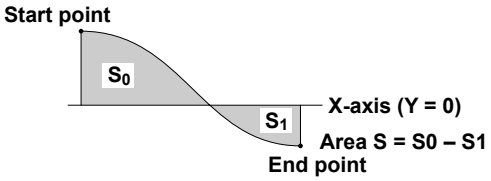
(3)



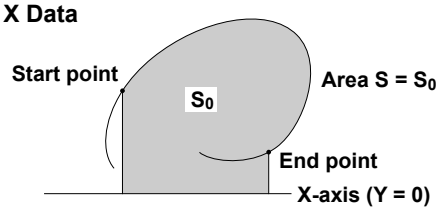
(4)

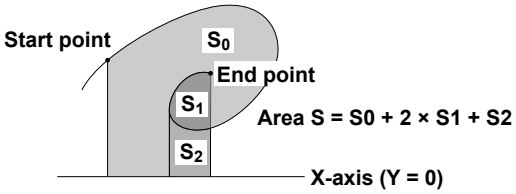


When the Waveform Extends into the Negative Side



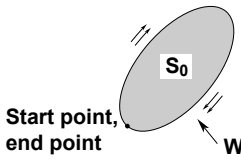
When Multiple Y Data Corresponds to X Data





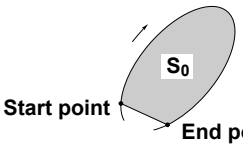
Close

Multiple Loops



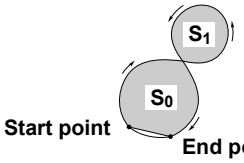
Area S = n×S0
n: The number of loops

Non-Closed Curve



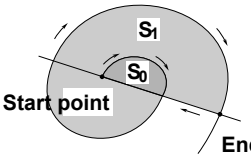
Area S = S_0
Area enclosed by a curve connecting the start and end points

Loop Tracing a Figure-Eight



Area S = |S0 – S1|

Loop Tracing a Spiral



Area S = 2 × S0 + S1
The number of overlaps varies according to the number of loops.

Appendix 2 User-Defined Computation

Digital Filters

Types

Type	Bandwidth
FIR	LowPass/HighPass/BandPass
IIR	LowPass/HighPass/BandPass

Filter Order

See the following table for the filter orders.

		2 %	5 %	10 %	20 %	30 % (Cutoff*)
FIR	LowPass	88	36	18	9	8
	HighPass	159	65	33	17	13
IIR	LowPass	4	4	4	3	2
	HighPass	4	4	4	4	3

* The cutoff percentage is with respect to the sample rate.

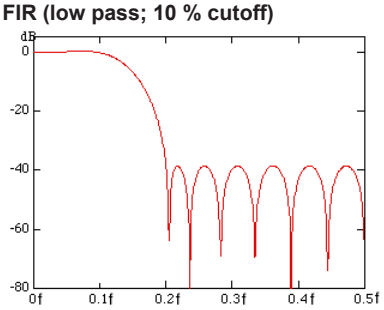
Filter Response

Filter	Pass-band Ripple	Attenuation Slope	Attenuation at the Stop-band	Phase
FIR	±0.3dB	–40 dB at 1 oct (Lowpass),	−40 dB	Linear phase
		−40 dB at−1oct(Highpass)	–	Linear phase
IIR	0 dB	–5 dB at 1/6 oct (Lowpass),	–	Non-linear phase
		−20 dB at−1oct(Highpass)	–	Non-linear phase

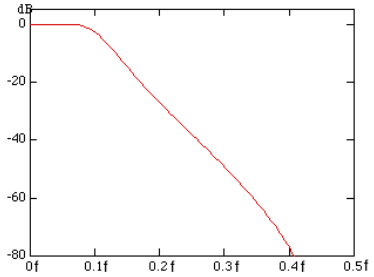
Examples of Filter Frequency Responses

f: Frequency (Hz)

FIR (low pass; 10 % cutoff)



IIR (low pass; 10 % cutoff)



Computations take more time with higher filter orders.

Hilbert Function (HLBT)

Normally, when we analyze real-time signals, it is useful to think of these signals as the real part of functions of complex variables, and to carry out the actual signal analysis using such functions.
If the real-time signal is considered to be the real part of the function, the imaginary part can be determined with the Hilbert transform of the real part.
The Hilbert transform does not change the order of the individual variables. Hilbert transform of a time signal results in another time signal.
The Hilbert transform procedure is as follows.
When a time-domain signal is transformed, the signal is first transformed into the frequency domain through Fourier transform. Next, the phase of each frequency component is shifted by –90 degrees if the frequency is positive and +90 degrees if the frequency is negative. Lastly, taking the inverse Fourier transform completes the Hilbert transform.

Example

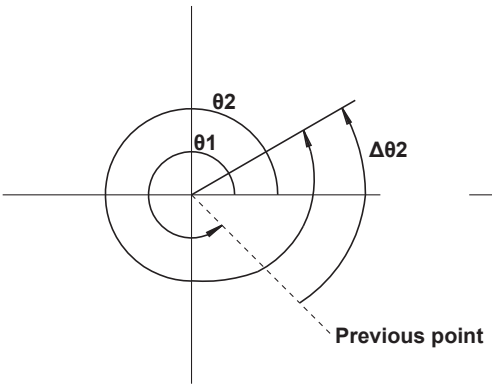
The Hilbert transform can be used to analyze an envelope waveform.

AM (amplitude modulation): SQRT(C1 × C1 + HLBT(C1) × HLBT(C1))

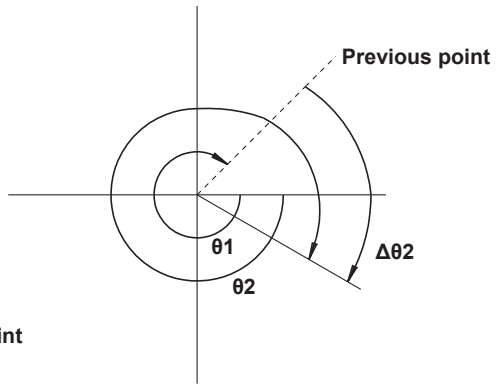
Demodulation of an FM Signal: DIF(PH(C1, HLBT(C1)))

Phase Function (PH)

Phase function PH(X1, Y1) computes $\tan^{-1}(X1/Y1)$.
The phase function takes the phase of the previous point into consideration and continues to sum even when the value exceeds ±π (the ATAN function reflects at ±π).
The unit is radians.



θ2 = θ1 + Δθ2



θ2 = θ1 – Δθ2

Differentiation and Integration

The computation of the differentiated value uses the 5th order Lagrange interpolation formula to derive a point of data from the five points of data before and after the target point.
The following equations use data f0 to fn and I0 to In with respect to sampling time x0 to xn. The derivative and integrated values corresponding to these data points are computed as follows:

Differentiation (DIFF)

Point x_k f_k' = $\frac{1}{12h}$ $[f_{k-2} - 8f_{k-1} + 8f_{k+1} - f_{k+2}]$

h = Dx is the sampling interval (sec) (example: When 5 kHz, h=200 × 10^{-6})

Integration(INTEG)

Point x0 $I_0 = 0$

Point x1 $I_1 = \frac{1}{2}(f_0 + f_1)h$

Point x2 $I_2 = \frac{1}{2}(f_0 + f_1)h + \frac{1}{2}(f_1 + f_2)h = I_1 + \frac{1}{2}(f_1 + f_2)h$

Point xn $I_n = I_{n-1} + \frac{1}{2}(f_{n-1} + f_n)h$

Moving Average(MEAN)

Determines the moving average of the source waveform by using the specified harmonic order. The moving average is calculated as follows:

- When harmonic order N is even (2 k)

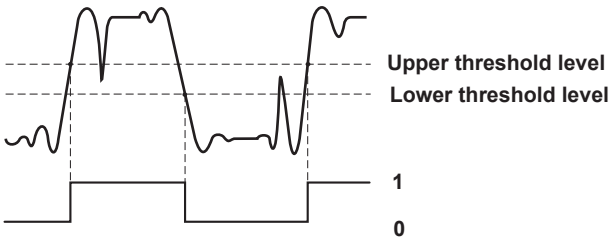
$$X_n = \frac{1}{N}\left\{ X_n + 0.5 \times (X_{n-k} + X_{n+k}) + \sum_{i=1}^{k-1}(X_{n-i} + X_{n+i}) \right\}$$

- When harmonic order N is odd (2 k + 1)

$$X_n = \frac{1}{N}\left\{ X_n + \sum_{i=1}^{k}(X_{n-i} + X_{n+i}) \right\}$$

Binary Conversion(BIN)

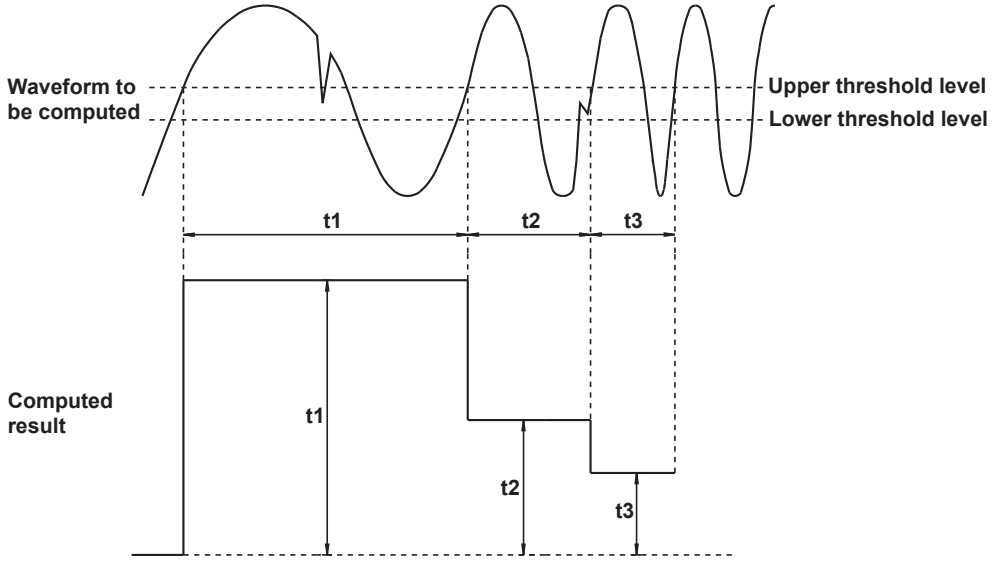
Performs binary conversion using the specified threshold levels.



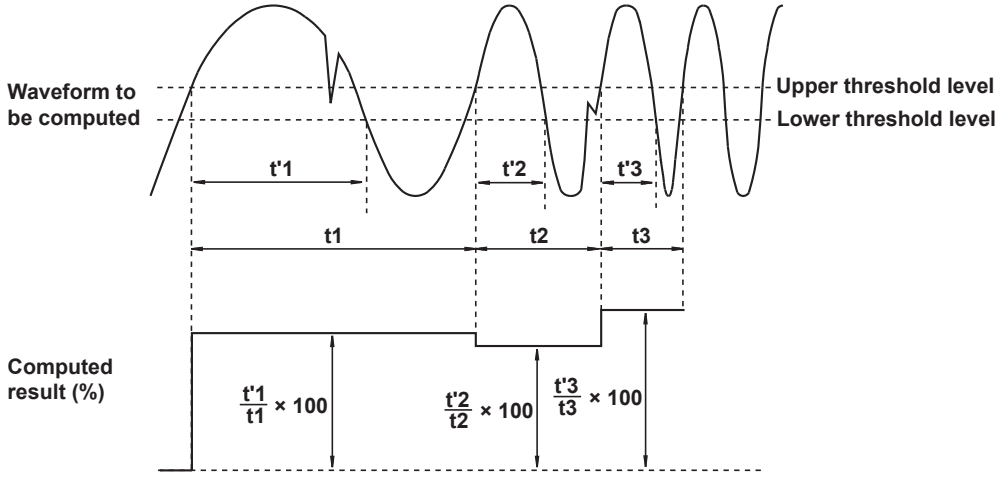
Pulse Width Computation

The signal is converted to binary values by comparing to the preset threshold level, and the time of the pulse width is plotted as the Y-axis value for that interval.
You can set the interval to one of the settings below.
PWHH: From a rising edge to the next rising edge.
PWHL: From a rising edge to the next falling edge.
PWLH: From a falling edge to the next rising edge.
PWLL: From a falling edge to the next falling edge.
PWXX: From a rising or falling edge to the next rising or falling edge.
FV: The inverse of PWHH.
DUTYH: Duty cycle of the high side of each period of the specified waveform.
DUTYL: Duty cycle of the low side of each period of the specified waveform.

Example 1, When the Interval Is Set to PWHH



Example 2, When the Interval Is Set to DUTYH



FFT Function

Each frequency component G of a linear spectrum is represented by G = R + jI, where R is the real part and I is the imaginary part.

Linear Spectrum

The linear spectrum can be directly determined with the FFT. Through this spectrum, the magnitude and phase of each frequency component included in the measured waveform can be found. The power spectrum and cross spectrum can also be determined from one or two linear spectra. Because the FFT is a complex function, the linear spectrum produces the real part and imaginary part of the frequency components. The magnitude and phase of the linear spectrum can also be determined from this result.

This instrument can determine the following spectra.

Item	Formula	Computation
Real part	LS-REAL	R
Imaginary part	LS-IMAG	I
Amplitude	LS-MAG	$\sqrt{(R^2 + I^2)}$
Log magnitude	LS-LOGMAG	$20 \times \log \sqrt{(R^2 + I^2)}$
Phase	LS-PHASE	$\tan^{-1}(I/R)$

Log magnitude reference (0 dB): 1 Vpeak

RMS Spectrum

The RMS spectrum expresses the amplitudes of the linear spectrum with RMS values. It does not contain phase information.

This instrument can determine the following spectra.

Item	Formula	Computation
Amplitude	RS-MAG	$\sqrt{(R^2 + I^2)/2}$
Log magnitude	RS-LOGMAG	$20 \times \log \sqrt{(R^2 + I^2)/2}$

Log magnitude reference (0 dB): 1 Vrms

Power Spectrum

The power spectrum expresses the power (squared value) of each frequency component included in the measured signal. It is determined by taking the product of the linear spectrum and its complex conjugate. It does not contain phase information.

This instrument can determine the following spectra.

Item	Formula	Computation	
Amplitude	PS-MAG	DC component	$R^2 + I^2$
		AC component	$(R^2 + I^2)/2$
Log magnitude	PS-LOGMAG	DC component	$10 \times \log(R^2 + I^2)$
		AC component	$10 \times \log\{(R^2 + I^2)/2\}$

Log magnitude reference (0 dB): 1 $Vrms^2$

Power Spectrum Density

The power spectrum density expresses the power spectrum per unit frequency. It is determined by dividing the power spectrum by the frequency resolution Δf found during the analysis of the power spectrum. The computation varies depending on the window function.

Power spectrum density is used to compare power spectra analyzed at different frequency bands. However, it is not necessary for signals having a line spectrum such as sine waves.

This instrument can determine the following spectra.

Item	Formula	Computation	
Amplitude	PSD-MAG	PS-MAG/Δf	Rectangle window
		PS-MAG/(1.5Δf)	Hanning window
		PS-MAG/(3.19693Δf)	Flattop window
Log magnitude	PSD-LOGMAG	10 × logPS-MAG/Δf	Rectangle window
		10 × logPS-MAG/(1.5Δf)	Hanning window
		10 × logPS-MAG/(3.19693Δf)	Flattop window

Log magnitude reference (0 dB): 1 $Vrms^2$

Cross Spectrum

The cross spectrum is determined from two signals. It is found by taking the product of the linear spectrum of one signal (Gy) and the complex conjugate (Gx*) of the linear spectrum of the other signal (Gx).
If the linear spectra of the two signals are represented by

Gx = Rx + jIx

Gy = Ry + jIy

then the cross spectrum Gyx is

Gyx = Gy × Gx* = (Ry + jIy)(Rx jIx) = Ryx + jIyx

where Ryx = RyRx + IyIx, Iyx = RxIy RyIx

This instrument can determine the following spectra.

Item	Formula	Computation	
Real part	CS-REAL	DC component	Ryx
		AC component	Ryx/2
Imaginary part	CS-IMAG	DC component	Iyx
		AC component	Iyx/2
Amplitude	CS-MAG	DC component	$\sqrt{(Ryx^2 + Iyx^2)}$
		AC component	$\sqrt{(Ryx^2 + Iyx^2)}/2$
Log magnitude	CS-LOGMAG	DC component	$10 \times \log \sqrt{(Ryx^2 + Iyx^2)}$
		AC component	$10 \times \log(\sqrt{(Ryx^2 + Iyx^2)}/2)$
Phase	CS-PHASE		$\tan^{-1}(Iyx/Ryx)$

Transfer Function

The transfer function expresses the frequency responses of the input to and the output from the transfer system. The transfer function is determined by the ratio of the output linear spectrum (Gy) and the input spectrum (Gx) at each frequency. Also, as can be seen from the following equation, the transfer function can be defined as the ratio of the cross spectrum of the input and output (Gyx) and the input power spectrum (Gxx).

Transfer function = Gy/Gx = (Gy×Gx*)/(Gx×Gx*) = Gyx/Gxx = (Ryx + jIyx)/(Rx^2 + Ix^2)

The instrument can determine the following items.

Item	Formula	Computation
Real part	TF-REAL	Ryx/(Rx^2 + Ix^2)
Imaginary part	TF-IMAG	Iyx/(Rx^2 + Ix^2)
Amplitude	TF-MAG	$\sqrt{(Ryx^2 + Iyx^2)}$/(Rx^2 + Ix^2)
Log magnitude	TF-LOGMAG	$20 \times \log \sqrt{(Ryx^2 + Iyx^2)}$/($Rx^2$ + Ix^2)
Phase	TF-PHASE	$\tan^{-1}(Iyx/Ryx)$

The magnitude of the transfer function shows the ratio of the magnitudes of the output linear spectrum and the input linear spectrum while the phase shows the phase difference of the two.

Coherence Function

The coherence function expresses the ratio of the output power generated by the input signal to the transfer system and the total output power.

Coherence function = Gyx × Gyx*/(Gxx × Gyy)

Item	Formula	Computation
Amplitude	CH-MAG	(Ryx^2 + Iyx^2)/(Gxx × Gyy)

If the output signal is due entirely to the input signal, the coherence function becomes 1. As the ratio decreases, it falls below 1. Thus, the coherence function always takes on a value between 0 and 1.

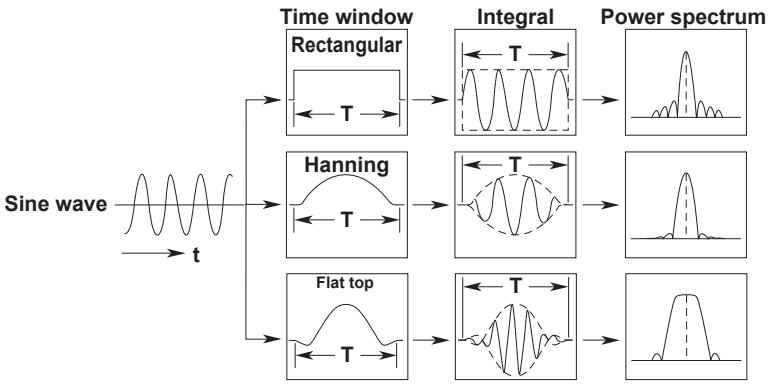


On one data acquisition, the coherence function becomes 1 across all frequencies. Make sure to take the frequency average of the computation.

Time Windows

You can select from rectangular, Hanning, or flattop time windows.

The rectangular window is best suited to transient signals, such as impulse waves, which attenuate completely within the time window. The Hanning and flattop windows allow continuity of the signal by gradually attenuating the parts of the signal located near the ends of the time window down to the 0 level. Hence, they are best suited to continuous signals. The Hanning window provides a higher frequency resolution compared to the flattop window. However, the flattop window has a higher level of accuracy. When the waveform being analyzed is a continuous signal, consider the above characteristics in selecting the proper window to be applied.



Rectangular : $W(t) = u(t) - u(t - T)$ U(t): Step function

Hanning : $W(t) = 0.5 - 0.5\cos(2\pi\frac{t}{T})$

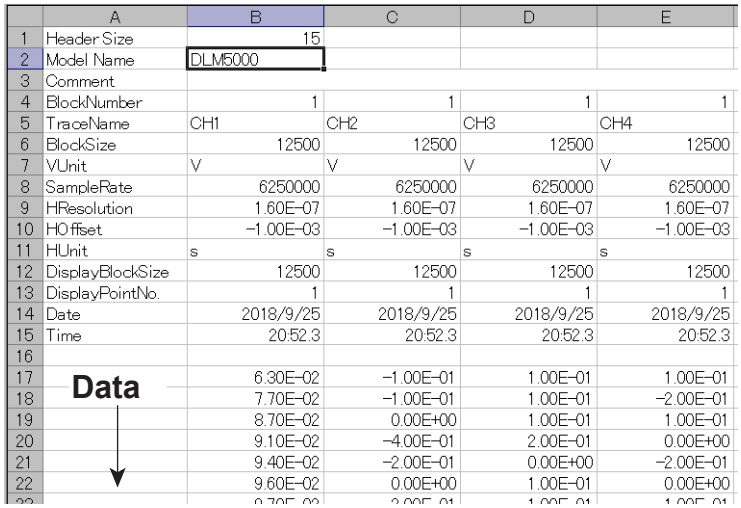
Flat top : $W(t) = \{0.54 - 0.46\cos(2\pi\frac{t}{T})\}\frac{\sin\{2\pi(1 - 2t/T)\}}{2\pi(1 - 2t/T)}$

Notes When Executing the FFT Computation

Computation is normally performed on the sampled data in the acquisition memory. However, for waveforms that have been acquired in envelope mode, computation is performed on the maximum and minimum values per acquisition interval.

Appendix 3 ASCII Data File Format

The instrument can save waveform data to ASCII files. The format of such files is given below.



	A	B	C	D	E
1	Header Size	15			
2	Model Name	DLM5000			
3	Comment				
4	BlockNumber	1	1	1	1
5	TraceName	CH1	CH2	CH3	CH4
6	BlockSize	12500	12500	12500	12500
7	VUnit	V	V	V	V
8	SampleRate	6250000	6250000	6250000	6250000
9	HResolution	1.60E-07	1.60E-07	1.60E-07	1.60E-07
10	HOffset	-1.00E-03	-1.00E-03	-1.00E-03	-1.00E-03
11	HUnit	s	s	s	s
12	DisplayBlockSize	12500	12500	12500	12500
13	DisplayPointNo.	1	1	1	1
14	Date	2018/9/25	2018/9/25	2018/9/25	2018/9/25
15	Time	20:52.3	20:52.3	20:52.3	20:52.3
16					
17	Data	6.30E-02	-1.00E-01	1.00E-01	1.00E-01
18		7.70E-02	-1.00E-01	1.00E-01	-2.00E-01
19		8.70E-02	0.00E+00	1.00E-01	1.00E-01
20		9.10E-02	-4.00E-01	2.00E-01	0.00E+00
21		9.40E-02	-2.00E-01	0.00E+00	-2.00E-01
22		9.60E-02	0.00E+00	1.00E-01	0.00E+00

Header Size	The number of header lines.
Model Name	The model name.
Comment	Comment attached at the time the data file was saved.
BlockNumber	Block number for this group. When the block numbers vary depending on the waveform, this is the maximum block number.
TraceName	Name of each waveform.
BlockSize	The number of data points in one block for each waveform.
VUnit	Each waveform's Y-axis unit (this has no effect on the data).
SampleRate	The sample rate at the time of waveform acquisition.
HResolution	Each waveform's X-axis conversion coefficient, HResolution. X-axis value = HResolution × (Data No. – 1) + HOffset
HOffset	Each waveform's X-axis conversion coefficient, HOffset. X-axis value = HResolution × (Data No. – 1) + HOffset
HUnit	Each waveform's X-axis unit (this has no effect on the data).
DisplayBlockSize	The length of the data displayed on the screen (the display record length).
DisplayPointNo.	This number shows what point in memory is displayed on the left-most side of the display record length.
Date	Date when waveform acquisition completed.
Time	Time when waveform acquisition completed.

Appendix 4 TCP and UDP Port Numbers

The TCP and UDP port numbers that are used on the Ethernet interface of the instrument are listed below.

TCP Port Numbers

Port Number	Description	Used For
20	File Transfer [Default Data]	FTP server, FTP client*
21	File Transfer [Control]	FTP server, FTP client
25	Simple Mail Transfer Protocol	SMTP client
80	HTTP	Web server
515	–	LPR client
111	–	Instrument control through the Ethernet interface
1024	–	
1025	–	

UDP Port Numbers

Port Number	Description	Used For
67	Bootstrap Protocol Server	DHCP client
68	Bootstrap Protocol Client	(listen port)
111	–	Instrument control through the Ethernet interface
123	Network Time Protocol	SNTP client

* The port number when FTP passive mode is disabled. When FTP passive mode is enabled, you can set any port number. When FTP passive mode is disabled, connections are established from the server. If you are connecting the instrument from behind a firewall, enable FTP passive mode.

Appendix 5 How Power Measurement Items Are Determined

The power measurement feature is available on models with the /G03 option. The following table shows how the power measurement items are determined or the equations that are used.

Measurement Item	Methods of Determination and Equation		
Voltage U [V] **Maximum U+pk** **Minimum U-pk** **Amplitude Up-p** **True rms value Urms** **DC component Udc** **AC component Uac** **Rectified mean value calibrated to the rms value Umn** **Rectified mean value Urmn**	U+pk	U−pk	Up-p
	Maximum (same as waveform parameter “Max”)	**Minimum** (same as waveform parameter “Min”)	**Bandwidth** (same as waveform parameter “P-P”)
	Urms	Udc	Uac
	$\sqrt{\frac{1}{T}\int_0^T u(t)^2\,dt}$	$\frac{1}{T}\int_0^T u(t)\,dt$	$\sqrt{Urms^2 - Udc^2}$
	Umn	Urmn	
	$\frac{\pi}{2\sqrt{2}}\frac{1}{T}\int_0^T \lvert u(t)\rvert\,dt$	$\frac{1}{T}\int_0^T \lvert u(t)\rvert\,dt$	
Current I [A] **Maximum I+pk** **Minimum I-pk** **Amplitude Ip-p** **True rms value Irms** **DC component Idc** **AC component Iac** **Rectified mean value calibrated to the rms value Imn** **Rectified mean value Irmn**	I+pk	I−pk	Ip-p
	Maximum (same as waveform parameter “Max”)	**Minimum** (same as waveform parameter “Min”)	**Bandwidth** (same as waveform parameter “P-P”)
	Irms	Idc	Iac
	$\sqrt{\frac{1}{T}\int_0^T i(t)^2\,dt}$	$\frac{1}{T}\int_0^T i(t)\,dt$	$\sqrt{Irms^2 - Idc^2}$
	Imn	Irmn	
	$\frac{\pi}{2\sqrt{2}}\frac{1}{T}\int_0^T \lvert i(t)\rvert\,dt$	$\frac{1}{T}\int_0^T \lvert i(t)\rvert\,dt$	
Apparent power S [VA]	Urms•Irms		
Active power P [W]	$\frac{1}{T}\int_0^T u(t)\bullet i(t)dt$ u(t) • i(t): Instantaneous power		
Reactive power Q [var]	$\sqrt{S^2 - P^2}$		
Load circuit Impedance Z [Ω]	$\frac{Urms}{Irms}$		
Power factor λ	$\frac{P}{S}$		
Watt-hours [Wh] Wp Wp+ Wp- Abs.Wp	$\int_0^T u(t)\bullet i(t)\,dt$ Wp is the sum of positive and negative watt hours. Wp+ is the sum of positive P (consumed watt-hours). Wp- is the sum of negative P (watt-hours returned to the power supply). Abs.Wp is the sum of Wp+ and Wp- (the sum of absolute watt-hours).		
Ampere-hours [Ah] q q+ q- Abs.q	$\int_0^T i(t)\,dt$ q is the sum of positive and negative Idc (ampere-hours). q+ is the sum of positive Idc (ampere-hours). q- is the sum of negative Idc (ampere-hours). Abs.q is the sum of q+ and q- (the sum of absolute ampere-hours).		
Average frequency Avg Freq [Hz]	**Average frequency (same as waveform parameter “Avg Freq”)**		

T: measurement time period, u(t): sampled data of the voltage, i(t): sampled data of the current

Appendix 6 Trigger and Detected Points of SENT Signals

The following table shows the trigger and detected points of SENT signals.

Trigger/search type		Trigger/detected point				
		Normal, with SYNC/CAL error, with S&C error	**Nibble Number with error**	**NDV in S&C with error**	**NDV in DataNDV with error**	**NDV in CRC with error**
Every Fast CH		End of S&C of the relevant frame				
Fast CH S&C		End of S&C of the relevant frame		Not triggered or searched	End of S&C of the relevant frame	
Fast CH Data		End of the last piece of data of the relevant frame			Not triggered when there is an NDV error in the data being compared	End of the last piece of data of the relevant frame
Every Slow CH		End of S&C of the last fast channel of the relevant slow channel				
Slow CH ID/Data						
Error	Successive CAL Pulses (Preferred Option)	Trigger point: End of S&C of the succeeding frame Detected point: End of S&C of the relevant frame				
	Successive CAL Pulses (Option 2)	End of S&C of the relevant frame				
	Nibble Number	Trigger point: End of S&C of the succeeding frame Detected point: End of S&C of the relevant frame				
	Nibble Data Value (NDV)	End of the relevant nibble				
	Fast CH CRC	End of the relevant CRC				
	Status and Communication (S&C)	End of the relevant S&C		Not triggered or searched	End of the relevant S&C	
	Slow CH CRC	End of S&C of the last fast channel of the relevant slow channel				

For the figure of the SENT signal frame format, see the explanation of SENT trigger.

▶ See here.

Appendix 7 Firmware Version and New Features

This manual covers firmware versions 3.00 or later of this instrument. The following table contains new features that are available for each firmware version. If you are using an older version, you will not be able to use all the features described in this manual. To view the firmware version, press the Overview soft key on the UTILITY menu and check Firmware Version on the Overview screen that is displayed.

Version	Suffix Code	New Features	Manual Edition Number
1.00 and later	Standard	−	1st Edition
2.00 and later	Standard	IEEE 1588 time synchronization feature	2nd Edition
	/SYN	Synchronous operation	
	/F06	PSI5 trigger and analysis	
2.50 and later	Standard	Counting condition and reset condition of the rotary count	3rd Edition
		FFT unit “dBm”	
		Measurement frequency range of the FFT peak cursor	
		FFT waveform measurement mode parameter	
		Cursor measurement item ΔV/ΔT	
		The ΔV formula for the ΔT cursor and angle cursor was changed from V1 − V2 to V2 − V1.	
	/F01	Expanded User Define setting range for UART triggers	
		Expanded setting ranges for User Define and byte space of UART signal analysis and search	
	/F01 to /F06	Decoded display label and display position	
2.80 and later	Standard	The name of standard deviation [V] was changed from Sdev to Sdev (AC RMS).	
		Waveform gradation was added to the screen image settings.	
		Expanded file numbers for auto naming numbering.	
3.00 and later	Standard	TIME/DIV settings were added to the following record lengths.* • 5M Points: 400 µs/div • 50M Points: 4 ms/div • 500M Points: 40 ms/div	4th Edition
		A feature for moving cursors between the main window and zoom window through touch control.*	
		150 MHz filter was added to the bandwidth limit.	
		A Web server feature was added.	
		Reset timing was added to the trigger output settings.	
	/F01	Expanded the data length setting range for SPI bus triggers.	
		Expanded the ranges for data length, field size, and effective bits of SPI bus signal analysis and search.	
	/F01 to /F06	Auto setup feature was expanded for analyzing serial bus signals.	

* Descriptions are provided in the *Getting Started Guide*, IM DLM5058-03EN, or the *User’s Manual*, IM DLM5058-02EN.

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DLM5034, DLM5038, DLM5054, DLM5058

Mixed Signal Oscilloscope

USER'S MANUAL

YOKOGAWA
Yokogawa Test & Measurement Corporation

IM DLM5058-02EN
4th Edition

Thank you for purchasing the DLM5034, DLM5038, DLM5054, or DLM5058 Series Mixed Signal Oscilloscope.
This User's Manual explains how to use the instrument. To ensure correct use, please read this manual thoroughly before operation.
The manuals for this instrument are listed on the next page. Please read all manuals.

Contact information of Yokogawa offices worldwide is provided on the following sheet.

Document No.	Description
PIM 113-01Z2	List of worldwide contacts

Notes

- The contents of this manual are subject to change without prior notice as a result of improvements to the product's performance and functionality. Refer to our website to view our latest manuals.
- The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
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Revisions

- September 2020 1st Edition
- March 2021 2nd Edition
- April 2023 3rd Edition
- June 2025 4th Edition

4th Edition: June 2025 (YMI)
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Manuals

The following manuals, including this one, are provided as manuals for this instrument. Please read all manuals.

Manuals Included with the Product

Manual Title	Manual No.	Description
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope Getting Started Guide	IM DLM5058-03EN	This guide explains the handling precautions, common operations, troubleshooting measures, and specifications of this instrument.
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope Operation Guide	IM DLM5058-04EN	Explains the basic operations of this instrument. Operations are described in steps from “Preparation” to “Displaying Waveforms,” “Measuring Waveforms,” and “Saving Screen Captures.”
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope Request to Download Manuals	IM DLM5058-73Z2	Describes the manuals provided on the website.
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope	IM DLM5058-92Z1	Document for China
Safety Instruction Manual	IM 00C01C01-01Z1	Safety manual (European languages)

Manuals Provided on the Website

Download the following manuals from the YOKOGAWA website.

Manual Title	Manual No.	Description
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope Features Guide	IM DLM5058-01EN	This manual explains all the instrument’s features other than the communication interface features.
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope User’s Manual	IM DLM5058-02EN	This document. The manual explains how to operate this instrument.
DLM5034, DLM5038, DLM5054, DLM5058 Mixed Signal Oscilloscope Communication Interface User’s Manual	IM DLM5058-17EN	Explains the functions of the this instrument’s communication interface, how to configure it, and the commands used to control this instrument from a PC through the interface.

For details on downloading manuals, see Request to Download Manuals (IM DLM5058-73Z2). To view the PDF data, you need Adobe Acrobat Reader or a software application that can open PDF data.

The “EN”, “Z1”, and “Z2” in the manual numbers are the language codes.

Online Help

The content similar to the Features Guide, IM DLM5058-01EN, is included in this instrument as a help file (some the content may be omitted). For instructions on how to use the help, see section 3.10 in the Getting Started Guide, IM DLM5058-03EN.

DLM Models and Conventions Used in This Manual

Models Explained

This manual explains the 8-channel model of this instrument. Channel settings vary depending on the model.

Prefixes k and K

Prefixes k and K used before units are distinguished as follows:

k:	Denotes 1000.	Example: 100 kS/s (sample rate)
K:	Denotes 1024.	Example: 720 KB (file size)

Displayed Characters

Bold characters in procedural explanations are used to indicate panel keys and soft keys that are used in the procedure and menu items that appear on the screen.

Notes and Cautions

The notes and cautions in this manual are categorized using the following symbols.



Improper handling or use can lead to injury to the user or damage to the instrument. This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."

WARNING Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

CAUTION Calls attention to actions or conditions that could cause light injury to the user or damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

French

AVERTISSEMENT Attire l'attention sur des gestes ou des conditions susceptibles de provoquer des blessures graves (voire mortelles), et sur les précautions de sécurité pouvant prévenir de tels accidents.

ATTENTION Attire l'attention sur des gestes ou des conditions susceptibles de provoquer des blessures légères ou d'endommager l'instrument ou les données de l'utilisateur, et sur les précautions de sécurité susceptibles de prévenir de tels accidents.

Note Calls attention to information that is important for the proper operation of the instrument.

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1.1 Configuring Channels (Analog Signal)

This section explains the following settings for the vertical scale for analog signals:

CH menu
- Turning the waveform display on and off
- Input coupling
- Probe
- Turning waveform display inversion on and off
- Linear scaling
- Label display
- Bandwidth limit
- Offset

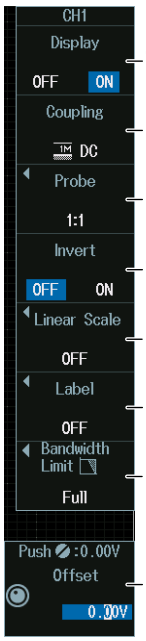
UTILITY menu
- Turning offset cancel on and off

► "Vertical Axis (Analog Signal)" in the Features Guide

CH Menu

1. Press any of the **CH1** to **CH8** keys. The channel key illuminates brightly, and the following menu appears.

- You can also tap the channel information display area ( ) at the top of the screen to select the CH menu.
- You can also tap **MENU** ( ) in the upper left of the screen and select the CH menu from VERTICAL on the top menu.



Turns the waveform display on or off

Input coupling

Probe

Turns waveform display inversion on or off

Linear scaling

Label

Bandwidth limit

Offset

Note

The available channel settings vary depending on the model.
- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

2. If you press a channel key different from step 1, that channel becomes configurable.

Note

- When the waveform display is on, the channel key and the channel information display area illuminate. When the channel key and the channel information display area are turned off, if you press a key or tap the display area, the waveform display is turned on. When the channel key and the channel information display area are illuminated brightly, if you press a key or tap the display area, the waveform display is turned off.
- On the ACQUIRE menu, if you set the record length (Record Length) to the maximum record length, the waveforms of CH2, CH4, CH6, and CH8 cannot be acquired. For details on the ACQUIRE menu, see section 3.1.

Input Coupling (Coupling)

WARNING

- If over-range is indicated, the instrument may be receiving a voltage higher than the observed waveform or measured waveform values. To prevent electric shock, change the vertical scale with the SCALE knob so that the entire amplitude of the waveform is displayed within the waveform display area, and check the input voltage level.



Over-range indication

- If the input coupling is AC, in accordance with the frequency response, the input signal is attenuated more in lower frequencies. As such, even when a high voltage signal is received, the over-range indicator may not be displayed on the instrument's screen. As necessary, switch the input coupling to DC to check the input signal voltage.

CAUTION

- The maximum input voltage for 1 MΩ input is 300 Vrms or 400 Vpeak when the frequency is 100 kHz or less. Applying a voltage greater than either of these limits may damage the input section. If the frequency is above 100 kHz, damage may occur even when the voltage is below this value.
- The maximum input voltage for 50 Ω input is 5 Vrms or 10 Vpeak. Applying a voltage greater than either of these limits may damage the input section.
- If you change the input coupling setting while waveform acquisition is stopped, the input coupling on the instrument is actually changed when waveform acquisition is executed the next time. Be careful of the maximum input voltage.

French

AVERTISSEMENT

- En cas de dépassement de plage, l'instrument risque de recevoir une tension supérieure à la forme d'onde observée ou aux valeurs de forme d'onde mesurées. Pour éviter tout risque de choc électrique, modifier l'échelle de gain vertical à l'aide du bouton SCALE, de sorte que l'amplitude entière de la forme d'onde s'affiche sur l'afficheur, et vérifier le niveau de tension d'entrée.



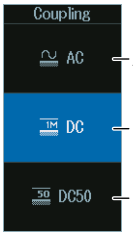
Dépassement de plage

- Si le courant du couplage d'entrée est alternatif (CA), conforme à la réponse en fréquence, le signal d'entrée est plus atténué aux fréquences plus basses. Ainsi, même si un signal haute tension est reçu, le voyant de dépassement de plage risque de ne pas s'afficher à l'écran de l'instrument. Le cas échéant, basculez le couplage d'entrée sur CC (courant continu) afin de vérifier la tension du signal d'entrée.

ATTENTION

- La tension d'entrée maximum pour une entrée de 1 MΩ est de 300 Vrms ou 400 V crête lorsque la fréquence est inférieure ou égale à 100 kHz. Le fait d'appliquer une tension dépassant l'une de ces limites risque d'endommager la section d'entrée. Si la fréquence est supérieure à 100 kHz, des dommages risquent de survenir même lorsque la tension est inférieure à cette valeur.
- La tension d'entrée maximale pour une entrée de 50 Ω est de 5 Vrms ou 10 Vcrête. L'application d'une tension supérieure à l'une de ces limites pourrait endommager la section d'entrée.
- Si vous modifiez le paramètre de couplage d'entrée alors que l'acquisition de forme d'onde est arrêtée, le couplage d'entrée sur l'instrument est en réalité modifié lorsque la prochaine acquisition de forme d'onde est exécutée. Faites attention à la tension d'entrée maximale.

Press the **Coupling** soft key to display the following menu.



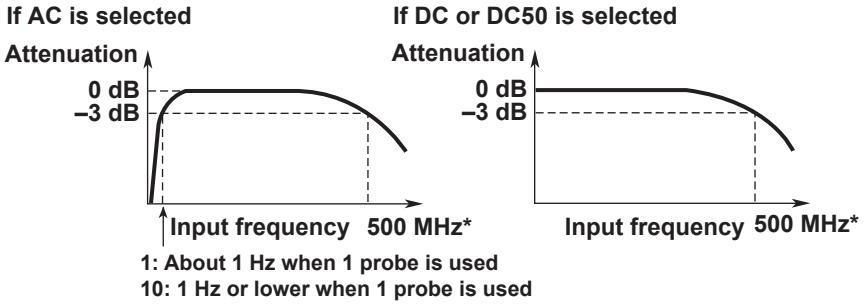
AC
Displays only the AC component of the input signal through 1 MΩ

DC
Displays both the DC and AC components of the input signal through 1 MΩ

DC50
Displays both the DC and AC components of the input signal through 50 Ω

Input Coupling

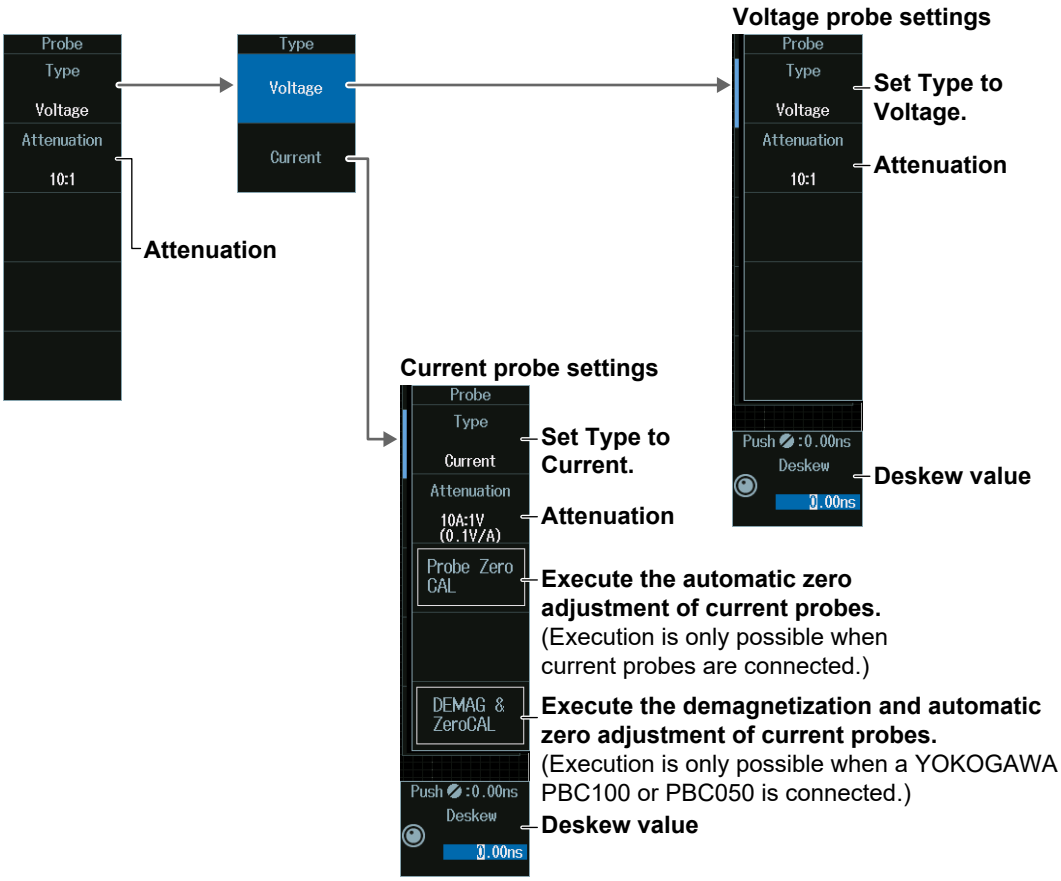
The frequency responses when the input coupling is set to AC, DC, or DC50 are shown below. Please note that when set to AC, the instrument does not acquire low frequency signals or low frequency components, as seen in the following figure.



* The high-frequency –3 dB point differs according to the model and the voltage scale settings.

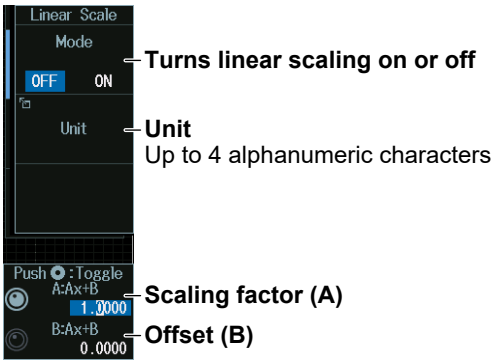
Probe (Probe)

Press the **Probe** soft key to display the following menu.



Linear Scaling (Linear Scale)

Press the **Linear Scale** soft key to display the following menu.



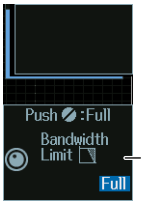
Label Display (Label)

Press the **Label** soft key to display the following menu.



Bandwidth Limit (Bandwidth Limit)

Press the **Bandwidth Limit** soft key. The jog shuttle now controls the Bandwidth Limit setting.



Bandwidth limit

Offset (Offset)

When the CH menu is displayed, the jog shuttle controls the offset.

Jog shuttle setting menu

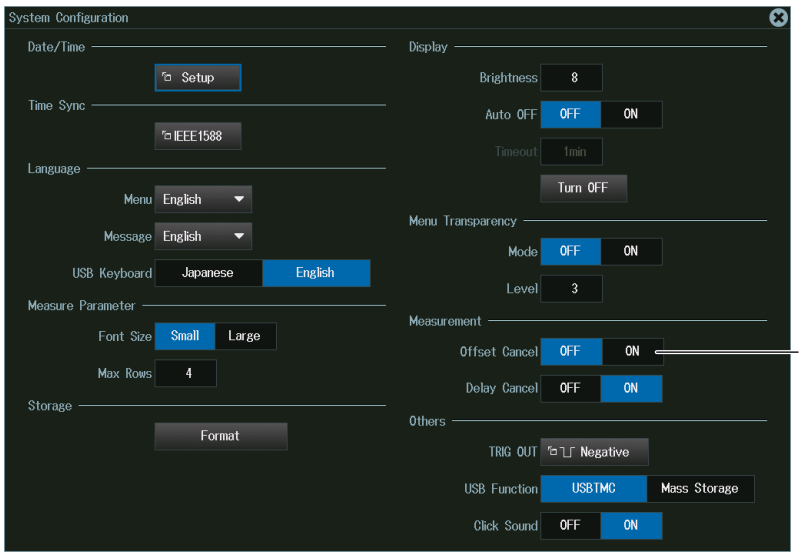


Offset

Offset Cancel (Offset Cancel)

Press **UTILITY** and then press the **System Configuration** soft key to display the following menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.



Turns offset cancel on or off

Note

- The offset setting applies to all input coupling settings (AC, DC, DC50).
- If you change the probe attenuation, the vertical scale settings change the values that have been scaled with the new attenuation ratio.
- The offset value does not change even if you change the vertical scale. However, if the offset value goes outside the selectable range, the offset is set to the maximum or minimum value in the vertical scale range. If you do not change the offset and set the vertical scale back to its original value, the offset returns to its original value.

1.2 Copying Channel Information (Analog Signals)

The analog signal input channel settings entered in section 1.1 can be copied to other channels.

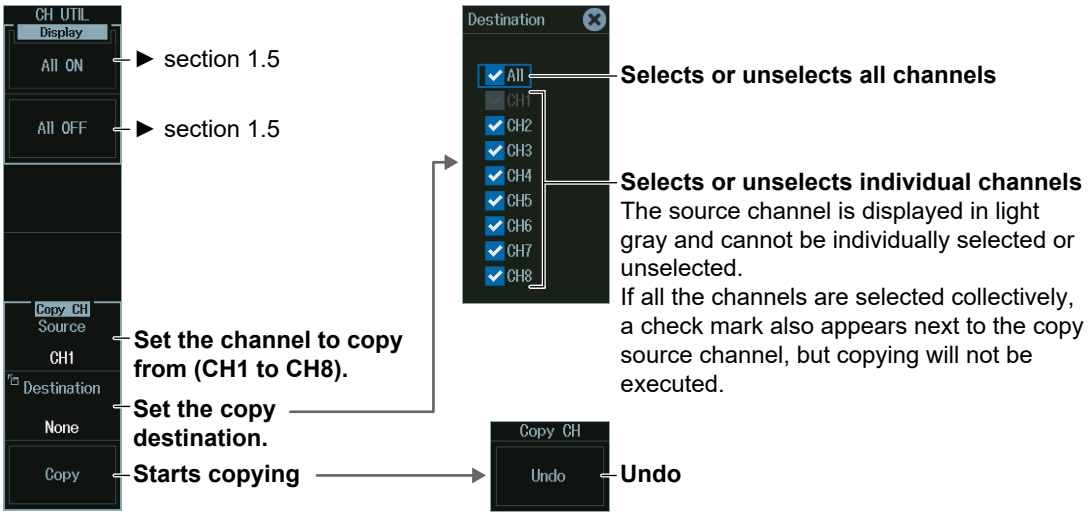
CH UTIL Menu
- Copying channel information

► "Copying Channel Information (Copy CH)" in the Features Guide

CH UTIL Menu

Press **CH UTIL** to display the CH UTIL menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the CH UTIL menu from VERTICAL on the top menu.



Note

The available channel settings vary depending on the model.
- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

1.3 Setting the Logic (Logic Signal)

This section explains the following settings for the vertical scale for logic signals:

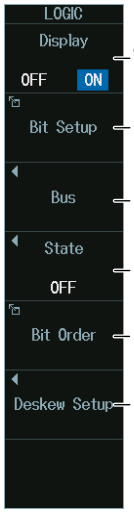
LOGIC menu
- Turning the waveform display on and off
- Bit settings
  Turning the bit display on and off
  Label name, threshold level, and noise rejection
- Bus display
  Turning the bus display on and off
  Bus bit assignment, label name, and format
- Bit and bus display order
- State display
  Turning the state display on and off
  Clock source; clock source polarity, detection level, and hysteresis; and state assignment
- Deskewing

► “Vertical Axis (Logic Signal)” in the Features Guide

LOGIC Menu

Press **LOGIC**. The LOGIC key illuminates brightly, and the following menu appears.

- You can also tap the state information display area (Logic State) at the top of the screen to select the LOGIC menu.
- You can also tap **MENU** (MENU) in the upper left of the screen and select the LOGIC menu from VERTICAL on the top menu.



Turns the waveform display on or off

Set bits.

Bus display

State display

Bit and bus display order

Deskewing

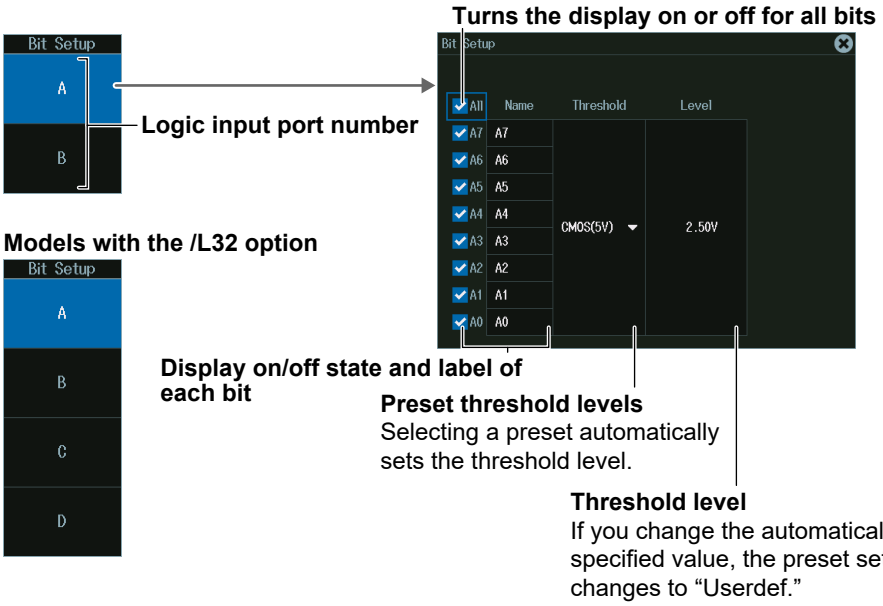
Note

On the ACQUIRE menu, if you set the record length (Record Length) to the maximum record length, the waveforms of C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D) cannot be acquired. For details on the ACQUIRE menu, see section 3.1.

Bit Settings (Bit Setup)

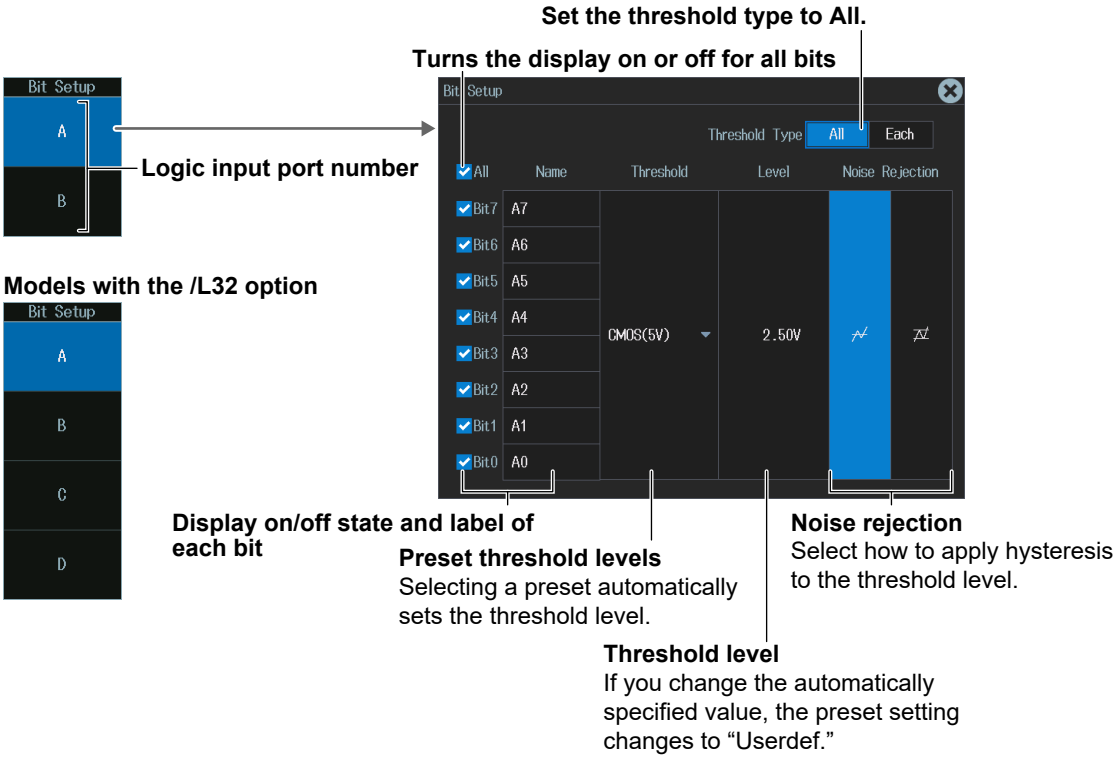
Press the **Bit Setup** soft key to display the following menu.

For Logic Probes Other Than the 701989

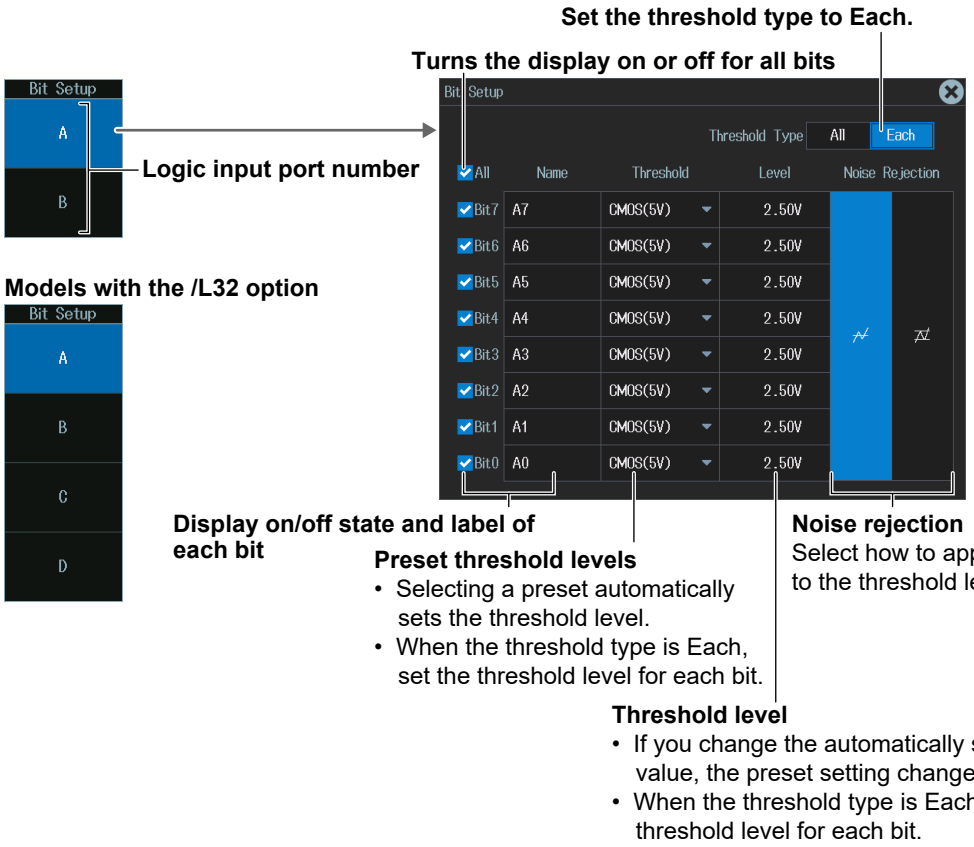


For the 701989 Logic Probe

- **When the Threshold Type is All**



- **When the Threshold Type is Each**

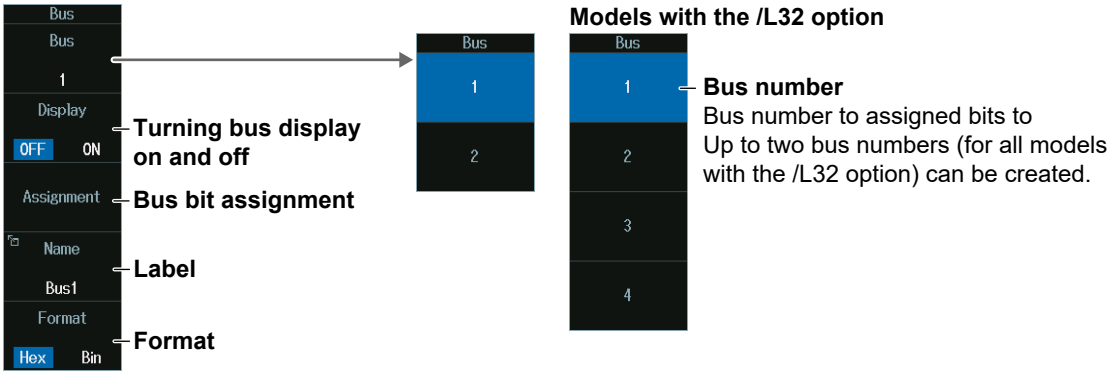


Note

- For logic probes other than the 701989, the threshold type is All. The setup menu is not displayed.
- Level and Noise Rejection in the bit settings (Bit Setup) are synchronized to those for when the trigger source is set to Logic.
  Noise Rejection can be set when the logic probe is 701989.

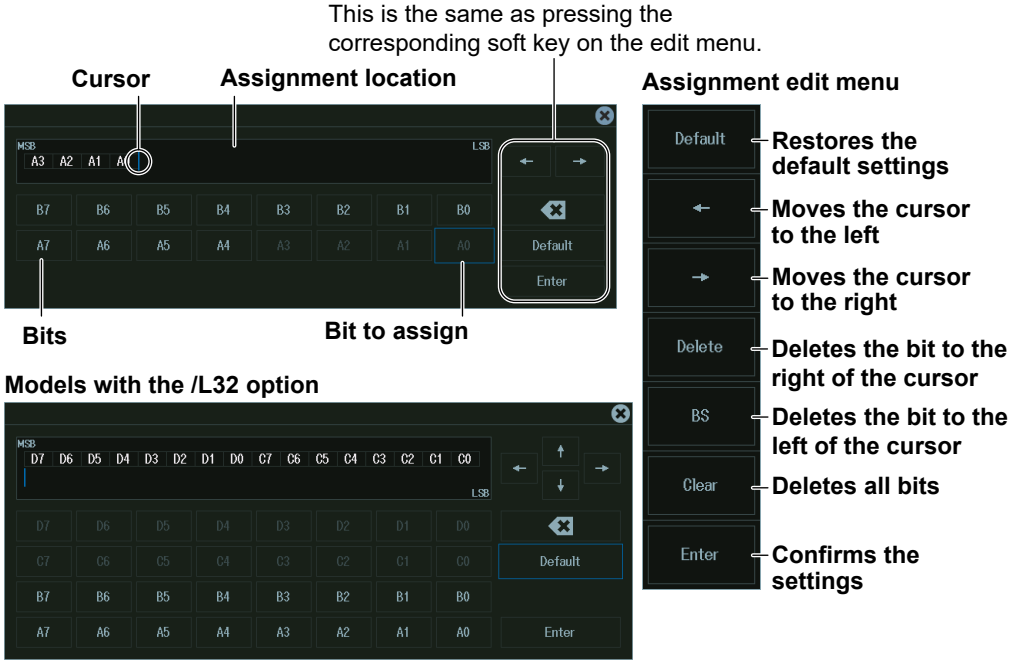
Bus Display (Bus)

Press the **Bus** soft key to display the following menu.



Bus Bit Assignments

1. Press the **Assignment** soft key to display the assignment destination edit screen.
2. Press the cursor movement soft keys on the edit menu to move the cursor to the right of the position to assign the bit.
3. Turn the jog shuttle, or move the **SET** key up, down, left, or right to select the bit to assign from the bit group.
4. Press the SET key to assign the selected bit to the left of the cursor position.
5. Press the **ENTER** soft key to confirm the setting.

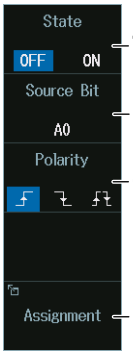


Note

If you need to change the bit assignments (arrangement) when all bits are assigned to the assignment destination, delete a portion of the bits first, and then edit the bit assignments (arrangement).

State Display (State)

Press the **State** soft key to display the following menu.



Turns state display on or off

Clock source bit
Select the logic bit.

Clock source polarity (Polarity)

State assignment

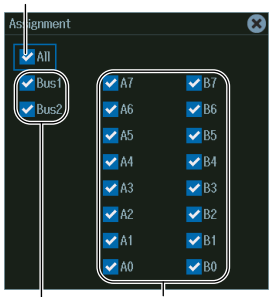
Note

The following clock source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

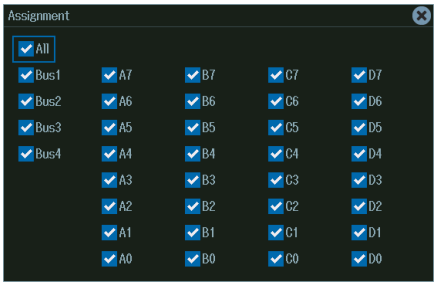
State Assignment

Press the **Assignment** soft key to display the following screen.

Turns the display on or off for all bits and the bus



Models with the /L32 option



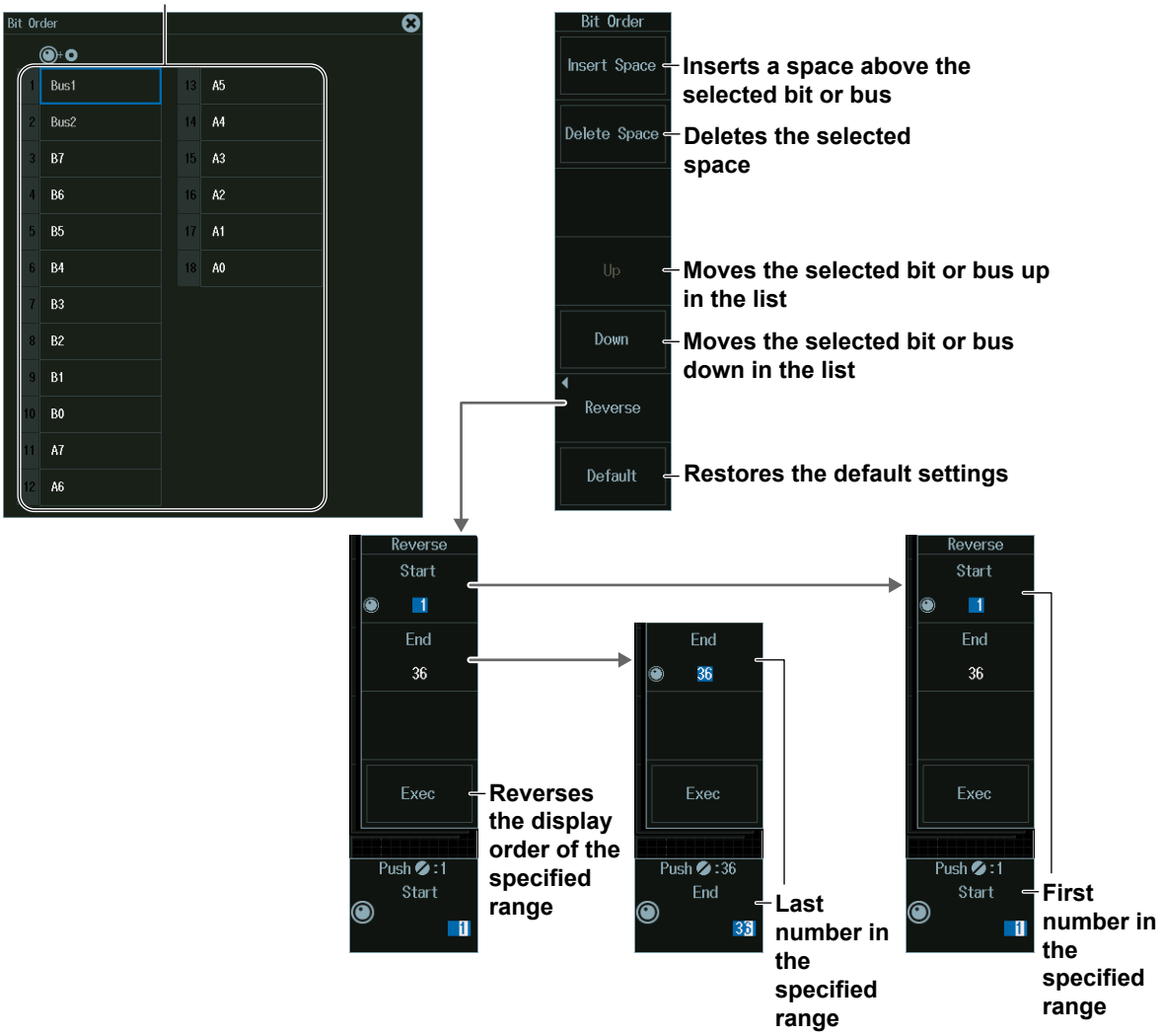
Turns each each bit on or off

Turns each bus display on or off

Display Order of Bits and the Buses (Bit Order)

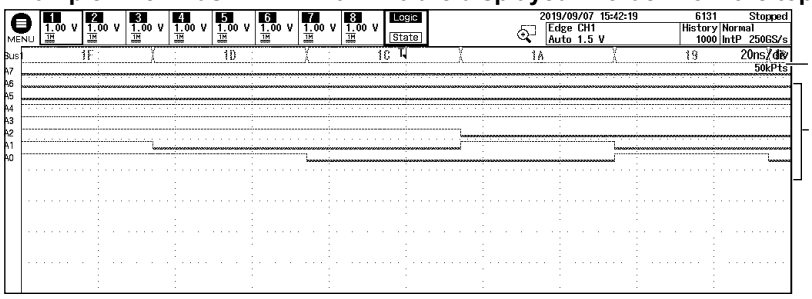
Press the **Bit Order** soft key to display the following menu.

Select a bit or the bus, and edit the display order.

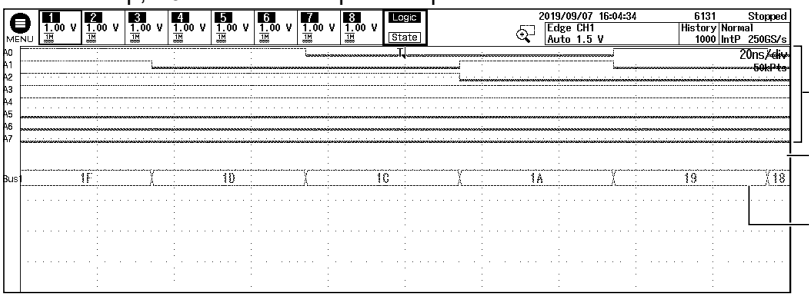


Bit and Bus Display Order

Example when Bus1→A7→A6 ... A0 are displayed in order from the top

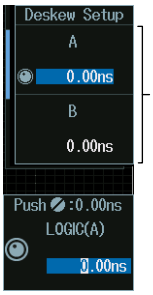


Example when the display order is reversed and a space is inserted
From the top, A0→A1 ... A7→Space→Space→Bus1



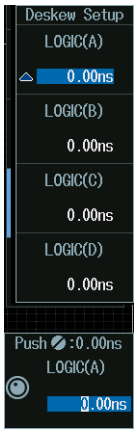
Deskewing (Deskew)

1. Press the **Deskew Setup** soft key to display the following menu.



Select the logic port to deskew.

Models with the /L32 option



2. Press the soft key corresponding to the logic port you want to deskew.

3. Turn the jog shuttle to set the time offset adjustment (skew).

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- Deskewing is performed on all eight bits collectively.

Jog shuttle setting menu



Deskewing

1.4 Setting the Vertical Axis (Analog and Logic Signals)

This section explains the following settings for the vertical scale:

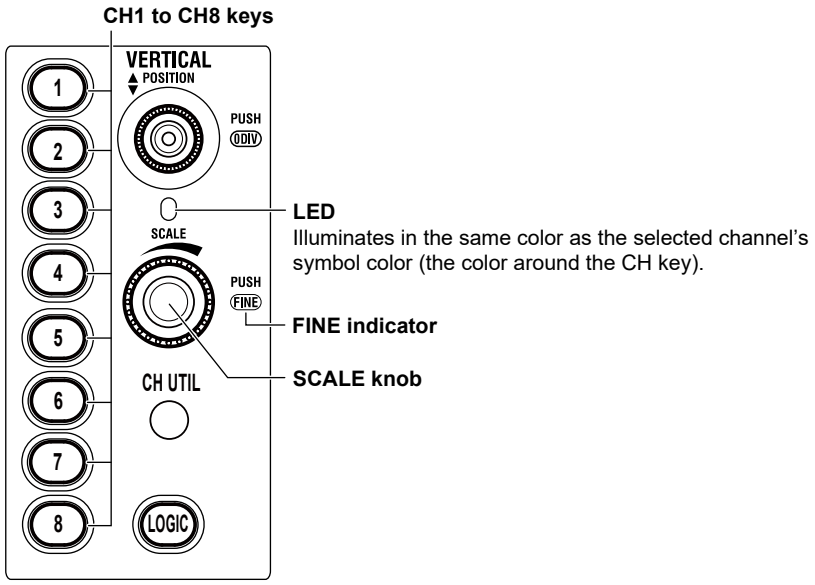
SCALE knob
- Vertical scale (analog signal)
- Display size (logic signal)

▲▼ POSITION knob
- Vertical position (analog and logic signals)

► **"Display Range (SCALE knob)," "Vertical Scale (SCALE knob)," "Vertical Position (POSITION knob)" in the Features Guide**

Vertical Scale (SCALE knob)

1. Press a key from **CH1** to **CH8** to select the channel that you want to set the vertical scale for.
   - You can also tap the channel information or state display area ( ) at the top of the screen to select the channel.
   - The LED between the **SCALE** and ▲▼ **POSITION** knobs illuminates in the symbol color of the selected channel.
2. Turn the **SCALE** knob to set the vertical scale.
   If you push the **SCALE** knob, the FINE indicator illuminates, and you can set the vertical scale with higher resolution.



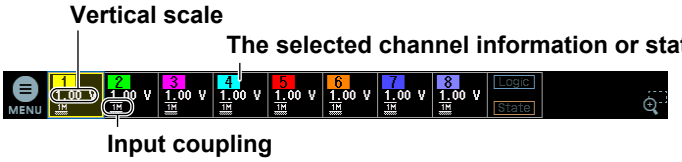
Note

The number of channel keys varies depending on the model.
- The channel keys on 8ch models are as follows:
  CH1 to CH8
- The channel keys on 4ch models are as follows:
  CH1 to CH4

Preview

If you change the vertical scale when waveform acquisition is stopped, the waveform is displayed expanded or reduced vertically.

Vertical Scale

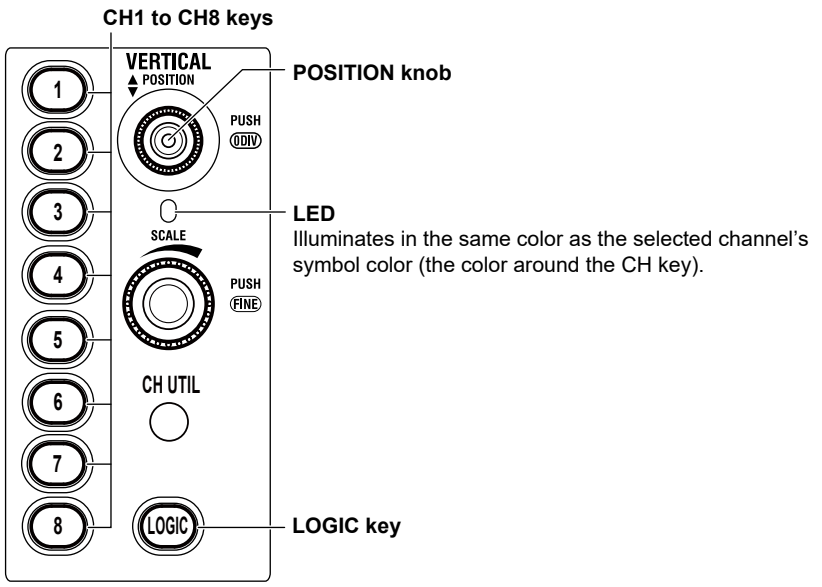


Display Range (SCALE knob)

1. Press the **LOGIC** key to make the SCALE knob control the LOGIC setting.
   - The LOGIC key illuminates brightly.
   - The LED between the SCALE and ▲▼ POSITION knobs illuminates in the same color as the LOGIC symbol color.
2. Turn the **SCALE** knob to set the display size.

Vertical Position (POSITION knob)

1. Press a key from **CH1** to **CH8** or **LOGIC** to select the channel that you want to set the vertical waveform position for.
   - You can also tap the channel information or state display area (or) at the top of the screen to select what the POSITION knob controls.
   - The LED between the **SCALE** and ▲▼ **POSITION** knobs illuminates in the symbol color of the selected channel.
2. Turn the ▲▼ **POSITION** knob to set the vertical position.
   If the POSITION knob is controlling a channel from CH1 to CH8, pressing POSITION will set the vertical position to 0 div.



Note

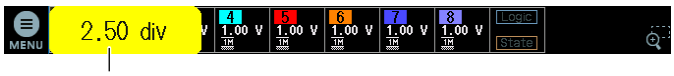
The number of channel keys varies depending on the model.

- The channel keys on 8ch models are as follows:
  CH1 to CH8
- The channel keys on 4ch models are as follows:
  CH1 to CH4

Preview

If you change the vertical position when waveform acquisition is stopped, the waveform display position changes.

Vertical Channel Position (Position)



While you control the knob, the vertical waveform position value is displayed in the corresponding channel information display area. Displayed with the same background color as the symbol color of the selected channel (example of CH1) The display disappears after a few seconds when you stop controlling the knob.

Indicates that the input waveform is outside the effective data range (within ±5 div of the Main window center) This also appears when the input waveform moves outside the range as a result of changing the vertical scale.



1.5 All ON/All OFF

You can collectively show or hide all the analog signal input channel waveforms.

CH UTIL Menu
- All ON/All OFF

► “All ON/All OFF (Display)” in the Features Guide

CH UTIL Menu

Press **CH UTIL** to display the CH UTIL menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the CH UTIL menu from VERTICAL on the top menu.



All ON
Shows all channels collectively

All OFF
Hides all channels collectively

Note

Logic signals cannot be collectively shown or hidden.

1.6 Setting the Horizontal Scale (Time Scale)

This section explains the following settings for the horizontal scale (time scale):

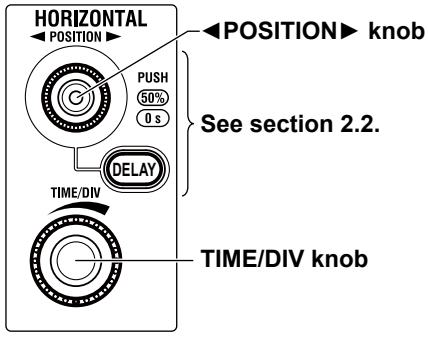
TIME/DIV Knob
- Horizontal scale (time scale) sensitivity

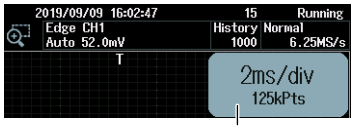
◄POSITION► knob
See section 2.2.

► "Time Scale (TIME/DIV knob)" in the Features Guide

Horizontal Scale (Time Scale) Sensitivity (TIME/DIV knob)

Turn the **TIME/DIV** knob to set the horizontal scale sensitivity.





While you control the knob, the time scale value and display record length are displayed in the upper right of the screen. The display disappears after a few seconds when you stop controlling the knob.

◄POSITION► Knob

Turn the ◄ POSITION ► knob to move the waveforms displayed on the screen horizontally. The trigger position moves along with the waveform.
You can set the trigger position to 50% by pressing the knob.
When waveform acquisition (RUN/STOP) is running, you can turn the ◄ POSITION ► knob to move the waveforms horizontally the waveform display is being updated. For details on the trigger position, see section 2.2.

2.1 Setting the Trigger Mode and Trigger Hold-off Time

This section explains the following settings for updating the displayed waveform:

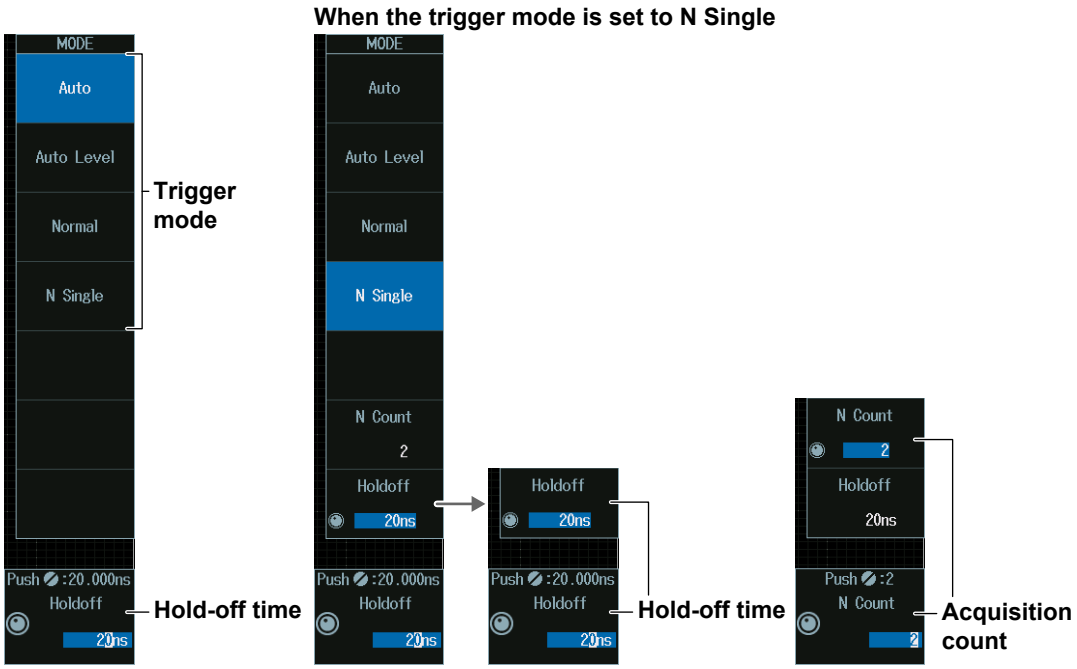
- Trigger mode, acquisition count
- Hold-off time

► "Trigger Mode (Trigger Mode)," "Trigger Hold-off (Holdoff)" in the Features Guide

MODE Menu

Press **MODE** to display the following menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the MODE menu from TRIGGER on the top menu that is displayed.



Trigger Mode

Auto	If the trigger conditions are met within a timeout period,[1] the instrument updates the displayed waveforms on each trigger occurrence. If not, this instrument automatically updates the displayed waveforms. If the time axis is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled.[2]
Auto Level	If a trigger occurs before a timeout,[1] the instrument updates the waveform in the same way that it does in Auto mode. If a trigger does not occur before a timeout, the instrument automatically changes the trigger level to the center value of the trigger source amplitude, triggers on that value, and updates the displayed waveform. If the time axis is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled.[2]
Normal	The instrument updates the waveform display only when the trigger conditions are met.
N Single	The instrument acquires signals each time the trigger conditions are met until a specified number of signals have been acquired, stops acquisition, and displays all of the acquired signals.

1 The timeout period is 100 ms or the time corresponding to 10 divisions on the time axis, whichever is longer.
2 Waveforms are displayed so that they flow from the right of the screen to the left.

Note

Press any of the trigger mode soft keys to execute waveform acquisition in the selected trigger mode.

Single Mode

There is also a Single trigger mode in which the instrument updates the displayed waveform once and stops signal acquisition when the trigger conditions are met. Press SINGLE on the front panel to execute Single Mode waveform acquisition.

Acquisition Count (N Count)

1. Press the **N Count** soft key.
2. Turn the **jog shuttle** to set the acquisition count.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

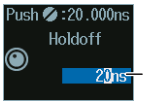


The number of waveforms to acquire

Hold-off Time (Holdoff)

1. Press the **Holdoff** soft key.
2. Turn the **jog shuttle** to set the hold-off time.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Hold-off time

2.2 Setting the Trigger Position and Trigger Delay

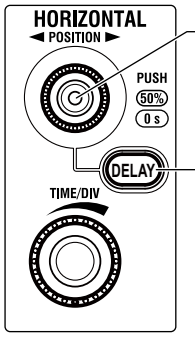
This section explains the following settings for updating the displayed waveform:

- Trigger position
- Trigger delay
- Turning delay cancel on and off

► "Trigger Position (POSITION Knob)," "Trigger Delay (DELAY)," "Delay Cancel (Delay Cancel)," in the Features Guide

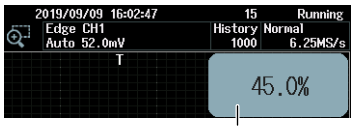
Trigger Position (◄POSITION► knob)

1. Turn the ◄**POSITION**► knob to set the trigger position.
   The specified trigger position is shown at the top of the screen while you control the knob. The display disappears after a few seconds when you stop controlling the knob.



◄POSITION► knob
Press the knob to initialize the trigger position value or trigger delay value.

Trigger delay



You can set the trigger position even when waveforms are not being acquired.

Trigger Delay (DELAY)

1. Press **DELAY**. The DELAY key illuminates.
2. Turn the ◄**POSITION**► knob to set the trigger delay.
   The specified trigger delay is shown at the top of the screen while you control the knob. The display disappears after a few seconds when you stop controlling the knob.



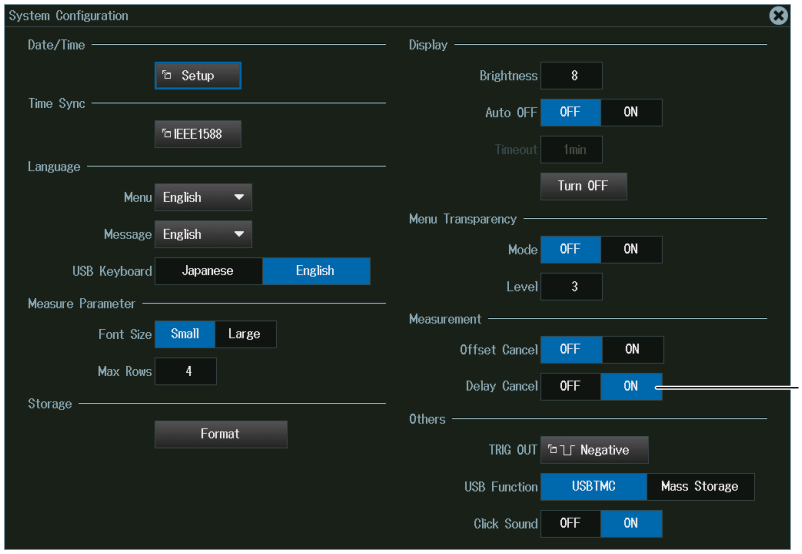
You can set the trigger delay even when waveforms are not being acquired.

3. Press the **DELAY** key again. The DELAY key turns off, and you can set the trigger position.

Delay Cancel (Delay Cancel)

Press **UTILITY** and then press the **System Configuration** soft key to display the following menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.



Turns delay cancel on or off

Note

The delay value is retained even if you change the horizontal scale sensitivity by turning the TIME/DIV knob.

Trigger Delay Cancel

You can select whether or not to apply the specified trigger delay to the time measurement values.

ON: The instrument measures time values by setting the trigger position to 0 s (the delay is not applied to time measurement values).

OFF: The instrument measures time values by setting the trigger point to 0 s (the delay is applied to time measurement values).

2.3 Triggering on an Edge Trigger

This section explains the following settings for triggering on trigger source edges:

- Trigger source
  Trigger slope, HF rejection, noise rejection,
  level for detecting trigger source edges, source bit
- Probe attenuation
- Input range

► **"Edge Trigger [EDGE]," "Trigger Source (Source)," "Trigger Slope (Slope/Polarity)," "Trigger Level (Level)," "HF Rejection (HF Rejection)," "Noise Rejection (Noise Rejection)" in the Features Guide**

EDGE Menu

Press **EDGE**. The menu that appears varies depending on the specified trigger source.

You can also tap **MENU** (MENU) in the upper left of the screen and select the EDGE menu from TRIGGER on the top menu that is displayed.

When the Trigger Source Is a Channel from CH1 to CH8

Select the source from CH1 to CH8 when using a signal received through an analog input terminal on the front panel as a trigger source.



Set the trigger source to a channel from1 to CH8.

Trigger slope

HF rejection

Noise rejection

Level for detecting trigger source edges

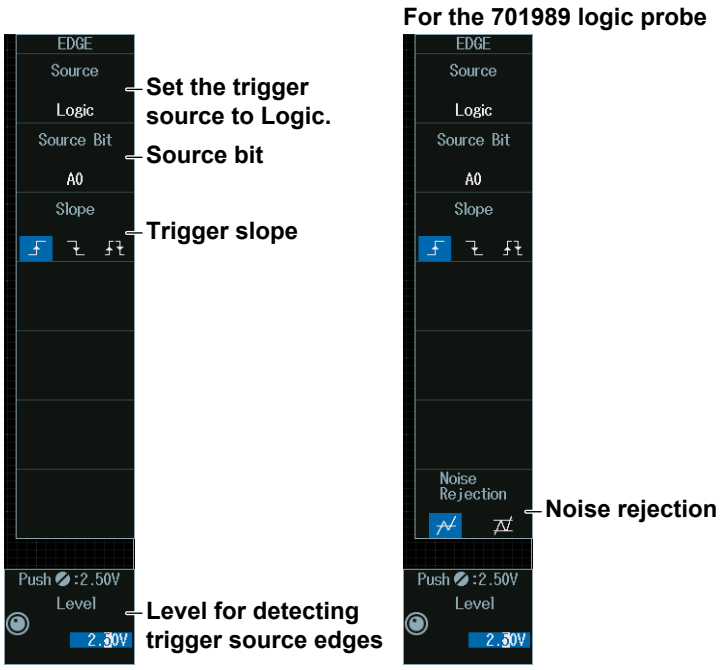
Note

The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Trigger Source Is Logic

Set the source to Logic when using a signal received through a LOGIC signal input port on the front panel as a trigger source. If you select LOGIC, you need to set the source bit (A0 to A7, B0 to B7, C0 to C7, or D0 to D7).

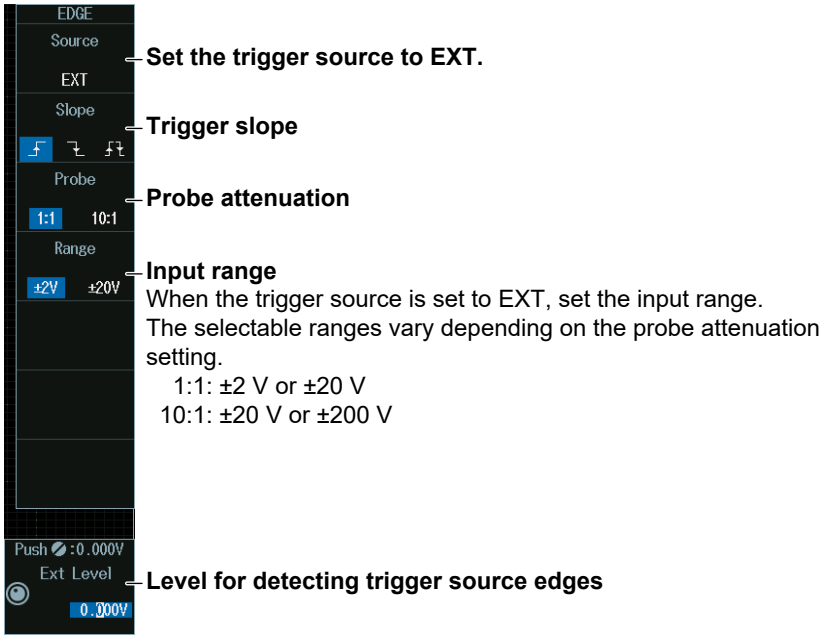


Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

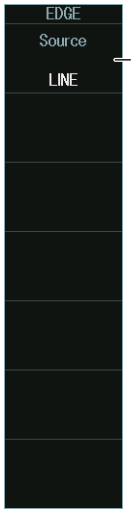
When the Trigger Source Is EXT (External trigger signal)

Set the source to EXT when using an external signal received through the external trigger input terminal (TRIGGER IN) on the rear panel as a trigger source.



When the Trigger Source Is LINE

Set the source to LINE when using the instrument's power source as a trigger source.
The instrument only triggers on the rising edge.



Set the trigger source to LINE.

Level for Detecting Trigger Source Edges (CH Level, Level, Ext Level)

Turn the **jog shuttle** to set the level for detecting trigger source edges.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the trigger source is set to CH1 to CH8



Level for detecting trigger source edges

When the trigger source is LOGIC



Level for detecting trigger source edges

Level

The level is displayed in unit of bits or pods depending on the connected logic probe and logic probe settings.

2.4 Triggering on the OR of Multiple Edge Triggers

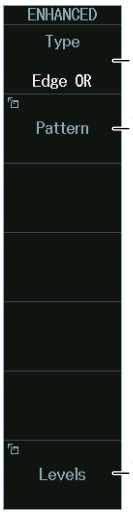
This section explains the following settings for triggering on the logical OR of multiple edge triggers:

- Trigger source pattern
  Trigger source, trigger slope
- Trigger level
  Level for detecting trigger source edges, HF rejection, noise rejection

► “Edge OR Trigger [ENHANCED],” “Noise Rejection (Noise Rejection)” in the Features Guide

ENHANCED Edge OR Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **Edge OR** to display the following menu.



Set the trigger type to Edge OR.

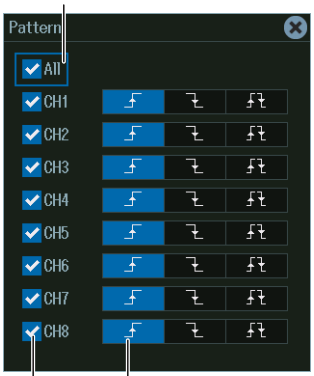
Trigger source pattern

Trigger level

Trigger Source Pattern (Pattern)

Press the **Pattern** soft key to display the following menu.

Selecting this check box selects all the channels.

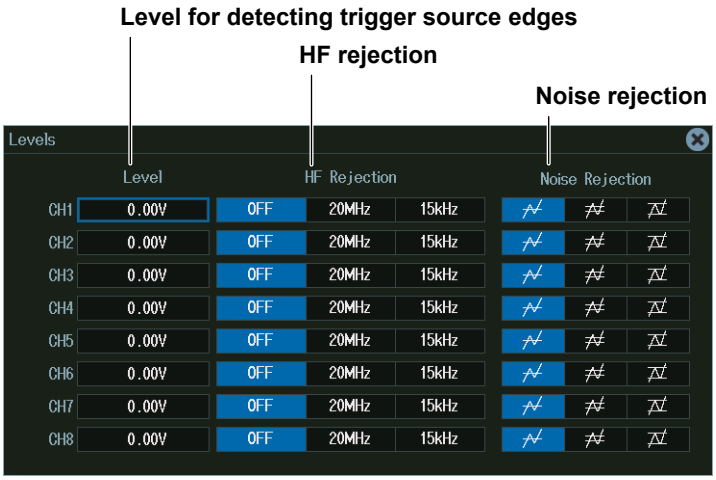


Trigger slope

Select the check boxes of the channels to be used as the trigger sources.

Trigger Levels (Levels)

Press the **Levels** soft key to display the following menu.



Note

The available channel settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

2.5 Triggering on Multiple Input Patterns

This section explains the following settings for triggering on multiple input patterns:

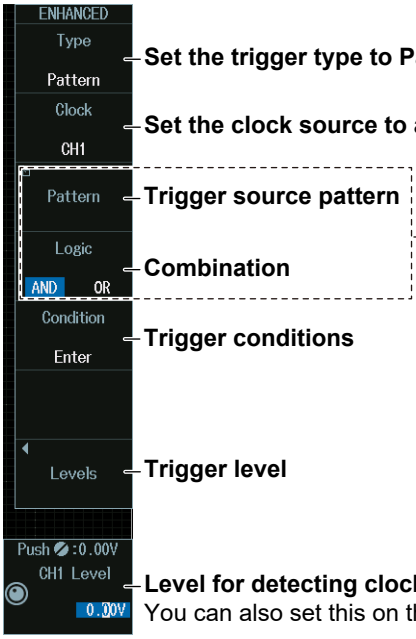
- Clock source
  Source bit
- Comparison condition
  Trigger source pattern, combination
- Trigger conditions
- Time conditions, reference times
- Trigger level
  Level for detecting trigger source edges, HF rejection, noise rejection
- Level for detecting clock source edges

► **"Pattern Trigger [ENHANCED]," "HF Rejection (HF Rejection)," "Noise Rejection (Noise Rejection)" in the Features Guide**

ENHANCED Pattern Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **Pattern** to display the following menu.

When the Clock Source Is a Channel from CH1 to CH8



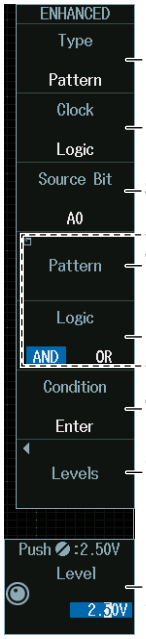
You can also set this on the trigger level (Levels) setup screen.

Note

The available channel settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Clock Source Is Logic



Set the trigger type to Pattern.

Set the clock source to Logic.

Source bit

Trigger source pattern

Combination

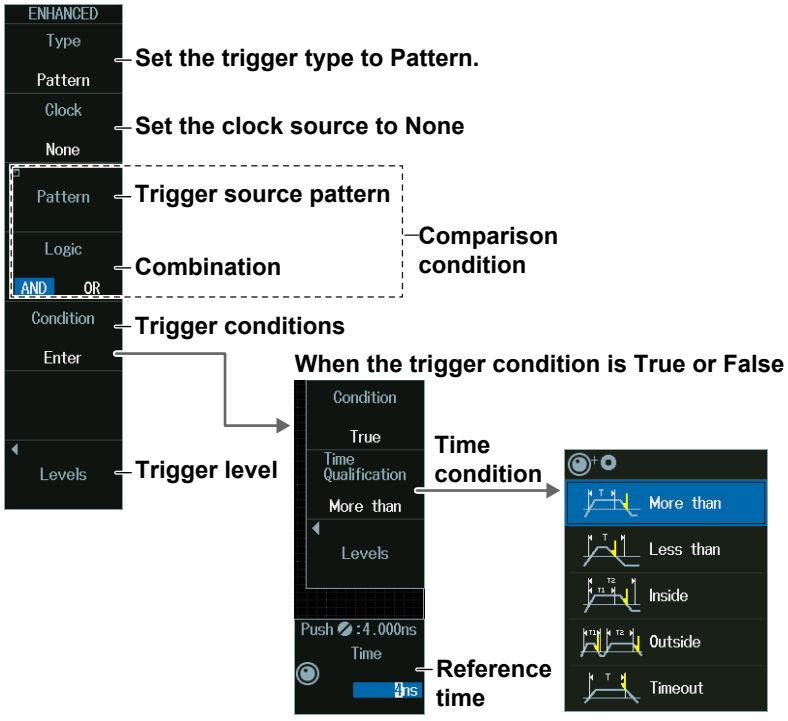
Comparison condition

Trigger conditions

Trigger level

Level for detecting clock source edges
You can also set this on the trigger level (Levels) setup screen.

No Clock Source (None)



Set the trigger type to Pattern.

Set the clock source to None

Trigger source pattern

Combination

Comparison condition

Trigger conditions

Trigger level

When the trigger condition is True or False

Time condition

Reference time

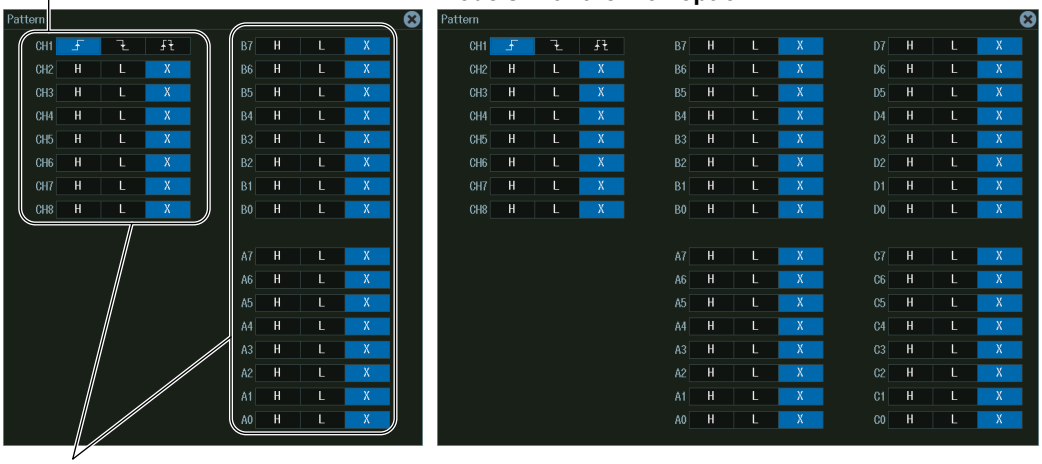
Trigger Source Pattern (Pattern)

Press the **Pattern** soft key to display the following menu.

When the Clock Source Is a Channel from CH1 to CH8 or Logic

Set the slope of the signal set as the clock source

Models with the /L32 option



Set the pattern of the trigger source (signal other than the clock source).

Note

- The available channel settings vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8
  - The available settings on 4ch models are as follows:
    CH1 to CH4
- You cannot set a pattern to a signal that is set as the clock source.
- The following clock source bit display applies to models with the /L32 option.
  C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

No Clock Source

The same menu appears as that shown above for when the clock source is a channel from CH1 to CH8 or Logic.

Set the pattern for all trigger sources (all signals from CH1 to CH8 and Logic).

Trigger Levels (Levels)

When the Trigger Source Is Set to CH1 to CH8

Press the **Levels** soft key and then the **CH** soft key to display the following menu.

Level for detecting trigger source states

HF rejection

Noise rejection



Note

The available channel settings vary depending on the model.

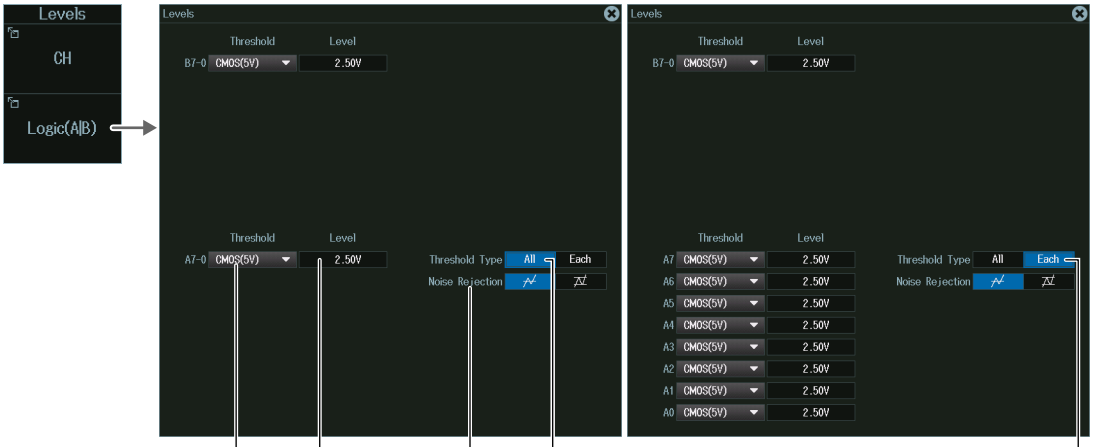
- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Trigger Source Is Logic (Example for LOGIC port A)

Press the **Levels** soft key and then the **Logic(A|B)** soft key to display the following menu.

For the 701989 Logic Probe

• When the Threshold Type is All **• When the Threshold Type is Each**



Set the threshold type to All.

Set the threshold type to Each.

Noise rejection

Threshold level
If you change the automatically specified value, the preset setting changes to "Userdef."

Preset threshold levels
Selecting a preset automatically sets the threshold level.

For Logic Probes Other Than the 701989



Threshold level
If you change the automatically specified value, the preset setting changes to "Userdef."

Preset threshold levels
Selecting a preset automatically sets the threshold level.

Note

The following clock source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Level for Detecting Clock Source Edges (CH Level, Level)

1. Press the **CH Level** or **Level** soft key.
2. Turn the **jog shuttle** to set the level for detecting clock source edges.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the trigger source is set to CH1 to CH8



Level for detecting clock source edges

When the trigger source is LOGIC



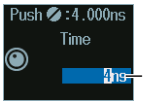
Level for detecting clock source edges

Time Conditions (Time Qualification) and Reference Times (Time, Time1, Time2) (When clock source is none (None) and the trigger condition is True or False)

1. Press the **Time Qualification** soft key to set the time conditions.
2. Turn the **jog shuttle** to set the reference times.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the time condition is More than or Less than



Reference time

When the time condition is Inside



Reference time 1

Reference time 2

Press SET (upper right on the front panel) to switch between reference time 1 and reference time 2.

Satisfaction of Conditions

Set what kind of relationship must be established between Comparison condition achievement time and the specified reference times (Time, Time1, Time2) for the instrument to trigger.

More than	When Comparison condition achievement time is longer than the specified reference time
Less than	When Comparison condition achievement time is shorter than the specified reference time
Inside	When Comparison condition achievement time is longer than reference time Time1 but shorter than reference time Time2.
Outside	When Comparison condition achievement time is shorter than reference time Time1 or longer than reference time Time2.

For details on the trigger points when the time condition is met, see chapter 4, “Trigger” in the Features Guide (IM DLM5058-01EN).

2.6 Triggering on a Pulse Width Trigger

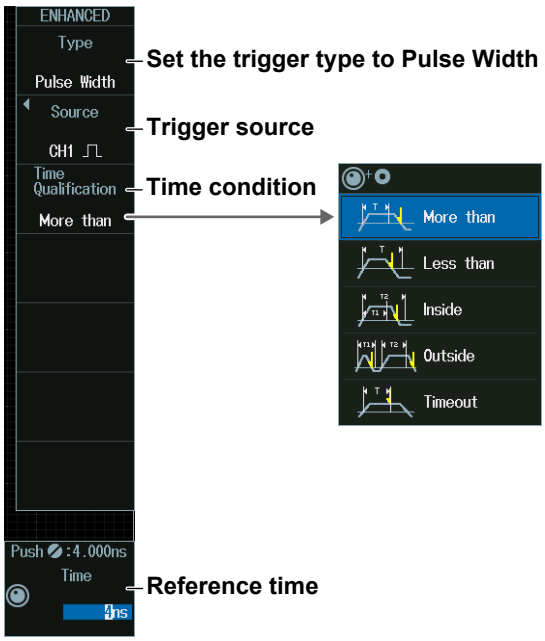
This section explains the following settings for triggering on pulse width:

- Trigger source
  Polarity, HF rejection, noise rejection, source bit,
  level for detecting trigger source edges
- Time conditions, reference times

► "Pulse Width Trigger [ENHANCED]," "HF Rejection (HF Rejection)," "Noise Rejection (Noise Rejection)" in the Features Guide

ENHANCED Pulse Width Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **Pulse Width** to display the following menu.



Trigger Source (Source)

Press the **Source** soft key to display the following menu.

When the Trigger Source Is a Channel from CH1 to CH8



Set the trigger source to a channel from1 to CH8.

Trigger source polarity

HF rejection

Noise rejection

Level for detecting trigger source edges

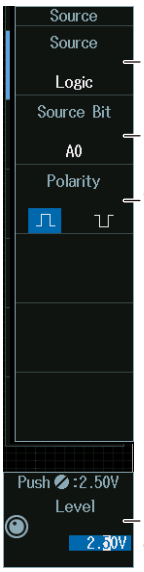
Note

The available channel settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Trigger Source Is Logic

For the 701989 logic probe

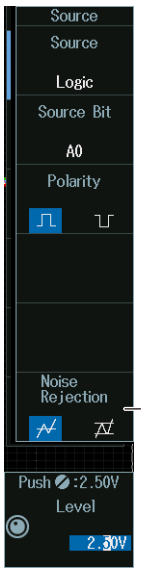


Set the trigger source to Logic.

Source bit

Trigger source polarity

Level for detecting trigger source edges



Noise rejection

Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Level for Detecting Trigger Source Edges (CH Level, Level)

Turn the **jog shuttle** to set the level for detecting trigger source edges.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the trigger source is set to CH1 to CH8



Level for detecting trigger source edges

When the trigger source is LOGIC



Level for detecting trigger source edges

Level

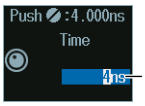
The level is displayed in unit of bits or pods depending on the connected logic probe and logic probe settings.

Time Conditions (Time Qualification) and Reference Times (Time, Time1, Time2)

1. Press the **Time Qualification** soft key to set the time conditions.
2. Turn the **jog shuttle** to set the reference times.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the time condition is More than, Less than, or Timeout



Reference time

When the time condition is Inside



Reference time 1

Reference time 2

Press SET (upper right on the front panel) to switch between reference time 1 and reference time 2.

Satisfaction of Conditions

Set what kind of relationship must be established between the trigger source's pulse width and the specified reference times (Time, Time1, Time2) for the instrument to trigger.

More than	When the pulse width is longer than the specified reference time
Less than	When the pulse width is shorter than the specified reference time
Inside	When the pulse width is longer than Time1 but shorter than Time2
Outside	When the pulse width is shorter than Time1 or longer than Time2
Timeout	When the pulse width reaches the specified reference time

For details on the trigger points when the time condition is met, see chapter 4, "Trigger" in the Features Guide (IM DLM5058-01EN). When Timeout is selected, the instrument triggers when a timeout occurs.

2.7 Triggering on Rise Times and Fall Times

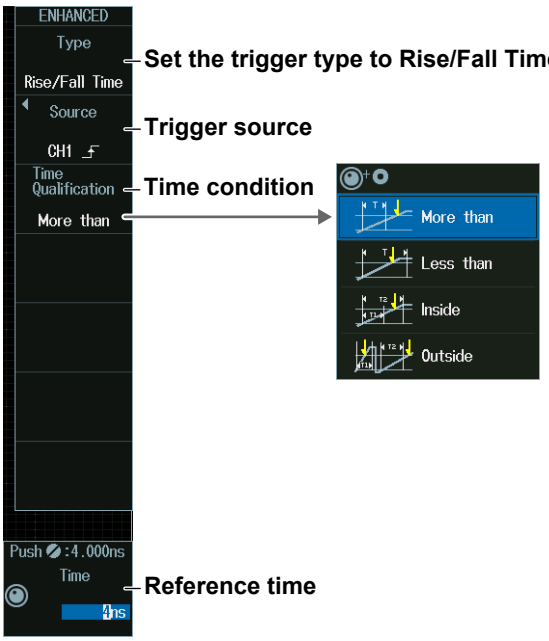
This section explains the following settings for triggering on rise times and fall times:

- Trigger source
  Trigger slope, HF rejection, level for detecting trigger source edges
- Time conditions, reference times

► “Rise/Fall Time Trigger [ENHANCED],” “HF Rejection (HF Rejection)” in the Features Guide

ENHANCED Rise/Fall Time Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **Rise/Fall Time** to display the following menu.



Trigger Source (Source)

Press the **Source** soft key to display the following menu.



Trigger source

Trigger slope

HF rejection

Level for detecting trigger source edges (Upper)

Level for detecting trigger source edges (Lower)

Note

The available trigger source settings vary depending on the model.

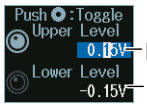
- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

Level for Detecting Trigger Source Edges (Upper Level, Lower Level)

Turn the **jog shuttle** to set the level for detecting trigger source edges.

- Press **SET** (upper right on the front panel) to switch between Upper Level and Lower Level.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Level for detecting trigger source edges (Upper)

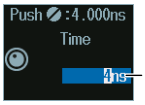
Level for detecting trigger source edges (Lower)

Time Conditions (Time Qualification) and Reference Times (Time, Time1, Time2)

1. Press the **Time Qualification** soft key to set the time conditions.
2. Turn the **jog shuttle** to set the reference times.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the time condition is More than or Less than



Reference time

When the time condition is Inside



Reference time 1

Reference time 2

Press SET (upper right on the front panel) to switch between reference time 1 and reference time 2.

Satisfaction of Conditions

Set what kind of relationship must be established between the trigger source's rise or fall times and the specified reference times (Time, Time1, Time2) for the instrument to trigger.

More than	When the rise time or fall time is longer than the specified reference time
Less than	When the rise time or fall time is shorter than the specified reference time
Inside	When the rise time or fall time is longer than reference time Time1 but shorter than reference time Time2.
Outside	When the rise time or fall time is shorter than reference time Time1 or longer than reference time Time2.

For details on the trigger points when the time condition is met, see chapter 4, "Trigger" in the Features Guide (IM DLM5058-01EN).

2.8 Triggering on Runt Signals

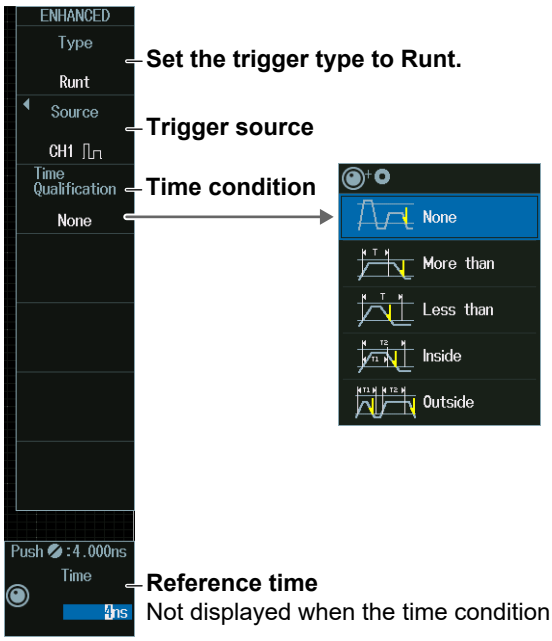
This section explains the following settings for triggering on runt signals:

- Trigger source
  Trigger source polarity, HF rejection, noise rejection,
  level for detecting trigger source edges
- Time conditions, reference times

► **"Runt Trigger [ENHANCED]," "HF Rejection (HF Rejection)," "Noise Rejection (Noise Rejection)" in the Features Guide**

ENHANCED Runt Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **Runt** to display the following menu.



Set the trigger type to Runt.

Trigger source

Time condition

Reference time
Not displayed when the time condition is set to None

Trigger Source (Source)

Press the **Source** soft key to display the following menu.



Trigger source

Trigger source polarity

HF rejection

Noise rejection

Level for detecting trigger source edges (Upper)

Level for detecting trigger source edges (Lower)

Note

The available trigger source settings vary depending on the model.

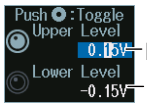
- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

Level for Detecting Trigger Source Edges (Upper Level, Lower Level)

Turn the **jog shuttle** to set the level for detecting trigger source edges.

- Press **SET** (upper right on the front panel) to switch between Upper Level and Lower Level.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Level for detecting trigger source edges (Upper)

Level for detecting trigger source edges (Lower)

Time Conditions (Time Qualification) and Reference Times (Time, Time1, Time2)

1. Press the **Time Qualification** soft key to set the time conditions.
2. Turn the **jog shuttle** to set the reference times.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the time condition is More than or Less



Reference time

When the time condition is Inside



Reference time 1

Reference time 2

Press SET (upper right on the front panel) to switch between reference time 1 and reference time 2.

Satisfaction of Conditions

Set what kind of relationship must be established between the runt signal's pulse width and the specified reference times (Time, Time1, Time2) for the instrument to trigger.

None	Without a time condition
More than	When the runt signal's pulse width is longer than the specified reference time
Less than	When the runt signal's pulse width is shorter than the specified reference time
Inside	When the runt signal's pulse width is longer than Time1 but shorter than Time2
Outside	When the runt signal's pulse width is shorter than Time1 or longer than Time2

For details on the trigger points when the time condition is met, see chapter 4, "Trigger" in the Features Guide (IM DLM5058-01EN).

2.9 Triggering on a Timeout Period

This section explains the following settings for triggering on a timeout period:

- Trigger source
  Trigger source polarity, HF rejection, noise rejection, and source bit
  Level used to detect trigger source edges
- Timeout Period

► “Timeout Trigger [ENHANCED],” “HF Rejection (HF Rejection),” “Noise Rejection (Noise Rejection)” in the Features Guide

ENHANCED Timeout Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **Timeout** to display the following menu.



Set the trigger type to Timeout.

Trigger source

Timeout period

Trigger Source (Source)

Press the **Source** soft key. The menu that appears varies depending on the specified trigger source.

When the Trigger Source Is a Channel from CH1 to CH8



Set the trigger source to a channel from1 to CH8.

Trigger source polarity

HF rejection

Noise rejection

Level for detecting trigger source edges

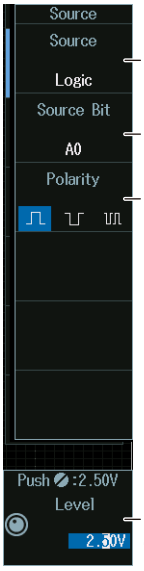
Note

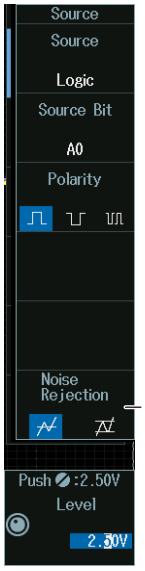
The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Trigger Source Is Logic

For the 701989 logic probe





Set the trigger source to Logic.

Source bit

Trigger source polarity

Noise rejection

Level for detecting trigger source edges

Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Level for Detecting Trigger Source Edges (CH Level, Level)

Turn the **jog shuttle** to set the level for detecting trigger source edges.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the trigger source is set to CH1 to CH8



Level for detecting trigger source edges

When the trigger source is LOGIC



Level for detecting trigger source edges

Level

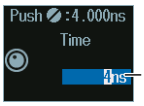
The level is displayed in unit of bits or pods depending on the connected logic probe and logic probe settings.

Timeout Period (Time)

Turn the **jog shuttle** to set the timeout period.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Timeout period

2.10 Triggering on a Window Trigger

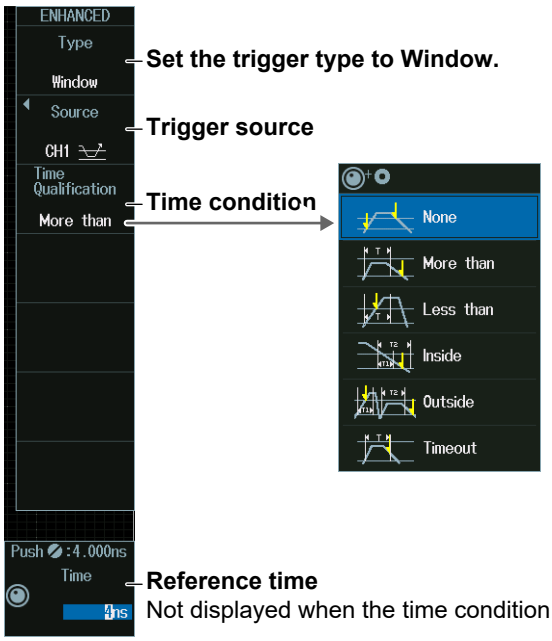
This section explains the following settings for triggering on a window (level range):

- Trigger source
  Trigger source polarity, HF rejection, noise rejection,
  and level range window
- Time conditions, reference times

► “Window Trigger [ENHANCED],” “HF Rejection (HF Rejection),”
“Noise Rejection (Noise Rejection)” in the Features Guide

ENHANCED Window Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **Window** to display the following menu.



Set the trigger type to Window.

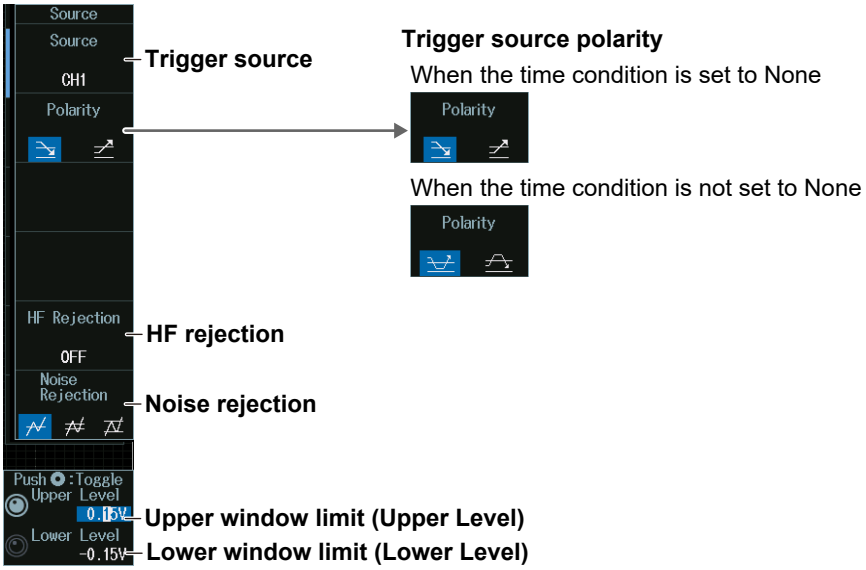
Trigger source

Time condition

Reference time
Not displayed when the time condition is set to None

Trigger Source (Source)

Press the **Source** soft key to display the following menu.



Note

The available trigger source settings vary depending on the model.

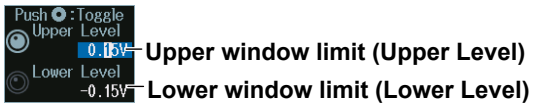
- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

Upper and Lower Window Limits (Upper Level, Lower Level)

Turn the **jog shuttle** to set the level range window.

- Press **SET** (upper right on the front panel) to switch between Upper Level and Lower Level.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

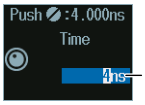


Time Conditions (Time Qualification) and Reference Times (Time, Time1, Time2)

1. Press the **Time Qualification** soft key to set the time conditions.
2. Turn the **jog shuttle** to set the reference times.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the time condition is More than, Less than, or Timeout



Reference time

When the time condition is Inside



Reference time 1

Reference time 2

Press SET (upper right on the front panel) to switch between reference time 1 and reference time 2.

Satisfaction of Conditions

Set what kind of relationship must be established between the time that the waveform stays inside or outside the window and the specified reference times (Time, Time1, Time2) for the instrument to trigger.

None	Without a time condition (when the waveform enters or leaves the window)
More than	When the time that the waveform stays inside or outside the window is longer than the specified reference time
Less than	When the time that the waveform stays inside or outside the window is shorter than the specified reference time
Inside	When the time that the waveform stays inside or outside the window is longer than reference time Time1 but shorter than reference time Time2.
Outside	When the time that the waveform stays inside or outside the window is shorter than reference time Time1 or longer than reference time Time2.
Timeout	When the time that the waveform stays inside or outside the window reaches the specified reference time

For details on the trigger points when the time condition is met, see chapter 4, “Trigger” in the Features Guide (IM DLM5058-01EN). When Timeout is selected, the instrument triggers when a timeout occurs.

2.11 Triggering on the OR of Multiple Window Triggers

This section explains the following settings for triggering on the logical OR of multiple window triggers (without a time condition):

- Trigger source pattern
  Trigger source, trigger source polarity
- Trigger level
  Level range window, HF rejection, noise rejection

► **"Window OR Trigger [ENHANCED]," " HF Rejection (HF Rejection)," "Noise Rejection (Noise Rejection)" in the Features Guide**

ENHANCED Window OR Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **Window OR** to display the following menu.



Set the trigger type to Window OR.

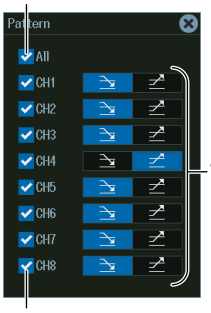
Trigger source pattern

Trigger level

Trigger Source Pattern (Pattern)

Press the **Pattern** soft key to display the following menu.

Selecting this check box selects all the channels.

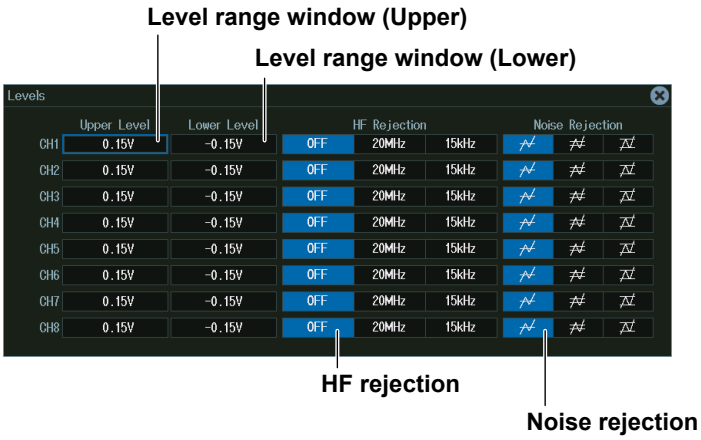


Trigger source polarity

Select the check boxes of the channels to be used as the trigger sources.

Trigger Levels (Levels)

Press the **Levels** soft key to display the following menu.



Note

The available trigger source, pattern, and trigger level settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

2.12 Triggering on Edge Intervals

This section explains the following settings for triggering on edge intervals:

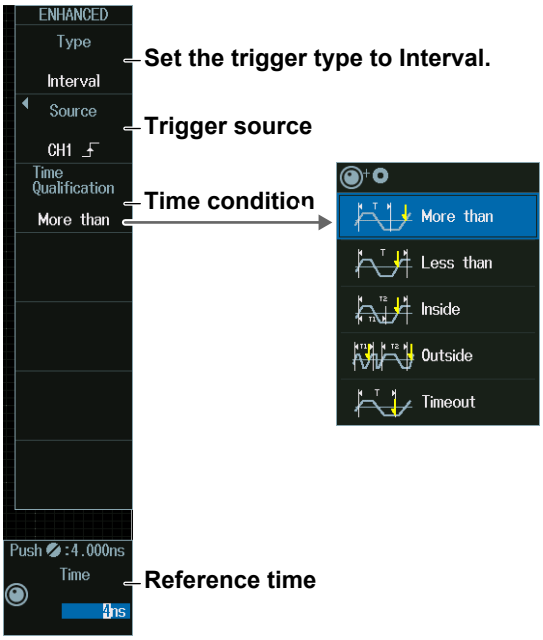
- Trigger source
  Trigger slope, HF rejection, noise rejection, source bit,
  level for detecting trigger source edges

- Time conditions, reference times

► “Interval Trigger [ENHANCED],” “HF Rejection (HF Rejection),”
“Noise Rejection (Noise Rejection)” in the Features Guide

ENHANCED Interval Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **Interval** to display the following menu.



Trigger Source (Source)

Press the **Source** soft key. The menu that appears varies depending on the specified trigger source.

When the Trigger Source Is a Channel from CH1 to CH8



Set the trigger source to a channel from1 to CH8.

Trigger slope

HF rejection

Noise rejection

Level for detecting trigger source edges

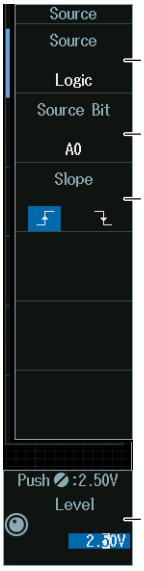
Note

The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Trigger Source Is Logic

For the 701989 logic probe

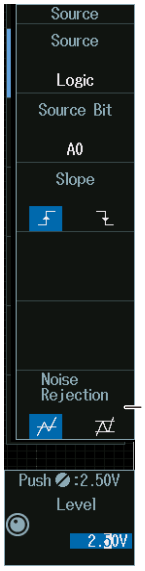


Set the trigger source to Logic.

Source bit

Trigger slope

Level for detecting trigger source edges



Noise rejection

Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Level for Detecting Trigger Source Edges (CH Level, Level)

Turn the **jog shuttle** to set the level for detecting trigger source edges.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the trigger source is set to CH1 to CH8



Level for detecting trigger source edges

When the trigger source is LOGIC



Level for detecting trigger source edges

Level

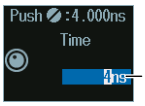
The level is displayed in unit of bits or pods depending on the connected logic probe and logic probe settings.

Time Conditions (Time Qualification) and Reference Times (Time, Time1, Time2)

1. Press the **Time Qualification** soft key to set the time conditions.
2. Turn the **jog shuttle** to set the reference times.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the time condition is More than, Less than, or Timeout



Reference time

When the time condition is Inside



Reference time 1

Reference time 2

Press SET (upper right on the front panel) to switch between reference time 1 and reference time 2.

Satisfaction of Conditions

Set what kind of relationship must be established between the interval between two consecutive edges (rising or falling) and the specified reference times (Time, Time1, Time2) for the instrument to trigger.

More than	When the edge interval is longer than the specified reference time
Less than	When the edge interval is shorter than the specified reference time
Inside	When the edge interval is longer than Time1 but shorter than Time2
Outside	When the edge interval is shorter than Time1 or longer than Time2
Timeout	When the edge interval reaches the specified reference time

For details on the trigger points when the time condition is met, see chapter 4, “Trigger” in the Features Guide (IM DLM5058-01EN). When Timeout is selected, the instrument triggers when a timeout occurs.

2.13 Triggering on FlexRay Bus Signals (Option)

This section explains the following settings for triggering on FlexRay bus signals:

- Trigger source
  Bit rate, bus channel assignment, HF rejection
- Level and hysteresis for detecting trigger source states
- Trigger type
  Trigger conditions

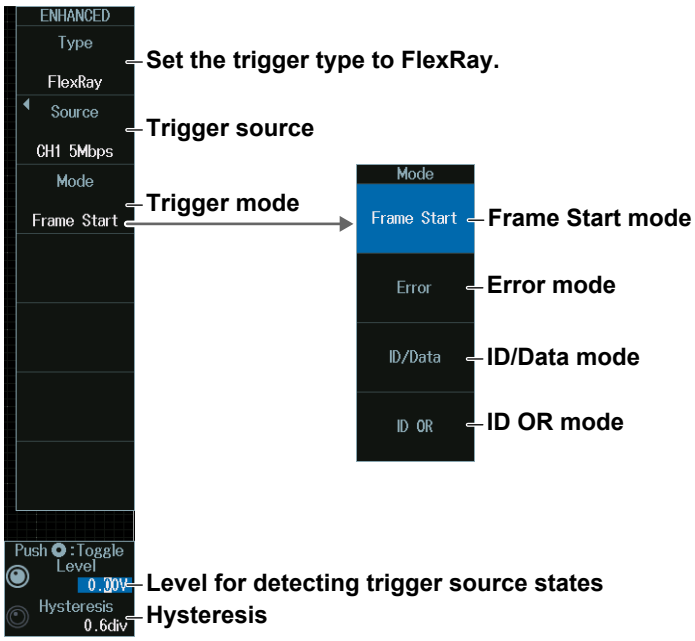
► “FlexRay Bus Trigger [ENHANCED, option],” “HF Rejection (HF Rejection)” in the Features Guide

Auto Setup

The instrument can automatically set the trigger source level and bit rate from the received FlexRay bus signal and trigger on them. For details, see section 12.1.

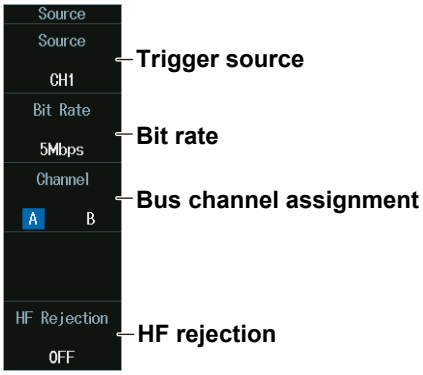
ENHANCED FlexRay Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **FlexRay** to display the following menu.



Trigger Source (Source)

Press the **Source** soft key to display the following menu.



Note

The available trigger source settings vary depending on the model.

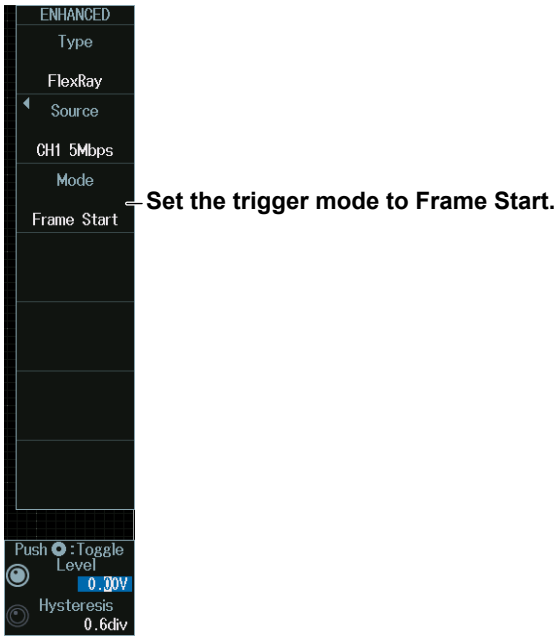
- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

Trigger Mode (Mode)

Frame Start Mode (Frame Start)

Press the **Mode** soft key and then the **Frame Start** soft key to display the following menu.

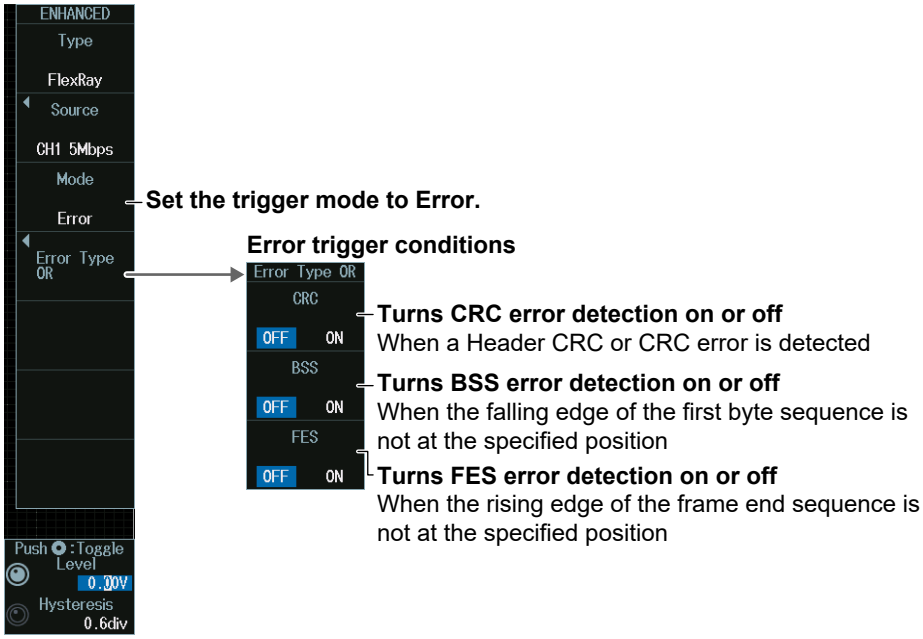
The instrument triggers on the start of FlexRay bus signal frames.



Error Mode (Error)

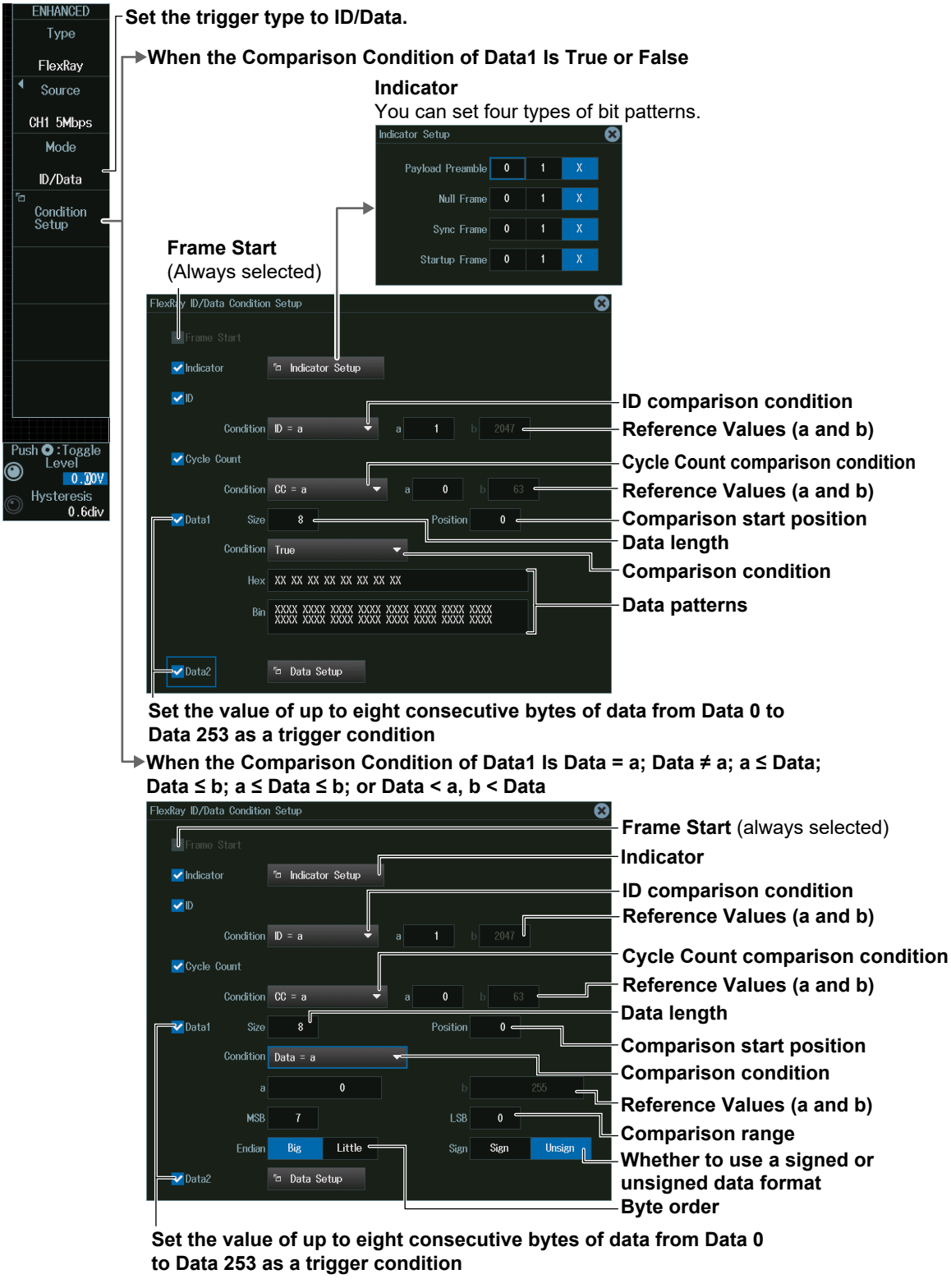
Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument triggers by detecting FlexRay bus signal errors.



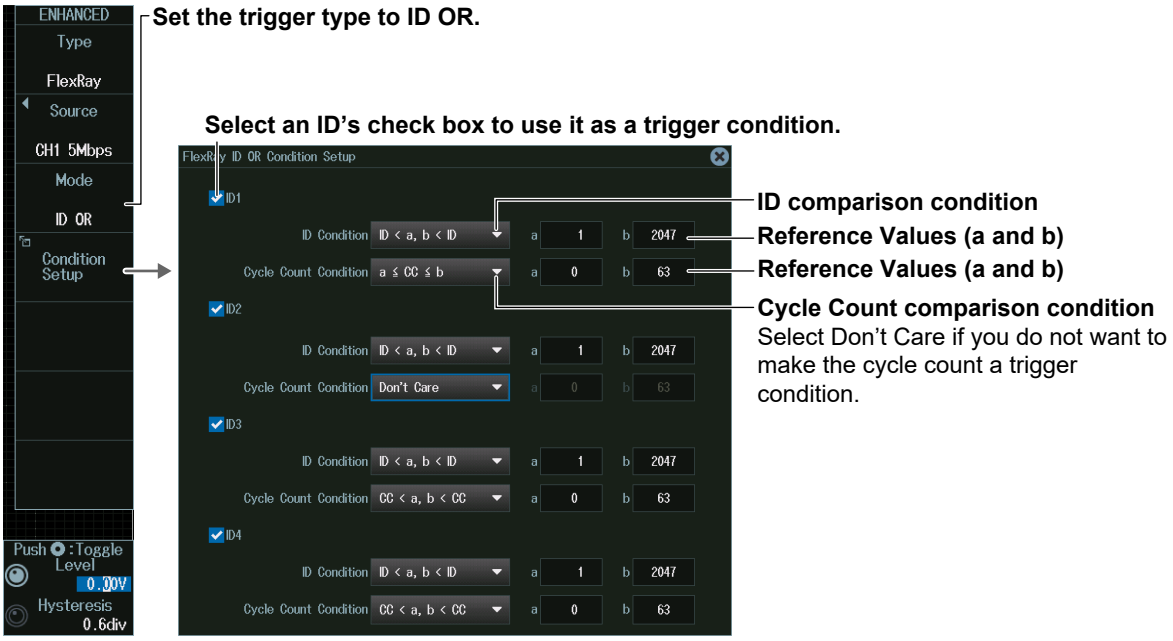
ID/Data Mode (ID/Data)

1. Press the **Mode** soft key and then the **ID/Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers on the AND of Frame Start, Indicator, ID, Cycle Count, Data1, and Data2. Items whose check boxes are selected are used as trigger conditions.



ID OR Mode (ID OR)

1. Press the **Mode** soft key and then the **ID OR** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers when the condition of one of the four IDs is met. Items whose check boxes are selected are used as trigger conditions.



Level for Detecting Trigger Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Press SET (upper right on the front panel) to switch between level and hysteresis.

2.14 Triggering on CAN Bus Signals (Option)

This section explains the following settings for triggering on CAN bus signals:

- Trigger source
  Bit rate, recessive level, HF rejection, sample point
- Level and hysteresis for detecting trigger source states
- Trigger type
  Trigger conditions

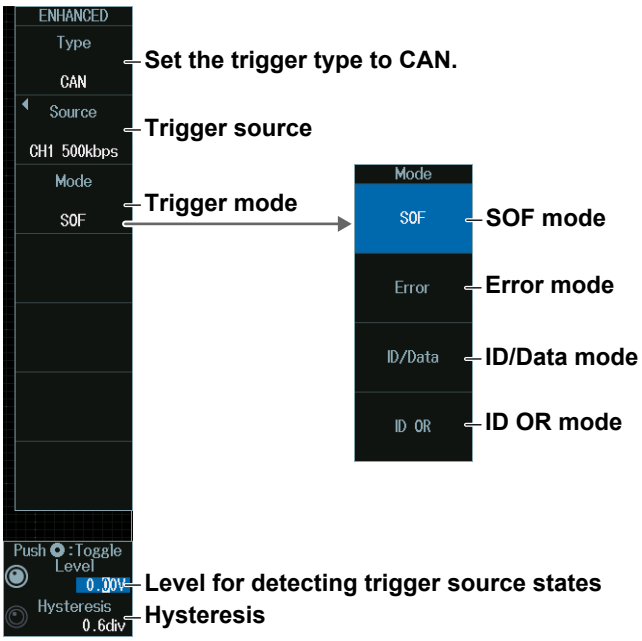
► "CAN Bus Trigger [ENHANCED, option]," "HF Rejection (HF Rejection)" in the Features Guide

Auto Setup

The instrument can automatically set the trigger source level and bit rate from the received CAN bus signal and trigger on them. For details, see section 12.2.

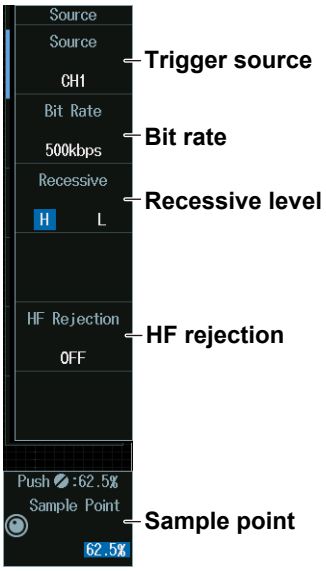
ENHANCED CAN Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **CAN** to display the following menu.



Trigger Source (Source)

Press the **Source** soft key to display the following menu.



When the bit rate is set to User Define



Note

The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

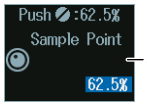
Sample Point (Sample Point) and Bit Rate (Bit Rate)

When the bit rate is not set to User Define

Turn the **jog shuttle** to set the sample point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up list that appears on the screen.

Jog shuttle setting menu



When the bit rate is set to User Define

Turn the **jog shuttle** to set the sample point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up list that appears on the screen.

Jog shuttle setting menu



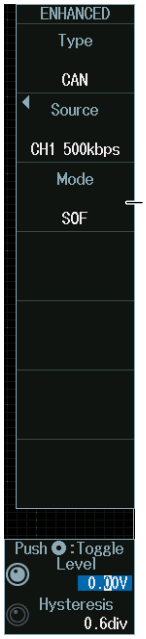
Press SET (upper right on the front panel) to switch between bit rate and sample point.

Trigger Mode (Mode)

SOF Mode (Start of Frame)

Press the **Mode** soft key and then the **SOF** soft key to display the following menu.

The instrument triggers on the start of CAN bus signal frames.

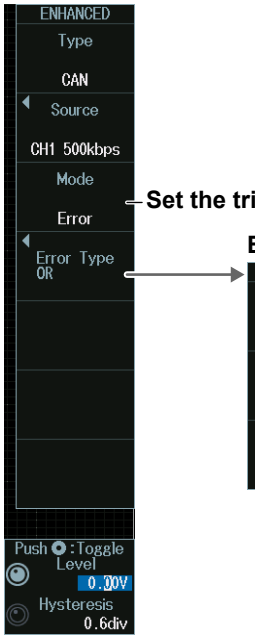


Set the trigger mode to SOF.

Error Mode (Error)

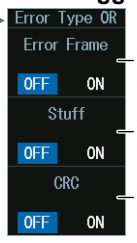
Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument triggers on error frames (when the error flag is active) or when it detects various errors.



Set the trigger mode to Error.

Error trigger conditions



Turns error frame detection on or off
When an active error flag is detected

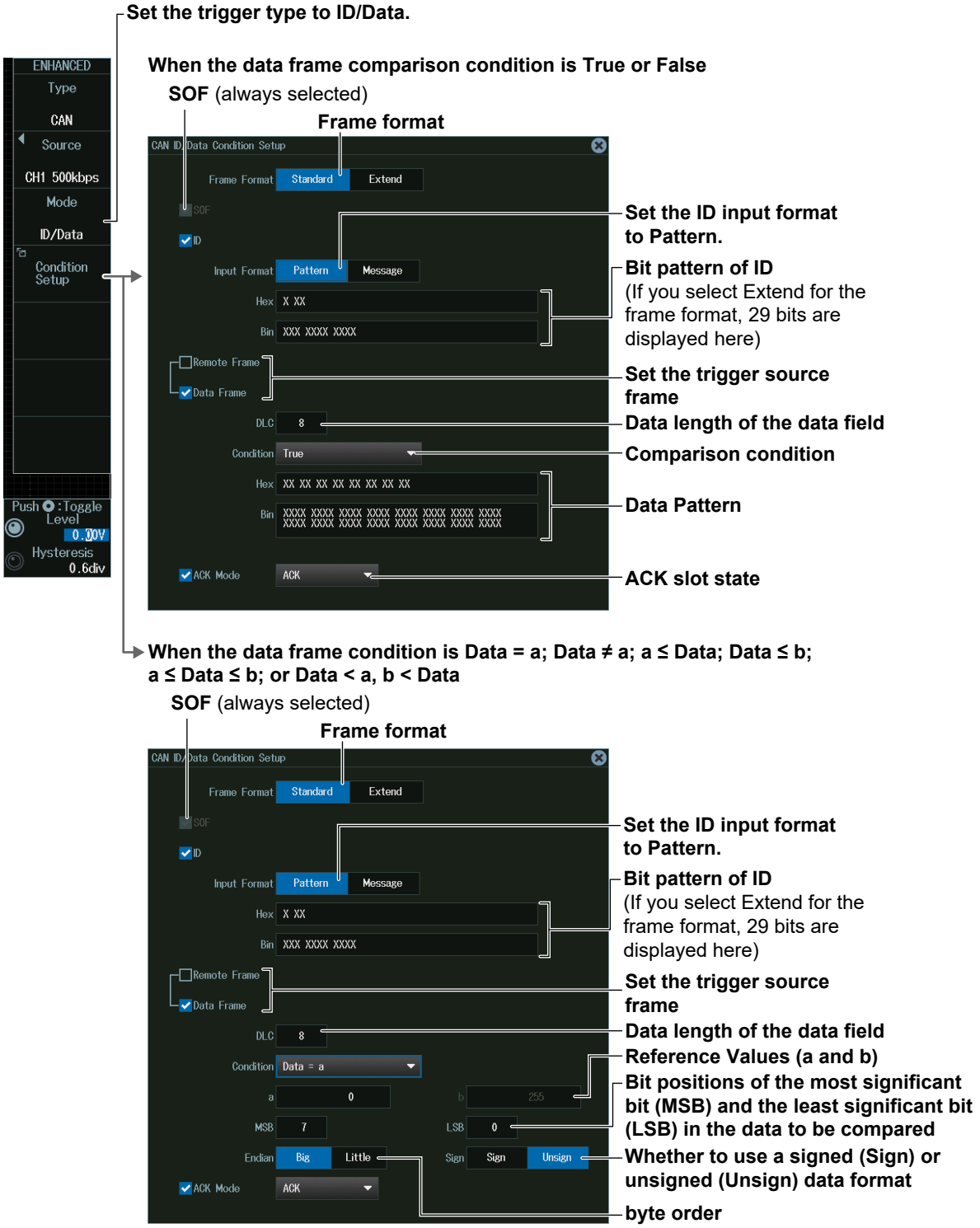
Turns stuff error detection on or off
When stuff bits are not inserted properly

Turns CRC error detection on or off
When a CRC error is detected

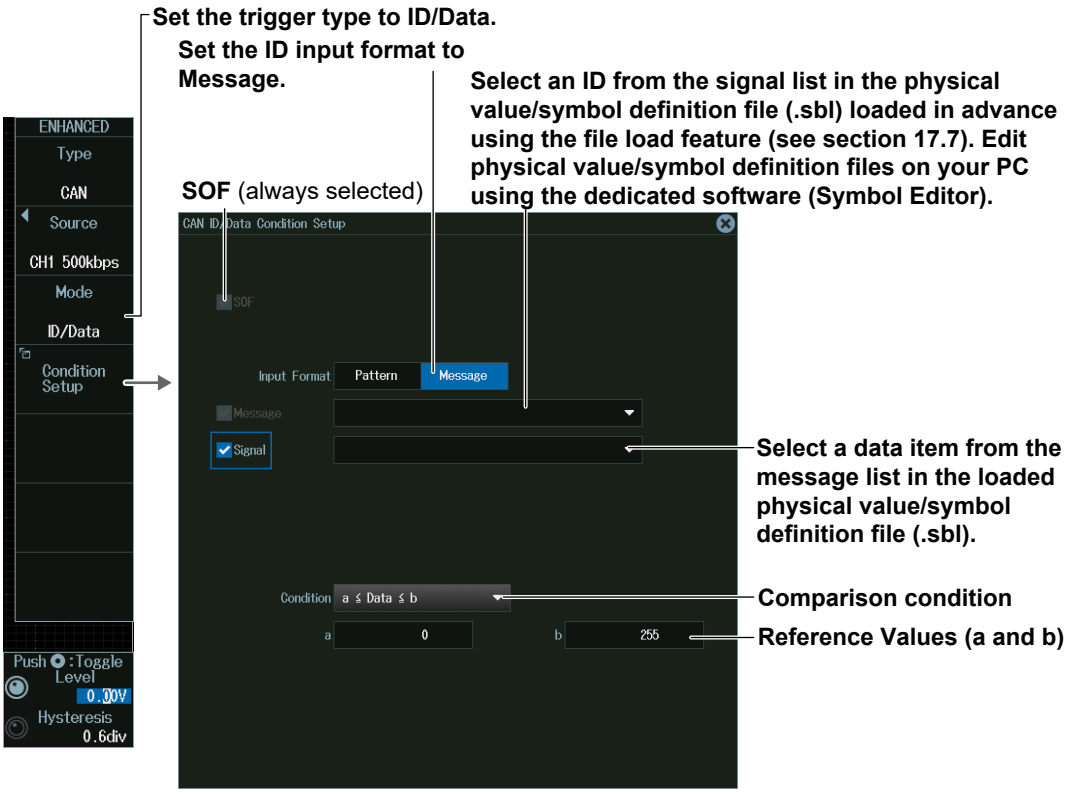
ID/Data Mode (ID/Data)

1. Press the **Mode** soft key and then the **ID/Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers on the AND of the SOF, ID, frame type (Remote Frame or Data Frame), Data, and ACK Mode conditions. Items whose check boxes are selected are used as trigger conditions.

- **When ID Input Format Is Pattern**



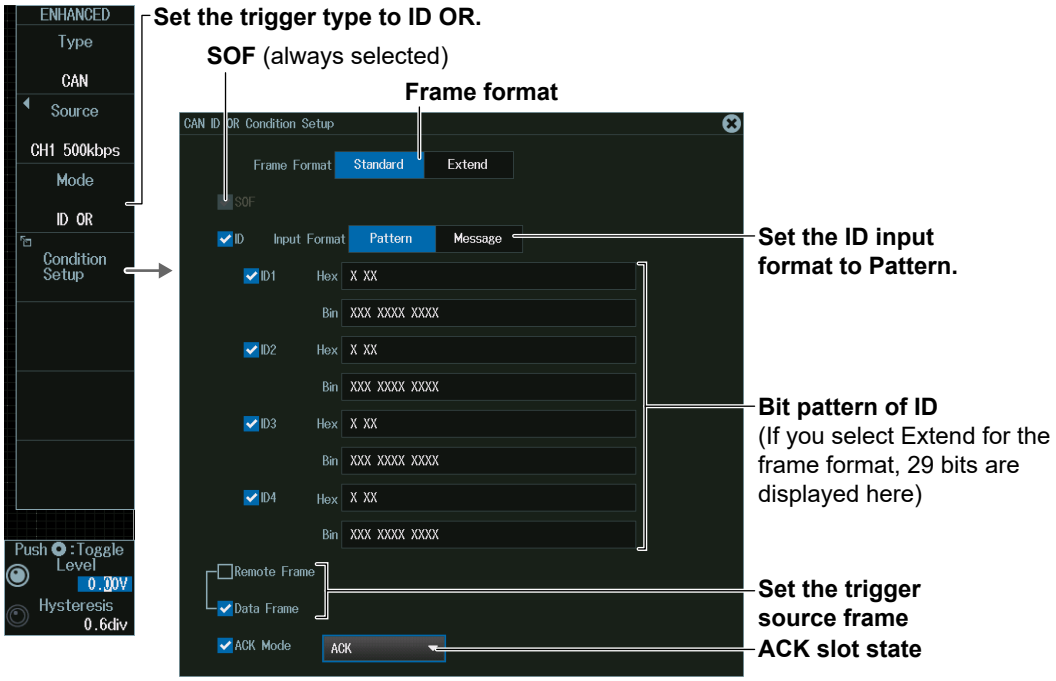
- **When ID Input Format Is Message**



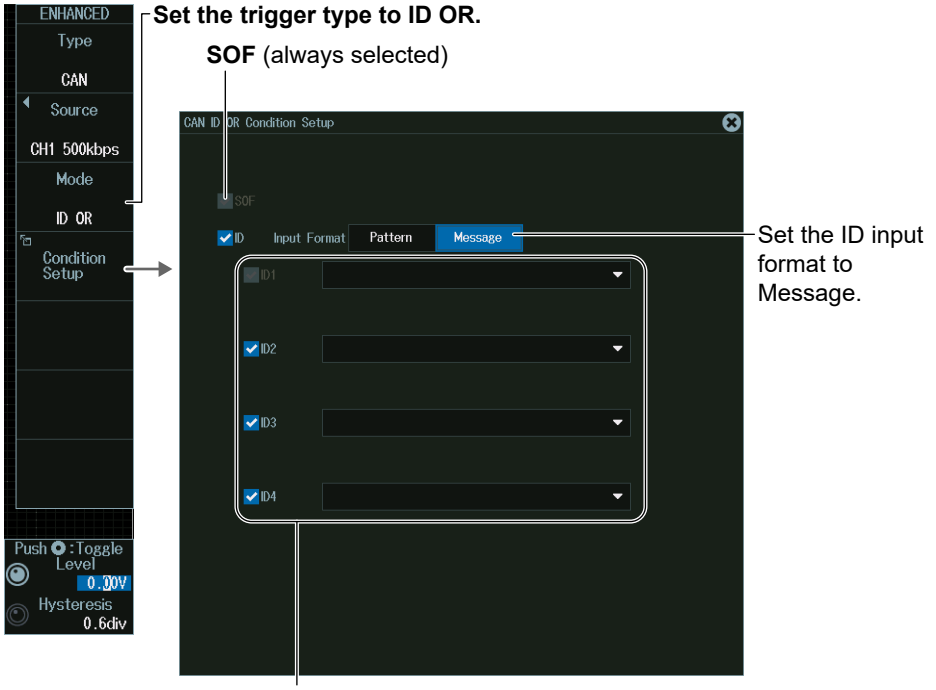
ID OR Mode (ID OR)

1. Press the **Mode** soft key and then the **ID OR** soft key.
2. Press the **Condition Setup** soft key to display the following screen.
   The instrument triggers on the AND of the SOF, frame type (Remote Frame or Data Frame), and ACK Mode conditions and of the condition of one of the four IDs. Items whose check boxes are selected are used as trigger conditions.

- **When ID Input Format Is Pattern**



- **When ID Input Format Is Message**



Level for Detecting Trigger Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting trigger source states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

2.15 Triggering on CAN FD Bus Signals (Option)

This section explains the following settings for triggering on CAN FD signals:

- Trigger source
  Bit rate, sample point, data phase bit rate,
  data phase sample point, recessive level, HF rejection
- Level and hysteresis for detecting trigger source states
- Trigger type
  Trigger conditions
- CAN FD standard

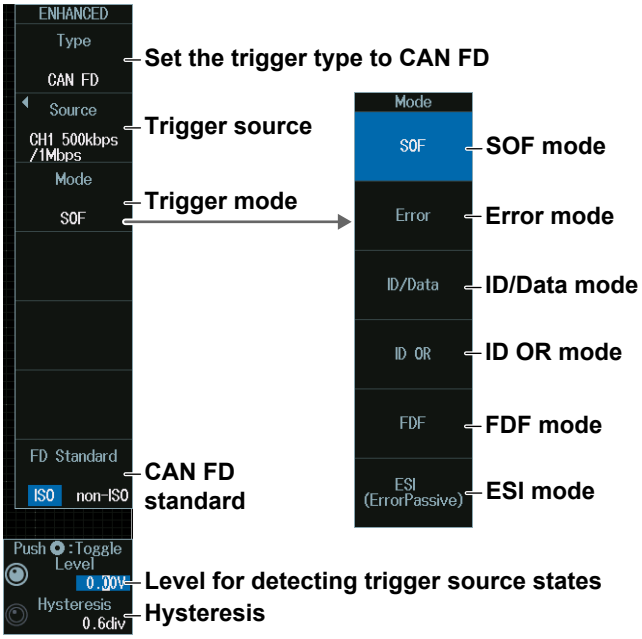
► **"CAN FD Bus Trigger [ENHANCED, option]," "HF Rejection (HF Rejection)" in the Features Guide**

Auto Setup

The instrument can automatically set the trigger source level and bit rate from the received CAN FD bus signal and trigger on them. For details, see section 12.3.

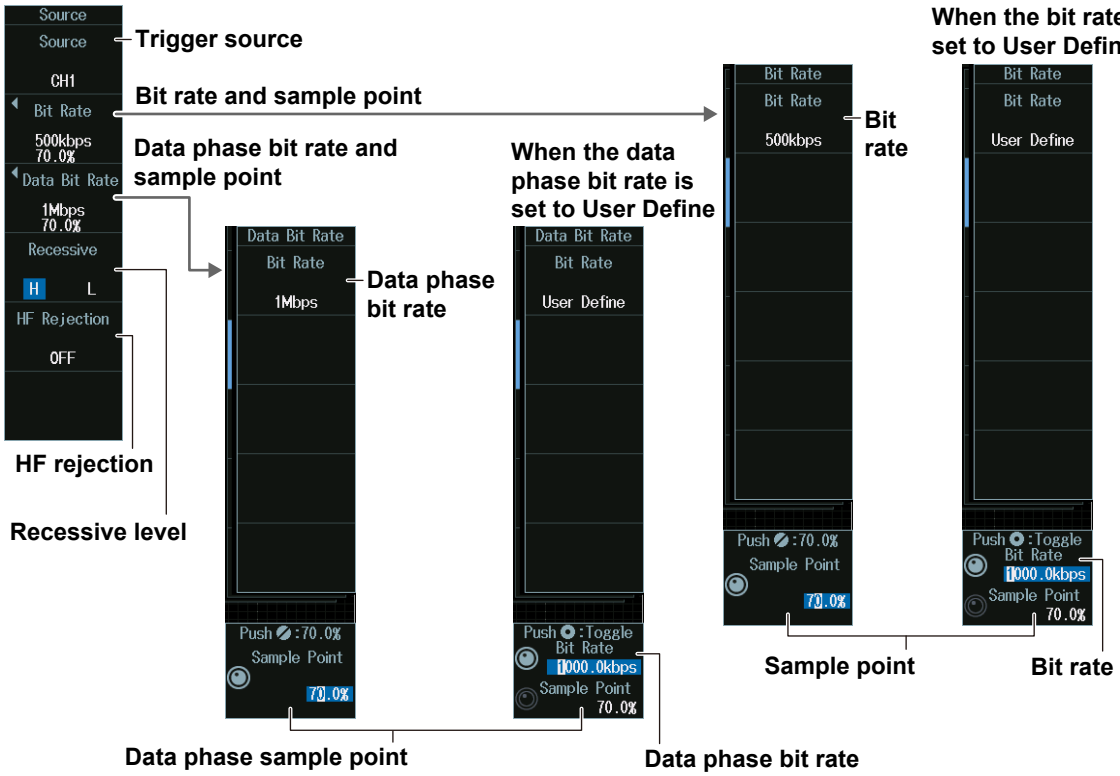
ENHANCED CAN FD Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **CAN FD** to display the following menu.



Trigger Source (Source)

Press the **Source** soft key to display the following menu..



Note

The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

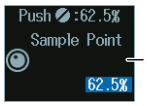
Sample Point (Sample Point) and Bit Rate (Bit Rate)

When the bit rate is not set to User Define

Turn the **jog shuttle** to set the sample point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up list that appears on the screen.

Jog shuttle setting menu

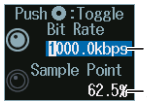


When the bit rate is set to User Define

Turn the **jog shuttle** to set the bit rate and sample point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up list that appears on the screen.

Jog shuttle setting menu



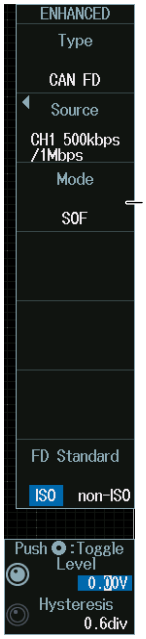
Press SET (upper right on the front panel) to switch between bit rate and sample point.

Trigger Mode (Mode)

SOF Mode (Start of Frame)

Press the **Mode** soft key and then the **SOF** soft key to display the following menu.

The instrument triggers on the start of CAN FD bus signal frames.

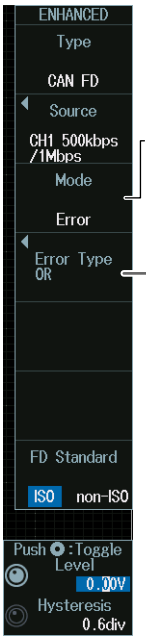


Set the trigger mode to SOF.

Error Mode (Error)

Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument triggers on error frames (when the error flag is active) or when it detects various errors.



Set the trigger mode to Error.

Error trigger conditions

When FD Standard is set to ISO

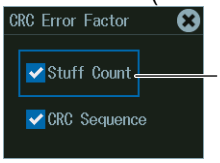


Turns error frame detection on or off
When an active error flag is detected

Turns stuff error detection on or off
When stuff bits are not inserted properly

Turns fixed stuff error detection on or off
When fixed CRC stuff bits are not inserted properly

Turns CRC error detection on or off
When a CRC error is detected When the specified error factor is detected if the CAN FD standard (FD Standard) is set to ISO



Select the check boxes for the CRC error factors to detect.

CRC errors are not detected if both check boxes are cleared.

When FD Standard is set to non-ISO

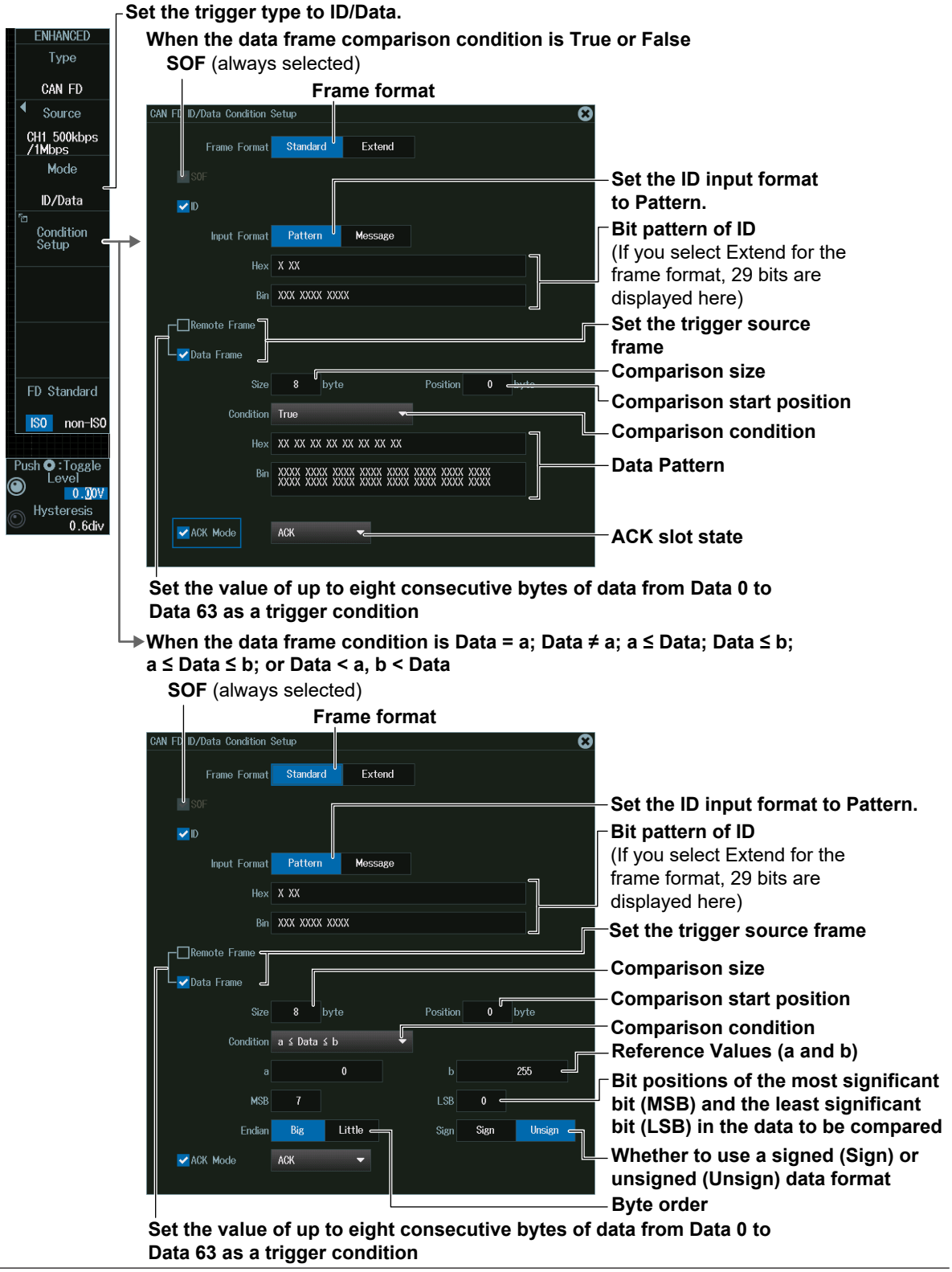


(When CRC is set to ON)

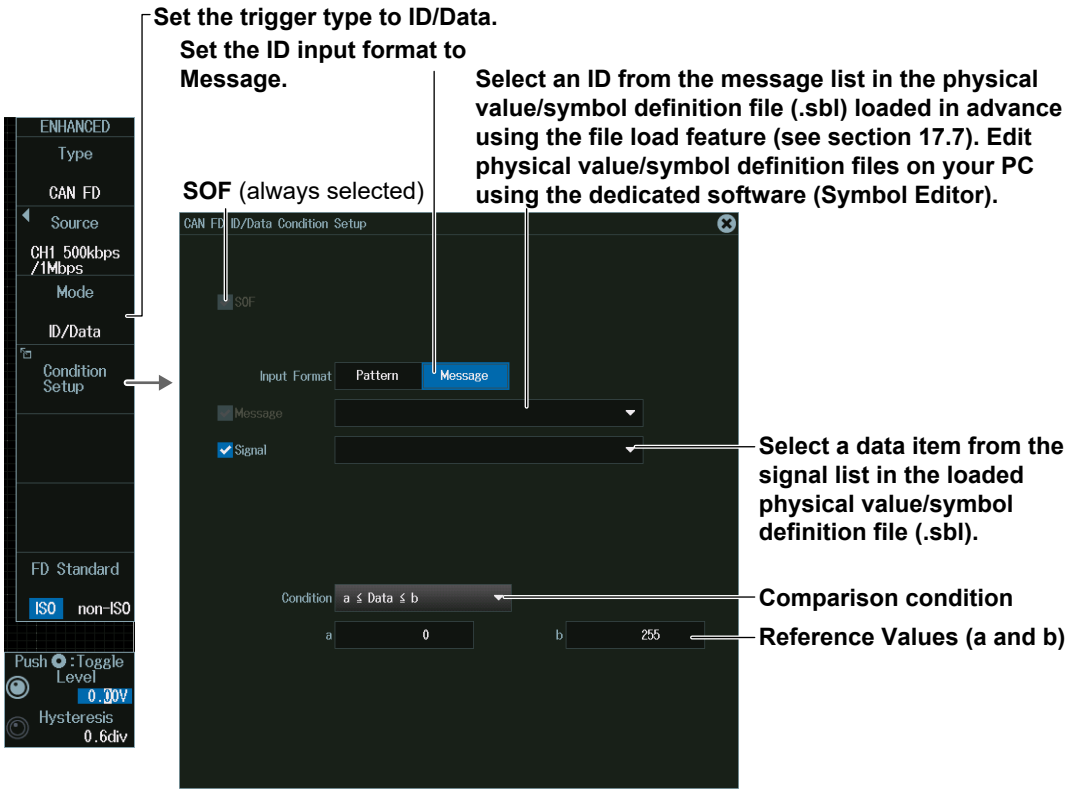
ID/Data Mode (ID/Data)

1. Press the **Mode** soft key and then the **ID/Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers on the AND of the SOF, ID, frame type (Remote Frame or Data Frame), Data, and ACK Mode conditions. Items whose check boxes are selected are used as trigger conditions.

- **When ID Input Format Is Pattern**



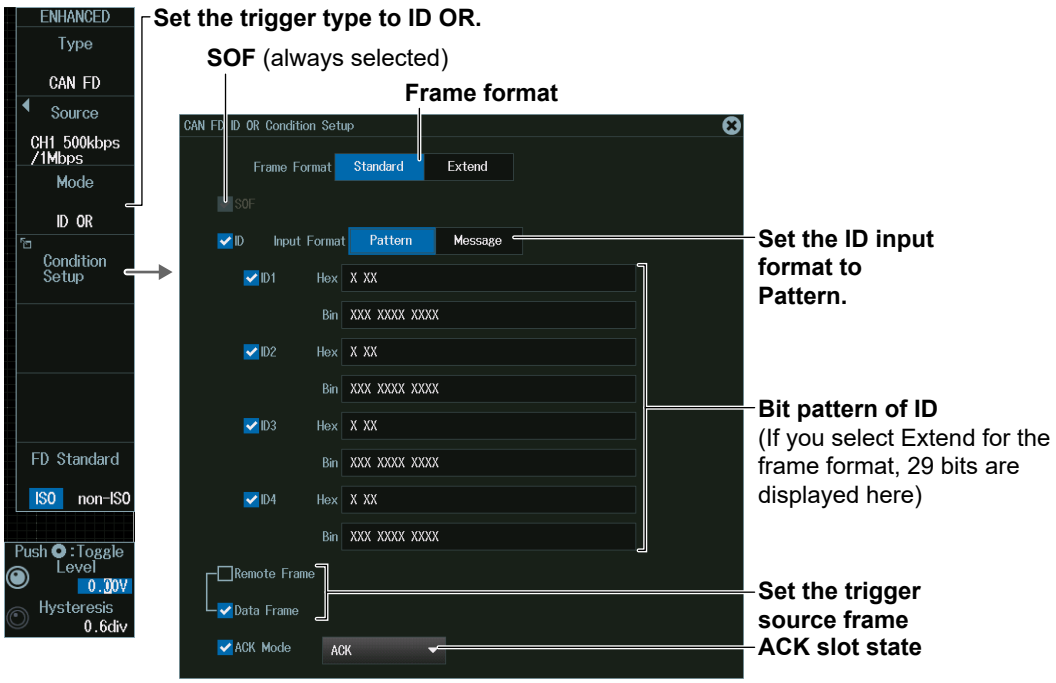
- **When ID Input Format Is Message**



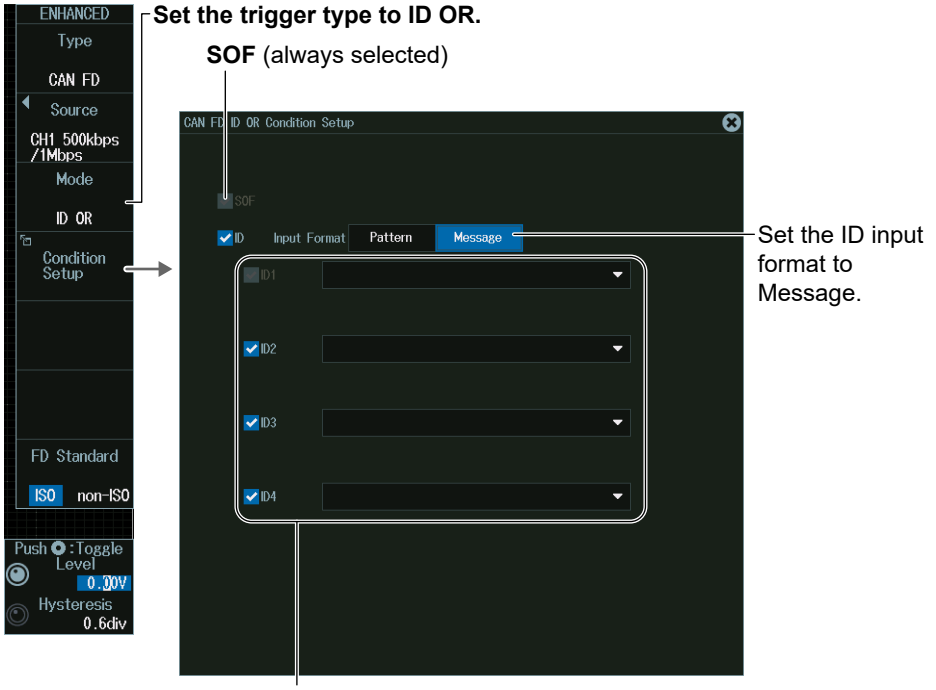
ID OR Mode (ID OR)

1. Press the **Mode** soft key and then the **ID OR** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers on the AND of the SOF, frame type (Remote Frame or Data Frame), and ACK Mode conditions and of the condition of one of the four IDs. Items whose check boxes are selected are used as trigger conditions.

- **When ID Input Format Is Pattern**

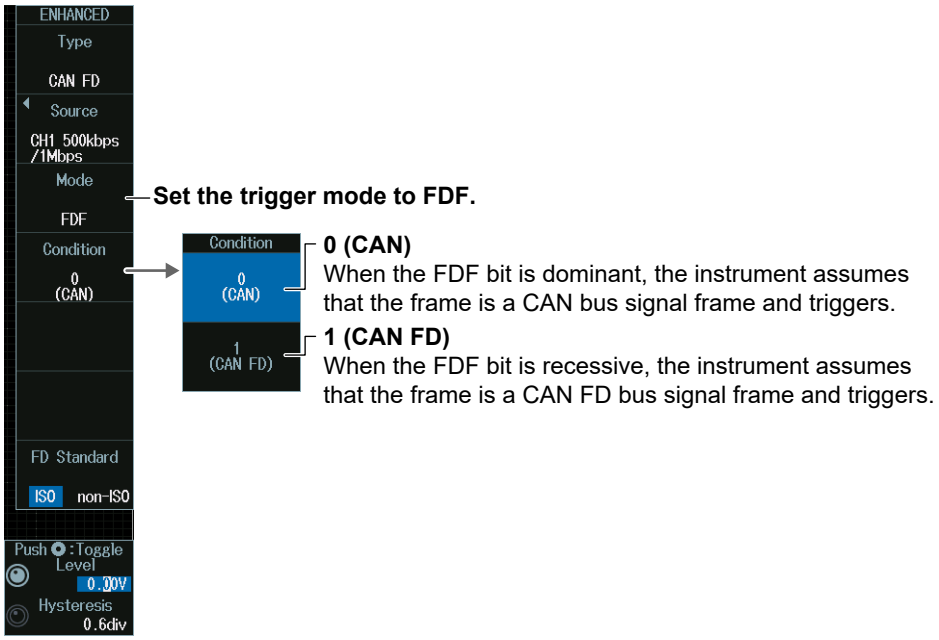


- **When ID Input Format Is Message**



FDF Mode (FDF)

1. Press the **Mode** soft key and then the **FDF** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   Set the FDF bit state as a trigger condition.



ESI Mode (ESI (Error Passive))

Press the **Mode** soft key and then the **ESI (ErrorPassive)** soft key.

The instrument triggers when the ESI bit is recessive (error passive).



Set the trigger type to ESI (ErrorPassive).

CAN FD Standard

Press the **FD Standard** soft key to select the frame format.

For details on frames, see chapter 4, “CAN FD Bus Trigger,” in IM DLM5058-01EN.

Level for Detecting Trigger Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting trigger source states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

2.16 Triggering on LIN Bus Signals (Option)

This section explains the following settings for triggering on LIN bus signals:

- Trigger source
  Bit rate, HF rejection, sample point
- Level and hysteresis for detecting trigger source states
- Trigger type
  Trigger conditions

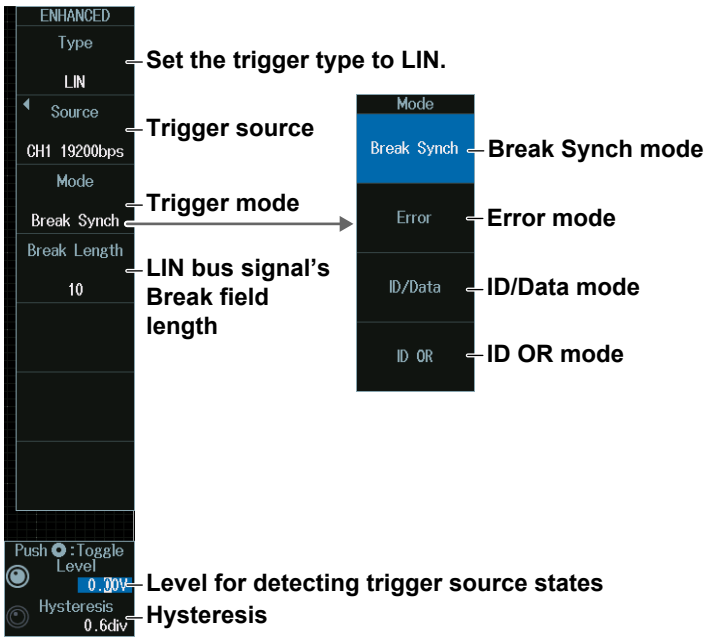
► **"LIN Bus Trigger [ENHANCED, option]," "HF Rejection (HF Rejection)" in the Features Guide**

Auto Setup

The instrument can automatically set the trigger source level and bit rate from the received LIN bus signal and trigger on them. For details, see section 12.4.

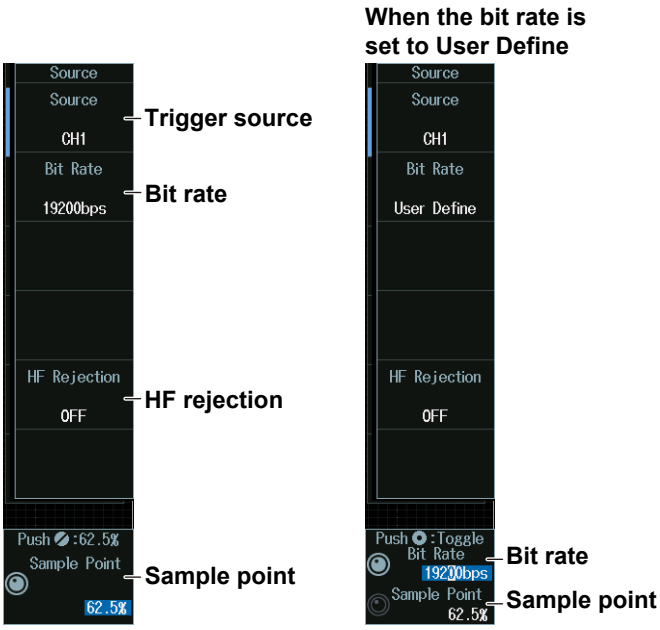
ENHANCED LIN Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **LIN** to display the following menu.



Trigger Source (Source)

Press the **Source** soft key to display the following menu.



Note

The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

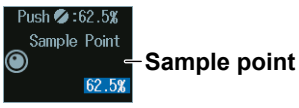
Sample Point (Sample Point) and Bit Rate (Bit Rate)

When the bit rate is not set to User Define

Turn the **jog shuttle** to set the sample point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up list that appears on the screen.

Jog shuttle setting menu

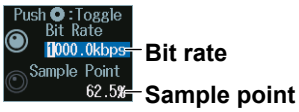


When the bit rate is set to User Define

Turn the **jog shuttle** to set the bit rate and sample point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up list that appears on the screen.

Jog shuttle setting menu



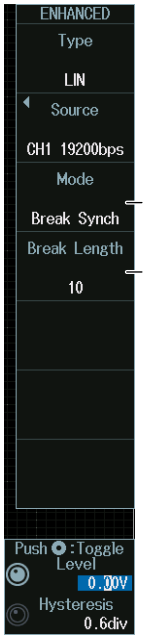
Press SET (upper right on the front panel) to switch between bit rate and sample point.

Trigger Mode (Mode)

Break Synch Mode

Press the Mode soft key and then the **Break Synch** soft key to display the following menu.

The instrument triggers when it detects a break field and then a synch field (Break Field + Synch Field).



Set the trigger mode to Break Synch.

Low-pulse bit length that is used to detect breaks

Error Mode

Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument triggers when it detects an error.



Set the trigger mode to Error.

Error trigger conditions

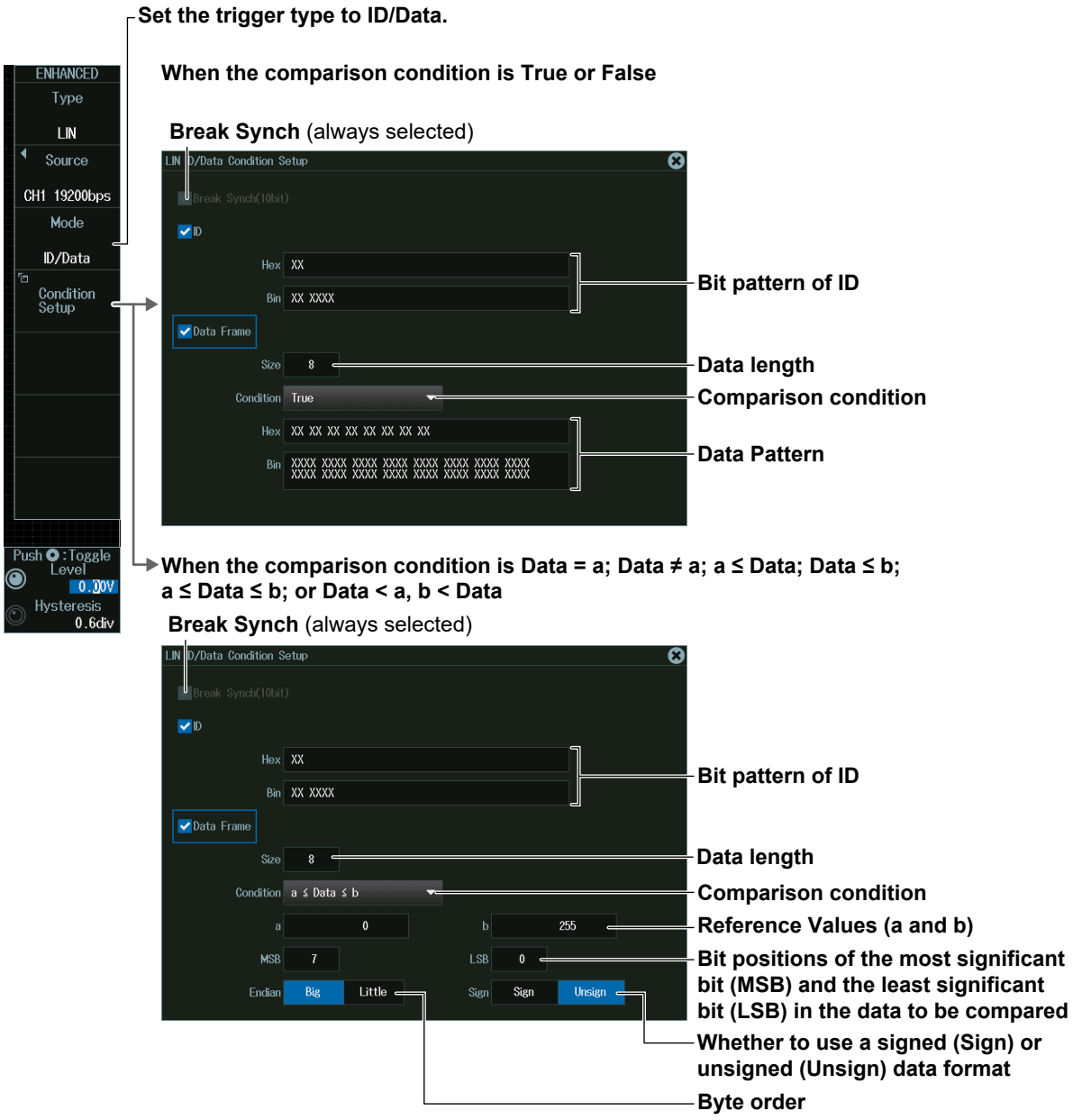


Turns parity error detection on or off
When the computed parity result of the Protected Identifier Field is in error

Turns sync error detection on or off
When the Synch Field is not 0x55

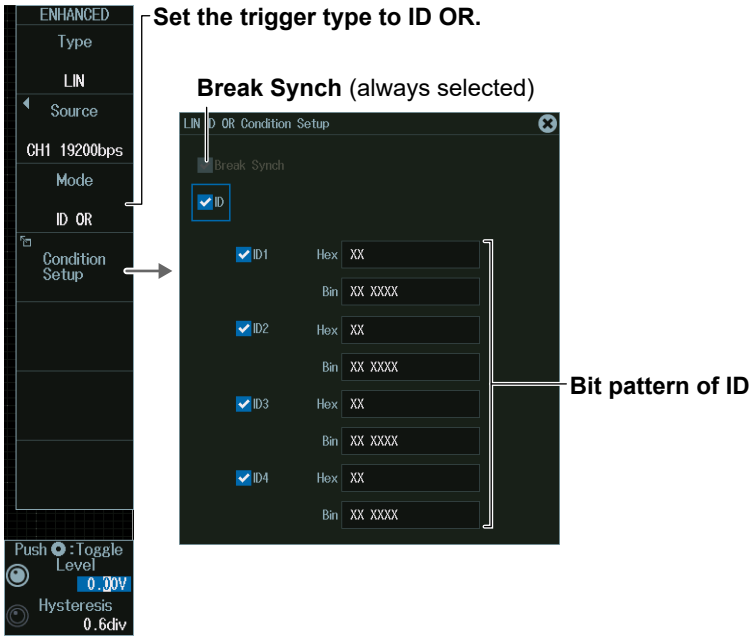
ID/Data mode

1. Press the **Mode** soft key and then the **ID/Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers on the AND of the Break Synch, ID, and Data Frame conditions. Items whose check boxes are selected are used as trigger conditions.



ID OR Mode

1. Press the **Mode** soft key and then the **ID OR** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers on the AND of the Break Synch condition and the condition of one of the four IDs. Items whose check boxes are selected are used as trigger conditions.



Level for Detecting Trigger Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Press SET (upper right on the front panel) to switch between level and hysteresis.

2.17 Triggering on CXPI Bus Signals (Option)

This section explains the following settings for triggering on CXPI bus signals:

- Trigger source
  Bit Rate, T Sample, Clock Tolerance, HF Rejection
- Level and hysteresis for detecting trigger source states
- Trigger type
  Trigger conditions

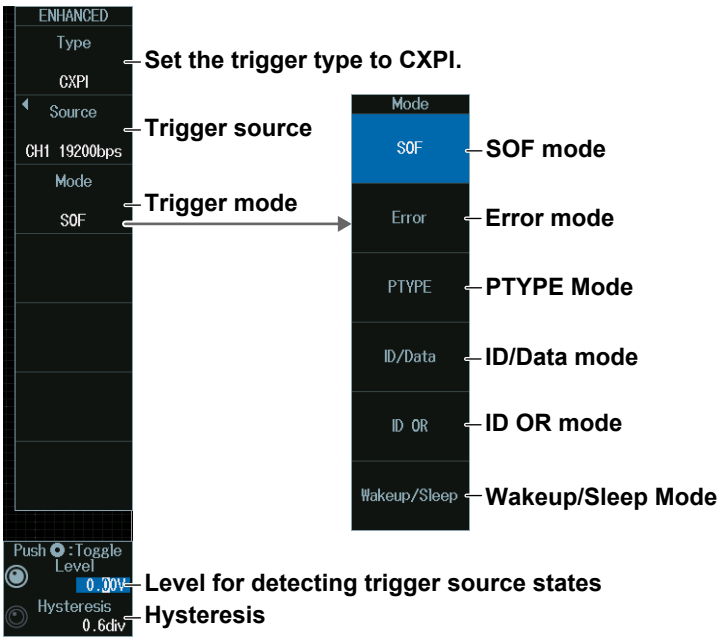
► **"CXPI Bus Trigger [ENHANCED, option]," "HF Rejection (HF Rejection)" in the Features Guide**

Auto Setup

The instrument can automatically set the trigger source level and bit rate from the received CXPI bus signal and trigger on them. For details, see section 12.5.

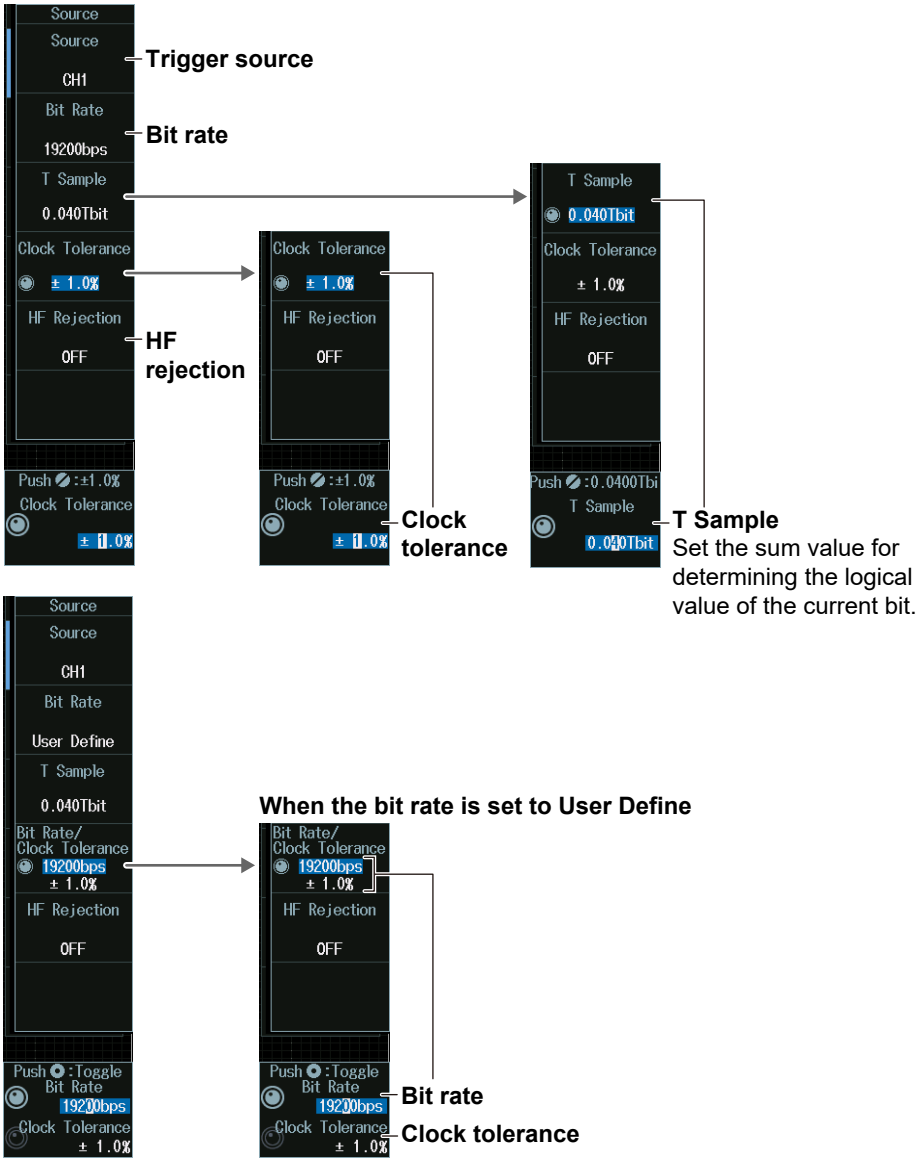
ENHANCED CXPI Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **CXPI** to display the following menu.



Trigger Source (Source)

Press the **Source** soft key to display the following menu..



Note

The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

Clock Tolerance (Clock Tolerance) and Bit Rate (Bit Rate)

When the bit rate is not set to User Define

Turn the **jog shuttle** to set the clock tolerance.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



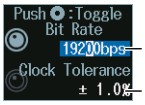
Clock tolerance

When the bit rate is set to User Define

Turn the **jog shuttle** to set the bit rate and clock tolerance.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Bit rate

Clock tolerance

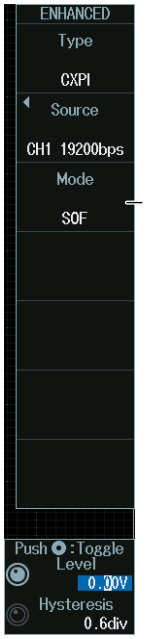
Press SET (upper right on the front panel) to switch between bit rate and clock tolerance.

Trigger Mode (Mode)

SOF Mode (Start of Frame)

Press the **Mode** soft key and then the **SOF** soft key. The following menu appears.

The instrument triggers on the start position of CXPI bus signal frames.

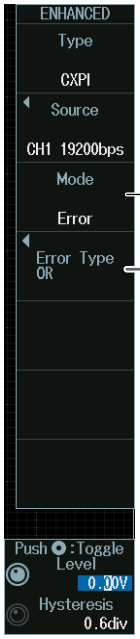


Set the trigger mode to SOF.

Error Mode

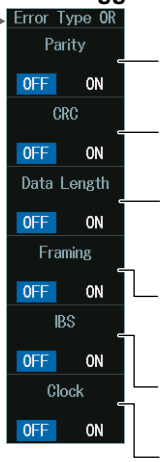
Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument triggers when it detects various types of errors.



Set the trigger mode to Error.

Error trigger conditions



Turns parity error detection on or off
When a parity error is detected

Turns CRC error detection on or off
When a CRC error is detected

Turns data length error detection on or off
When the DLC value and the number of data pieces in the data field (data length) do not match

Turns framing error detection on or off
When the logical value of the stop bit of a field or the stop bit of data is 0

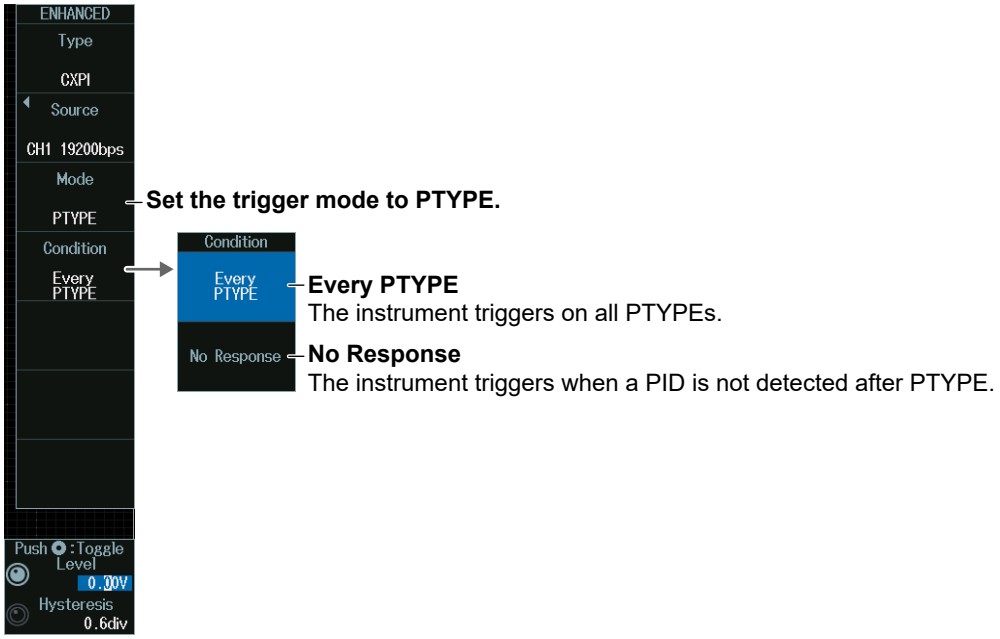
Turns IBS error detection on or off
When the number of IBS bits is 10 or more

Turns clock error detection on or off
When the clock width exceeds the specified tolerance

PTYPE mode

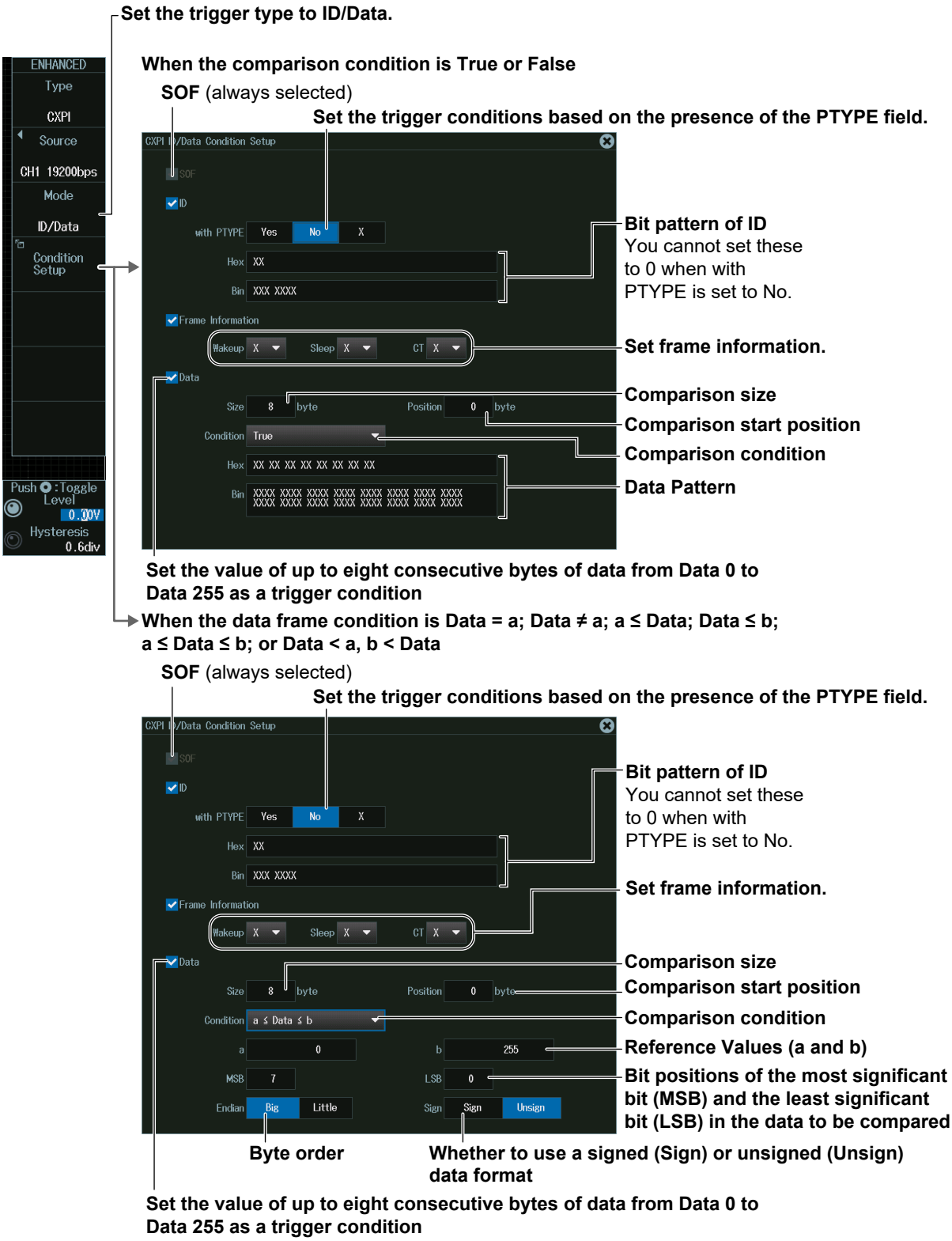
Press the **Mode** soft key and then the **PTYPE** soft key to display the following menu.

The instrument triggers by detecting CXPI bus signal's PTYPEs.



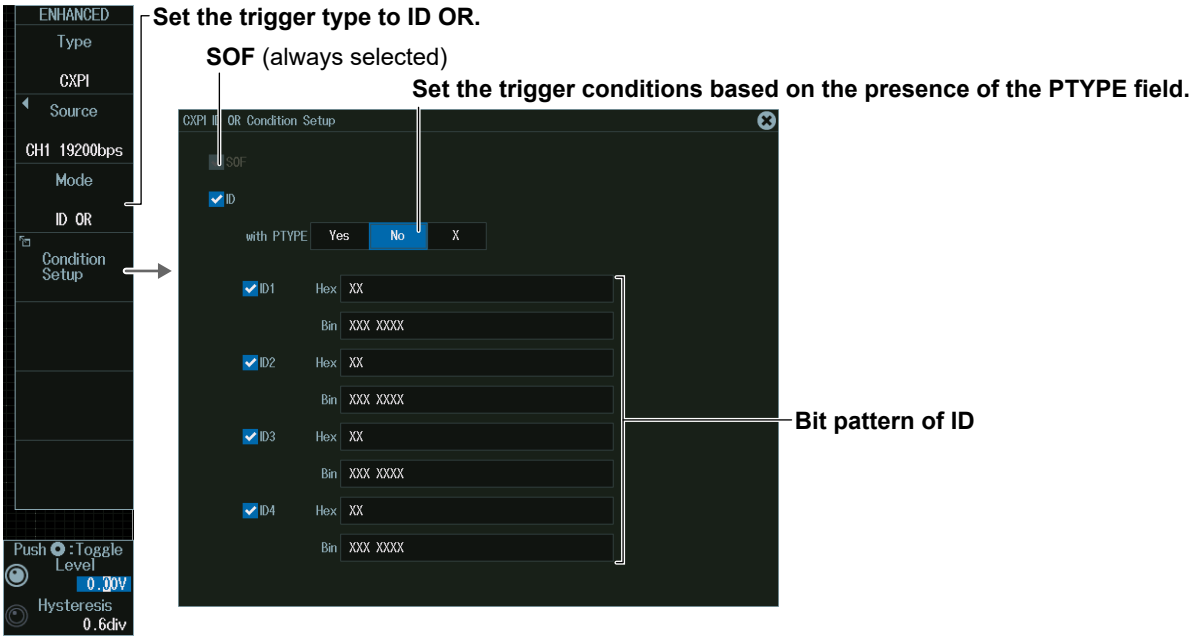
ID/Data mode

1. Press the **Mode** soft key and then the **ID/Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers on the AND of SOF, ID, frame information, and data. Items whose check boxes are selected are used as trigger conditions.



ID OR Mode

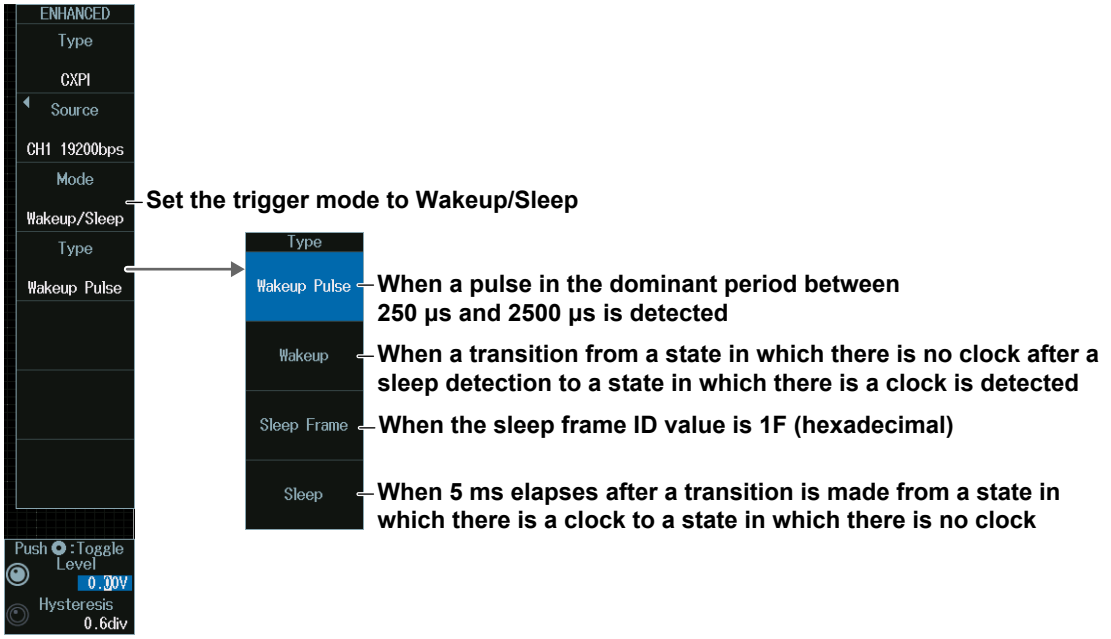
1. Press the **Mode** soft key and then the **ID OR** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers on the AND of the SOF condition and the condition of one of the four IDs. Items whose check boxes are selected are used as trigger conditions.



Wakeup/Sleep Mode

Press the Mode soft key and then the **Wakeup/Sleep** soft key to display the following menu.

The instrument triggers by detecting the specified type.



Level for Detecting Trigger Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting trigger source states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

2.18 Triggering on SENT Signals (Option)

This section explains the following settings for triggering on SENT signals:

- Trigger source
  HF rejection, source bit
- Level and hysteresis for detecting trigger source states
- Trigger type
  Trigger conditions
- Format

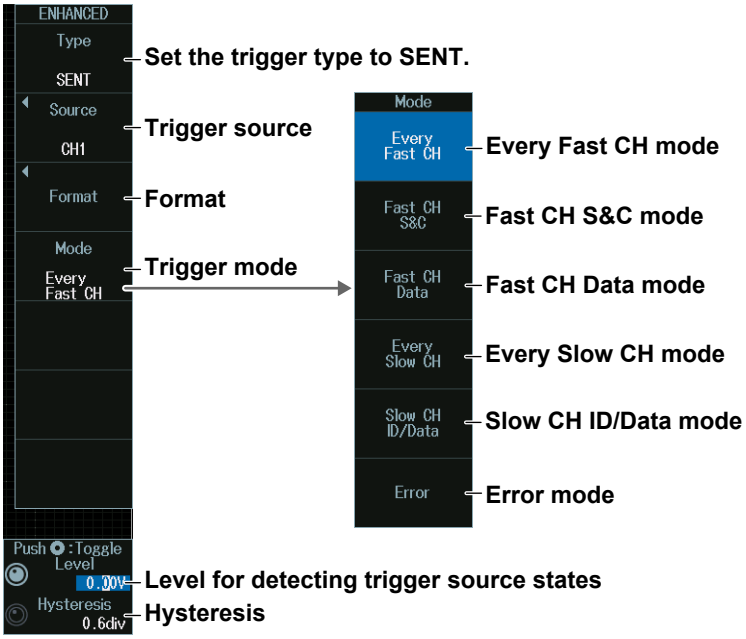
► "SENT Trigger [ENHANCED, option]," "HF Rejection (HF Rejection)" in the Features Guide

Auto Setup

The instrument can automatically set the source format, level, and hysteresis from the received SENT bus signal and trigger on it. For details, see section 12.6.

ENHANCED SENT Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **SENT** to display the following menu.



Trigger Source (Source)

Press the **Source** soft key. The menu that appears varies depending on the specified trigger source.

When the Trigger Source Is a Channel from CH1 to CH8



Set the trigger source to a channel from1 to CH8.

HF rejection

Level for detecting trigger source states

Hysteresis

Note

The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Trigger Source Is Logic

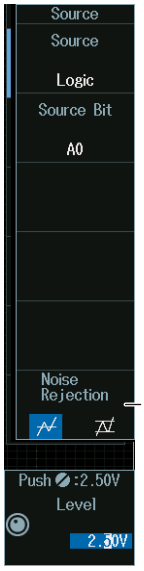
For the 701989 logic probe



Set the trigger source to Logic.

Source bit

Level for detecting trigger source states



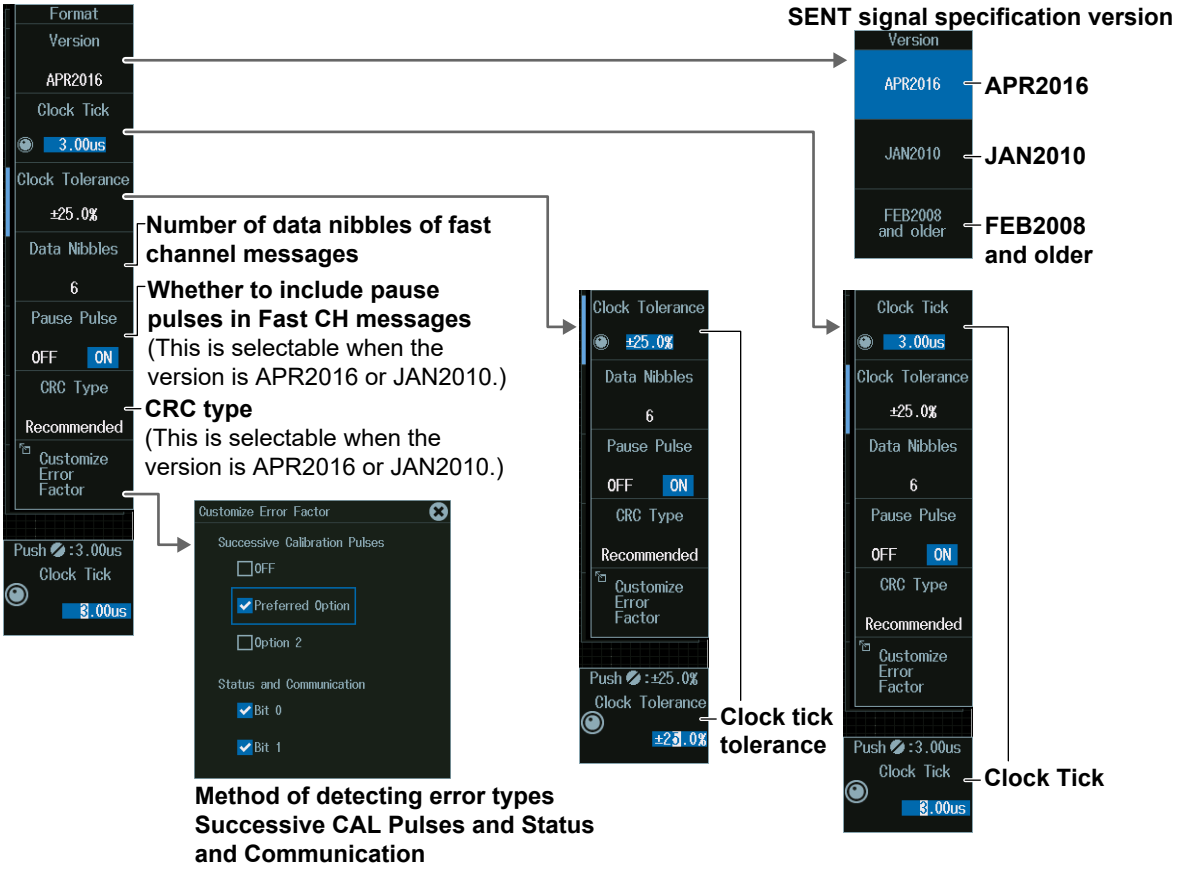
Noise rejection

Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Format (Format)

Press the **Format** soft key to display the following menu.



Setting the Clock Tick (Clock Tick)

1. Press the **Clock Tick** soft key.
2. Turn the **jog shuttle** to display the waveforms that have been found.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Clock Tick Tolerance (Clock Tolerance)

1. Press the **Clock Tolerance** soft key.
2. Turn the **jog shuttle** to display the waveforms that have been found.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

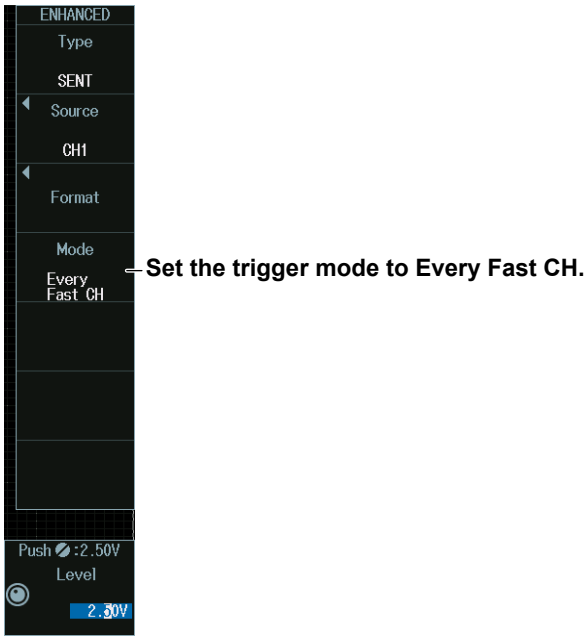


Trigger Mode (Mode)

Every Fast CH mode

Press the **Mode** soft key and then the **Every Fast CH** soft key to display the following menu.

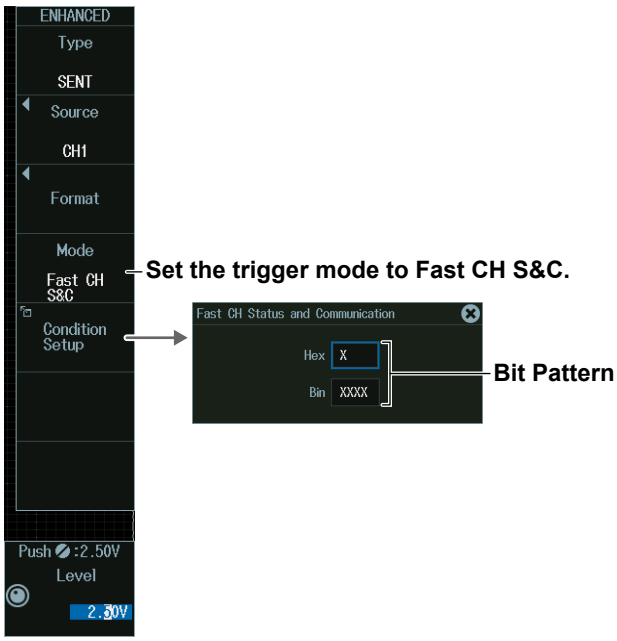
The instrument triggers when it detects a fast channel message.



Fast CH S&C mode

Press the **Mode** soft key and then the **Fast CH S&C** soft key to display the following menu.

The instrument triggers on the status and communication bit pattern.

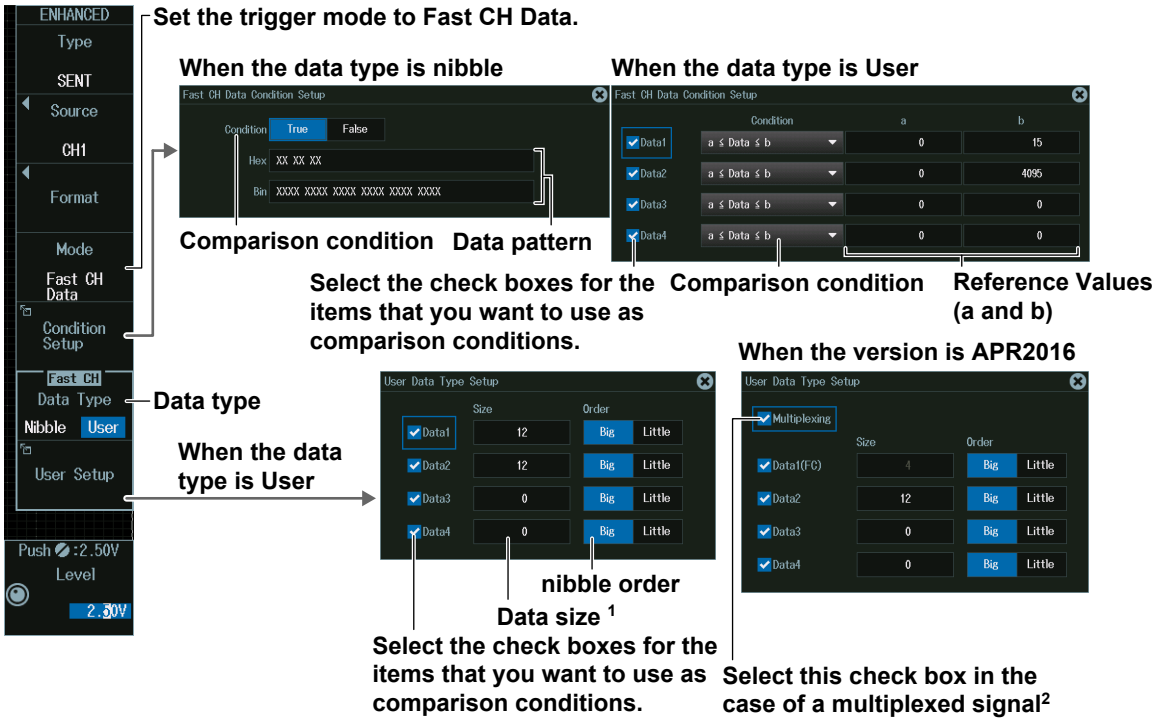


Fast CH Data mode

1. Press the **Mode** soft key and then the **Fast CH Data** soft key to display the following menu.

2. Press the **Condition Setup** soft key. The screen that appears varies depending on the specified fast channel data type.

   The instrument triggers on the AND of fast channel Data conditions. Items whose check boxes are selected are used as trigger conditions.



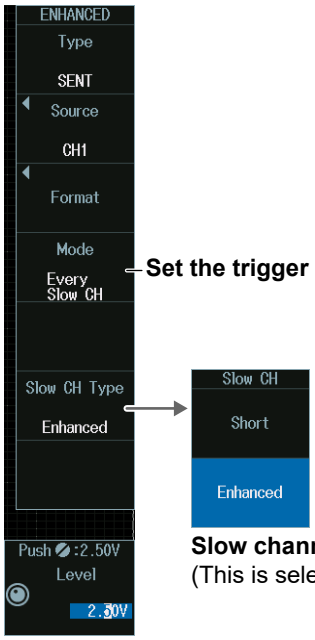
1 The total number of bits for Data1 to Data4 is up to 24. If you try to exceed the total number of bits, the data size of other pieces of Data is reduced.

2 When the check box for Multiplexing is selected, the Size of Data1 is fixed to 4 to correspond to FC.

Every Slow CH mode

Press the **Mode** soft key and then the **Every Slow CH** soft key to display the following menu.

The instrument triggers when it detects an “Every Slow CH” message.



Set the trigger mode to Every Slow CH.

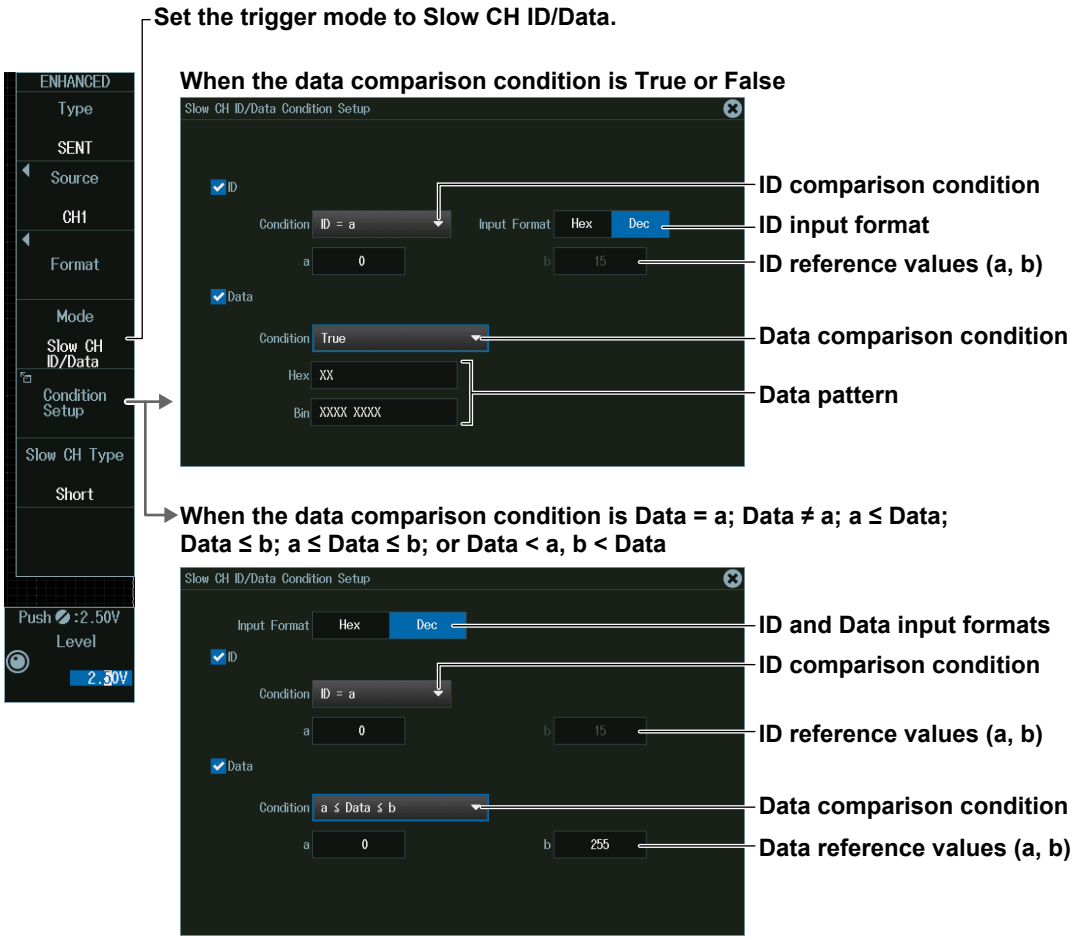
Slow channel message type
(This is selectable when the format version is APR2016 or JAN2010.)

Slow CH ID/Data mode

1. Press the **Mode** soft key and then the **Slow CH ID/Data** soft key.
2. Press the **Condition Setup** soft key. The menu that appears varies depending on the specified slow channel message type.

   The instrument triggers on the AND of the slow channel ID and Data conditions. Items whose check boxes are selected are used as trigger conditions. Set ID and data reference values a and b in Hex (hexadecimal) or Dec (decimal) according to the input format setting.

- **When the Message Type Is Short**



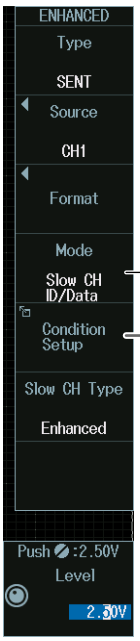
Setting ID/Data Reference Values a and b

Input format setting		Hex	Dec
Selectable range for reference values a and b	ID	0 to F	0 to 15
	Data	00 to FF	00 to 255

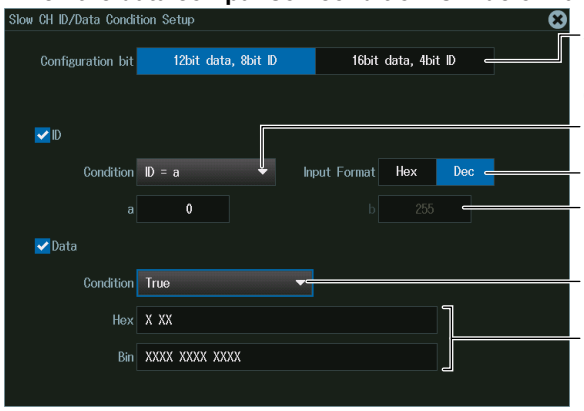
- **When the Message Type Is Enhanced**

  - **When the ID and Data Message Formats Are Set to "12bit data, 8bit ID"**

Set the trigger mode to Slow CH ID/Data.

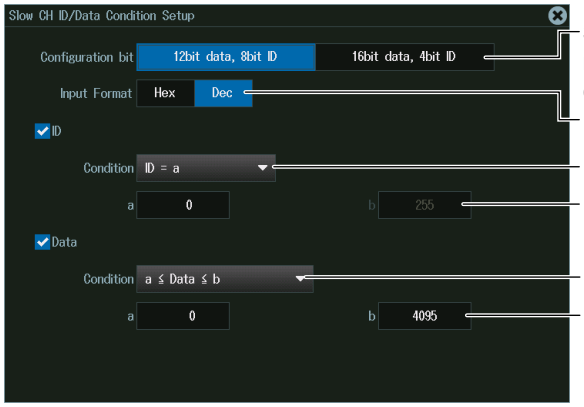


When the data comparison condition is True or False



Set the ID and data message formats to 12bit data and 8bit ID.
ID comparison condition
ID input format
ID reference values (a, b)
Data comparison condition
Data pattern

When the data comparison condition is Data = a; Data ≠ a; a ≤ Data; Data ≤ b; a ≤ Data ≤ b; or Data < a, b < Data



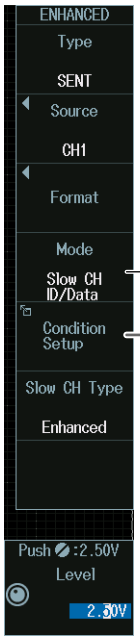
Set the ID and data message formats to 12bit data and 8bit ID.
ID and Data input formats
ID comparison condition
ID reference values (a, b)
Data comparison condition
Data reference values (a, b)

Setting ID/Data Reference Values a and b

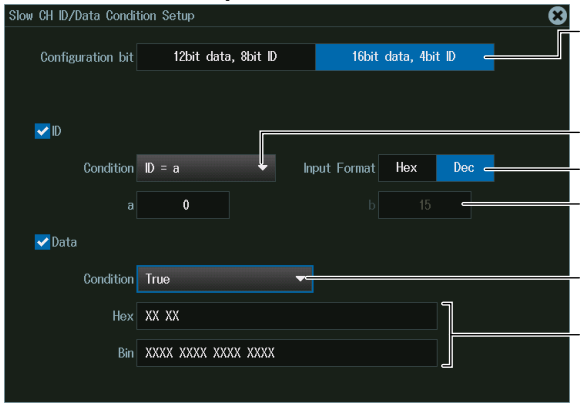
Input format setting		Hex	Dec
Selectable range for reference values a and b	ID	00 to FF	0 to 255
	Data	000 to FFF	0 to 4095

• When the ID and Data Message Formats Are Set to “16bit data, 4bit ID”

Set the trigger mode to Slow CH ID/Data.



When the data comparison condition is True or False



Set the ID and data message formats to 16bit data and 4bit ID.

ID comparison condition

ID input format

ID reference values (a, b)

Data comparison condition

Data pattern

When the data comparison condition is Data = a; Data ≠ a; a ≤ Data; Data ≤ b; a ≤ Data ≤ b; or Data < a, b < Data



Set the ID and data message formats to 16bit data and 4bit ID.

ID and Data input formats

ID comparison condition

ID reference values (a, b)

Data comparison condition

Data reference values (a, b)

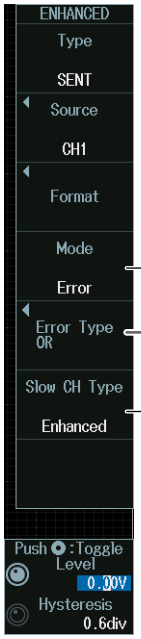
Setting ID/Data Reference Values a and b

Input format setting		Hex	Dec
Selectable range for reference values a and b	ID	0 to F	0 to 15
	Data	0000 to FFFF	0 to 65535

Error Mode

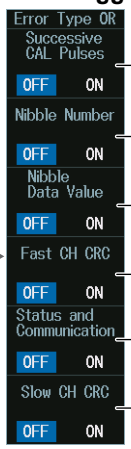
Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument triggers when it detects various types of errors.



Set the trigger mode to Error.

Error trigger conditions



Turns Successive CAL Pulses[1] error detection on or off
When there is a difference of 1/64 tick or more in the next or previous SYNC/CAL

Turns Nibble Number error detection on or off
When the number of nibbles in a single message does not match the specified value

Turns Nibble Data Value error detection on or off
When any of the Status and Communication, Data, and CRC tick counts is abnormal

Turns Fast CH CRC error detection on or off
When a Fast CH CRC error is detected

Turns Status and Communication[2] error detection on or off
Status and Communication bit 0 or bit 1 is 1

Turns Slow CH CRC error detection on or off
When a Slow CH CRC error is detected

1 Not selectable when Successive Calibration Pulses is set to OFF for Customize Error Factor in “Setting the Format (Format) (page 2-68)

2 Selectable when the Bit 0 or Bit 1 check box is selected under Status and Communication for Customize Error Factor in “Setting the Format (Format) (page 2-68)

Slow channel message type
(This is selectable when the format version is APR2016 or JAN2010.)

Level for Detecting Trigger Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu

When the trigger source is set to CH1 to CH8



Level for detecting trigger source states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

When the trigger source is LOGIC



Level for detecting trigger source states

2.19 Triggering on PSI5 Airbag Signals (Option)

This section explains the following settings for triggering on PSI5 Airbag signals:

- Trigger source (sync signal, data frame source)
  Bit rate, data length, error detection method, clock tolerance, HF rejection, sync signal noise rejection
- Time range of each slot
  Start position of each slot and the end position of the last slot
- Level and hysteresis for detecting trigger source states
- Trigger type
  Trigger conditions

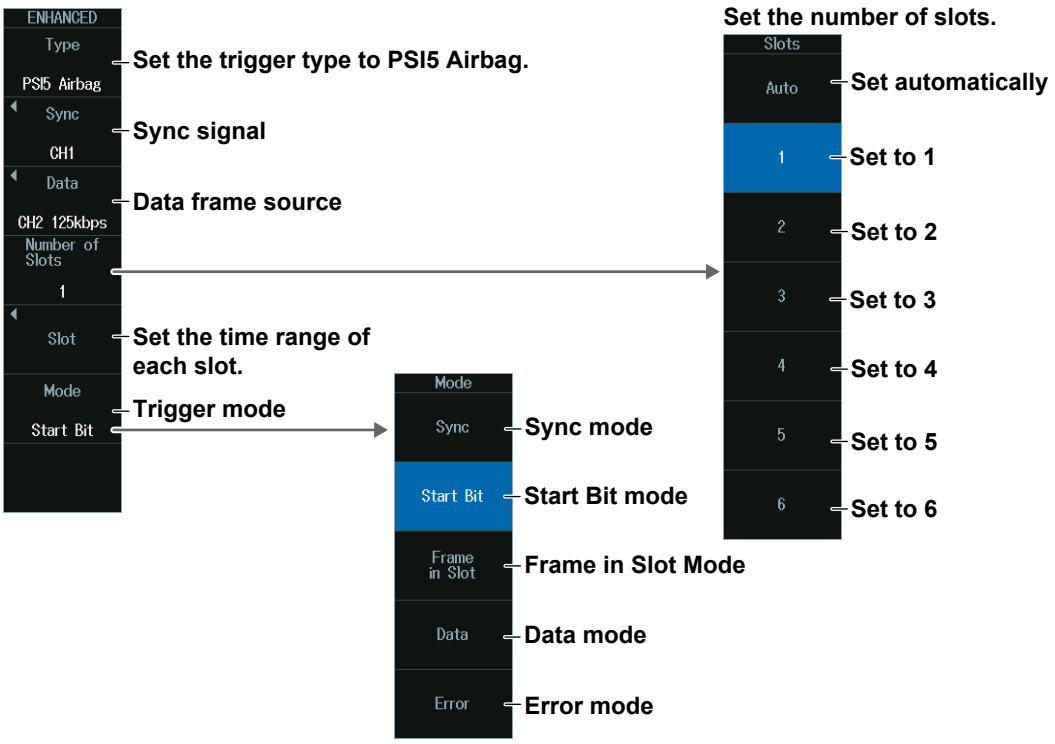
► **"PSI5 Airbag Trigger [ENHANCED, option]," "HF Rejection (HF Rejection)" in the Features Guide**

Auto Setup

The instrument can automatically set the bit rate, data length, error detection method, level, and hysteresis of the trigger source from the received PSI5 Airbag signal and trigger on them. For details, see section 12.7.

ENHANCED PSI5 Airbag Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **PSI5 Airbag** to display the following menu.



Sync Signal (Sync)

Press the **Sync** soft key. The following menu appears.



Set the sync signal to a channel from CH1 to CH8 or None.
When you set the sync signal to a channel from CH1 to CH4, the data frame sources also set to CH1 to CH4.
When you set the sync signal to a channel from CH5 to CH8, the data frame sources also set to CH5 to CH8.

HF rejection
Not displayed when the sync signal is set to None

Level for detecting sync signal states

Hysteresis

Note

The available sync signals vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

Level for Detecting Sync Signal States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



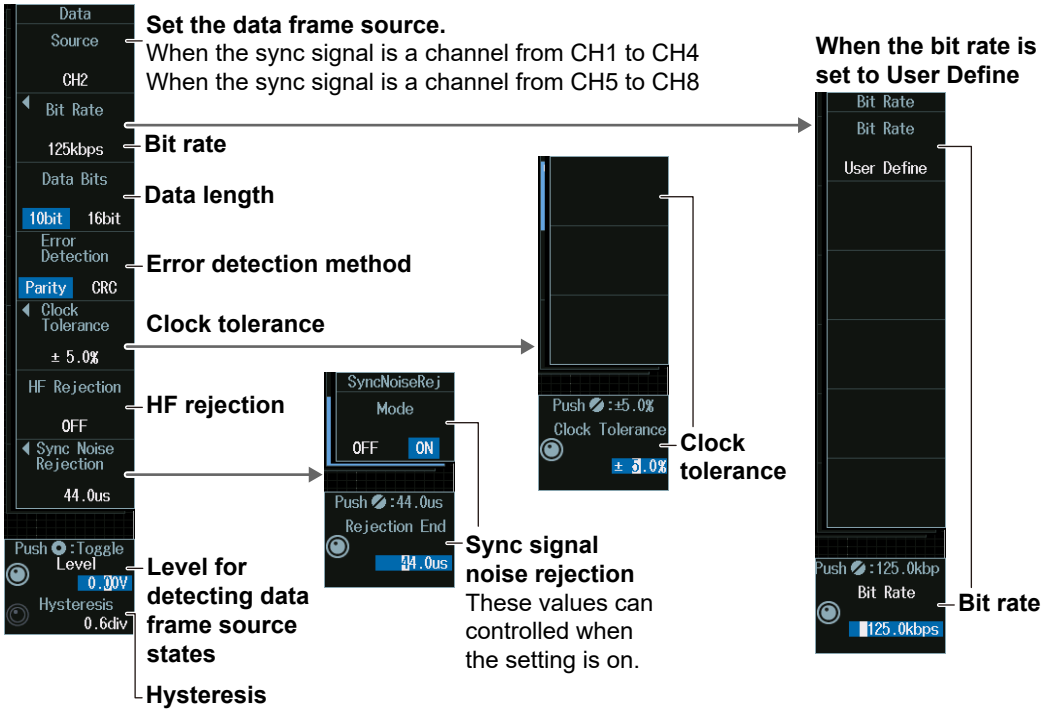
Level for detecting sync signal states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Data Frame Source (Data)

Press the **Data** soft key to display the following menu.



Level for Detecting Data Frame Source States (LEVEL, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Press SET (upper right on the front panel) to switch between level and hysteresis.

Clock Tolerance (Clock Tolerance)

1. Press the **Clock Tolerance** soft key.
2. Turn the **jog shuttle** to set the clock tolerance.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

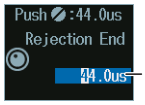
Jog shuttle setting menu



Sync Noise Rejection End (Rejection End)

1. Press the **Sync Noise Rejection** soft key.
2. Turn the **jog shuttle** to set the time period to the end of noise rejection.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

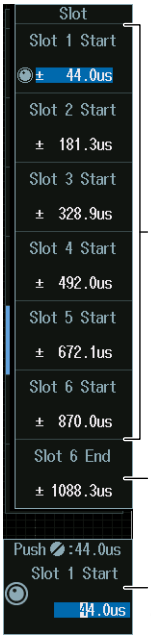


Sync noise rejection end

Setting the Time Range of Each Slot (Slot)

Press the **Slot** soft key to display the following menu.

Example when the number of slots is set to 6



Select the slot for setting the start position.

Select the last slot for setting the end position.

Set the start position of each slot and the end position of the last slot.

Set the start position (Start) of each slot and the end position (End) of the last slot.

1. Press any of the **Slot 1 Start** to **Slot 6** or **Slot End** soft key.
2. Turn the **jog shuttle** to set the start (Start) or end (End) position.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Set Slot Start and Slot End.

Note

- The slot start position that can be set varies depending on the number of slots (Number of Slots), which specifies the trigger source frame pattern.
- The slot end position that can be set is the largest number specified by Number of Slots.

Trigger Mode (Mode)

Sync Mode

Press the **Mode** soft key and then the **Sync** soft key to display the following menu.

The instrument triggers on the rising edge of sync pulses.



Set the trigger mode to Sync.

Start Bit Mode

Press the **Mode** soft key and then the **Start Bit** soft key to display the following menu.

The instrument triggers on start bits.

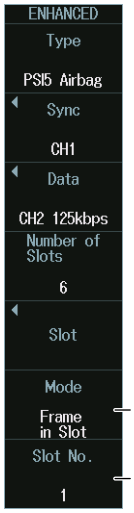


Set the trigger mode to Start Bit.

Frame in Slot Mode

Press the **Mode** soft key and then the **Frame in Slot** soft key to display the following menu.

The instrument triggers on data frames included in the selected slot. Frame in Slot mode will not be available if the sync signal (Sync) is set to None.



Set the trigger mode to Frame in Slot.

Set the slot number for specifying the trigger source frame pattern.

- 1 to N (the number of slots) when the number of slots* on the Setup menu is set to a number from 1 to 6
- 1 to 6 when the number of slots on the Setup menu is set to Auto

Data Mode

1. Press the **Mode** soft key and then the **Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers on data frames included in the selected slot.



Set the trigger mode to Data.

When the data comparison condition is True or False



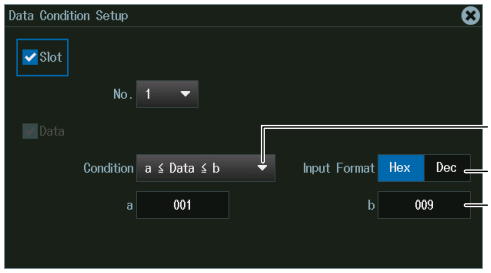
Trigger source slot number

Data (always selected)

Data comparison condition

Data pattern

When the data frame condition is Data = a; Data ≠ a; a ≤ Data; Data ≤ b; a ≤ Data ≤ b; or Data < a, b < Data



Data comparison condition

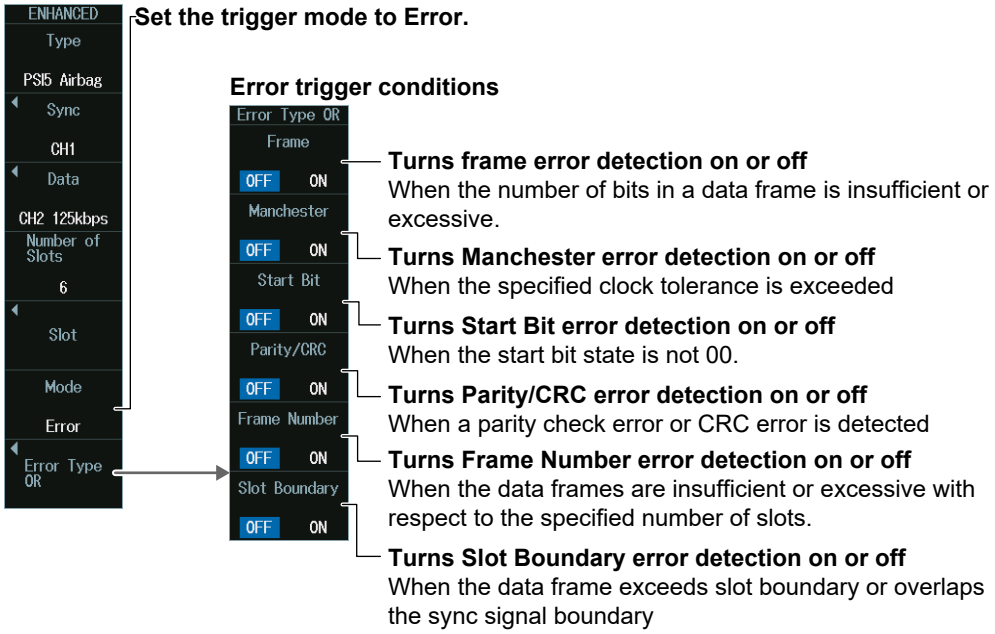
Data input format

Reference Values (a and b)

Error Mode

Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument triggers when it detects various types of errors.



2.20 Triggering on UART Signals (Option)

This section explains the following settings for triggering on UART signals:

- Trigger source
  Bit rate, bit order, polarity, HF rejection, source bit, sample point
- Format
- Level and hysteresis for detecting trigger source states
- Trigger type
  Trigger conditions

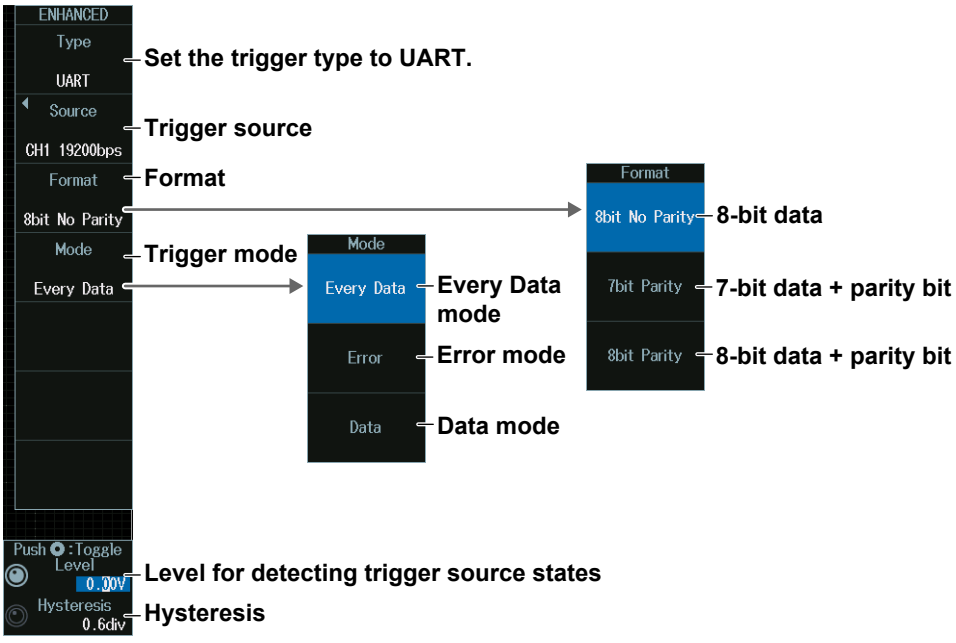
► “UART Trigger [ENHANCED, option],” “HF Rejection (HF Rejection)” in the Features Guide

Auto Setup

The instrument can automatically set the trigger source level and bit rate from the received UART signal and trigger on them. For details, see section 12.8.

ENHANCED UART Menu

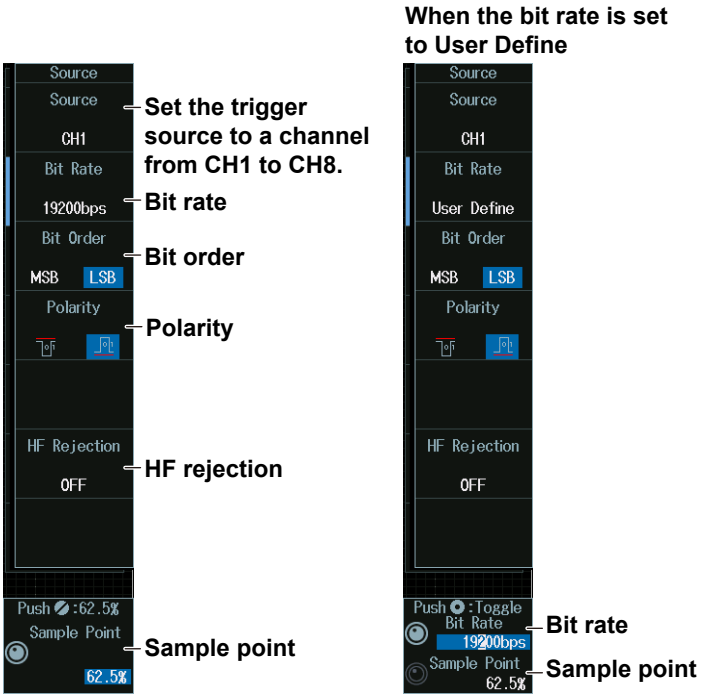
1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **UART** to display the following menu.



Trigger Source (Source)

Press the **Source** soft key to display the following menu..

When the Trigger Source Is a Channel from CH1 to CH8

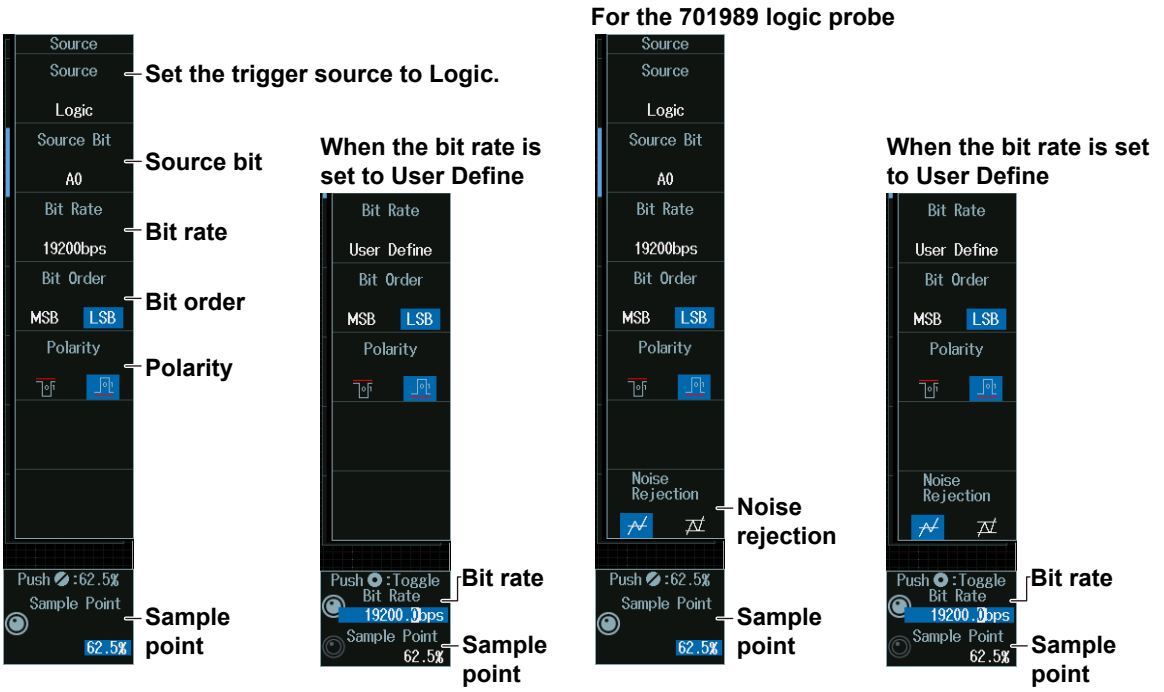


Note

The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Trigger Source Is Logic



Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

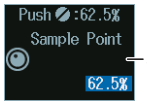
Sample Point (Sample Point) and Bit Rate (Bit Rate)

When the bit rate is not set to User Define

Turn the **jog shuttle** to set the bit rate and sample point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up list that appears on the screen.

Jog shuttle setting menu

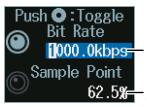


When the bit rate is set to User Define

Turn the **jog shuttle** to set the sample point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up list that appears on the screen.

Jog shuttle setting menu



Press SET (upper right on the front panel) to switch between bit rate and sample point.

Trigger Mode (Mode)

Every Data mode

Press the **Mode** soft key and then the **Every Data** soft key to display the following menu.

The instrument triggers on all data.

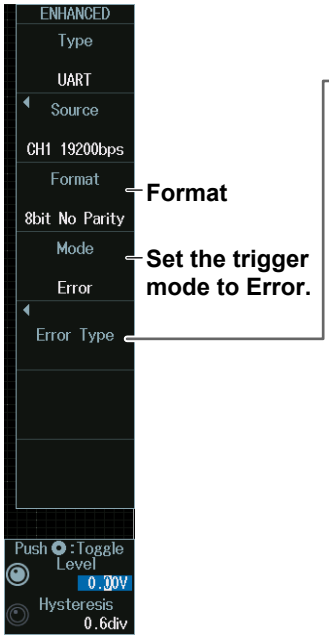


Set the trigger mode to Every Data.

Error Mode

Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument triggers when it detects various types of errors.

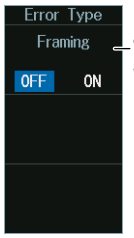


Format

Set the trigger mode to Error.

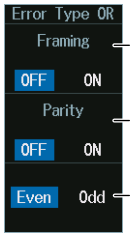
Error trigger conditions

When the format is 8bit No Parity



Turns framing error detection on or off
When the logical value of the stop bit is 0

When the format is 7bit Parity or 8bit Parity



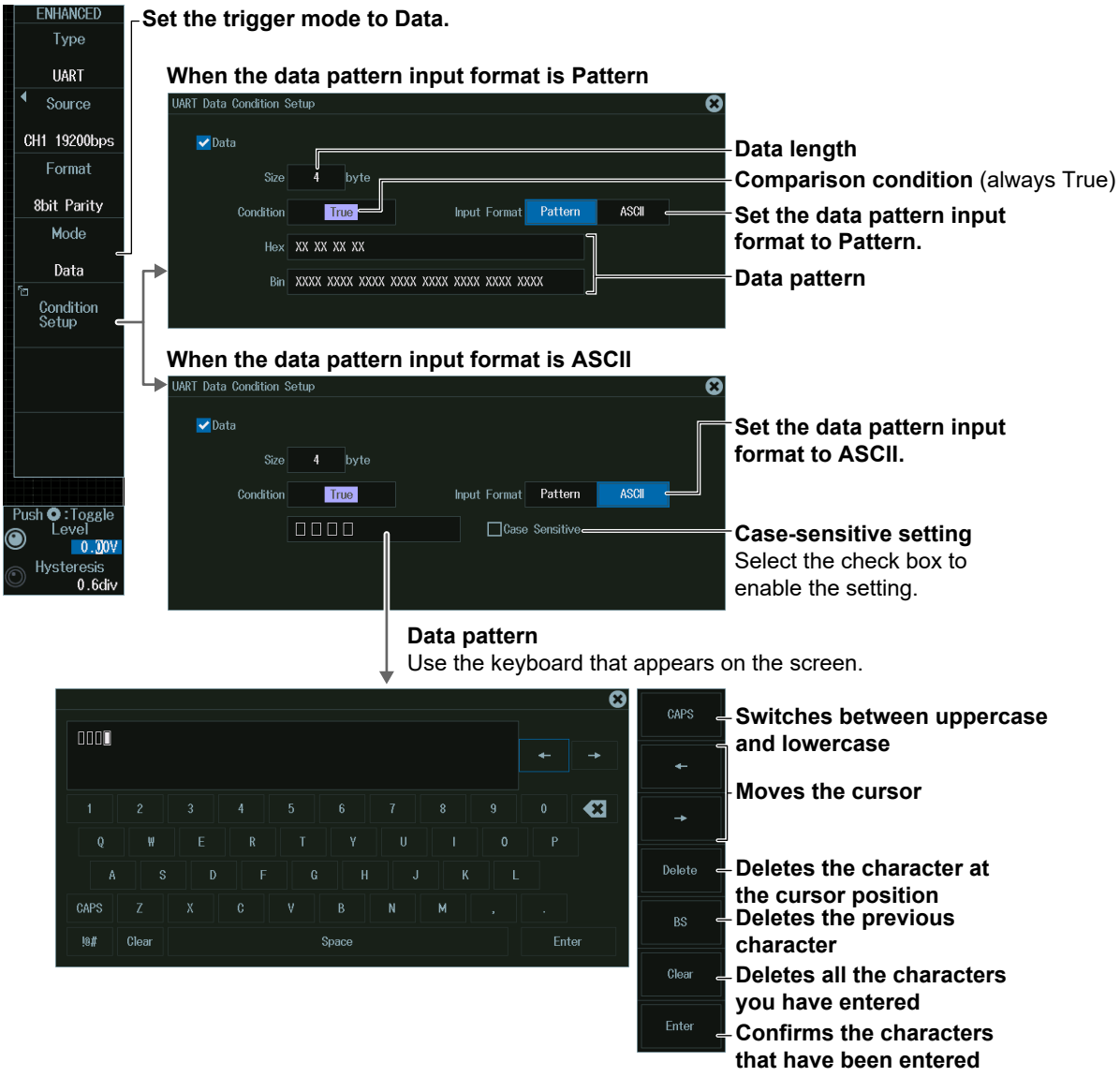
Turns framing error detection on or off
When the logical value of the stop bit is 0

Turns parity error detection on or off
When a parity error is detected in the received character

Specify whether to perform even or odd parity checks when parity error detection is on.

Data Mode

1. Press the **Mode** soft key and then the **Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers when the data pattern is matched.



Data Pattern

You can enter up to 4 characters.

- You can switch between uppercase and lowercase to enter alphabet characters. However, case is distinguished only when the Case Sensitive check box is selected.
- The special characters CR, LF, SP, and NUL are shown in single quotation marks. These special characters are counted as one character including the single quotation marks. Example: AB'CR'D (four characters), XY'SP' (three characters), P'NUL'WU (four characters)
- The entered string, including the character codes for the case, is retained even if the input format is changed to Bin or Hex. It is also retained when the format is changed from Bin or Hex to ASCII.
- If a character code that does not exist on the keyboard is entered when the input format is Bin or Hex and then the input format is changed to ASCII, a white square is displayed in the corresponding position.

Level for Detecting Trigger Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu

When the trigger source is set to CH1 to CH8



Level for detecting trigger source states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

When the trigger source is LOGIC



Level for detecting trigger source states

2.21 Triggering on I²C Bus Signals (Option)

This section explains the following settings for triggering on I²C bus signals:

- SCL source and SDA source
  HF rejection, source bit, level and hysteresis for detecting SCL and SDA source states
- Trigger type
  Trigger conditions

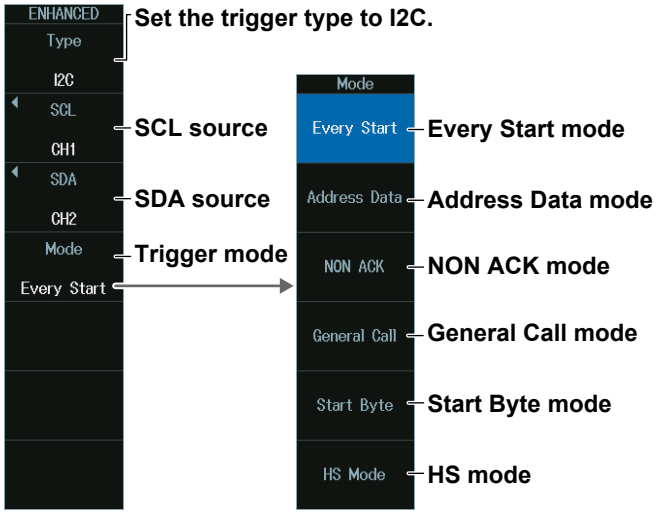
► "I²C Bus Trigger [ENHANCED, option]," "HF Rejection (HF Rejection)" in the Features Guide

Auto Setup

The instrument can automatically set the trigger source level from the received I²C bus signal and trigger on it. For details, see section 12.9.

ENHANCED I2C Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **I2C** to display the following menu.



SCL Source (SCL), SDA Source (SDA)

Press the **SCL** or **SDA** soft key. The menu that appears varies depending on the specified source.

When the SCL Source or SDA Source Is a Channel from CH1 to CH8

SCL



Set the SCL source to a channel from1 to CH8.

HF rejection

Level for detecting SCL source states

Hysteresis

SDA



Set the SDA source.

- When the SCL source is a channel from CH1 to CH4 (CH1 to CH4)
- When the SCL source is a channel from CH5 to CH8 (CH5 to CH8)

HF rejection

Level for detecting SDA source states

Hysteresis

Note

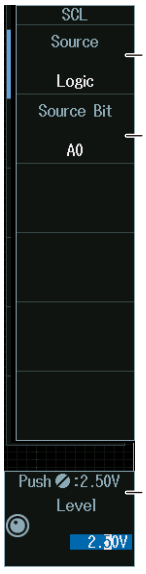
The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the SCL Source Is Logic

When the SCL source is set to Logic, the SDA source is fixed to Logic.

SCL source

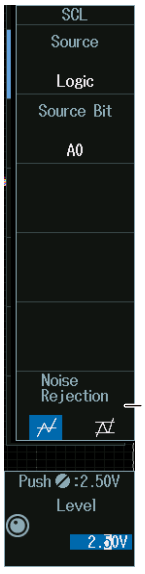


Set the SCL source to Logic.

Source bit

Level for detecting SCL source states

SCL source
For the 701989 Logic Probe



Noise rejection

SDA Source



Cannot be used

Level for detecting SCL source states

SDA Source
For the 701989 Logic Probe



Noise rejection

Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Level for Detecting SCL and SDA Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu

When the SCL or SDA source is set to CH1 to CH8



Level used to detect SCL or SDA source states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

When the SCL or SDA source is Logic



Level used to detect SCL or SDA source states

Trigger Mode (Mode)

Every Start Mode

Press the **Mode** soft key and then the **Every Start** soft key to display the following menu.

The instrument triggers when it detects a start condition.

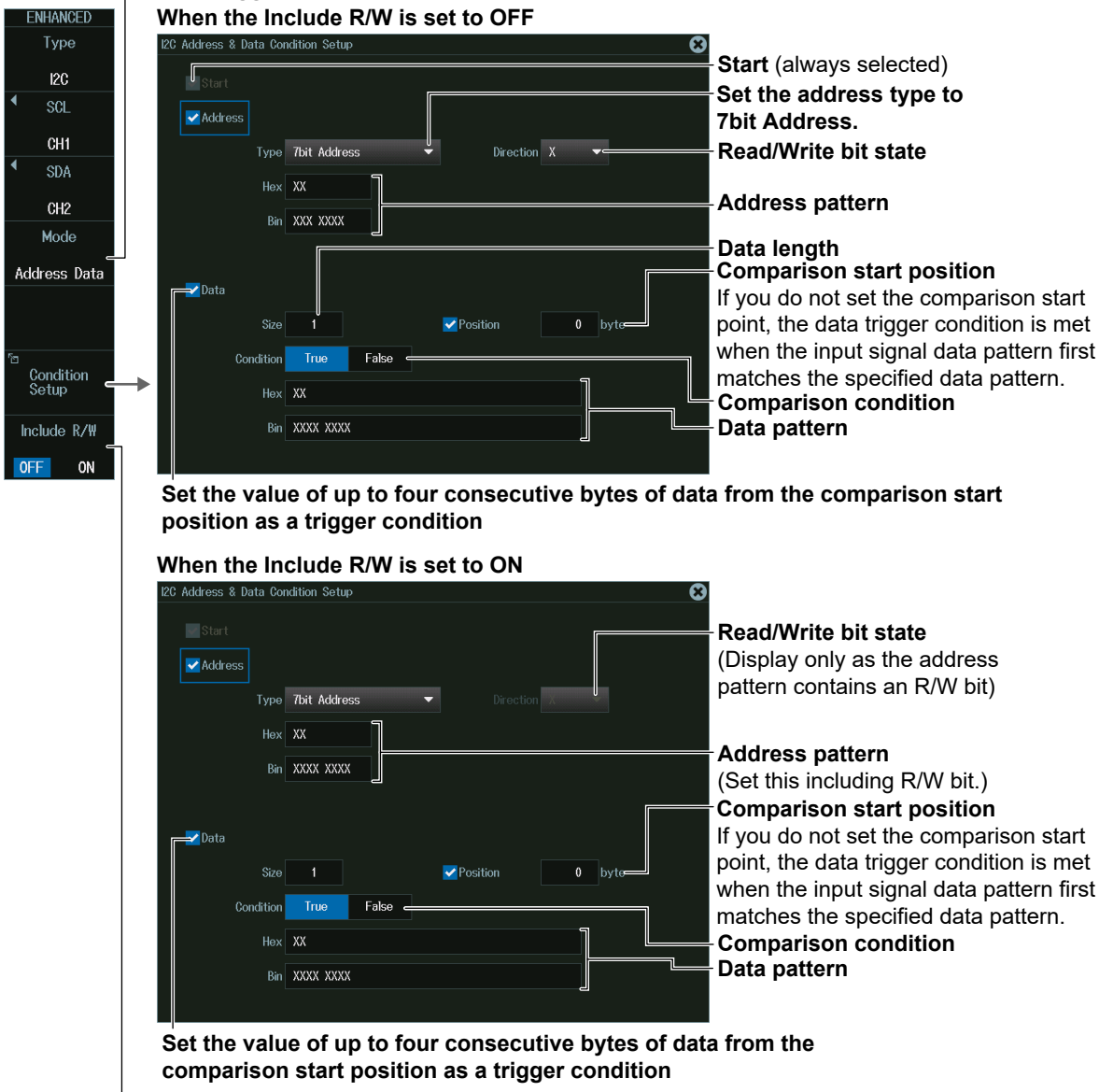


Set the trigger mode to Every Start.

Address Data mode

1. Press the **Mode** soft key and then the **Address Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument triggers on the AND of the start, address pattern, data pattern, and comparison start position conditions. Items whose check boxes are selected are used as trigger conditions.

- **When Address Type Is 7bit Address**



Set the trigger mode to AddressData.

When the Include R/W is set to OFF

Start (always selected)

Set the address type to 7bit Address.

Read/Write bit state

Address pattern

Data length

Comparison start position

If you do not set the comparison start point, the data trigger condition is met when the input signal data pattern first matches the specified data pattern.

Comparison condition

Data pattern

Set the value of up to four consecutive bytes of data from the comparison start position as a trigger condition

When the Include R/W is set to ON

Read/Write bit state

(Display only as the address pattern contains an R/W bit)

Address pattern

(Set this including R/W bit.)

Comparison start position

If you do not set the comparison start point, the data trigger condition is met when the input signal data pattern first matches the specified data pattern.

Comparison condition

Data pattern

Set the value of up to four consecutive bytes of data from the comparison start position as a trigger condition

Whether to include the R/W bit

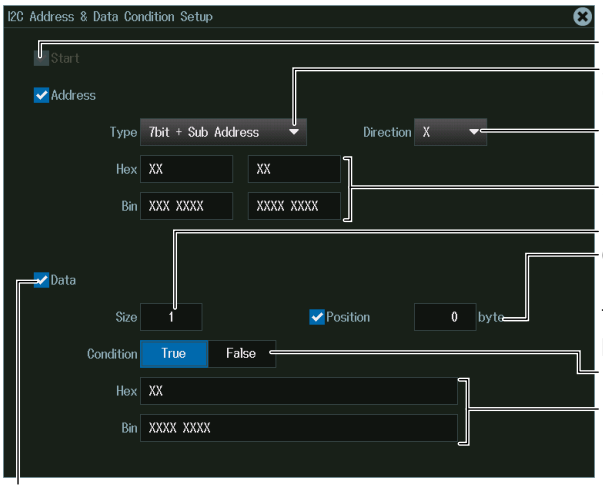
Specify whether to include the R/W bit (ON) or omit it (OFF) when setting the address pattern.

Note

R/W bit inclusion (Include R/W) can also be set by using Analyzing and Searching I2C Bus Signals and then Bus Setup (Setup). Settings are synchronized. For details on I2C bus signal analysis, see section 12.9.

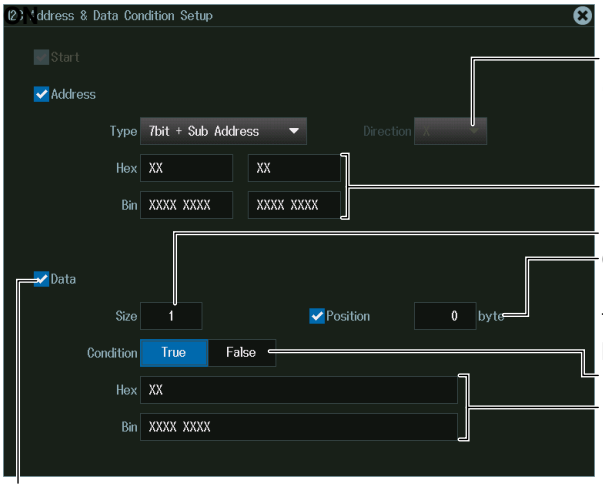
- **When Address Type Is 7bit+Sub Address**

When the Include R/W is set to OFF



Start (always selected)
Set the address type to 7bit + Sub Address.
Read/Write bit state
Address pattern
Data length
Comparison start position
If you do not set the comparison start point, the data trigger condition is met when the input signal data pattern first matches the specified data pattern.
Comparison condition
Data pattern
Set the value of up to four consecutive bytes of data from the comparison start position as a trigger condition

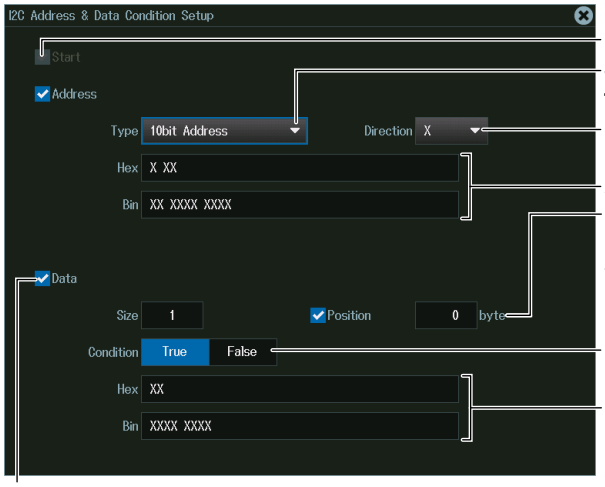
When the Include R/W is set to



Read/Write bit state
(Display only as the address pattern contains an R/W bit)
Address pattern
(Set this including R/W bit.)
Data length
Comparison start position
If you do not set the comparison start point, the data trigger condition is met when the input signal data pattern first matches the specified data pattern.
Comparison condition
Data pattern
Set the value of up to four consecutive bytes of data from the comparison start position as a trigger condition

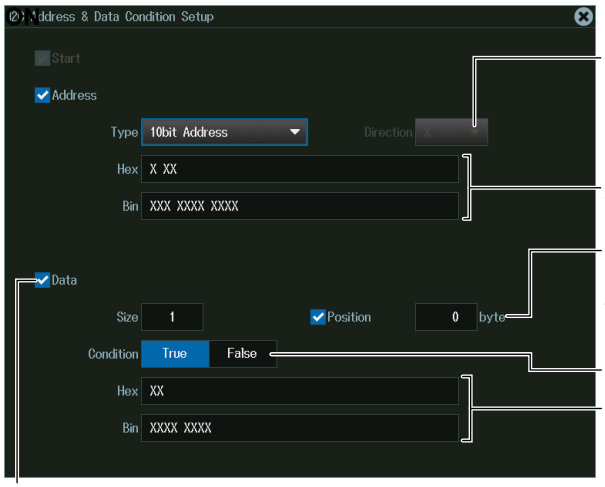
- **When Address Type Is 10bit Address**

When the Include R/W is set to OFF



Start (always selected)
Set the address type to 10bit Address.
Read/Write bit state
Address pattern
Comparison start position
If you do not set the comparison start point, the data trigger condition is met when the input signal data pattern first matches the specified data pattern.
Comparison condition
Data pattern
Set the value of up to four consecutive bytes of data from the comparison start position as a trigger condition

When the Include R/W is set to

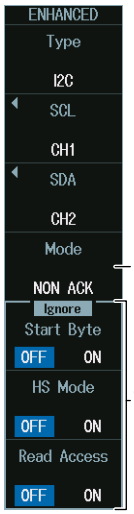


Read/Write bit state
(Display only as the address pattern contains an R/W bit)
Address pattern
(Set this including R/W bit.)
Comparison start position
If you do not set the comparison start point, the data trigger condition is met when the input signal data pattern first matches the specified data pattern.
Comparison condition
Data pattern
Set the value of up to four consecutive bytes of data from the comparison start position as a trigger condition

NON ACK Mode

Press the **Mode** soft key and then the **NON ACK** soft key. The following menu appears.

The instrument triggers when the acknowledgment bit is Nack.

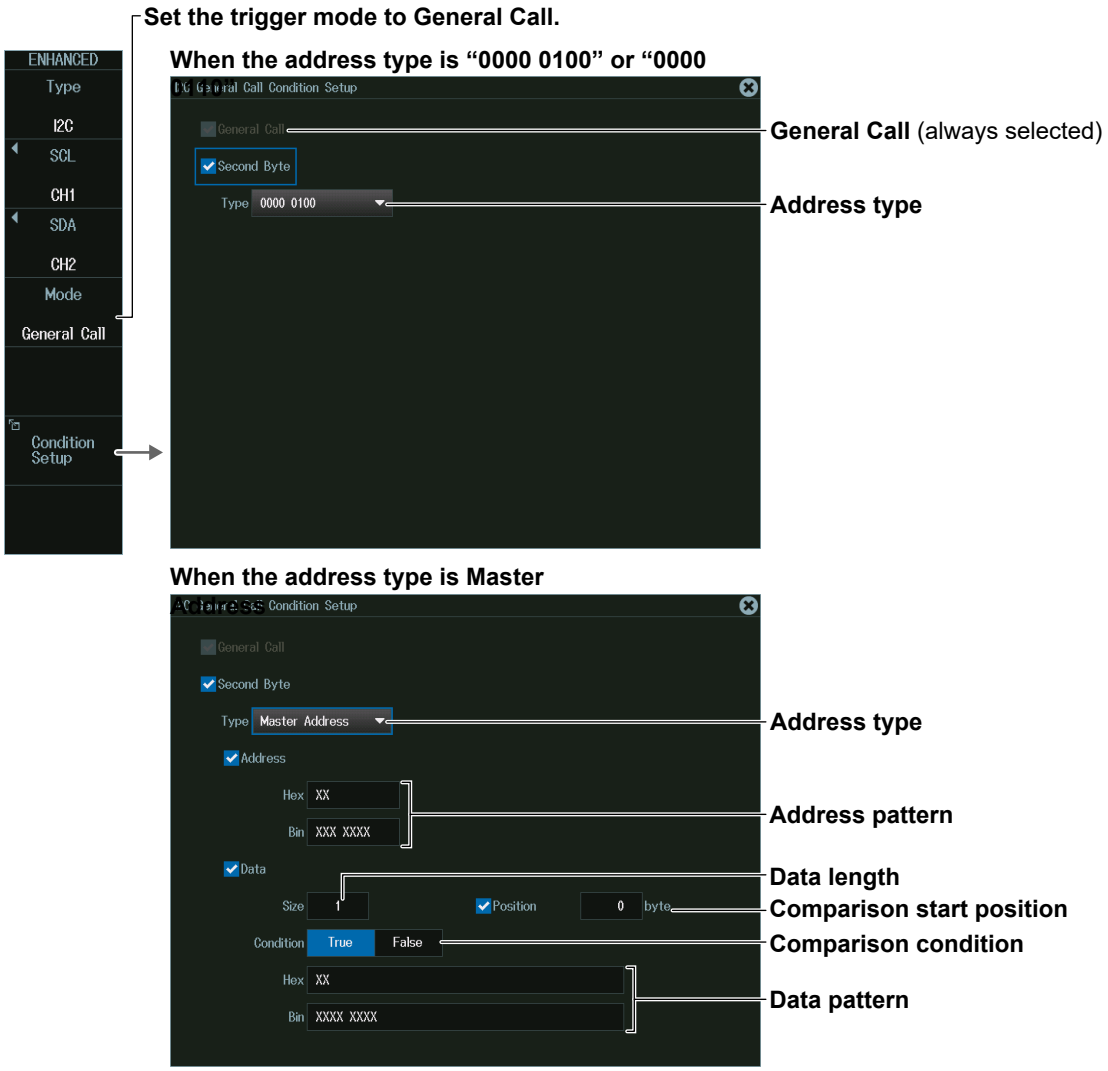


Set the trigger mode to NON ACK.

Whether to make the acknowledge bit of each signal a trigger source
- Start byte
- HS mode master code
- Read access byte

General Call Mode

1. Press the **Mode** soft key and then the **General Call** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   When Second Byte is set to Master Address, the instrument triggers on the AND of the general call address (0000 0000), second byte address pattern, data pattern, and comparison start position conditions.
   Otherwise, the instrument triggers on the AND of general call address (0000 0000) and Second Byte address pattern conditions. Items whose check boxes are selected are used as trigger conditions.



Start Byte Mode

Press the **Mode** soft key and then the **Start Byte** soft key to display the following menu.

The instrument triggers when it detects the start byte master code.



Set the trigger mode to Start Byte.

HS mode

Press the **Mode** soft key and then the **HS Mode** soft key to display the following menu.

The instrument triggers when it detects a high speed mode master code.



Set the trigger mode to HS Mode.

2.22 Triggering on SPI Bus Signals (Option)

This section explains the following settings for triggering on SPI bus signals:

- Wiring system (Mode)
- Clock source
  Polarity, HF rejection, source bit, level and hysteresis for detecting clock source edges
- Data source
  HF rejection, source bit, level and hysteresis for detecting data source states
- Chip select source
  Active state, source bit, level and hysteresis for detecting chip select source states
- Trigger conditions

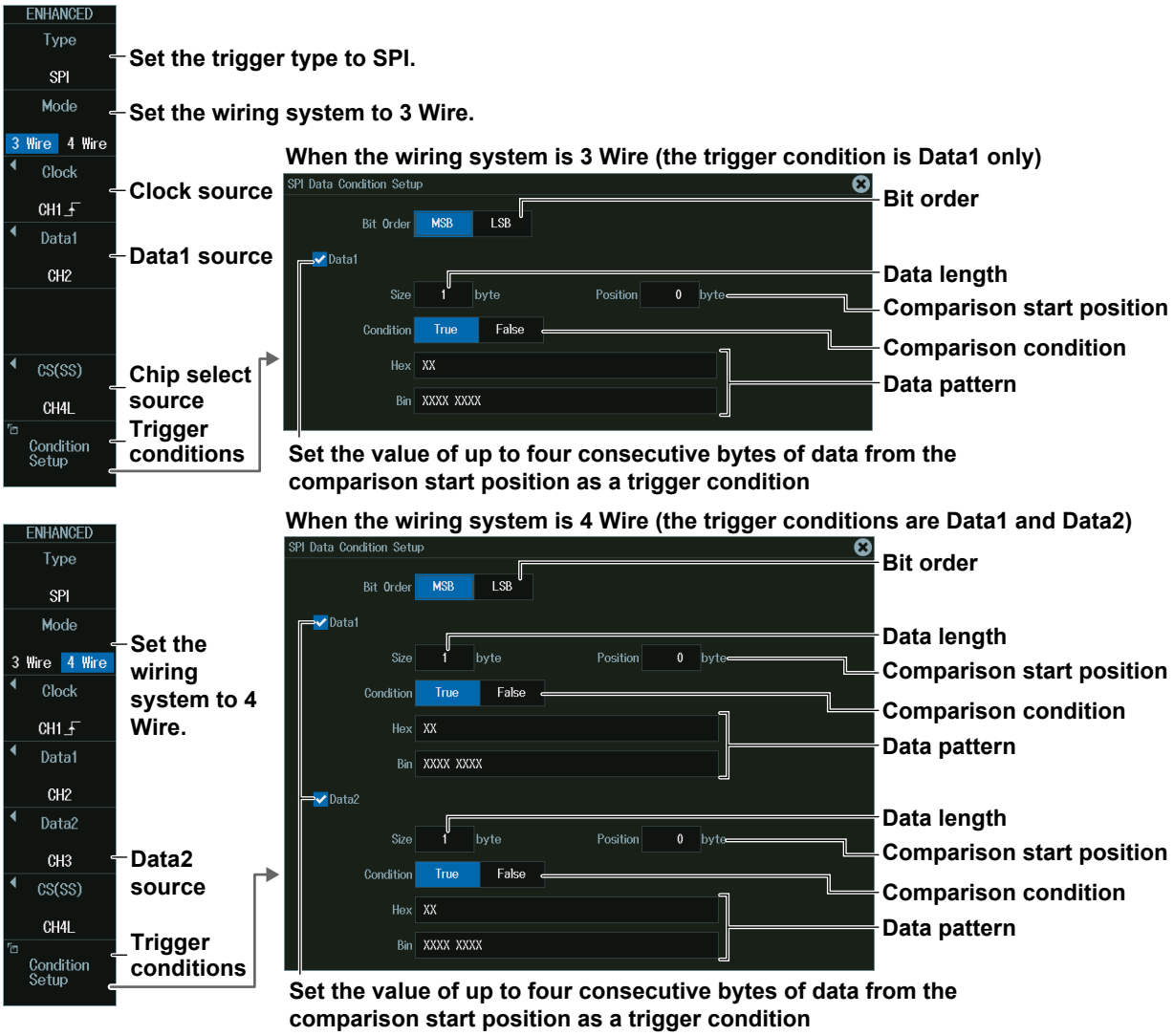
► “SPI Bus Trigger [ENHANCED, option],” “HF Rejection (HF Rejection)” in the Features Guide

Auto Setup

The instrument can automatically set the source level from the received SPI bus signal and trigger on it. For details, see section 12.10.

ENHANCED SPI Menu

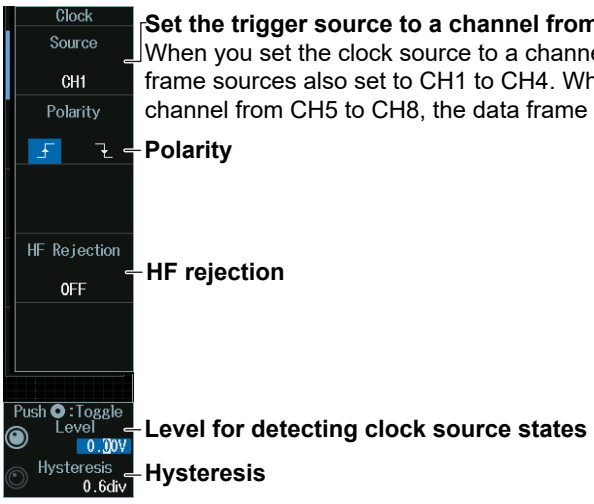
1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **SPI**



Clock Source (Clock)

Press the **Clock** soft key. The menu that appears varies depending on the specified clock source.

When the Clock Source Is a Channel from CH1 to CH8



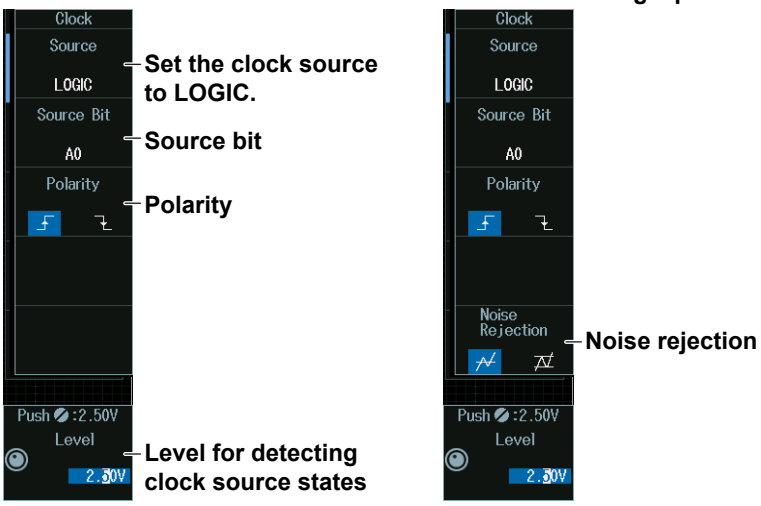
Note

The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Clock Source Is LOGIC

For the 701989 logic probe



Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

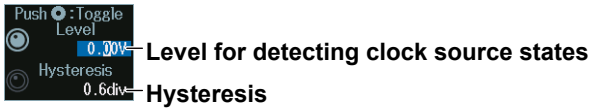
Level for Detecting Clock Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

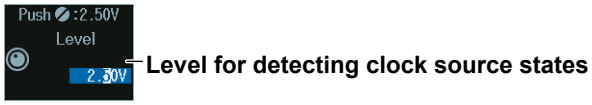
Jog shuttle setting menu

When the clock source is set to CH1 to CH8



Press SET (upper right on the front panel) to switch between level and hysteresis.

When the clock source is Logic

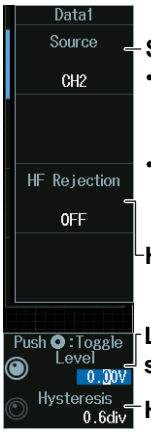


Data 1 Source (Data1), Data 2 Source (Data2)

Press the **Data1** or **Data2** soft key. The menu that appears varies depending on the specified data source. This section gives an explanation of the settings when the wiring system is 4 Wire. If the wire system is set to 3 Wire, there will be no data 2 source (Data2) menu.

When the Clock Source Is a Channel from CH1 to CH8 (for 4 Wire)

Data1 source



Set the Data 1 source.
- When the clock source is a channel from CH1 to CH4, set the source to CH1 to CH4.
- When the clock source is a channel from CH5 to CH8, set the source to CH5 to CH8.

HF rejection

Level for detecting data 1 source states

Hysteresis

Data2 source



Set the Data 2 source.
- When the clock source is a channel from CH1 to CH4, set the source to CH1 to CH4.
- When the clock source is a channel from CH5 to CH8, set the source to CH5 to CH8.

HF rejection

Level for detecting data 2 source states

Hysteresis

Note

The available data source settings vary depending on the model.
- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Clock Source Is Logic (for 4 Wire)

When the clock source is set to Logic, data 1 source and data 2 source are fixed to Logic.

Data1 source

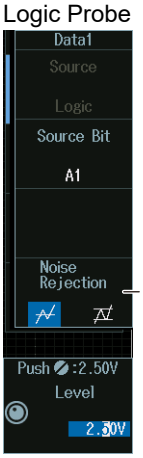


Cannot be used

Source bit

Level for detecting data 1 source states

Data1 source
For the 701989 Logic Probe



Noise rejection

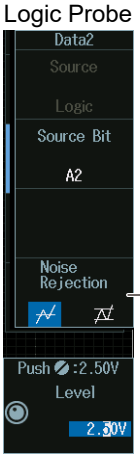
Data2 source



Cannot be used

Level for detecting data 2 source states

Data2 source
For the 701989 Logic Probe



Noise rejection

Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Level for Detecting Data 1 Source and Data 2 Source States (LEVEL, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu

When the data source is set to CH1 to CH8



Level for detecting data source states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

When the data source is Logic



Level for detecting data source states

Chip Select Source (CS (SS))

Press the **CS (SS)** soft key. The menu that appears varies depending on the specified chip select source.

When the Clock Source Is a Channel from CH1 to CH8



Set the chip select source.

- When the clock source is a channel from CH1 to CH4, set the source to CH1 to CH4.
- When the clock source is a channel from CH5 to CH8, set the source to CH5 to CH8.

Active state

HF rejection

Level for detecting chip select source states.

Hysteresis

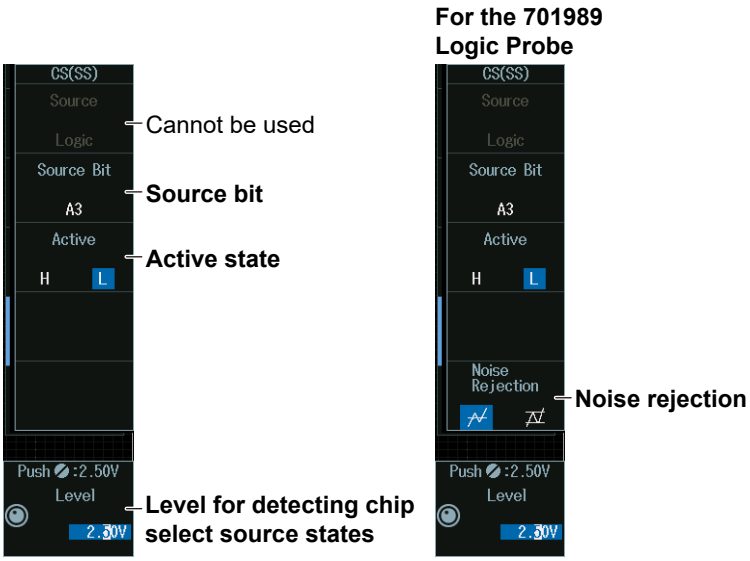
Note

The available data source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

When the Clock Source Is Logic

When the clock source is set to Logic, the chip select source is fixed to Logic.



Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Level for Detecting Chip Select Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu

When the chip select source is a channel from CH1 to CH8



Level for detecting chip select source states.

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

When the chip select source is Logic



Level for detecting chip select source states.

2.23 Triggering On User-Defined Serial Bus Signals

This section explains the following settings for triggering on user-defined serial bus signals:

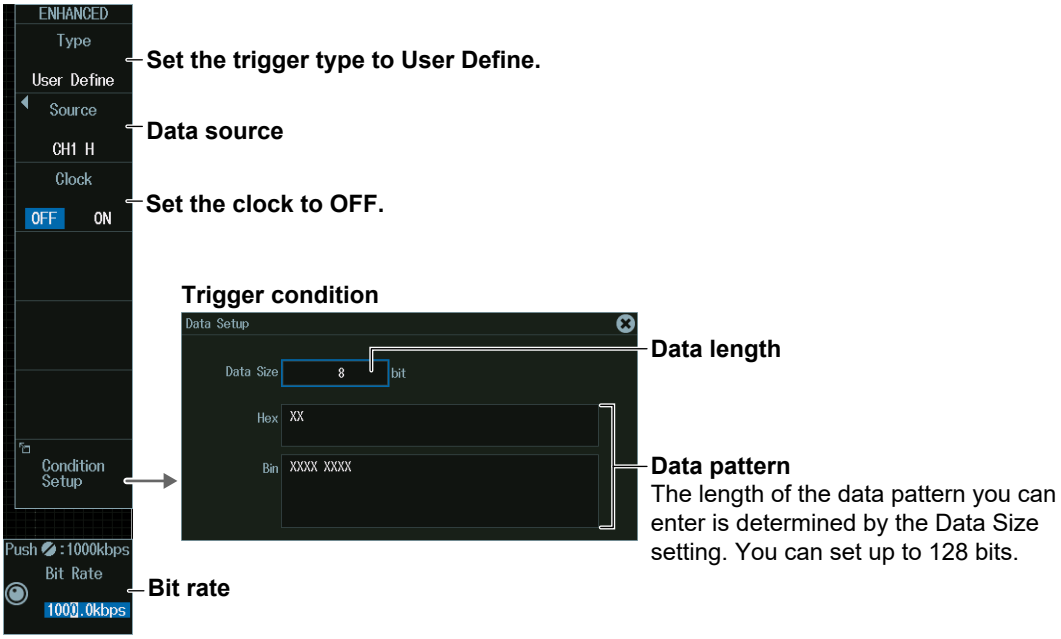
- Bit rate
- Data source
  Data source state, HF rejection, level and hysteresis for detecting data source states
- Turning the clock on and off
  - Clock source
    HF rejection, level and hysteresis for detecting clock source states
  - Enable source
    HF rejection, level and hysteresis for detecting enable source states
  - Latch source
    HF rejection, level and hysteresis for detecting latch source states
- Trigger conditions

► **"User-Defined Serial Bus Trigger [User Define, ENHANCED],"
"HF Rejection (HF Rejection)"
in the Features Guide**

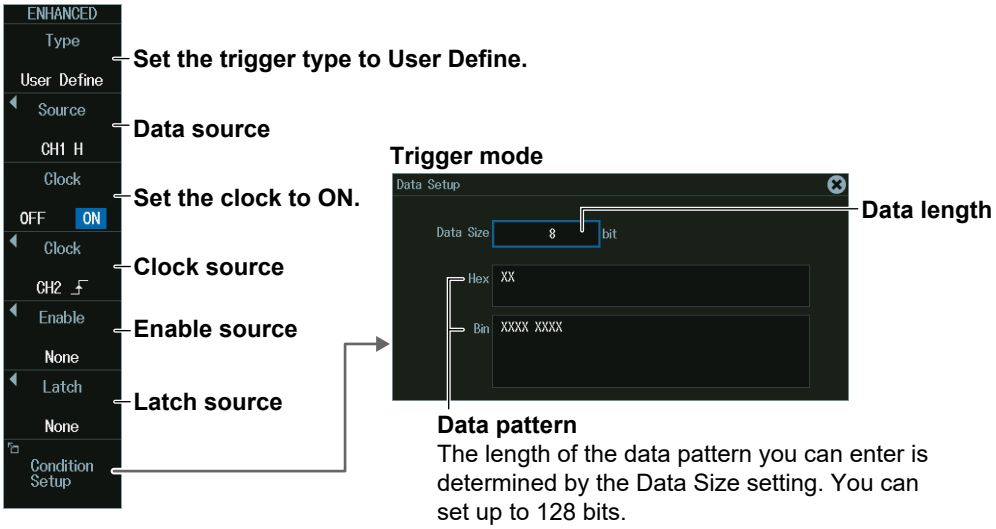
ENHANCED User Define Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **User Define** to display the following menu.

Serial Bus without a Clock



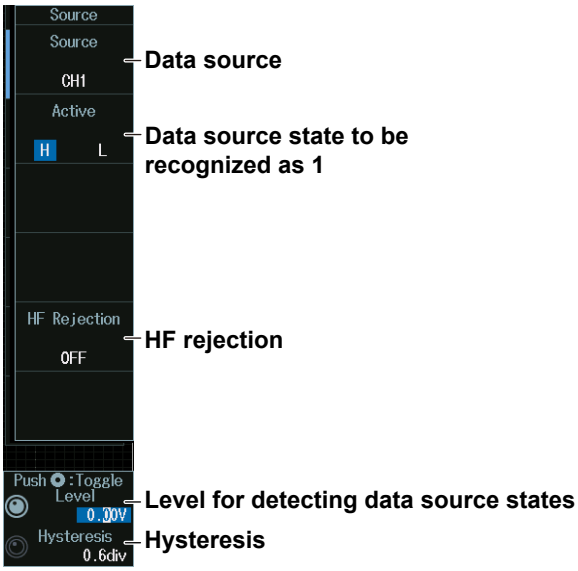
Serial Bus with a Clock



Data Source (Source)

Press the **Source** soft key to display the following menu.

Set the data source to compare with the pattern specified as a trigger condition.



Note

The available trigger source settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8
- The available settings on 4ch models are as follows:
  CH1 to CH4

Level for Detecting Data Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting data source states

Hysteresis

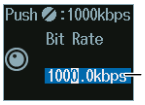
Press SET (upper right on the front panel) to switch between level and hysteresis.

Bit Rate (serial bus without a clock)

The instrument samples according to the bit rate.

1. Press the **Clock** soft key to select OFF.
2. Turn the **jog shuttle** to set the bit rate at which to sample the data source.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

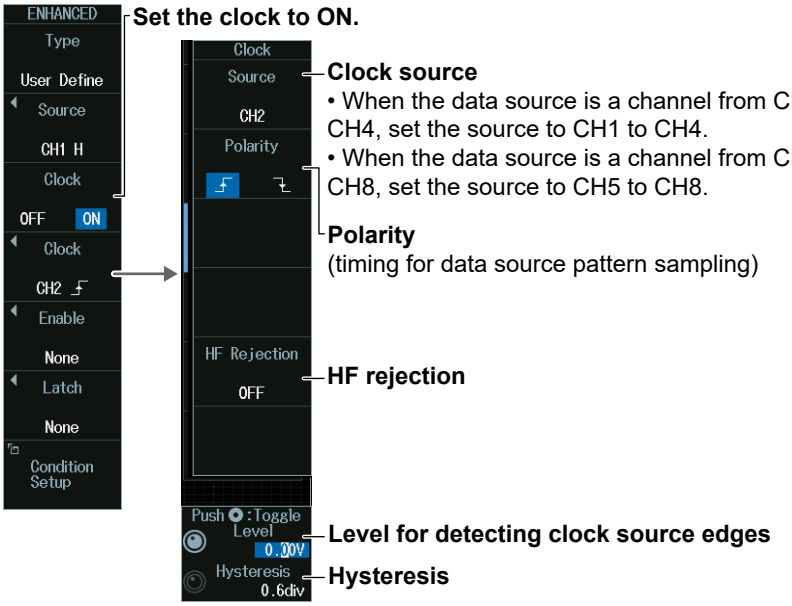


Bit rate

Clock Source (serial bus with a clock)

The instrument samples in sync with the clock source.

1. Press the **Clock** soft key to select ON.
2. Press the **Clock** soft key to display the following menu.
   Specify which clock source edge causes the data source to be sampled.



Set the clock to ON.

Clock source
• When the data source is a channel from CH1 to CH4, set the source to CH1 to CH4.
• When the data source is a channel from CH5 to CH8, set the source to CH5 to CH8.

Polarity
(timing for data source pattern sampling)

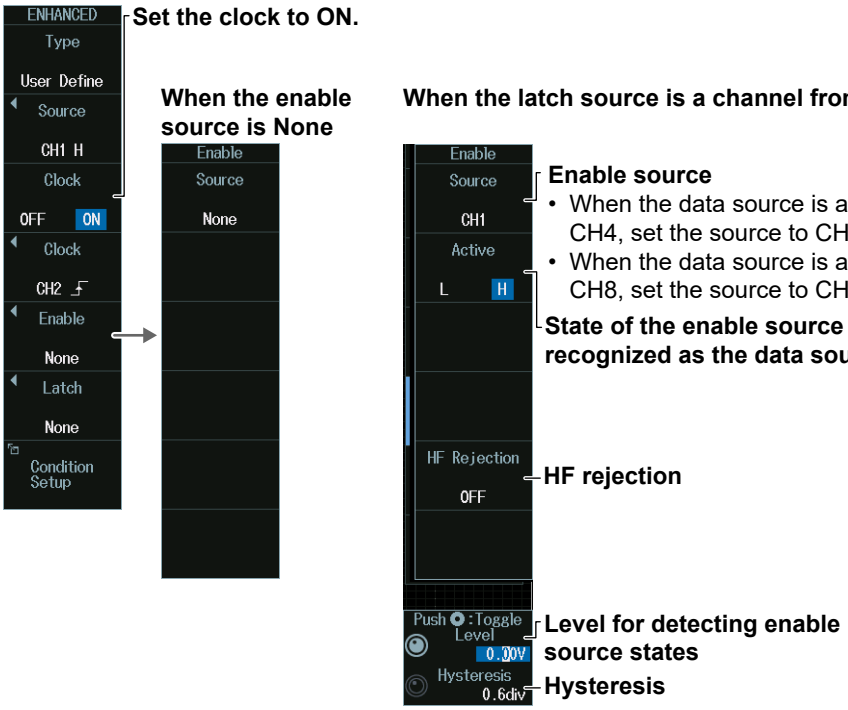
HF rejection

Level for detecting clock source edges

Hysteresis

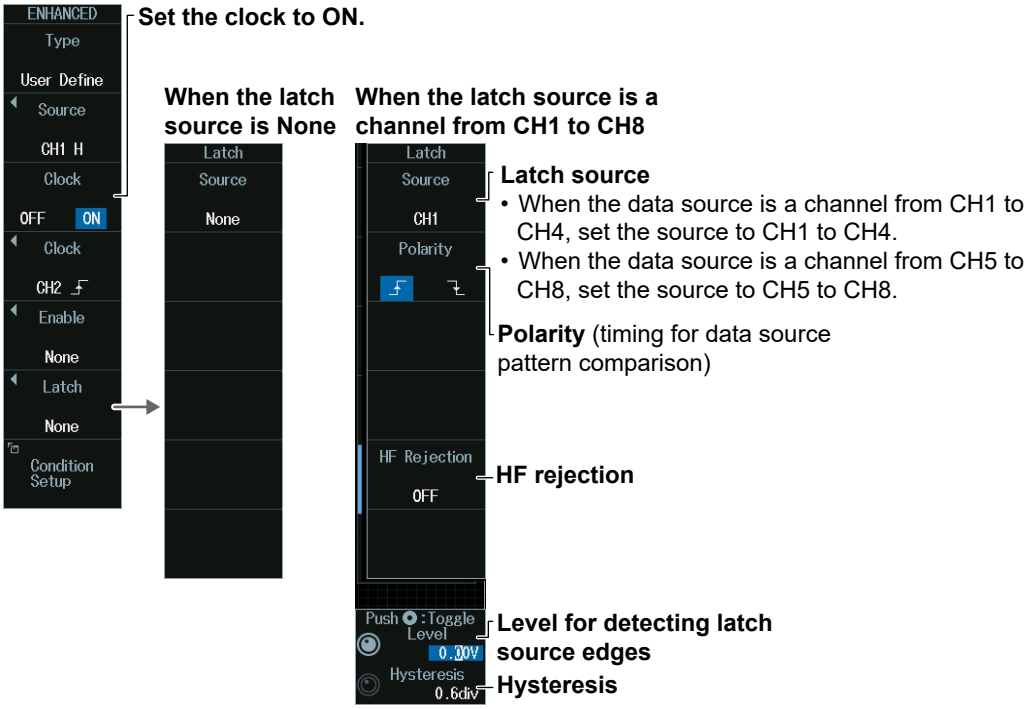
- **Setting the Enable Source**

3. Press the **Enable** soft key to display the following menu.
When the data source is sampled in sync with the clock source, the period for which the instrument tests the data source can be controlled using the enable source.



- **Setting the Latch Source**

4. Press the **Latch** soft key to display the following menu.
You can specify the timing at which the data source pattern sampled in sync with the clock source is compared with the specified pattern as a trigger condition.



Level for Detecting Clock, Enable, and Latch Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting data source states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

2.24 Triggering on a TV Trigger

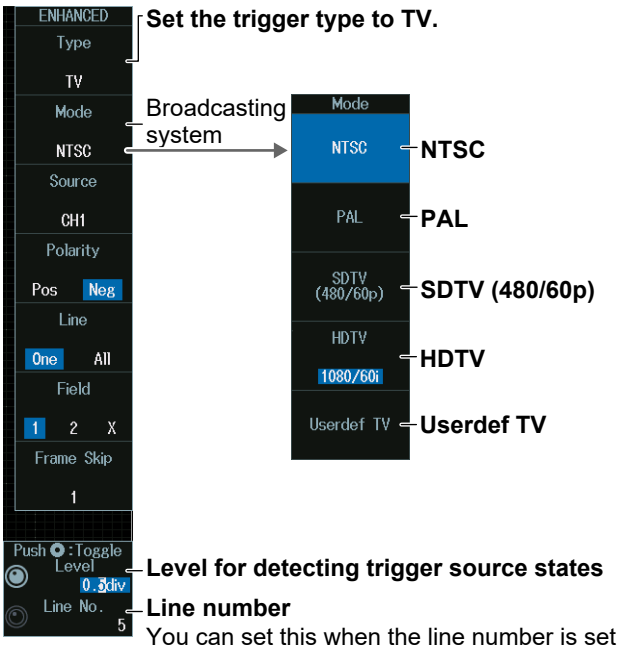
This section explains the following settings for triggering on a TV trigger:

- Broadcasting system
- Trigger source
  Polarity, line number, field number, frame skip, resolution
- Level for detecting trigger source states
- Channel source (Userdef TV)
  Polarity, HF rejection, horizontal sync frequency, sync guard frequency

► **"TV Trigger [ENHANCED]," "HF Rejection (HF Rejection)" in the Features Guide**

ENHANCED TV Menu

1. Press **ENHANCED** to display the ENHANCED menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ENHANCED menu from TRIGGER on the top menu that is displayed.
2. Press the **Type** soft key. From the setup menu that appears, select **TV** to display the following menu.

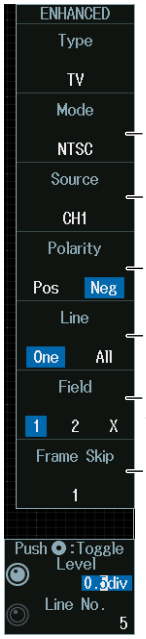


Broadcasting System (Mode)

NTSC mode

Press the **Mode** soft key and then the **NTSC** soft key to display the following menu.

The instrument triggers using the specified field and line of the NTSC signal as trigger conditions.



Set the broadcasting system to NTSC.

Trigger source

Polarity

Line number

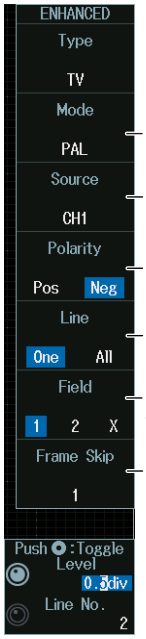
Field number
You can set this when the line number is set to 1.

frame skip
You can set this when the line number is set to 1.

PAL mode

Press the **Mode** soft key and then the **PAL** soft key. The following menu appears.

The instrument triggers using the specified field and line of the PAL signal as trigger conditions.



Set the broadcasting system to PAL.

Trigger source

Polarity

Line number

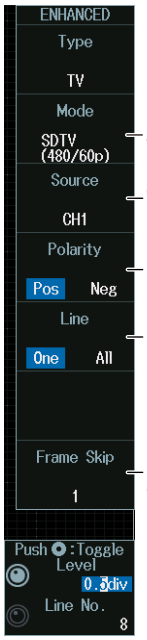
Field number
You can set this when the line number is set to 1.

frame skip
You can set this when the line number is set to 1.

SDTV (480/60p) Mode

Press the **Mode** soft key and then the **SDTV (480/60p)** soft key to display the following menu.

The instrument triggers using the specified line of the SDTV signal as trigger conditions.



Set the broadcasting system to SDTV(480/60p).

Trigger source

Polarity

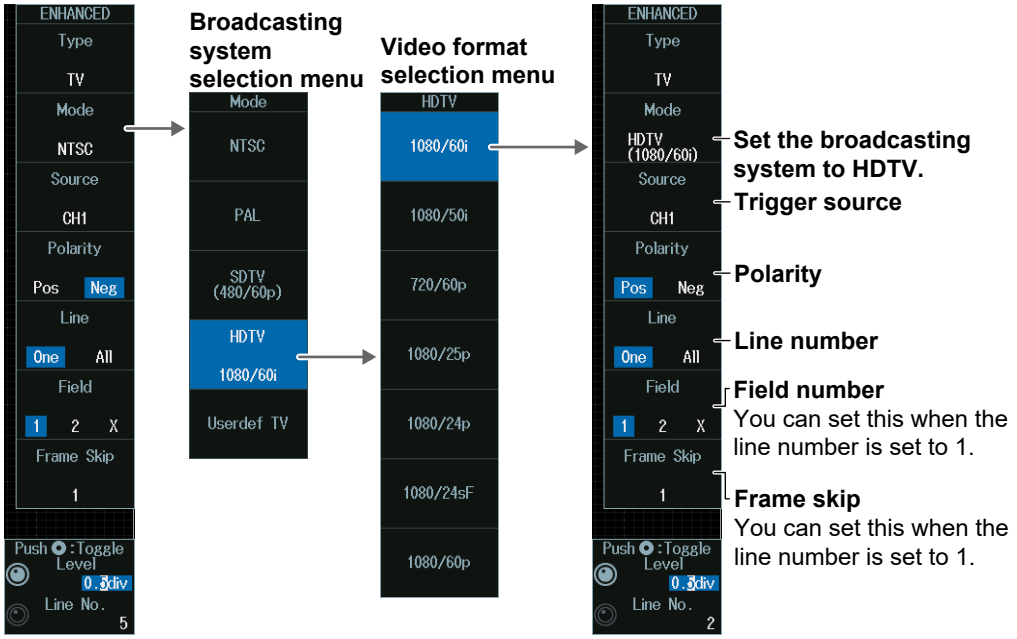
Line number

Frame skip
You can set this when the line number is set to 1.

HDTV mode

Press the **Mode** soft key and then the **HDTV** soft key. From the video format selection menu, select the format. The following menu appears.

The instrument triggers using the specified field and line of the HDTV signal as trigger conditions.



Set the broadcasting system to HDTV.

Trigger source

Polarity

Line number

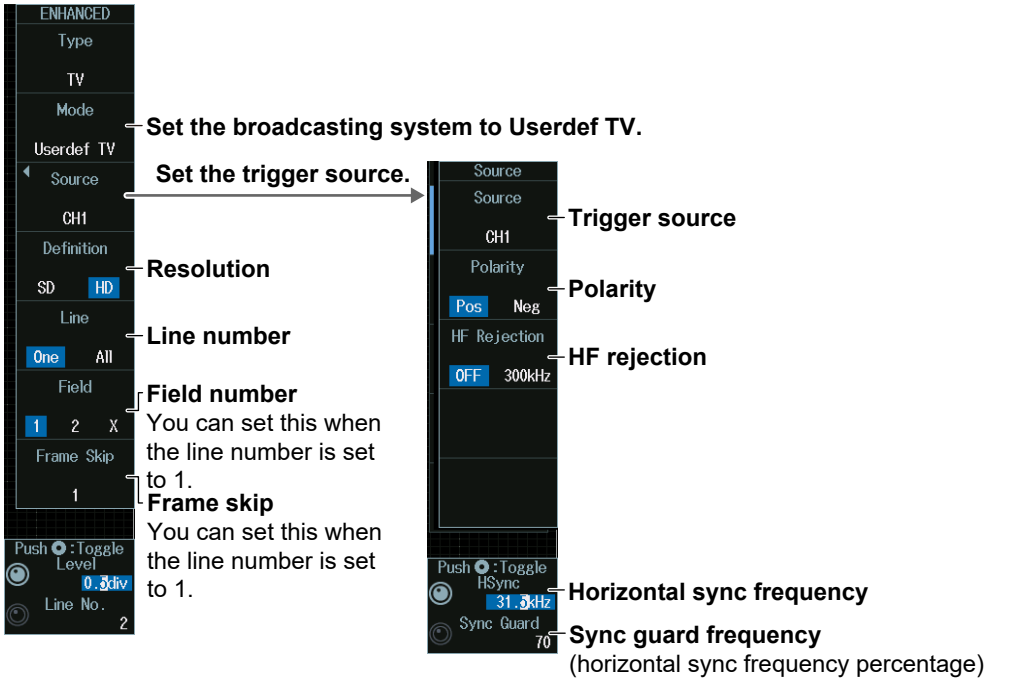
Field number
You can set this when the line number is set to 1.

Frame skip
You can set this when the line number is set to 1.

Userdef TV Mode

Press the **Mode** soft key and then the **Userdef TV** soft key to display the following menu.

The instrument triggers using the user-defined field and line as trigger conditions.



Level and Line Number for Detecting Trigger Source States (Level, Line No.)

Turn the **jog shuttle** to set the level or line number.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Press SET (upper right on the front panel) to switch between level and line number.

Setting the Horizontal Sync Frequency and Sync Guard Frequency (HSync/Sync Guard)

You can set these parameters when the broadcasting system is set to Userdef TV.

1. Press the **Source** soft key.
2. Turn the **jog shuttle** to set the horizontal sync frequency or sync guard frequency.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Press SET (upper right on the front panel) to switch between horizontal sync frequency and sync guard frequency.

2.25 Triggering on Combination Triggers (B TRIG)

This section explains the following settings for triggering on a combination trigger:

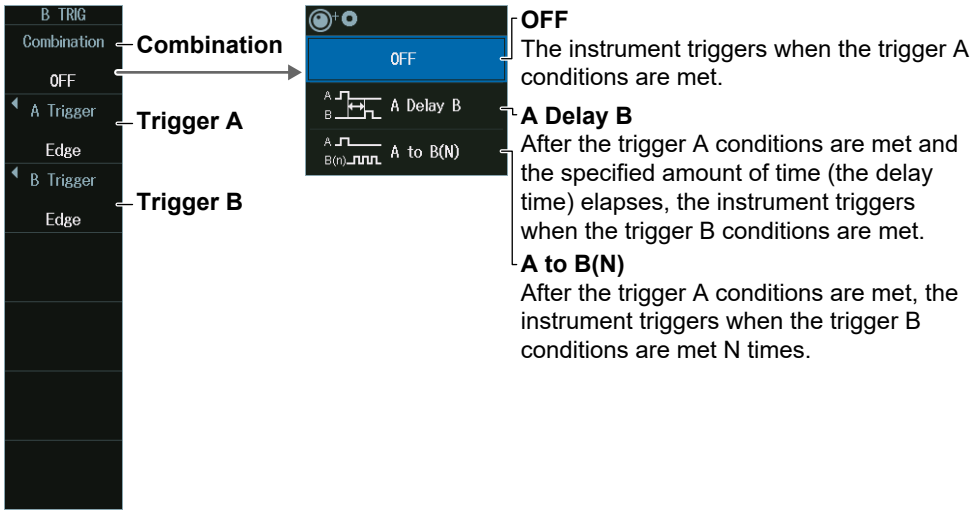
- Combination
  Delay time for condition B, number of times condition B must be met
- Trigger A: Condition A
- Trigger B: Condition B

► "Trigger B [B TRIG]" in the Features Guide

B TRIG Menu

Press **B TRIG** to display the following menu.

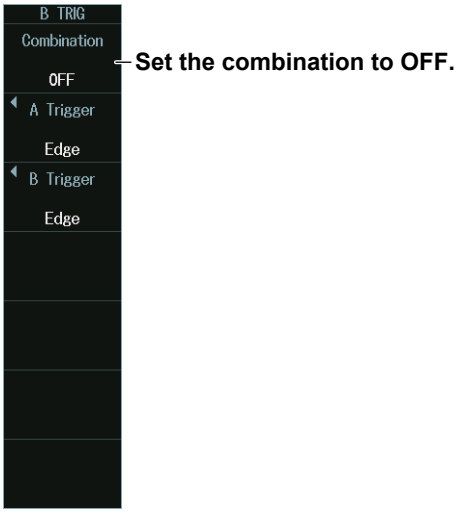
You can also tap **MENU** (MENU) in the upper left of the screen and select the B TRIG menu from TRIGGER on the top menu that is displayed.



Combination (Combination)

OFF

Press the **Combination** soft key and then the **OFF** soft key to display the following menu.



A Delay B

Press the **Combination** soft key and then the **A Delay B** soft key to display the following menu.

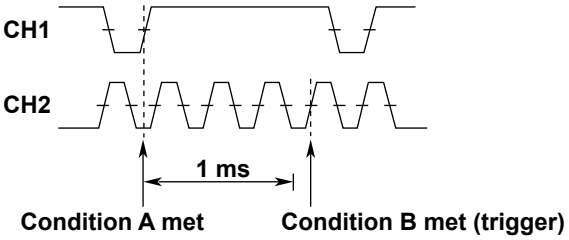


Set the combination to A Delay B.

Delay from condition A

A Delay B

After the trigger A conditions are met and the specified amount of time elapses, the instrument triggers when the trigger B conditions are first met.



Condition A: Edge trigger, CH1 = ↓,
Condition B: Edge trigger, CH2 = ↓, Delay = 1 ms

Delay (Delay) from Condition A

Turn the **jog shuttle** to set the delay.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Delay time

A to B(N)

Press the **Combination** soft key and then the **A to B(N)** soft key to display the following menu.

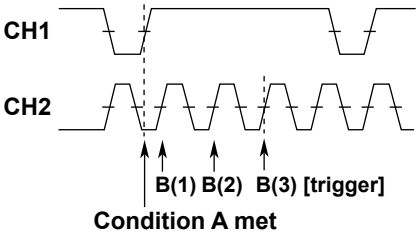


Set the combination to A to B(N).

Number of times condition B must be met

A to B(N)

After the trigger A conditions are met, the instrument triggers when the trigger B conditions are met N times.



Condition A: Edge trigger, CH1 = ↓,
Condition B: Edge trigger, CH2 = ↓, N = 3

Number of Times Condition B Must Be Met (N Count)

Turn the **jog shuttle** to set the number of times the conditions must be met.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



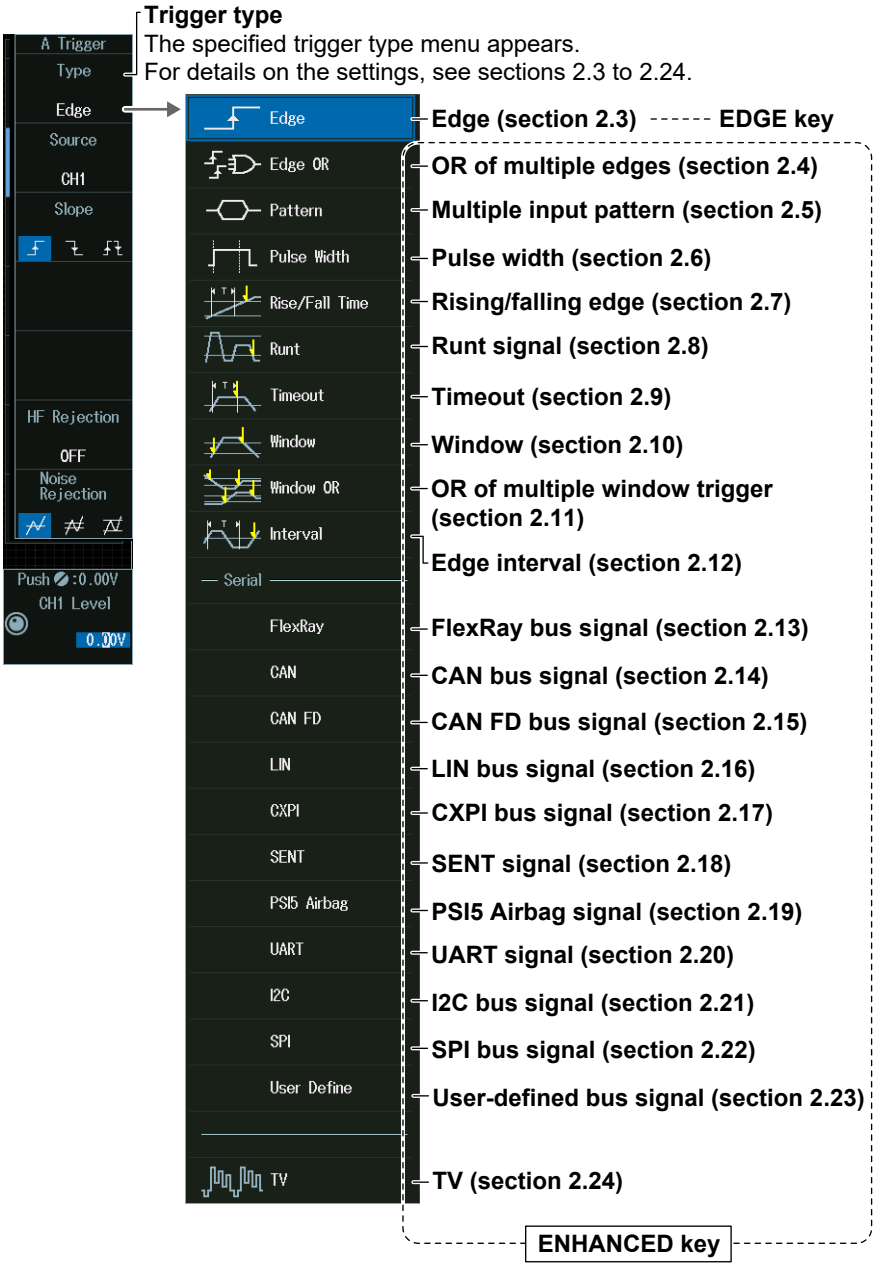
Number times the condition must be met

Trigger A (A Trigger)

Press the **A Trigger** soft key to display the following menu.

The procedure using the menu is same as that for edge trigger (section 2.3) and enhanced trigger (sections 2.4 to 2.24).

When you press EDGE or ENHANCED, the specified trigger conditions are assigned directly to trigger A conditions.



Trigger type
The specified trigger type menu appears.
For details on the settings, see sections 2.3 to 2.24.

- **Edge (section 2.3)** ------ **EDGE key**
- **OR of multiple edges (section 2.4)**
- **Multiple input pattern (section 2.5)**
- **Pulse width (section 2.6)**
- **Rising/falling edge (section 2.7)**
- **Runt signal (section 2.8)**
- **Timeout (section 2.9)**
- **Window (section 2.10)**
- **OR of multiple window trigger (section 2.11)**
- **Edge interval (section 2.12)**
- **FlexRay bus signal (section 2.13)**
- **CAN bus signal (section 2.14)**
- **CAN FD bus signal (section 2.15)**
- **LIN bus signal (section 2.16)**
- **CXPI bus signal (section 2.17)**
- **SENT signal (section 2.18)**
- **PSI5 Airbag signal (section 2.19)**
- **UART signal (section 2.20)**
- **I2C bus signal (section 2.21)**
- **SPI bus signal (section 2.22)**
- **User-defined bus signal (section 2.23)**
- **TV (section 2.24)**

ENHANCED key

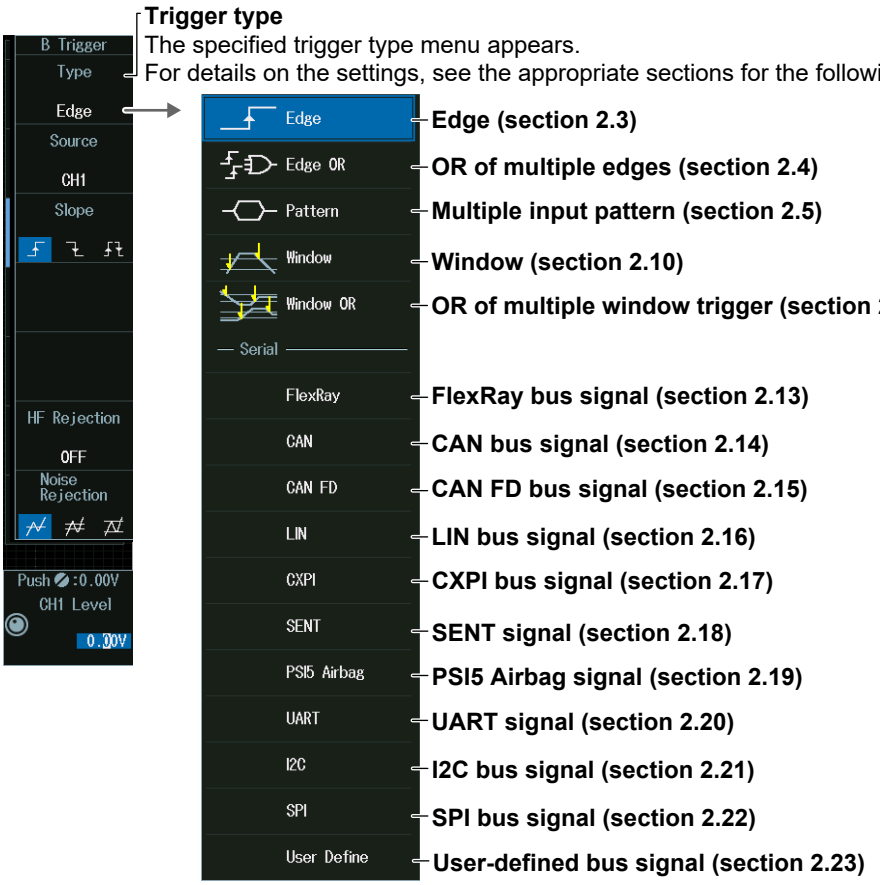
Note

The serial bus trigger (sections 2.13 to 2.23) can be assigned either to condition A or condition B.

Trigger B (B Trigger)

Press the **B Trigger** soft key to display the following menu.

The procedure using the menu is same as that for edge trigger (section 2.3) and enhanced trigger (only the types in the following figure can be used). Note that because the settings are not passed on, set trigger B from the beginning.



Trigger type
The specified trigger type menu appears.
For details on the settings, see the appropriate sections for the following types.

- **Edge (section 2.3)**
- **OR of multiple edges (section 2.4)**
- **Multiple input pattern (section 2.5)**
- **Window (section 2.10)**
- **OR of multiple window trigger (section 2.11)**
- **FlexRay bus signal (section 2.13)**
- **CAN bus signal (section 2.14)**
- **CAN FD bus signal (section 2.15)**
- **LIN bus signal (section 2.16)**
- **CXPI bus signal (section 2.17)**
- **SENT signal (section 2.18)**
- **PSI5 Airbag signal (section 2.19)**
- **UART signal (section 2.20)**
- **I2C bus signal (section 2.21)**
- **SPI bus signal (section 2.22)**
- **User-defined bus signal (section 2.23)**

Note

- The serial bus trigger can be assigned either to condition A or condition B.
- When condition B is set to Window trigger, Time Qualification is fixed to None.
- When condition B is set to Pattern and the clock source is set to None, trigger conditions True and False cannot be selected.

2.26 Forcing the Instrument to Trigger (FORCE TRIG)

► “Trigger Type (Type)” in the Features Guide

Forced Trigger [FORCE TRIG]

Press **SHIFT+B TRIG (FORCE TRIG)**. The instrument triggers even when the trigger conditions are not met.

You can also tap **MENU** (MENU) in the upper left of the screen and select FORCE TRIG from TRIGGER on the top menu that is displayed.

2.27 Setting the Action-On-Trigger Function

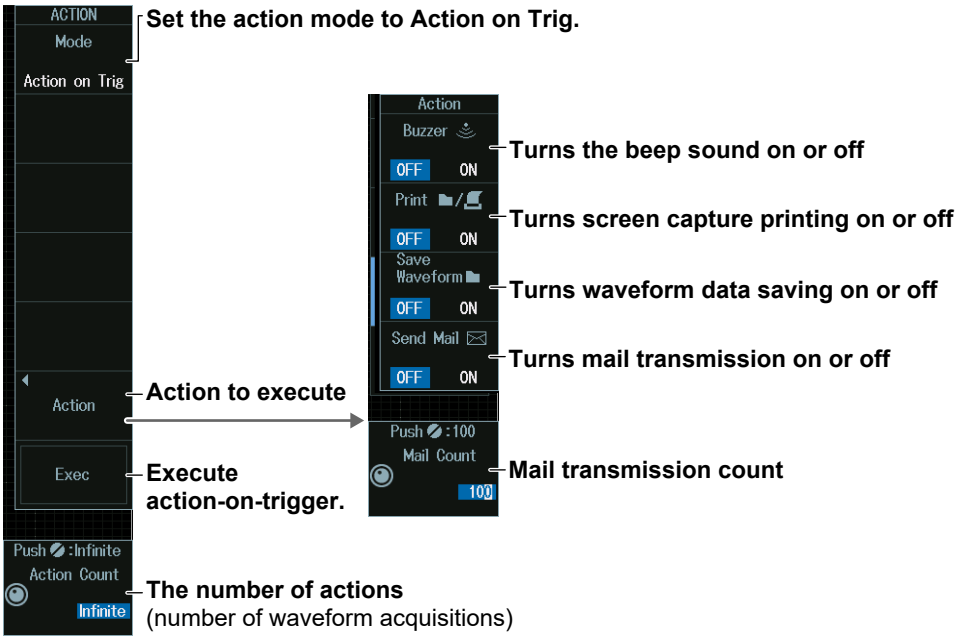
This section explains the following settings for executing the action-on-trigger function:

- Action mode
- Action to execute
- The number of actions
- Execute action-on trigger.

► "Executing Actions" in the Features Guide

ACTION Action on Trig Menu

1. Press **SHIFT+MODE**(ACTION GO/NO-GO) to display the ACTION menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ACTION menu (ACTION GO/NO-GO) from TRIGGER on the top menu that is displayed.
2. Press the **Mode** soft key and then the **Action on Trig** soft key to display the following menu.



Executing an Action-on-Trigger (Exec)

Press the **Exec** soft key.

- While an action-on-trigger is in progress, Exec changes to Abort. If you want to abort, press the **Abort** soft key.
- The instrument executes the action each time it triggers until the specified number of actions is reached.

Note

- You cannot execute action-on-trigger if Print To is set to Multi when Print is set to ON on the PRINT menu. ► section 16.6
- If the action to execute is mail transmission and the specified number of mail transmissions is less than the number of specified actions, mail transmission will stop after the specified number of transmissions. If the specified number of mail transmissions is greater than the number of specified actions, mail transmission will stop after the specified number of actions.

Number of Actions (Action Count)

Turn the **jog shuttle** to set the number of actions.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



The number of actions

E-mail Send Count (Mail Count)

Turn the **jog shuttle** to set the number of actions.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Mail transmission count

2.28 Performing GO/NO-GO Determination

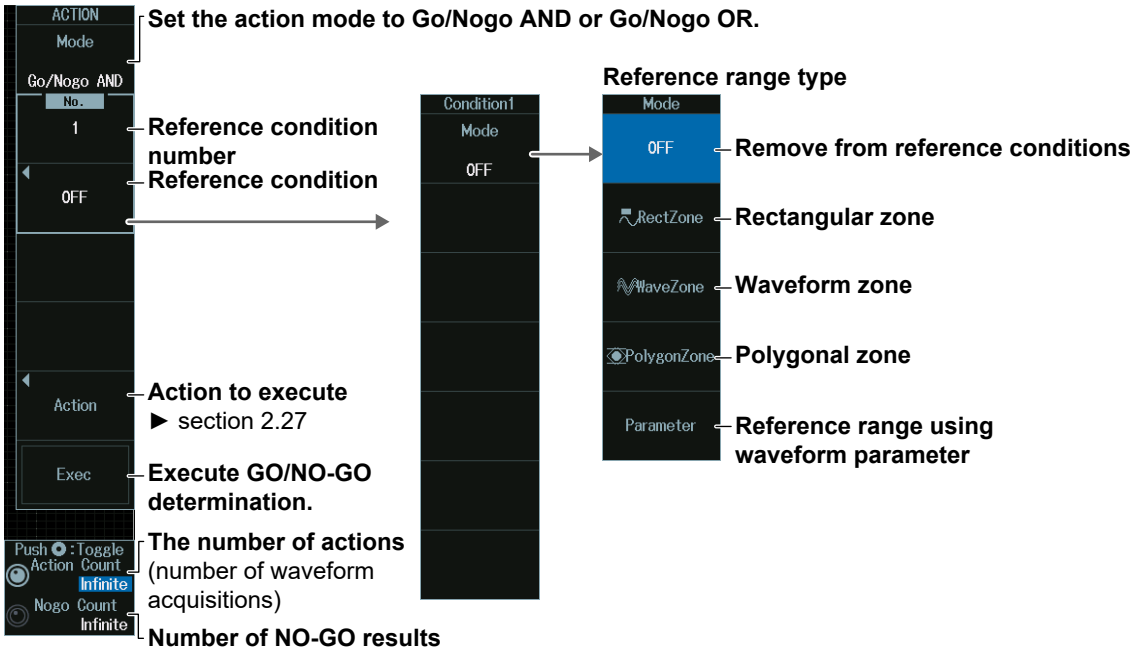
This section explains the following settings for performing GO/NO-GO determination:

- Action mode
- Number of actions, number of NO-GO determinations
- Reference condition
  Reference range type, determination source waveform, reference condition, determination source window, and zone settings
- Executing GO/NO-GO Determination

► "Executing Actions" in the Features Guide

ACTION Go/Nogo Menu

1. Press **SHIFT+MODE**(ACTION GO/NO-GO) to display the ACTION menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ACTION menu (ACTION GO/NO-GO) from TRIGGER on the top menu that is displayed.
2. Press the **Mode** soft key and then the **Go/Nogo AND** or **Go/Nogo OR** soft key to display the following menu.



Executing GO/NO-GO Determination (Exec)

Press the **Exec** soft key.

- While a GO/NO-GO determination is in progress, Exec changes to Abort. If you want to abort, press the **Abort** soft key.
- The instrument executes actions until either the specified number of actions or the number of NO-GO determinations is reached.

Note

- You cannot execute action-on-trigger if Print To is set to Multi when Print is set to ON on the PRINT menu. ► section 16.6
- If the action to execute is mail transmission and the specified number of mail transmissions is less than the number of specified actions, mail transmission will stop after the specified number of transmissions. If the specified number of mail transmissions is greater than the number of specified actions, mail transmission will stop after the specified number of actions.

Reference Condition and Reference Range

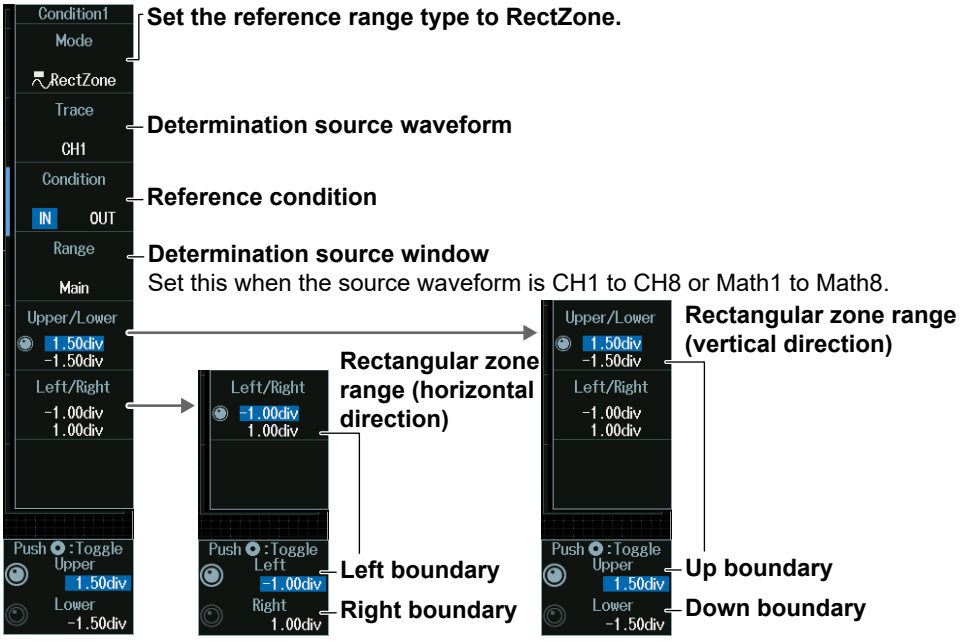
Depending on the determination source waveform, there are reference range types that you cannot specify.

Source Waveform	Reference Range Type			
	Rectangular zone	Waveform zone	Polygonal zone	Reference range using waveform parameter
CH1 to CH8	Yes	Yes	Yes	Yes
Logic	No	No	No	Yes
Math1 to Math8	Yes	Yes	Yes	Yes
XY1 to XY4	Yes	No	Yes	Yes
FFT1, FFT2	No	No	No	Yes

Rectangular Zone (RectZone)

Set the reference range (rectangular zone).

1. Press any of the reference condition **1** to **8** soft keys and then the **Mode** soft key.
   (Reference conditions 1 to 4 on 4ch models)
2. Press the **RectZone** soft key to display the following menu.



Note

The available source waveforms are as follows:

- No.1 to No.4
  CH1 to CH4, Math1 to Math4, XY1 to XY2
- No.5 to No.8 (8ch model)
  CH5 to CH8, Math5 to Math8, XY3 to XY4

Determination Source Window

To make Zoom1 or Zoom2 a determination source, turn on the Zoom1 or Zoom2 display from the ZOOM menu. For details, see section 10.1.

Rectangular Zone Range (Upper/Lower)

1. Press the **Upper/Lower** soft key.
2. Turn the **jog shuttle** to set the upper boundary (Upper) or lower boundary (Lower).
   - Press **SET** (upper right on the front panel) to switch between upper and lower boundaries.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Upper boundary

Lower boundary

Press SET (upper right on the front panel) to switch between upper and lower boundaries.

Rectangular Zone Range (Left/Right)

1. Press the **Left/Right** soft key.
2. Turn the **jog shuttle** to set the left boundary (Left) or right boundary (Right).
   - Press **SET** (upper right on the front panel) to switch between left and right boundaries.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Left boundary

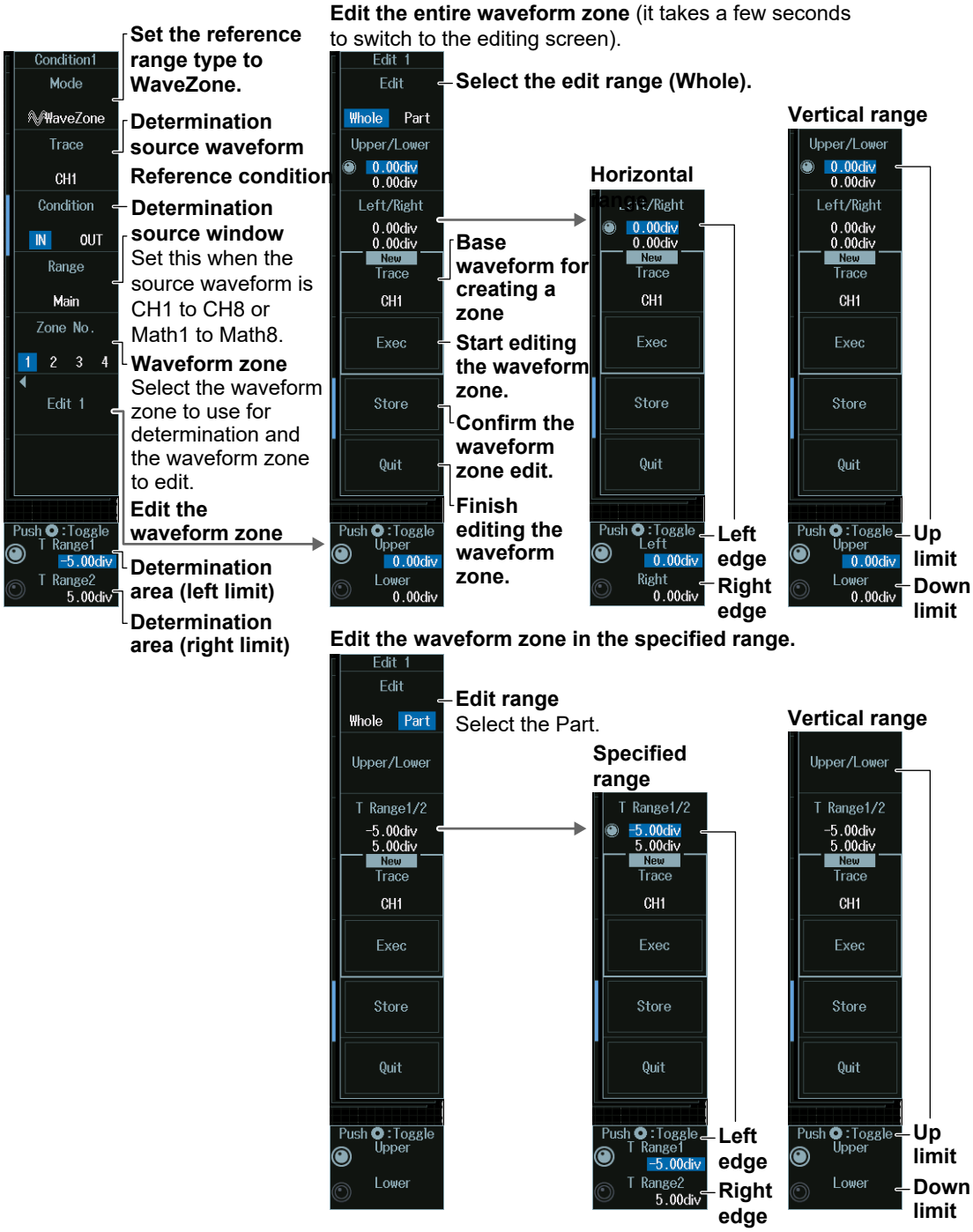
Right boundary

Press SET (upper right on the front panel) to switch between left and right boundaries.

Waveform Zone (WaveZone)

Set the reference range (waveform zone).

1. Press any of the reference condition **1** to **8** soft keys and then the **Mode** soft key.
   (Reference conditions 1 to 4 on 4ch models)
2. Press the **WaveZone** soft key to display the following menu.



Note

The available source waveforms are as follows:

- No.1 to No.4
  CH1 to CH4, Math1 to Math4
- No.5 to No.8 (8ch model)
  CH5 to CH8, Math5 to Math8

Editing the Waveform Zone
(Edit 1 to Edit 4: Reference conditions 1 to 4)
(Edit 5 to Edit 8: Reference conditions 5 to 8)

1. Press the **Zone No** soft key, and select the number of the waveform zone that you want to edit.

   The appearance of the waveform zone edit soft keys (Edit 1 to Edit 8) changes depending on the selected waveform zone number.

2. Press one of the soft keys from **Edit 1** to **Edit 8**, whichever is shown on the menu. An edit menu for the waveform zone that you selected will be displayed.

- **Selecting the Base Waveform**

  To edit without changing the base waveform, proceed to step 5.

3. Press the **Trace (New)** soft key, and from the displayed menu, select the base waveform.
4. Press the **Exec (New)** soft key. A waveform zone is created from the base waveform.

- **Editing the Entire Waveform Zone**

5. Press the **Edit** soft key to select **Whole**.
6. Press the **Upper/Lower** soft key or the **Left/Right** soft key to select the zone boundaries to edit.
7. Turn the **jog shuttle** to edit the waveform zone.

   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

   Jog shuttle setting menu

   Left boundary

   Right boundary

   Press SET (upper right on the front panel) to switch between left and right boundaries.

- **Editing a Part of the Waveform Zone**

5. Press the **Edit** soft key to select **Part**.
6. Press the **T Range1/2** soft key.
7. Turn the **jog shuttle** to edit the time scale range.

   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

   Jog shuttle setting menu

   Left edge

   Right edge

   Press SET (upper right on the front panel) to switch between left and right edges.

8. Press the **Upper/Lower** soft key to select the upper and lower zone boundaries.

9. Turn the **jog shuttle** to edit the waveform zone.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

   Jog shuttle setting menu



   Press SET (upper right on the front panel) to switch between up limit and down limit.

- **Confirming the Waveform Zone**

10. Press the Store soft key to confirm the waveform zone that you edited and store it in the internal memory.

- **Finishing Waveform Zone Editing**

11. Press the **Quit** soft key to return from the edit screen to the previous menu.
    If you do not confirm the edited waveform zone at step 10, the changes that you made will be lost.

Note

- If you change the base waveform (Trace (New)) for creating a zone, the waveform zone that you edited up to that point will be lost.
- If you want to switch from the edit menu to a different menu, you need to finish editing first. Press the Quit soft key to finish editing.

Determination Area (T Range)

Turn the **jog shuttle** to set the determination area.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Press SET (upper right on the front panel) to switch between left and right determination period boundaries.

Polygonal Zone (PolygonZone)

Set the reference range (polygonal zone).

1. Press any of the reference condition **1** to **8** soft keys and then the **Mode** soft key.
   (Reference conditions 1 to 4 on 4ch models)
2. Press the **PolygonZone** soft key to display the following menu.



Set the reference range type to PolygonZone.

Determination source waveform

Reference condition

Determination source window
Set this when the source waveform is CH1 to CH8 or Math1 to Math8.

Select the polygonal zone.
Load a polygonal shape in advance into the specified zone number (Zone No.1 to Zone No.8) using the file load feature (see section 17.7).
Create polygonal shapes on your PC using the dedicated software (Mask Editor Software).

Moves the polygonal zone (vertical position)

Moves the polygonal zone (horizontal position)

Note

The available source waveforms are as follows:

- No.1 to No.4
  CH1 to CH4, Math1 to Math4, XY1 to XY2
- No.5 to No.8 (8ch model)
  CH5 to CH8, Math5 to Math8, XY3 to XY4

Moving the Polygonal Zone (V-Position, H-Position)

Turn the **jog shuttle** to move the polygonal zone.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Moves the polygonal zone (vertical position)

Moves the polygonal zone (horizontal position)

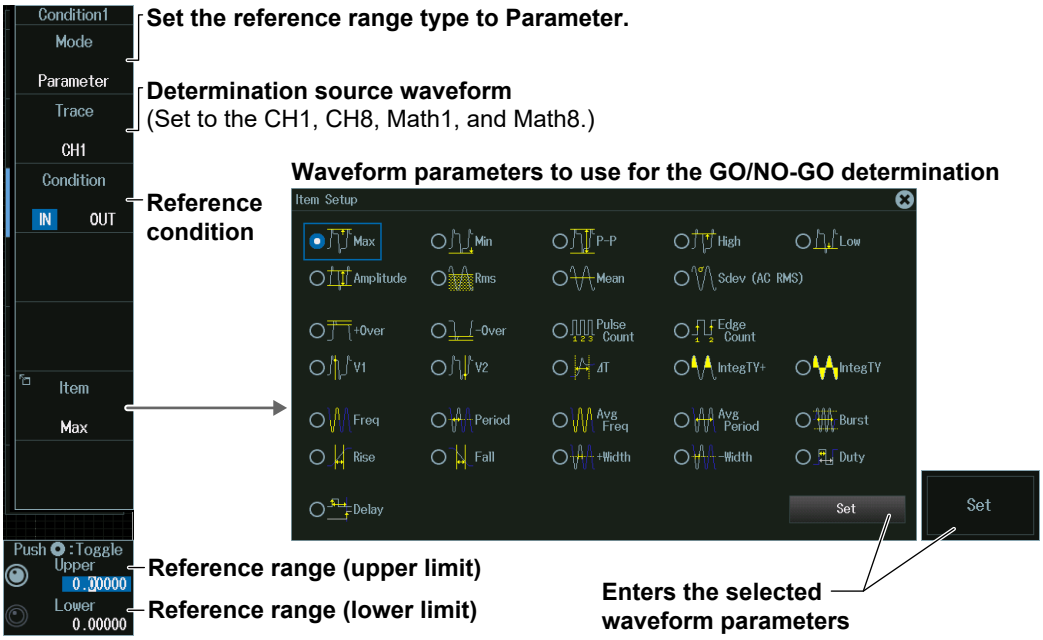
Press SET (upper right on the front panel) to switch between moving the polygonal zone horizontally or vertically.

Setting a Reference Range Using Parameters (Parameter)

Set the reference range (parameter).

1. Press any of the reference condition **1** to **8** soft keys and then the **Mode** soft key.
   (Reference conditions 1 to 4 on 4ch models)
2. Press the **Parameter** soft key to display the following menu.

When CH1 to CH8 or Math1 to Math8 Is the Determination Source Waveform



Note

Waveform Parameters

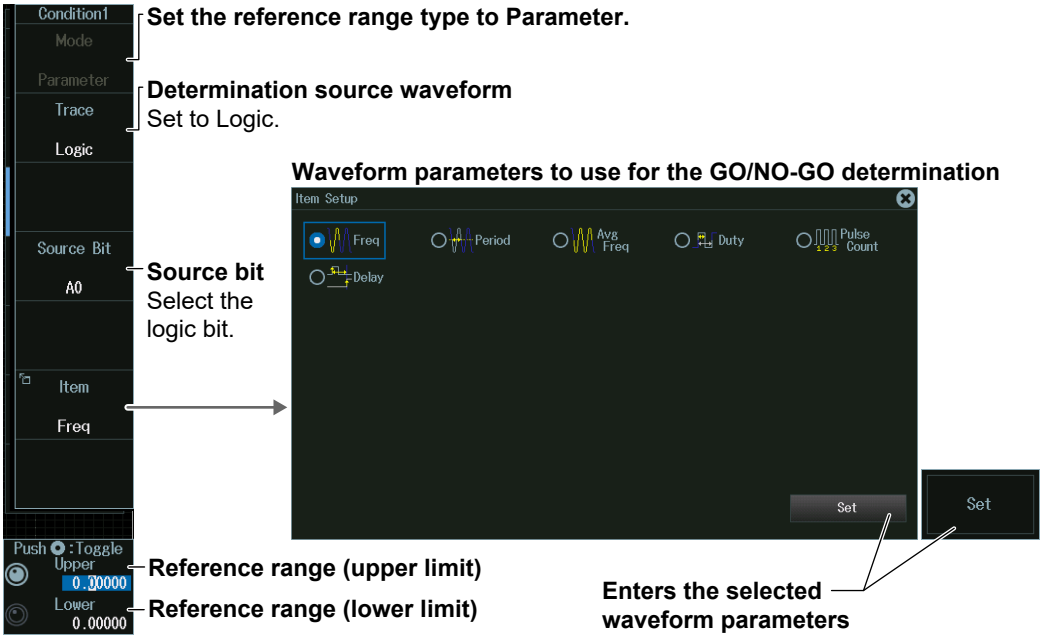
You can select the measurement items to use in GO/NO-GO determination from all of the items used for automated measurement of waveform parameters. For information on setting automated measurement of waveform parameters, see section 9.1.

Source Waveform

The available determination source waveform settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8
- The available settings on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4

When Logic Is the Determination Source Waveform



Note

Waveform Parameters

You can select the measurement item to use in the GO/NO-GO determination from the items used for time axis measurement of waveform parameters shown below.

Freq, Period, Avg Freq, Duty, Pulse Count, Delay

For information on setting automated measurement of waveform parameters, see section 9.1.

Source bit

The following source bit display applies to models with the /L32 option.

C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

When XY1 to XY4 Is the Determination Source Waveform



Set the reference range type to Parameter.

Determination source waveform
Set to a value from XY1 to XY4 (XY1 or XY2 on 4ch models).

Reference condition

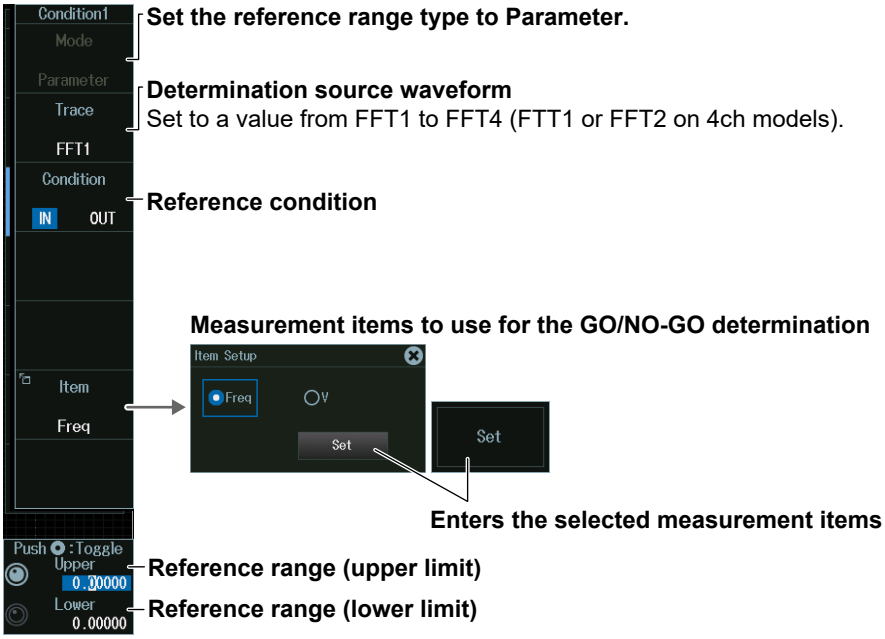
Reference range (upper limit)

Reference range (lower limit)

Note

The measurement item to use in the GO/NO-GO determination is the waveform area of XY1 to XY4 (XY1 and XY2 on 4ch models). For information on setting how the XY waveform is displayed and how its area is determined, see chapter 5 of this manual and appendix 1 of the *Features Guide*, IM DLM5058-01EN.

When FFT1 to FFT4 Is the Determination Source Waveform



Set the reference range type to Parameter.

Determination source waveform
Set to a value from FFT1 to FFT4 (FTT1 or FFT2 on 4ch models).

Reference condition

Measurement items to use for the GO/NO-GO determination

Enters the selected measurement items

Reference range (upper limit)

Reference range (lower limit)

Note

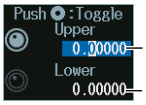
You can select the measurement item to use in the GO/NO-GO determination from the peak cursor measurement items (Freq, V) for FFT.
For details on peak cursor measurements, see section 7.2.

Reference Range (Upper/Lower)

Turn the **jog shuttle** to set the reference range.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Reference range (upper limit)

Reference range (lower limit)

Press SET (upper right on the front panel) to switch between upper and lower reference range limits.

3.1 Setting Conditions for Waveform Acquisition

This section explains the following settings for acquiring waveforms:

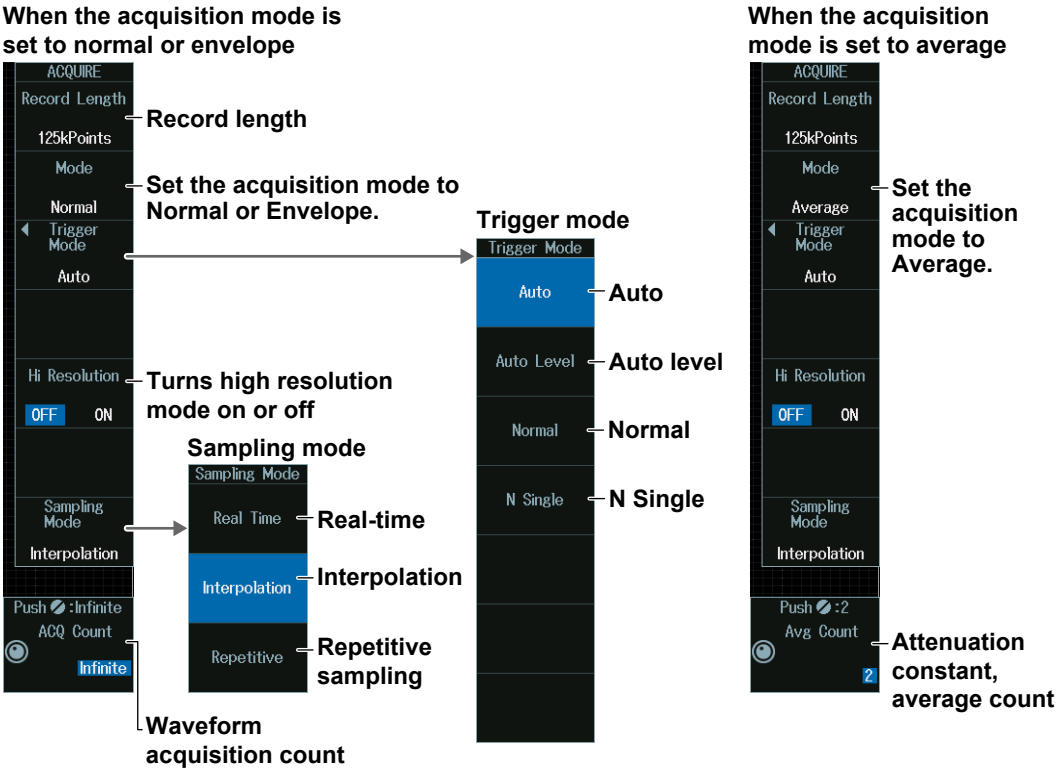
- Record length
- Acquisition mode
- Trigger mode
- Turning high resolution mode on or off
- Sampling mode
- Number of waveforms to acquire, attenuation constant, and number of times to average

► "Waveform Acquisition" in the Features Guide

ACQUIRE Menu

Press **ACQUIRE** to display the following menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the ACQUIRE menu from ACQ/DISP on the top menu that is displayed.



Acquisition Mode (Mode)

Set the waveform acquisition mode.

Normal	Displays waveforms without processing the sampled data. Set the waveform acquisition count.
Envelope	Displays waveforms in envelope mode. Set the waveform acquisition count.
Average	Displays averaged waveforms. Set the attenuation constant and the number of times to average.

Note

- If you set the acquisition mode to Envelope when the sample rate is set to 1.25 GS/s or higher, the instrument actually operates in Normal mode. In envelope mode, [Envelope] appears in the upper right of the screen. If envelope is in use in high resolution mode, [Env:Hi-Res] appears.
- To average waveforms that have been acquired in N Single mode, set the acquisition mode to Normal, and turn on history feature's averaging.

Trigger Mode (Trigger Mode)

The trigger mode determines the conditions for updating the displayed waveforms. You can set the trigger mode by pressing the MODE key. For details, see section 2.1.

Sampling Mode (Sampling Mode)

Set how to sample the number of waveform data points per unit time.

Realtime	The instrument samples at the specified time scale.
Interpolation	In Interpolation mode, the instrument interpolates the data sampled at 2.5 GS/s up to 100 times using the (sinx)/x function.
Repetive	The instrument acquires repetitive signals multiple times and displays them as a single waveform. This makes it possible to sample at an apparent rate higher than the actual rate.

Note

In the following cases, repetitive sampling mood (Repetitive) cannot be used.

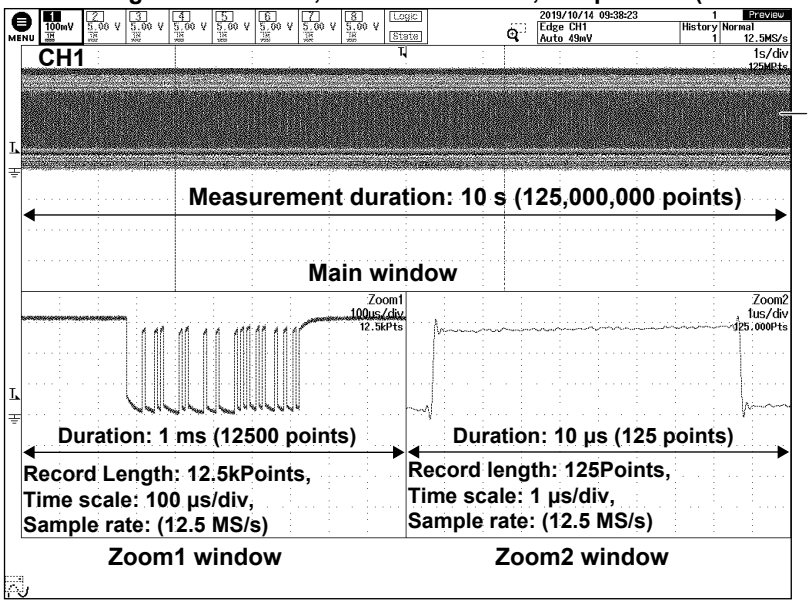
- When the trigger source is Logic
- When the record length is 2.5 Mpoint or more

Relationship between the Time Scale, Record Length, and Sample Rate

Record length refers to the number of data points that are stored to the acquisition memory for each channel.

Decreasing the time scale increases the sample rate. If you want to observe a long-term phenomenon at a high time resolution (at a high sample rate), set the record length to a high value. In the following waveform display example, the waveform of a CAN bus signal is measured for 10 seconds. The waveform is acquired for a long period (10 seconds), and the waveform is zoomed. This allows fine waveform variations to be viewed at a high sample rate.

Main window
Record length: 125MPoints, time scale: 1 s/div, sample rate: (12.5 MS/s)



Note

- When the record length is set the following values, a single waveform is acquired.
  - Models without the memory option
    25MPoints, 50MPoints, 125MPoints
  - Models with the /M1 option
    50MPoints, 125MPoints, 250MPoints
  - Models with the /M2 option
    125MPoints, 250MPoints, 500MPoints
- Note that when the record length is long, computation and measurement processing take longer than when the record length is short.
- There are limitations on waveform acquisition conditions and the number of waveforms that can be stored in the acquisition memory (the number of history waveforms) depending on the specified record length. For details, see chapter 6 in the Features Guide (IM DLM5058-01EN).

Number of Waveform Acquisitions (ACQ Count)

1. Press the **Mode** soft key and then the **Normal** or **Envelope** soft key.
2. Turn the **jog shuttle** to set the acquisition count.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

   Jog shuttle setting menu

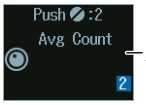


Waveform acquisition count

Attenuation Constant and Average Count (Avg Count)

1. Press the **Mode** soft key and then the **Average** soft key.
2. Turn the **jog shuttle** to set the attenuation constant or average count.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

   Jog shuttle setting menu



Attenuation constant, average count

Note

The calculation process of the attenuation constant and average count inside the instrument varies depending on the averaging process. Depending on the trigger mode of averaging mode (Average), they are processed as follows:

- **Auto, Auto Level, Normal, N Single**
  Avg Count indicates the attenuation constant (exponential averaging).
- **Single**
  Avg Count indicates the average count (simple averaging).

3.2 Acquiring Waveforms

► "Waveform Acquisition (RUN/STOP)," "Acquiring the Waveform Once (SINGLE)" in the Features Guide

Starting and Stopping Waveform Acquisition (RUN/STOP)

1. Press **RUN/STOP**.
   - The RUN/STOP key illuminates, and waveform acquisition starts. The acquired waveform is displayed.
   - If you set the record length to a value that allows only one waveform to be acquired, pressing the RUN/STOP key will produce the same result as pressing the SINGLE key.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the RUN/STOP menu on the top menu that is displayed.
2. Press **RUN/STOP** again.
   The RUN/STOP key light turns off, and waveform acquisition stops.

Acquiring a Waveform Once (SINGLE)

1. Press **SINGLE**.
   - The SINGLE key illuminates, and when the instrument triggers, it acquires and displays only one waveform and then stops waveform acquisition. The SINGLE key light turns off.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select SINGLE on the top menu that is displayed.
   - The trigger mode is set to single mode.
   - To stop waveform acquisition, press the RUN/STOP key.

4.1 Setting Display Conditions

This section explains the following settings for viewing the display:

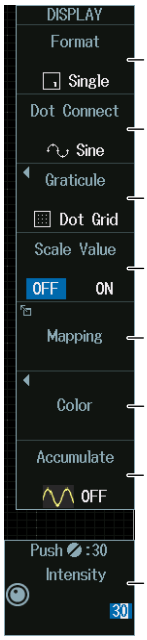
- Display format
- Display interpolation
- Grid
- Turning scale value display on or off
- Waveform mapping
- Color
- Waveform intensity

► "Display" in the Features Guide

DISPLAY Menu

Press **DISPLAY** to display the following menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the DISPLAY menu from ACQ/DISP on the top menu that is displayed.



Display format

Display interpolation

Grid

Turns the scale value display on or off

Waveform mapping

Color

► section 4.2

Waveform intensity

Display Format (Format)

Press the **Format** soft key to display the following menu.



Automatically divide the areas
The number of areas is automatically determined by the number of displayed waveforms.

Not divide the screen

Divide the screen into two areas

Divide the screen into three areas

Divide the screen into four areas

Divide the screen into six areas

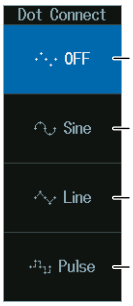
Divide the screen into eight areas

Note

Changing the number of screen divisions does not change the A/D converter resolution.

Display Interpolation (Dot Connect)

Press the **Dot Connect** soft key to display the following menu.



Display interpolation disabled
Displays waveforms with dots

Sine interpolation
Interpolates between two points using the sin x/x function

Linear interpolation
Linearly interpolates between two points

Pulse interpolation
Interpolates between two points in a staircase pattern

Note

In the following cases, the interpolation method is set to Pulse regardless of the interpolation method setting.

- The input signal is a logic signal.
- The acquisition mode is Envelope.
- The sampling mode is Repetitive Sampling.

Grid (Graticule)

Press the **Graticule** soft key to display the following menu.



Displays the grid with dotted lines

Displays the grid with solid lines

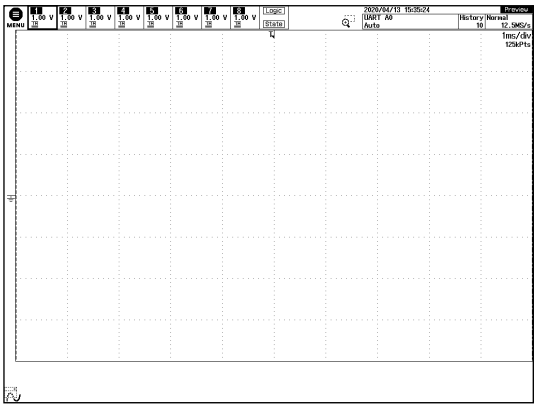
Displays a grid frame

Displays the grid with a crosshair

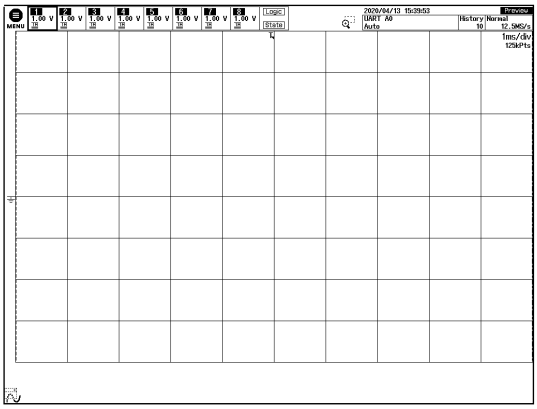
Turns fine grid display on or off

Grid Types

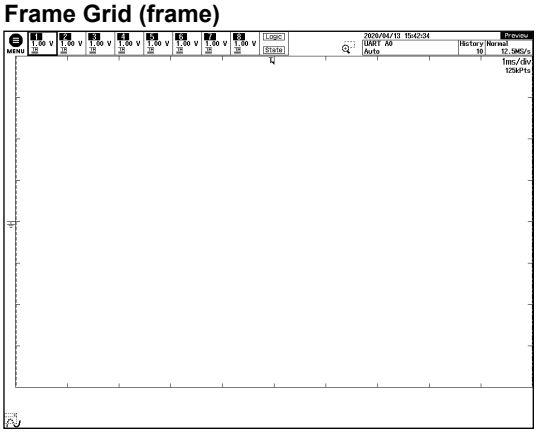
Dot Grid (dotted lines)



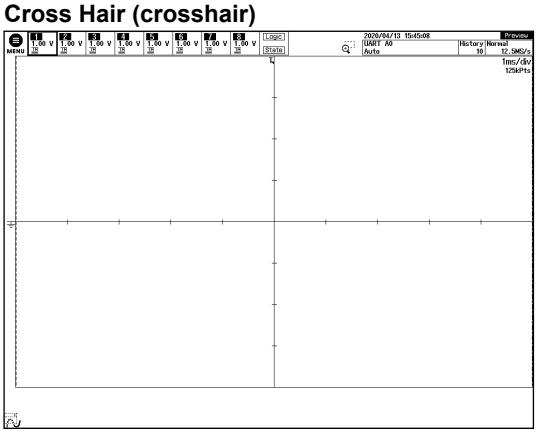
Line Grid (solid lines)



Frame Grid (frame)



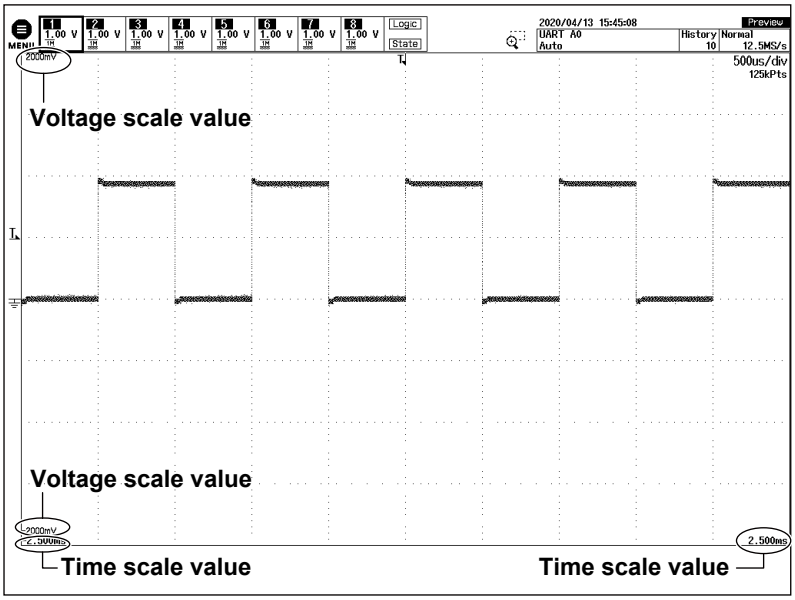
Cross Hair (crosshair)



Scale Value Display (Scale Value)

Press the **Scale Value** soft key to select On or Off.

You can display the upper and lower limits (scale values) of each channel's vertical or horizontal axes.



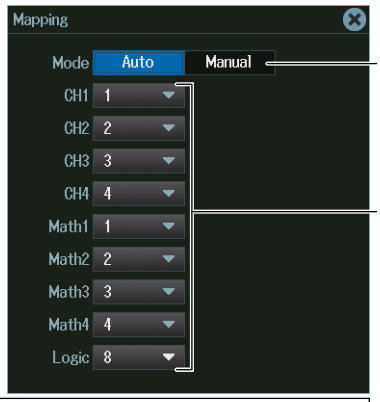
Waveform Mapping (Mapping)

Press the **Mapping** soft key to display the following menu.

8ch model

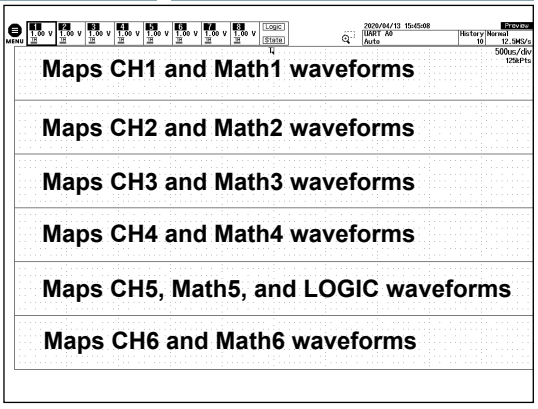


4ch model



Mapping mode

When the waveform mapping mode is set to Manual, set how to map each channel's waveform to the divided screens.



Example when the screen is divided into six areas (Manual mode)

Display Color (Color)

Press the **Color** soft key to display the following menu.



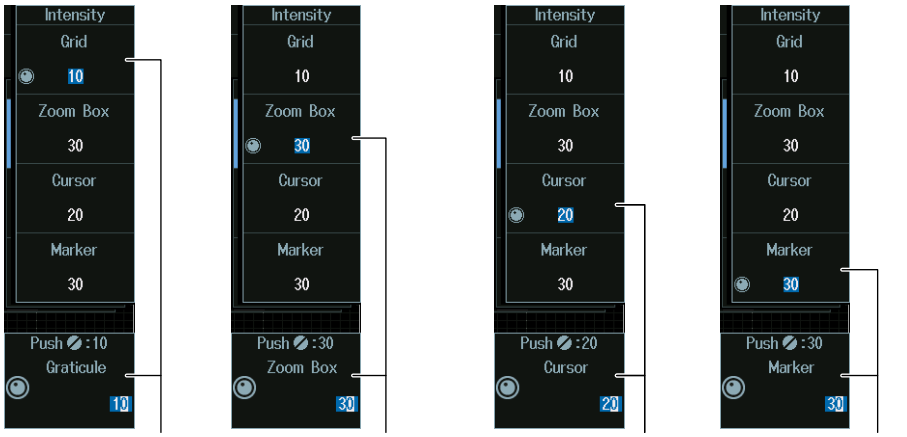
Graticule intensity

Waveform color

Serial bus trend color
This menu appears on models with the SENT option or the PSI5 Airbag option.

Intensity of the Grid, Zoom Box, Cursor, or Marker

Press the **Intensity Graticule** soft key to display the following menu.



Grid intensity **Zoom box intensity** **Cursor intensity** **Marker intensity**

* You can enter the value when the jog shuttle icon is displayed on the soft key that controls each intensity. For instructions on how to use the numeric keypad through the the touch panel, see section 3.3 in IM DLM5058-03EN.

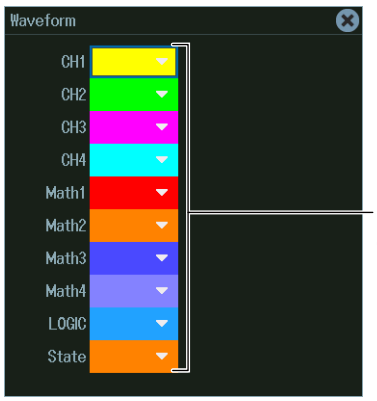
Waveform Color

Press the **Waveform** soft key to display the following menu.

8ch model



4ch model



Display color of each waveform

Serial Bus Trend Color

Press the **Serial Bus Trend** soft key to display the following menu.



Display color of each trend

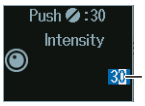
Waveform Intensity (Intensity)

Turn the **jog shuttle** to set the intensity.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When accumulation is set to OFF



Intensity
Pressing RESET (upper right on the front panel) returns the value to 30.

When accumulation is set to Intensity or Color



Intensity

Set the accumulation time

Press SET (upper right on the front panel) to switch between Intensity and accumulation time.

4.2 Using the Accumulate Feature

This section explains the following settings for using the accumulate feature:

- Accumulation frequency
- Accumulation time

► “Accumulation (Accumulate)” in the Features Guide

DISPLAY Menu

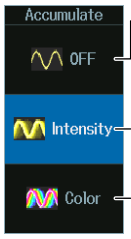
1. Press **DISPLAY** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the DISPLAY menu from ACQ/DISP on the top menu that is displayed.



Accumulation display mode

Accumulation time

2. Press the **Accumulate** soft key to display the following menu.



OFF
Accumulation display is not used. The waveform acquired once is displayed at the specified intensity.

Intensity
The frequency of accumulated waveforms is expressed with intensity.

Color
Waveform accumulation frequency is expressed with color.

Color

The 15 waveform accumulation frequency levels are expressed using different colors that range from blue to green to yellow to red to white starting with the lowest frequency.

Accumulation Time

1. Press **SET** to set the jog shuttle setting menu display to Accum Time.
2. Turn the **jog shuttle** to set the accumulation time.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the menu that appears on the screen.

Jog shuttle setting menu



Accumulation time

Note

Pressing CLEAR TRACE clears the accumulated waveforms.

Notes about Waveform Accumulation

- Automated measurement of waveform parameters and GO/NO-GO determination are performed on the most recent waveform.
- If you press RUN/STOP to stop waveform acquisition, accumulation stops. When you restart waveform acquisition, all the waveforms are cleared, and accumulation starts from the beginning.
- If the instrument does not trigger when the trigger mode is set to Normal, the waveform intensity is retained until the next time the instrument triggers.
- If you change the display format when accumulated waveforms are displayed, the instrument operates in the following manner.
  During accumulation: The instrument clears the screen and restarts displaying from the beginning.
  When accumulation is stopped: The instrument clears the waveforms and displays the most recent waveform.

4.3 Using the Snapshot and Clear Trace Features

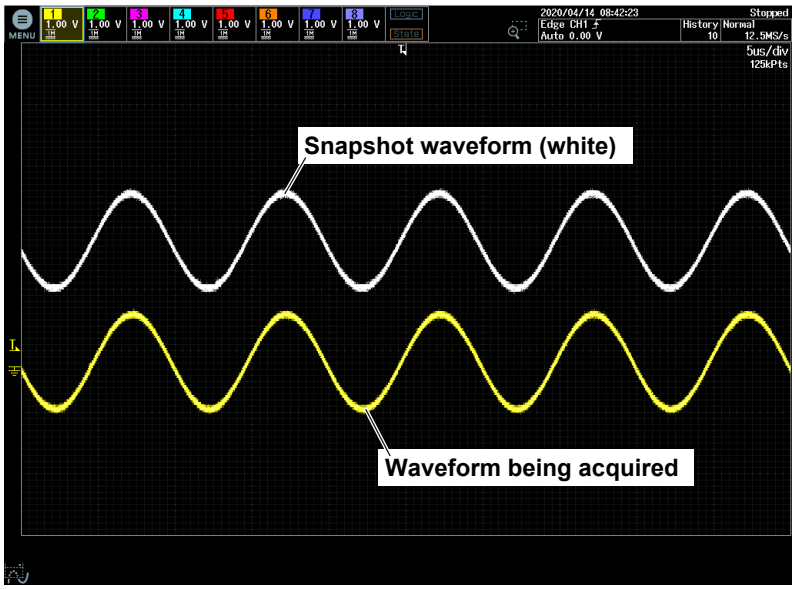
This section explains how to clear snapshots (temporary storage during waveform acquisition) and the waveform display.

- Snapshot
- Clear trace

► "Snapshot (SNAP SHOT)," "Clear Trace (CLEAR TRACE)" in the Features Guide

Snapshot (SNAP SHOT)

1. Acquire waveforms.
   ► section 3.2
2. Press **SNAP SHOT** (📷∿).
   - The currently displayed waveform is retained on the screen as a snapshot displayed in white. Snapshot waveforms remain on the screen until you execute a clear trace operation.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SNAP SHOT menu on the top menu that is displayed.



Clear Trace (CLEAR TRACE)

3. Press **CLEAR TRACE** (CLR∿).
   - All waveforms on the screen are cleared.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the CLEAR TRACE menu on the top menu that is displayed.

Note

If you execute a clear trace operation during waveform acquisition, the instrument clears all the history waveforms that it has acquired and restarts waveform acquisition from the first acquisition.

4.4 Adjusting the Backlight

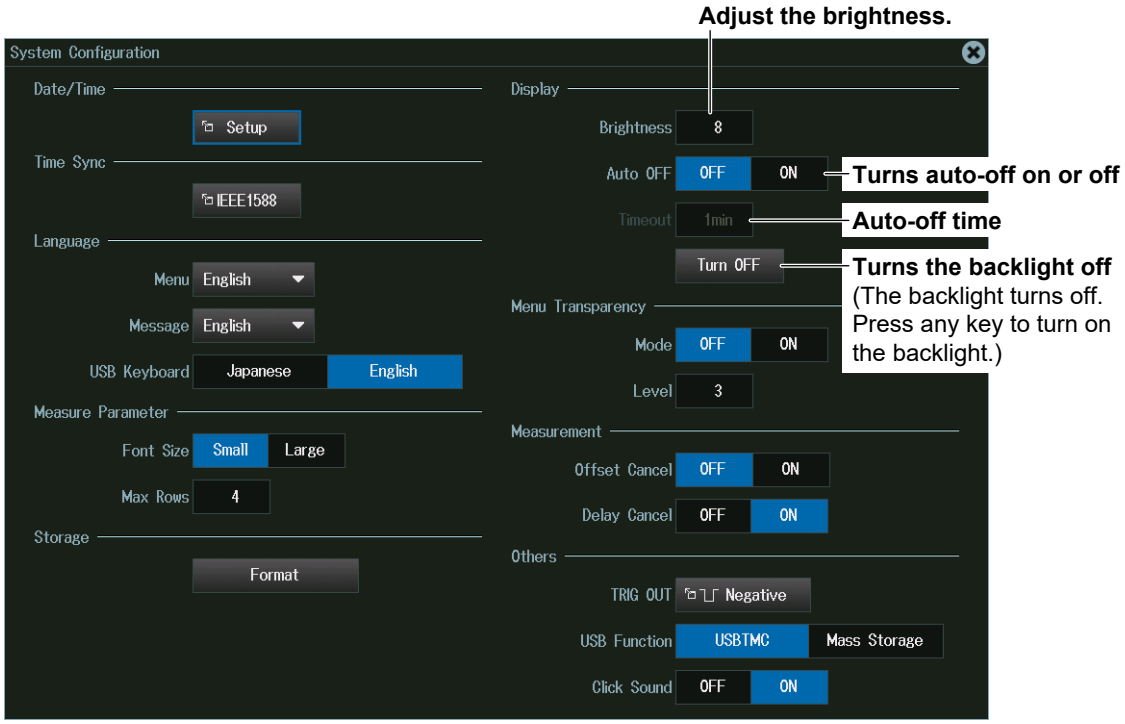
This section explains the following settings for adjusting the backlight:

- Brightness adjustment
- Turning auto power-off on or off
- Auto-off time
- Turning the backlight off

► “System Configuration (System Configuration)” in the Features Guide

UTILITY System Configuration menu

1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **System Configuration** soft key to display the following menu.



4.5 Displaying the Operation Screen Transparently

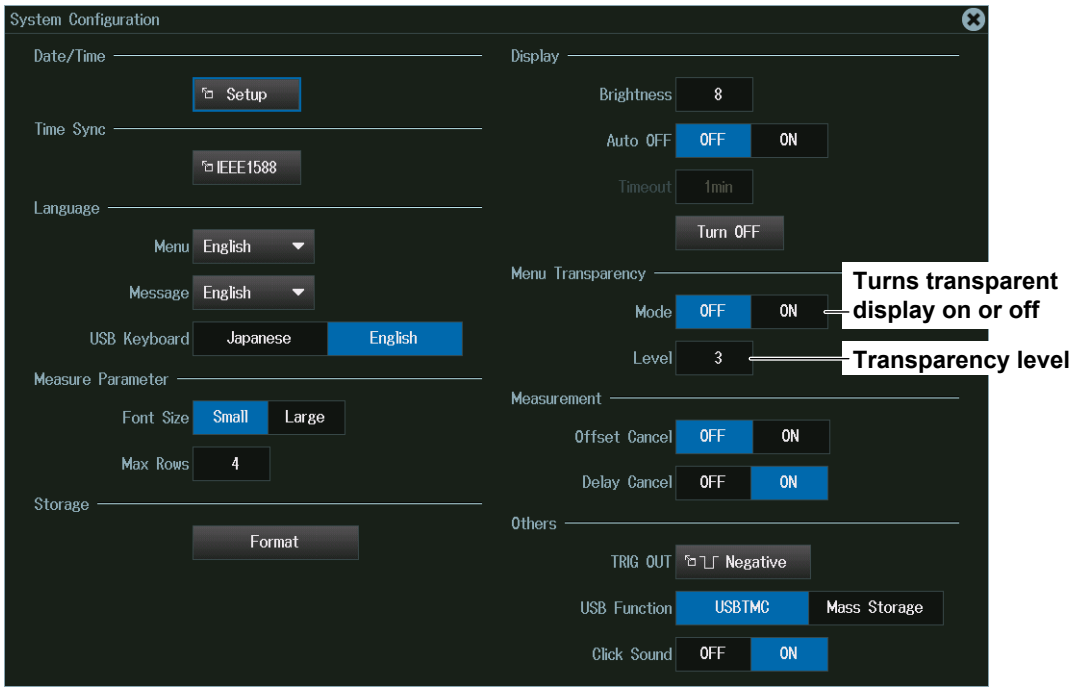
This section explains the following setting for displaying the operations screen (menus, dialog boxes, etc.) transparently.

- Turning transparent display on or off
- Transparency Level

► "System Configuration (System Configuration)" in the Features Guide

UTILITY System Configuration menu

1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top 4menu.
2. Press the **System Configuration** soft key to display the following menu.



Transparent Display

- **Turning Transparent Display On and Off (Mode)**
  When you turn transparent display on, the setup menus and dialog boxes that appear on the waveform display screen become transparent, allowing you to control the setup menus and dialog boxes while viewing the waveform shown in the background. You can also turn the mode on and off by tapping the transparent mode on/off icon displayed in the lower left of the waveform display screen.

- **Transparency Level (Level)**
  You can set the transparency level in the range of 1 (low) to 5 (high). The higher the transparency level, the clearer the waveform display shown in the background.

5.1 Displaying XY Waveforms

This section explains the following settings for displaying XY waveforms:

- XY waveform display
- X-axis and Y-axis source waveforms
- Display settings

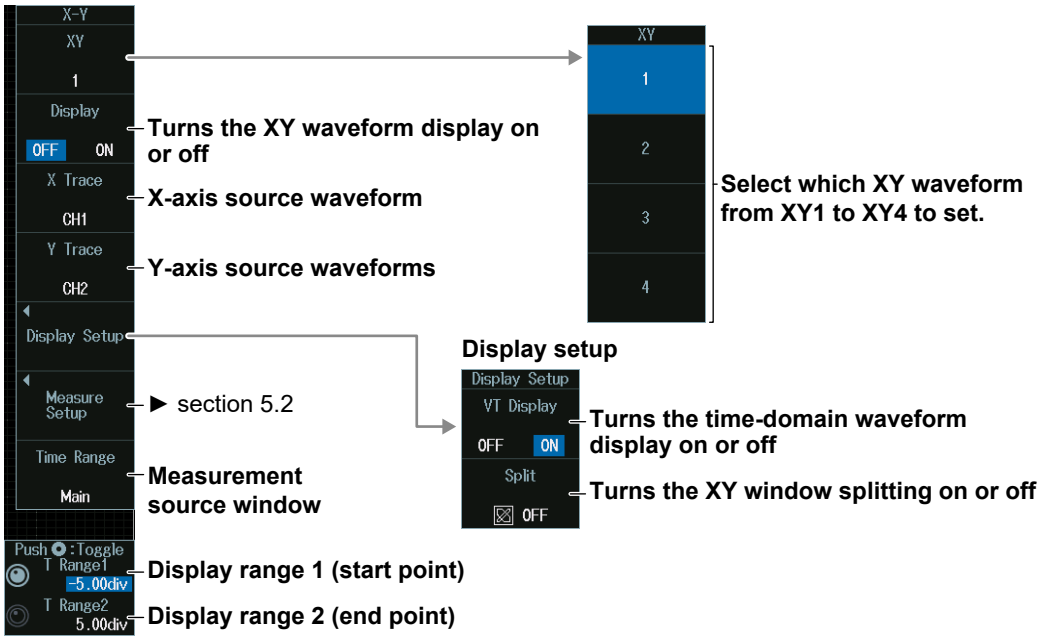
- Measurement source window
- Display range
- Display settings
  Turning time-domain waveform on or off, turning split display on or off

► "Displaying XY Waveforms" in the Features Guide

XY Menu

Press **SHIFT+DISPLAY (X-Y)** to display the X-Y menu.

- You can also tap **MENU** (MENU) in the upper left of the screen and select the X-Y menu from ACQ/DISP on the top menu that is displayed.
- Up to four XY waveforms can be displayed. To switch the setup menu, press the XY soft key.



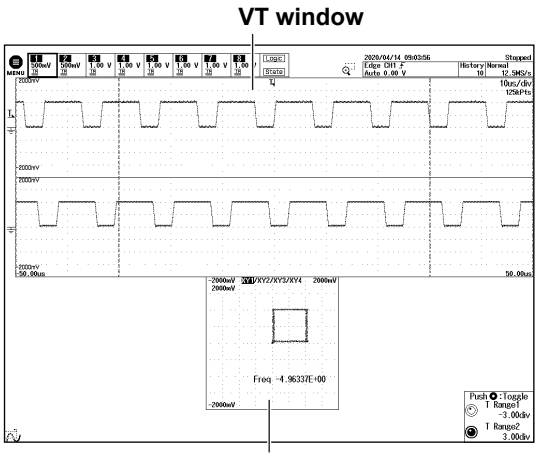
Note

Source Waveform (X Trace/Y Trace)

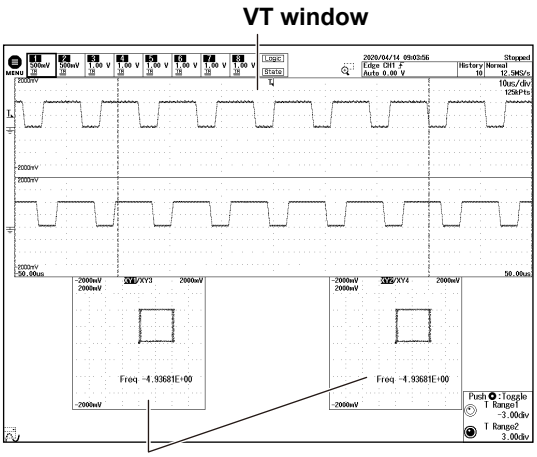
The available channel settings vary depending on the model.

- The available channel settings on 8ch models are as follows:
  XY1 and XY2: CH1 to CH4, Math1 to Math4
  XY3 and XY4: CH5 to CH8, Math5 to Math8
- The available channel settings on 4ch models are as follows:
  XY1 and XY2: CH1 to CH4, Math1 to Math4

XY Waveform Display (XY Window), VT Waveform Display (VT Window), XY Window Splitting



XY window (split display off)
XY1 to XY4 waveforms are displayed in the same window.



XY window (split display on)
XY1 to XY4 waveforms whose display is turned on are displayed in order starting with the left XY window, then the right XY window, then the left XY window, and so on.

Measurement Source Window (Time Range) and Display Range (T Range1/T Range2)

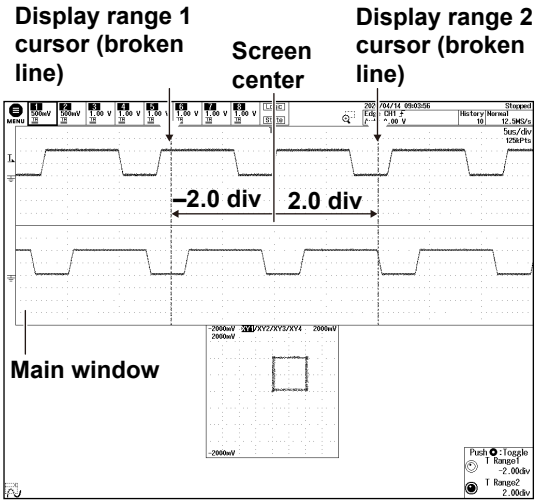
1. Press the **Time Range** soft key to select the measurement source window.
2. Turn the **jog shuttle** to set the display range.
   - Press **SET** (upper right on the front panel) to switch between display range 1 (start point) and display range 2 (end point).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



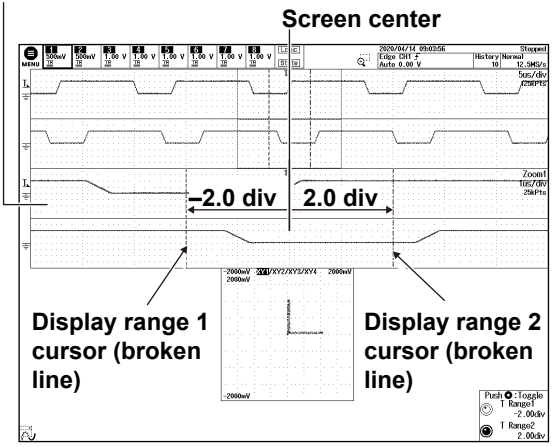
Display range 1 (start point)
Display range 2 (end point)

Measurement Source Window and Display Range



When the source window is Main
The XY waveform in the range enclosed by the display range cursor on the main window is displayed.

Zoom1 window ▶section 10.1



When the source waveform is Zoom1 to Zoom2
The XY waveform in the range enclosed by the display range cursor on the zoom window is displayed. The display range cursor cannot be moved outside the zoom window range.

5.2 Performing Cursor Measurements and Area Calculations

This section explains the following settings for determining cursor measurement values and the area of the displayed XY waveform:

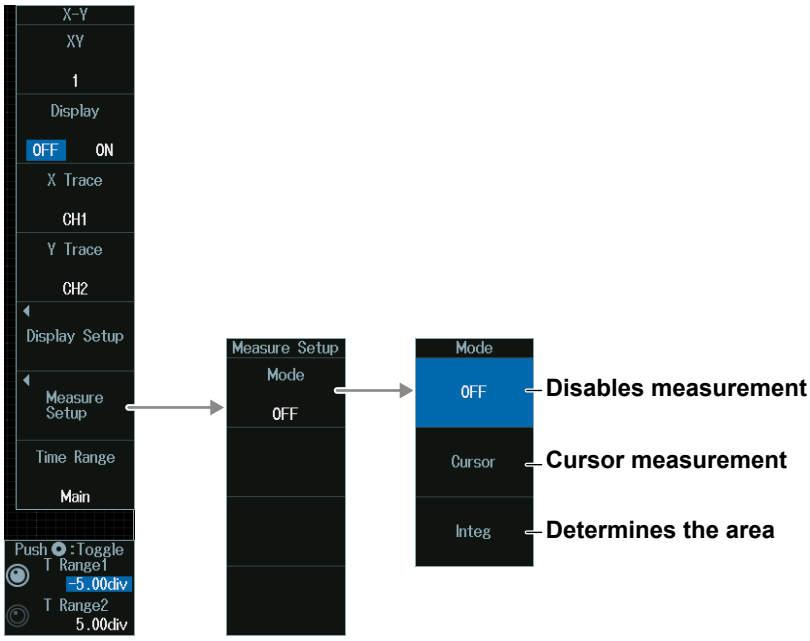
- Cursor measurements on the XY waveform display
- How to calculate the area of XY waveforms

► "Measurement Setup (Measure Setup)" in the Features Guide

XY Menu

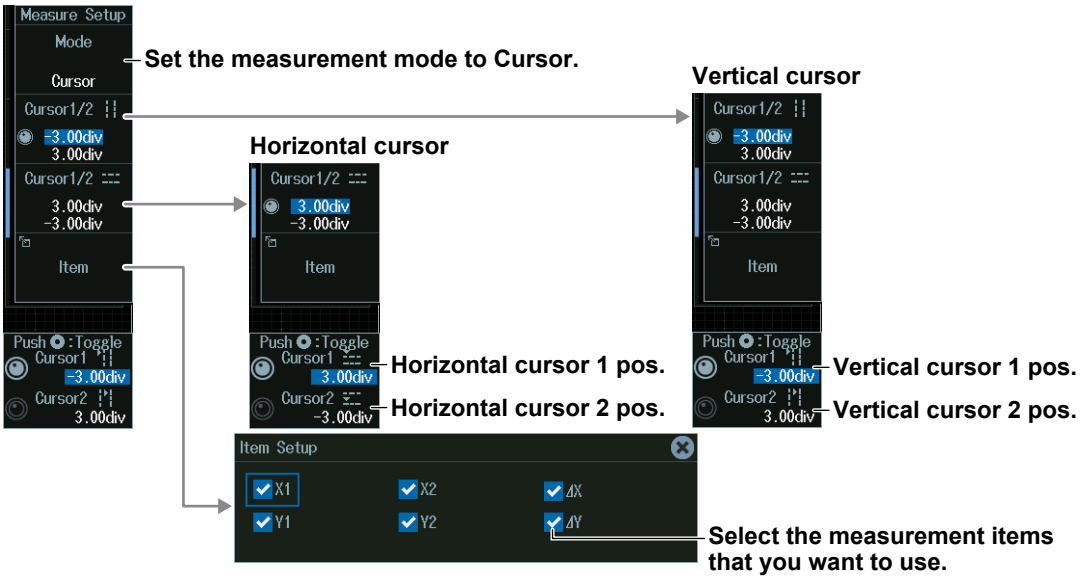
Press **SHIFT+DISPLAY (X-Y)** to display the X-Y menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the X-Y menu from ACQ/DISP on the top menu that is displayed.

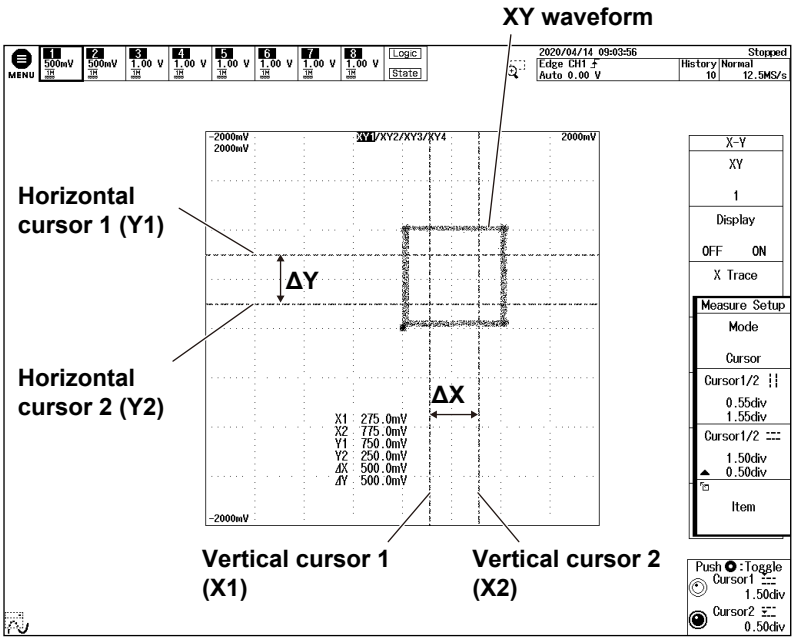


Cursor Measurement (Cursor)

Press the **Cursor** soft key to display the following menu.



Cursor Measurements on the XY Waveform Display



Vertical Cursor Position (Cursor1¦¦/Cursor2¦¦)

1. Press the **Cursor1/2¦¦** soft key.
2. Turn the **jog shuttle** to set vertical cursor 1 (Cursor1¦¦) or vertical cursor 2 (Cursor2¦¦).
   - Press **SET** (upper right on the front panel) to switch between vertical cursor 1 and vertical cursor 2.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Vertical cursor 1 position

Vertical cursor 2 position

Note

Setting the Vertical Cursor Positions

If you press SET several times and make the jog shuttle control both vertical cursor 1 and vertical cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen.

Horizontal Cursor Position (Cursor1===/Cursor2===)

1. Press the **Cursor1/2===** soft key.
2. Turn the **jog shuttle** to set horizontal cursor 1 (Cursor1===) or horizontal cursor 2 (Cursor2===).
   - Press **SET** (upper right on the front panel) to switch between horizontal cursor 1 and horizontal cursor 2.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Horizontal cursor 1 position

Horizontal cursor 2 position

Note

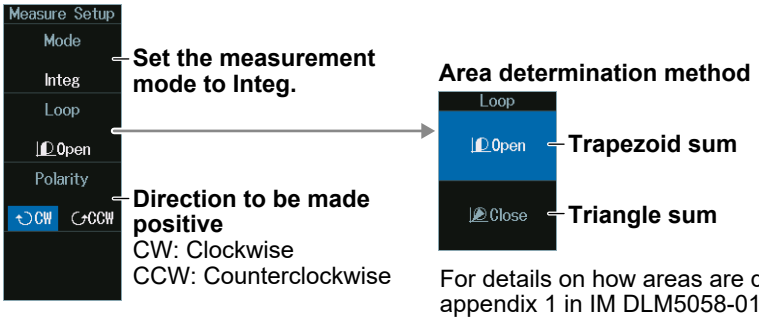
Setting the Horizontal Cursor Positions

If you press SET several times and make the jog shuttle control both horizontal cursor 1 and horizontal cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen.

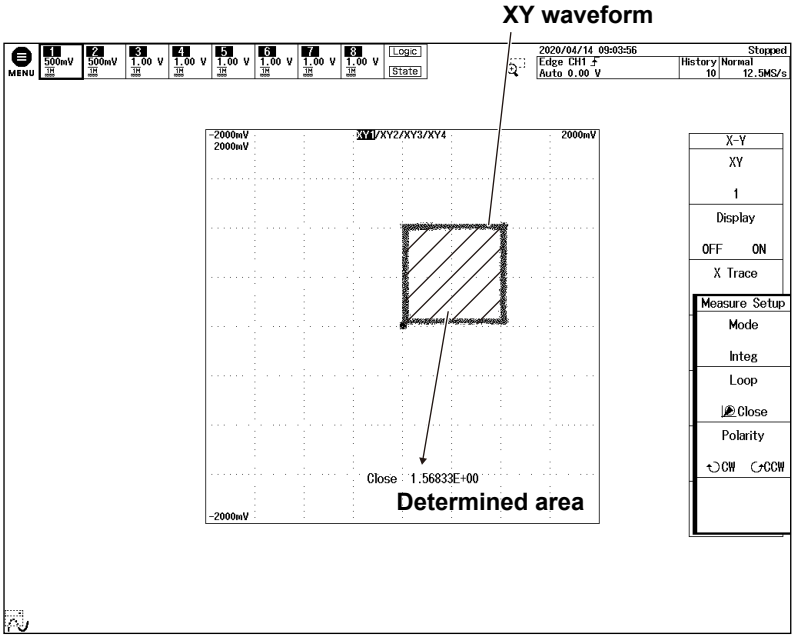
Performing Area Calculations (Integ)

Press the **Integ** soft key to display the following menu.



For details on how areas are determined, see appendix 1 in IM DLM5058-01EN.

Area of XY Waveforms



6.1 Setting the Computation Mode

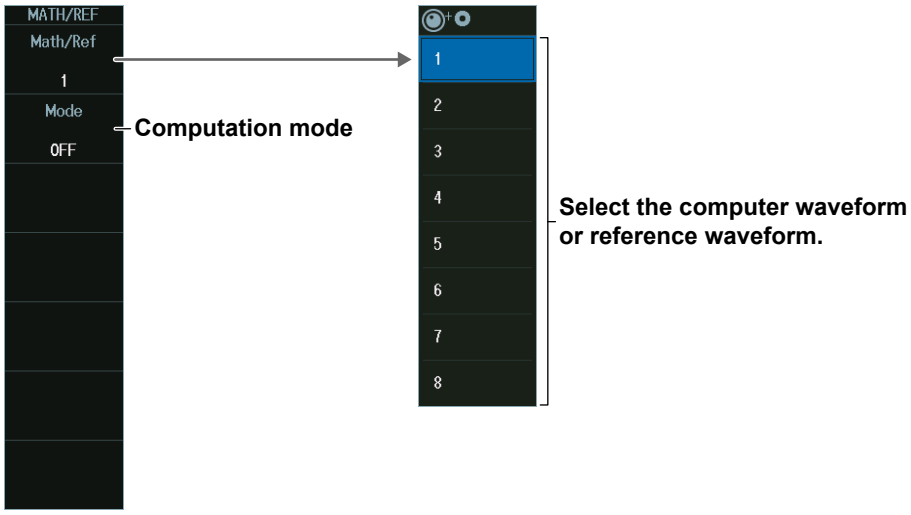
This section explains how to set the computation mode.

► “Computation Mode (Mode)” in the Features Guide

MATH/REF Menu

Press **MATH/REF** to display the following menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the MATH/REF menu from ANALYSIS on the top menu that is displayed.



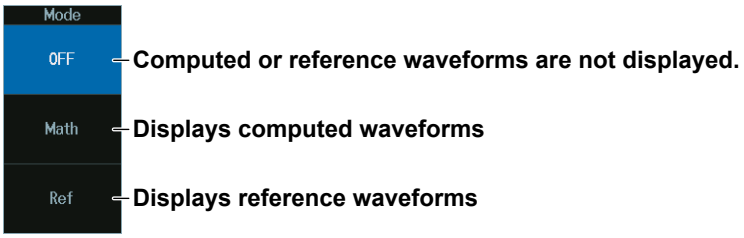
Note

Computed Waveforms or Reference Waveform (Math/Ref)

- The available settings vary depending on the model.
  - 8ch models: Math/Ref1 to Math/Ref8
  - 4ch models: Math/Ref1 to Math/Ref4
- Computed waveforms (MATH waveforms) are not displayed while acquiring waveforms in single mode. The instrument will display computed waveforms after it triggers and the roll mode display stops.
- On the ACQUIRE menu, if you set the record length (Record Length) to the maximum record length, Math/Ref2, Math/Ref4, Math/Ref6, and Math/Ref8 cannot be used. For details on the ACQUIRE menu, see section 3.1.

Computation Mode (Mode)

Press the **Mode** soft key to display the following menu.



6.2 Performing Addition, Subtraction, and Multiplication

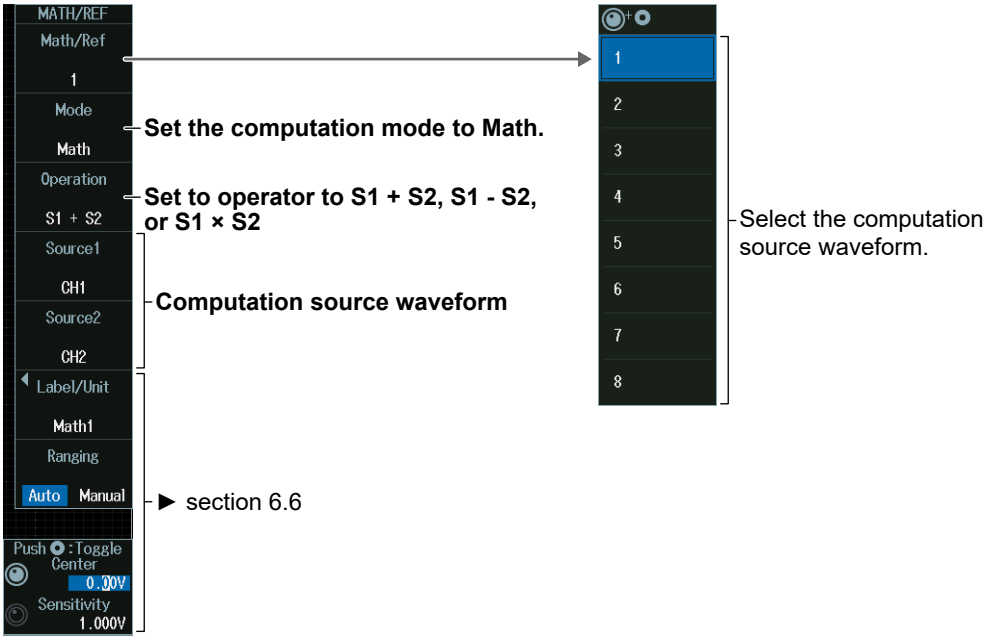
This section explains the following settings for performing addition, subtraction, and multiplication:

- Operators
- Computation source waveforms

► "Operators (Operation)" in the Features Guide

MATH/REF Menu

1. Press **MATH/REF** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the MATH/REF menu from ANALYSIS on the top menu that is displayed.
2. Press the **Mode** soft key and then the **Math** soft key.
3. Press the **Operation** soft key, and then the **S1 + S2**, **S1 - S2**, or **S1 x S2** soft key to display the following menu.



Math Source Waveforms (Source1 and Source2)

Below are the computation source waveforms that you can assign to Source1 and Source2.

Model	Computed Waveform (Waveform of Computer Result)	Computation Source Waveforms That You Can Assign to Source1 and Source2
8ch	Math1	CH1 to CH4
	Math2	CH1 to CH4, Math1
	Math3	CH1 to CH4, Math1, Math2
	Math4	CH1 to CH4, Math1 to Math3
	Math5	CH5 to CH8
	Math6	CH5 to CH8, Math5
	Math7	CH5 to CH8, Math5, Math6
	Math8	CH5 to CH8, Math5 to Math7
4ch	Math1	CH1 to CH4
	Math2	CH1 to CH4, Math1
	Math3	CH1 to CH4, Math1, Math2
	Math4	CH1 to CH4, Math1 to Math3

6.3 Performing Filter Functions

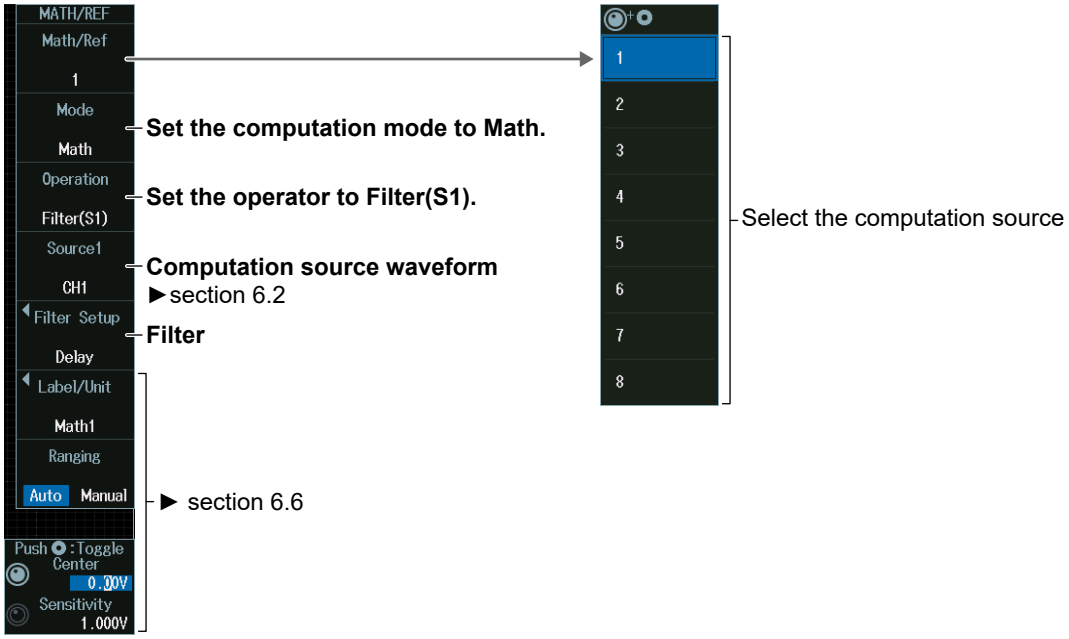
This section explains the following settings for applying filter functions (phase shift, moving average, IIR filter):

- Operators
- Computation source waveforms
- Filter

► "Operators (Operation)" in the Features Guide

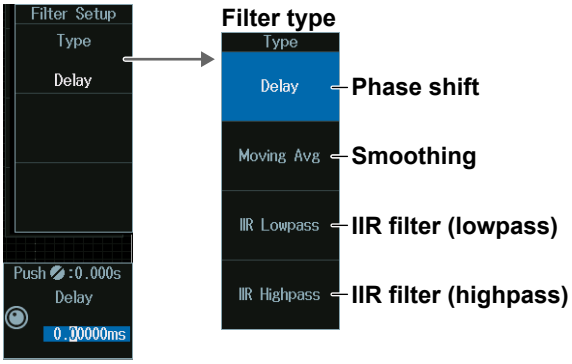
MATH/REF Menu

1. Press **MATH/REF** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the MATH/REF menu from ANALYSIS on the top menu that is displayed.
2. Press the **Mode** soft key and then the **Math** soft key.
3. Press the **Operation** soft key and then the **Filter (S1)** soft key to display the following menu.



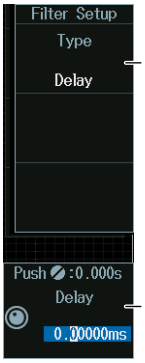
Filter (Filter Setup)

Press the **Filter Setup** soft key, then the **Type** soft key to display the following menu.



Phase Shifting (Delay)

Press the **Delay** soft key to display the following menu.

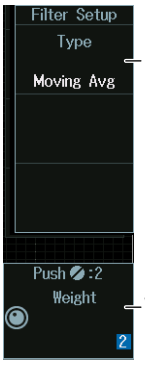


Set the filter type to Delay.

Delay

Smoothing (Moving Avg)

Press the **Moving Avg** soft key to display the following menu.

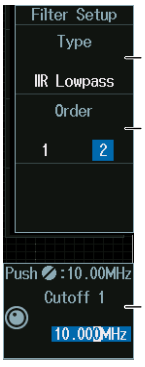


Set the filter type to Moving Avg.

Weighted points

IIR Filter (IIR Lowpass/IIR Highpass)

Press the **IIR Lowpass** or **IIR Highpass** soft key to display the following menu.



Set the filter type to IIR Lowpass or IIR Highpass.

Filter order

Cutoff frequency

6.4 Performing Integration

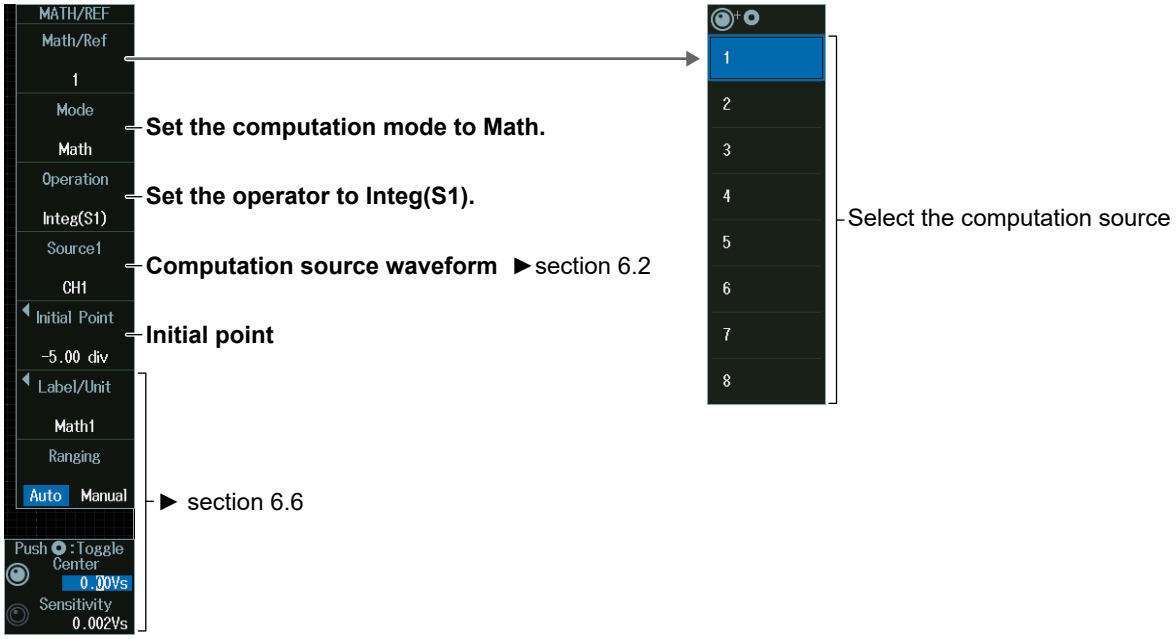
This section explains the following settings for performing integration:

- Operators
- Computation source waveforms
- Initial point

► "Operators (Operation)," "Initial Point (Initial Point)" in the Features Guide

MATH/REF Menu

1. Press **MATH/REF** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the MATH/REF menu from ANALYSIS on the top menu that is displayed.
2. Press the **Mode** soft key and then the **Math** soft key.
3. Press the **Operation** soft key and then the **Integ(S1)** soft key to display the following menu.



Initial Point

Press the **Initial Point** soft key to display the following menu.



6.5 Performing Count Computations

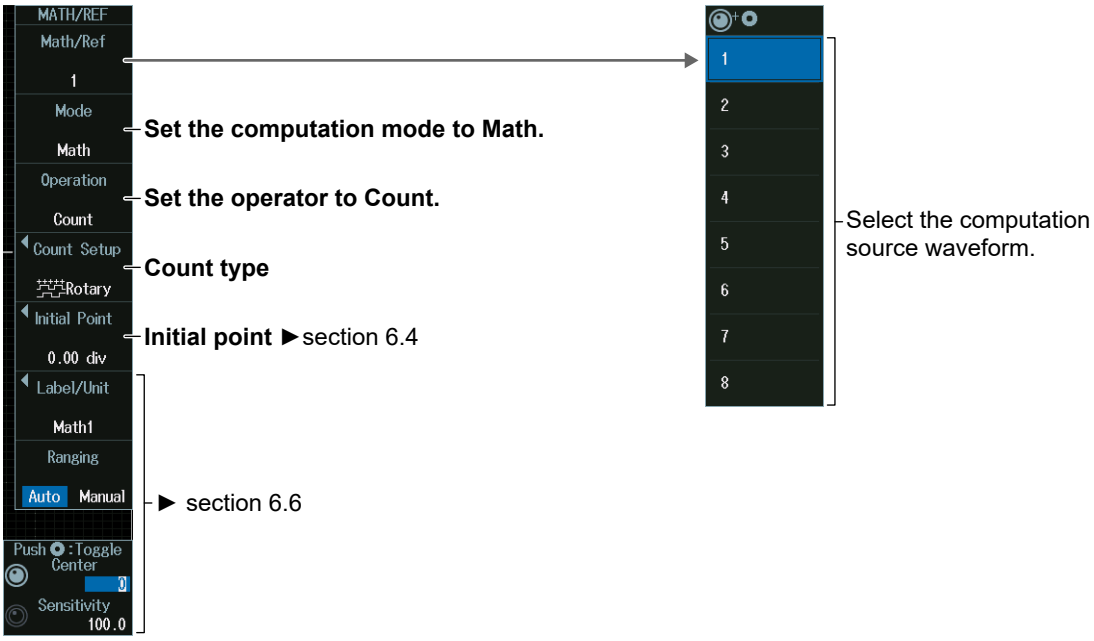
This section explains the following settings for performing edge count or rotary count:

- Operators
- Initial Point
- Count type
  Computation source waveform, polarity, level for detecting edges, rotary count threshold level, hysteresis

► “Operators (Operation),” “Edge Count or Rotary Count (Count)” in the Features Guide

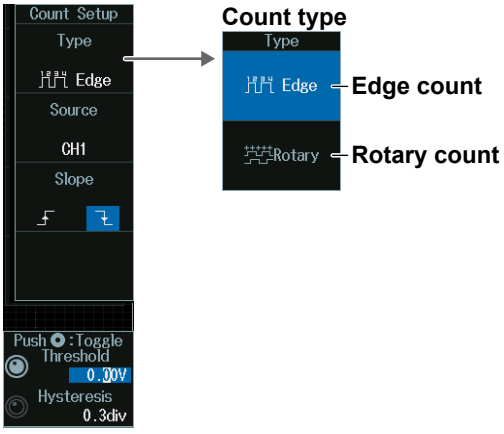
MATH/REF Menu

1. Press **MATH/REF** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the MATH/REF menu from ANALYSIS on the top menu that is displayed.
2. Press the **Mode** soft key and then the **Math** soft key.
3. Press the **Operation** soft key and then the **Count(S1)** soft key to display the following menu.



Count Type (Type)

Press the **Count Setup** soft key, then the **Type** soft key to display the following menu.



Edge Count (Edge)

Press the **Edge** soft key to display the following menu.



Computation source waveform ►section 6.2

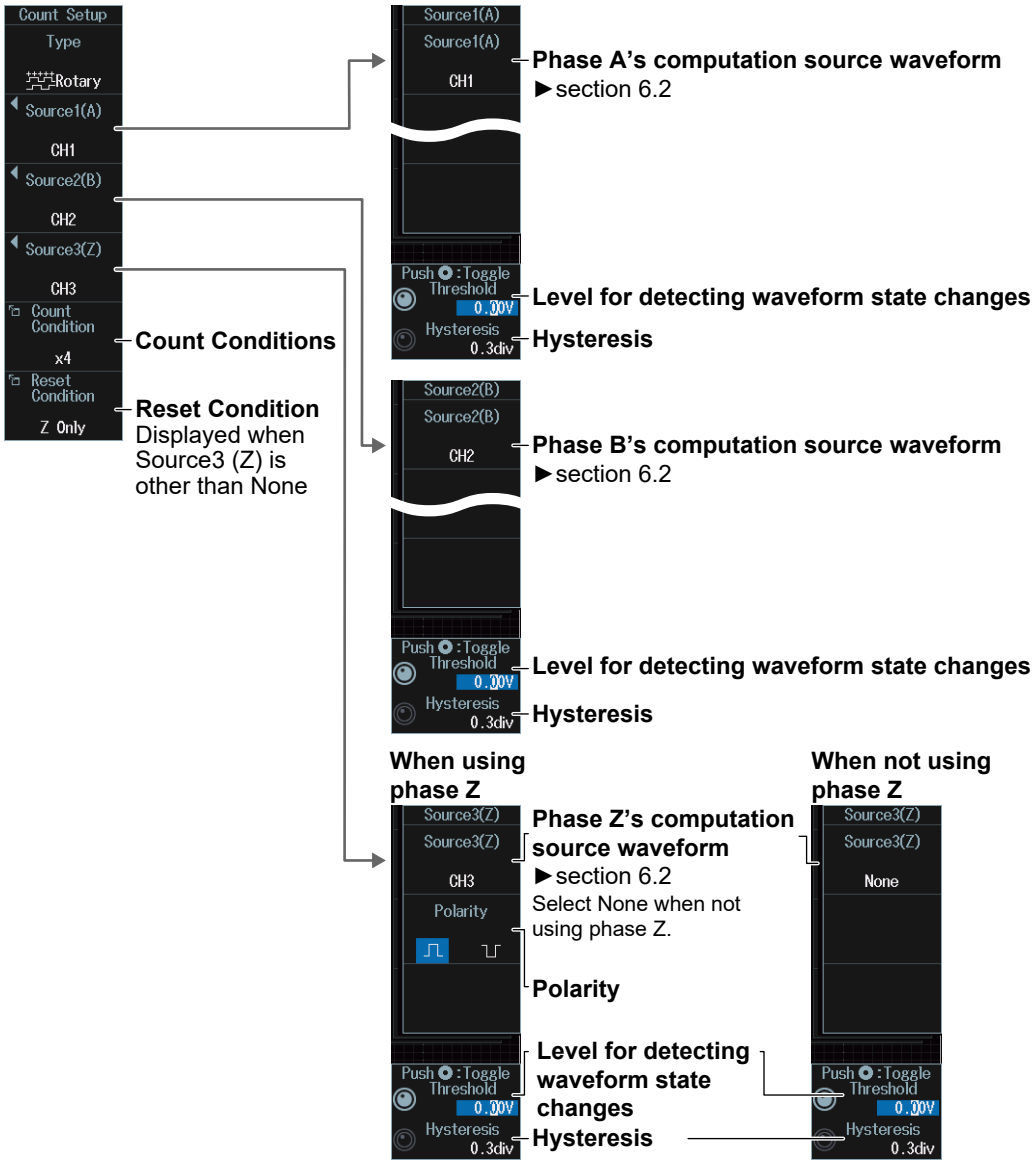
Polarity

Level used to detect edges

Hysteresis

Rotary Count (Rotary)

Press the **Rotary** soft key to display the following menu.



Phase A's computation source waveform ►section 6.2

Level for detecting waveform state changes

Hysteresis

Count Conditions

Reset Condition
Displayed when Source3 (Z) is other than None

Phase B's computation source waveform ►section 6.2

Level for detecting waveform state changes

Hysteresis

Phase Z's computation source waveform ►section 6.2
Select None when not using phase Z.

Polarity

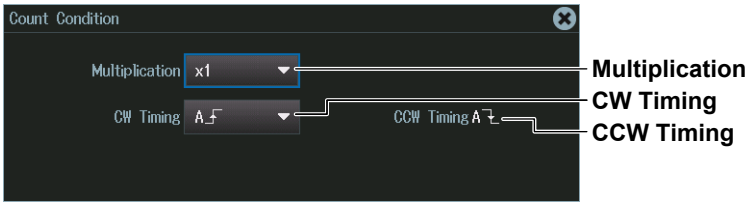
Level for detecting waveform state changes

Hysteresis

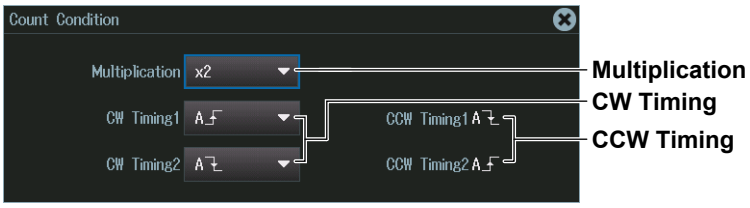
Count Conditions (Count Condition)

Press the **Count Condition** soft key. The following menu items appear.

When multiplication is set to x1



When multiplication is set to x2



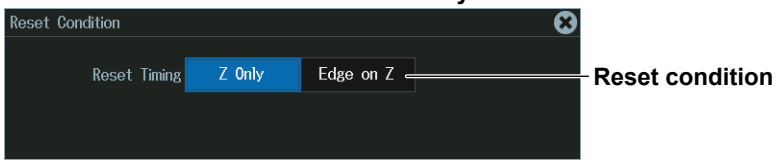
When multiplication is set to x4



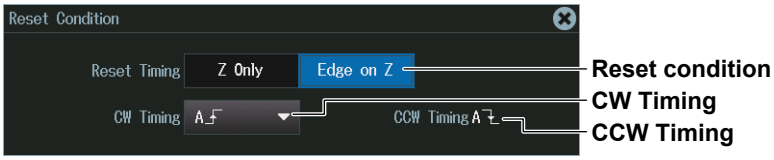
Reset Condition (Reset Condition)

Press the **Reset Condition** soft key. The following menu items appear.

When the reset condition is set to Z Only



When the reset condition is set to Edge on Z



6.6 Setting Labels, Units, and Scaling

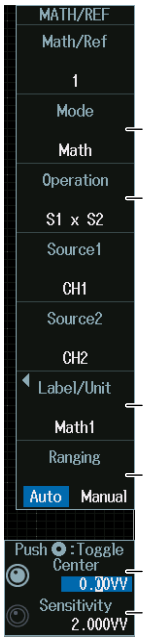
This section explains the following labels, units, and scaling settings:

- Labels and units
- Scaling

► **"Setting Labels and Units (Label/Unit)," "Scaling (Ranging)" in the Features Guide**

MATH/REF Menu

1. Press **MATH/REF** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the MATH/REF menu from ANALYSIS on the top menu that is displayed.
2. Press the **Mode** soft key and then the **Math** soft key.
3. Press the **Operation** soft key and then a soft key other than the **User Define** soft key to display the following menu.



Set the computation mode to Math.

Set the operator to other than User Define.

Labels and units

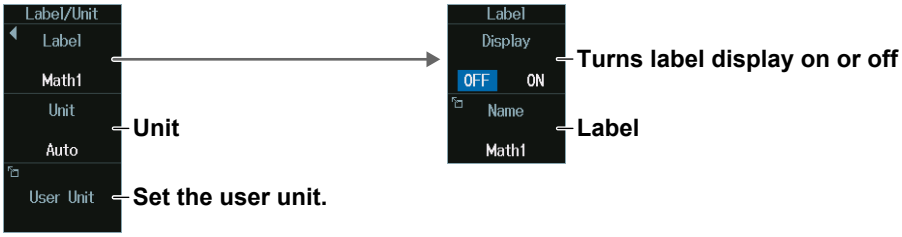
Scaling

Center point and the sensitivity (when scaling is Manual)

- **Center point**
- **Sensitivity**

Labels and Units (Label/Unit)

Press the **Label/Unit** soft key to display the following menu.



Turns label display on or off

Unit

Label

Set the user unit.

Scaling (Ranging)

Auto: Automatically set the vertical display range of the computed waveform.

Manual: Manually set the sensitivity (Sensitivity) and the signal level at the vertical center (Center).

6.7 Loading Reference Waveforms

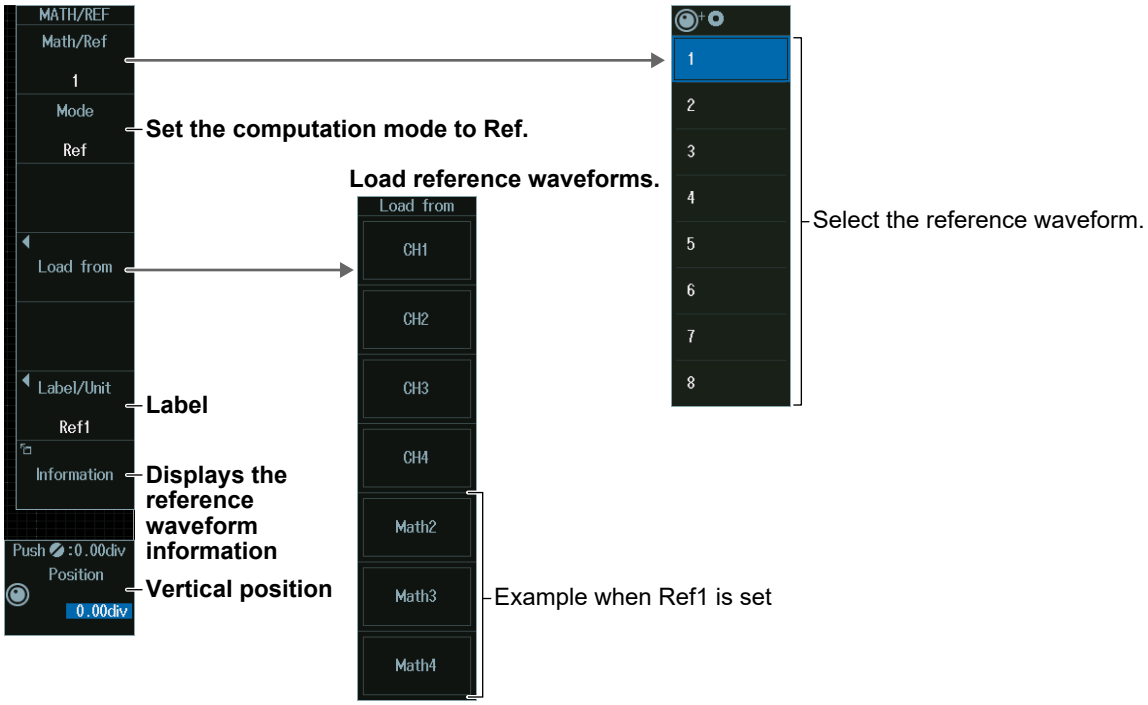
This section explains the following settings for loading reference waveforms:

- Loading reference waveforms
- Label
- Displaying the reference waveform information
- Vertical Position

► “Reference Waveforms” in the Features Guide

MATH/REF Menu

1. Press **MATH/REF**.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the MATH/REF menu from ANALYSIS on the top menu that is displayed.
2. Press the **Mode** soft key and then the **Ref** soft key to display the following menu.



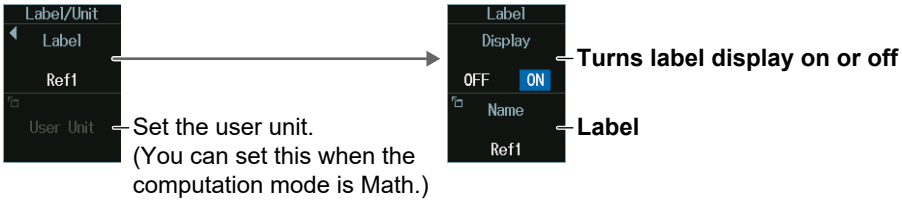
Loading the Reference Waveform (Load from)

Waveforms that can be assigned to (loaded into) the reference waveform are as follows:

Model	Reference waveform	Waveforms that can be assigned to the reference waveform
8ch	Ref1	CH1 to CH4, Math2 to Math4
	Ref2	CH1 to CH4, Math1, Math3, Math4
	Ref3	CH1 to CH4, Math1, Math2, Math4
	Ref4	CH1 to CH4, Math1 to Math3
	Ref5	CH5 to CH8, Math6 to Math8
	Ref6	CH5 to CH8, Math5, Math7, Math8
	Ref7	CH5 to CH8, Math5, Math6, Math8
	Ref8	CH5 to CH8, Math5 to Math7
4ch	Ref1	CH1 to CH4, Math2 to Math4
	Ref2	CH1 to CH4, Math1, Math3, Math4
	Ref3	CH1 to CH4, Math1, Math2, Math4
	Ref4	CH1 to CH4, Math1 to Math3

Label (Label)

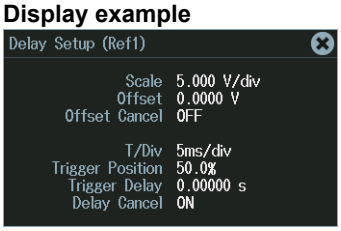
Press the **Label/Unit** soft key to display the following menu.



Reference Waveform Information Display (Information)

Press the **Information** soft key to display the reference waveform information.

Display example



6.8 Performing User-Defined Computations (Optional)

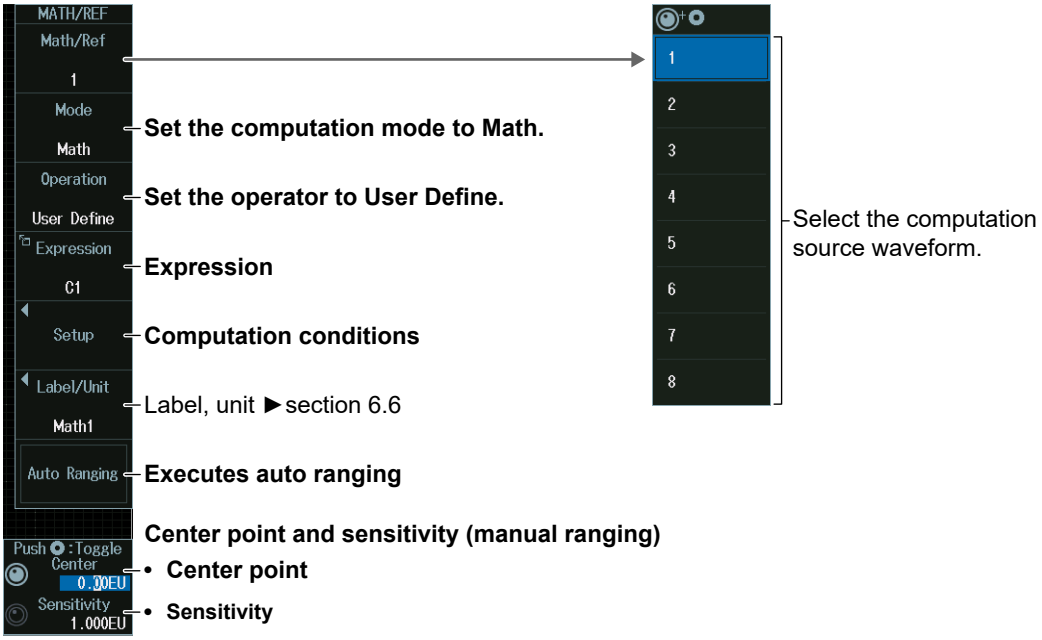
This section explains the following settings for performing user-defined computations:

- Operators
- Expression
- Computation conditions
- Labels and units
- Executing auto ranging

► "User-Defined Computation (User Define, Option)" in the Features Guide

MATH/REF Menu

1. Press **MATH/REF** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the MATH/REF menu from ANALYSIS on the top menu that is displayed.
2. Press the **Mode** soft key and then the **Math** soft key.
3. Press the **Operation** soft key and then the **User Define** soft key to display the following menu.



Expression (Expression)

Press the **Expression** soft key to display the following screen.

Define an expression by combining computation source waveforms and operators.

Add the results of automated measurement of waveform parameters to the expression.



Inserts a)

Moves the cursor to the left

Moves the cursor to the right

Deletes the character at the cursor position

Deletes the previous character

Deletes all characters

Enters the expression

Model	Computed waveform	Options
8ch	Math1	None
	Math2	M1
	Math3	M1 to M2
	Math4	M1 to M3
	Math5	M1 to M4
	Math6	M1 to M5
	Math7	M1 to M6
	Math8	M1 to M7

Model	Computed waveform	Options
4ch	Math1	None
	Math2	M1
	Math3	M1 to M2
	Math4	M1 to M3

Computation Conditions (Setup)

Press the **Setup** soft key to display the following menu.



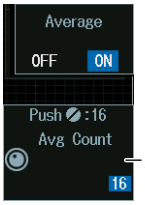
Performs computations on history waveforms.

Constants

Digital filter

Turns averaging on or off
(This setting is shared by computed waveforms.)

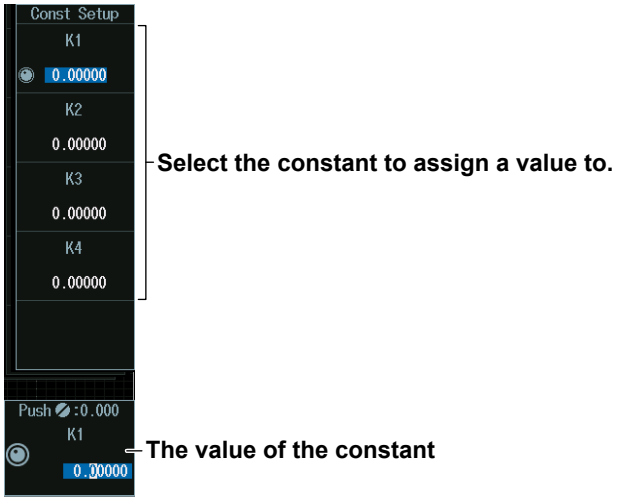
When Averaging Is On



Average count

Constant (Const Setup)

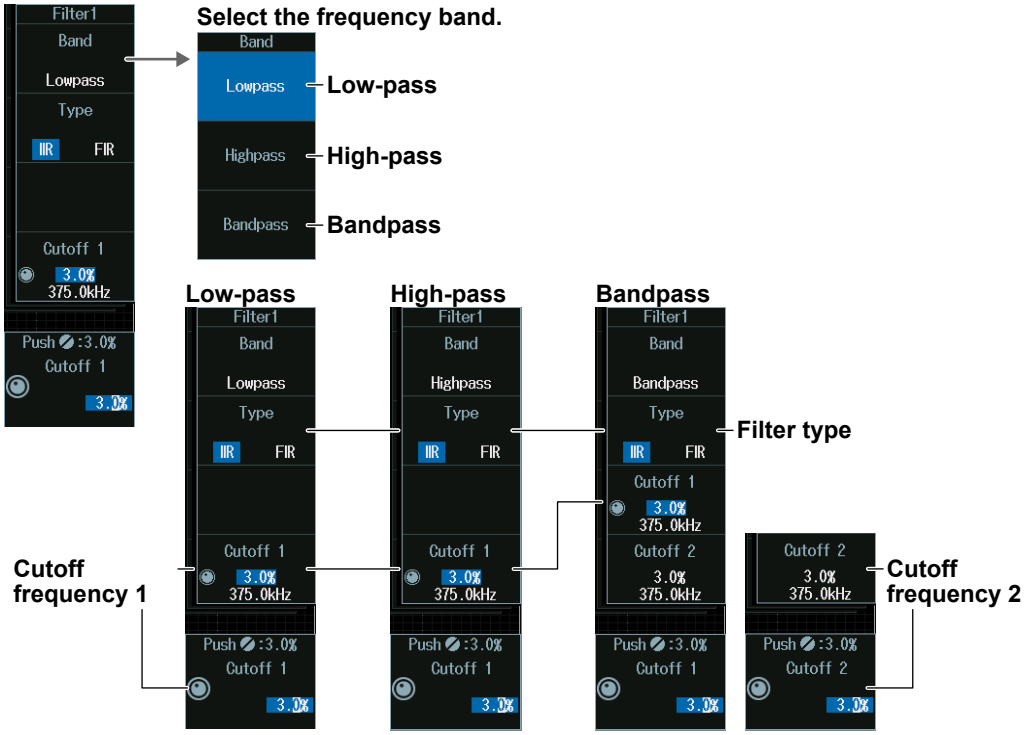
Press the **Const Setup** soft key to display the following menu.



Digital Filter (Filter1/Filter2)

Press the **Filter1** or **Filter2** soft key to display the following menu.

Filter1 example



Set **Filter2** in the same manner.

7.1 Displaying FFT Waveforms

This section explains the following settings for performing FFT analysis:

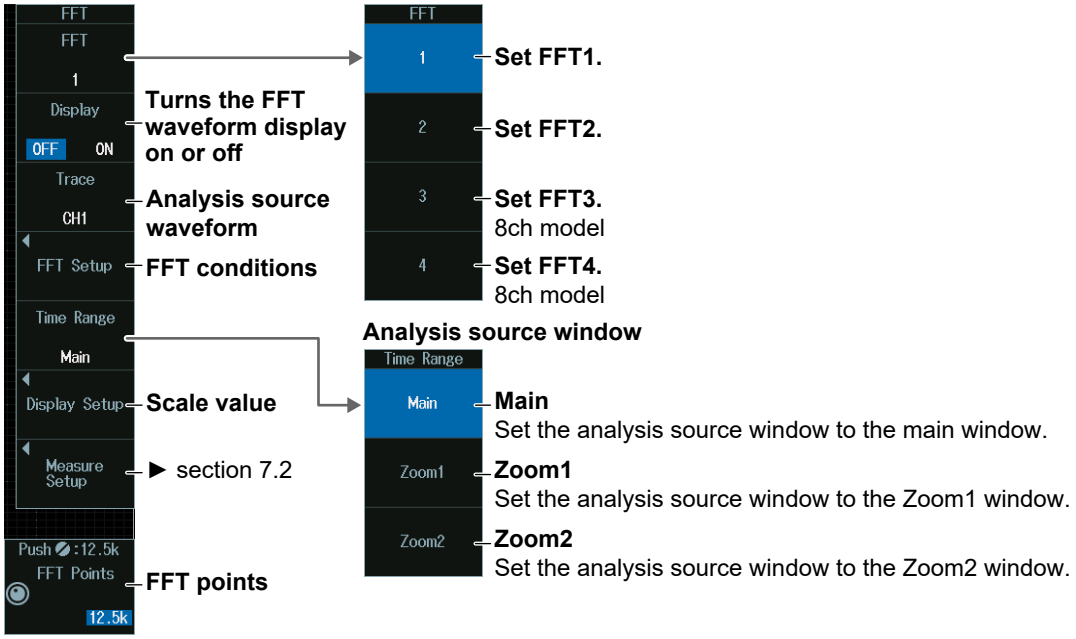
- Turning FFT waveform display on or off
- Analysis source waveform
- FFT conditions
- Analysis range
- Vertical and horizontal scale values
- FFT points

► "FFT" in the Features Guide

FFT Menu

Press **SHIFT+MATH/REF (FFT)** to display the following menu.

- You can also tap **MENU** (MENU) in the upper left of the screen and select the FFT menu from ANALYSIS on the top menu that is displayed.
- Up to four FFT waveforms can be displayed (two on 4ch models). To switch the setup menu, press the **FFT** soft key.



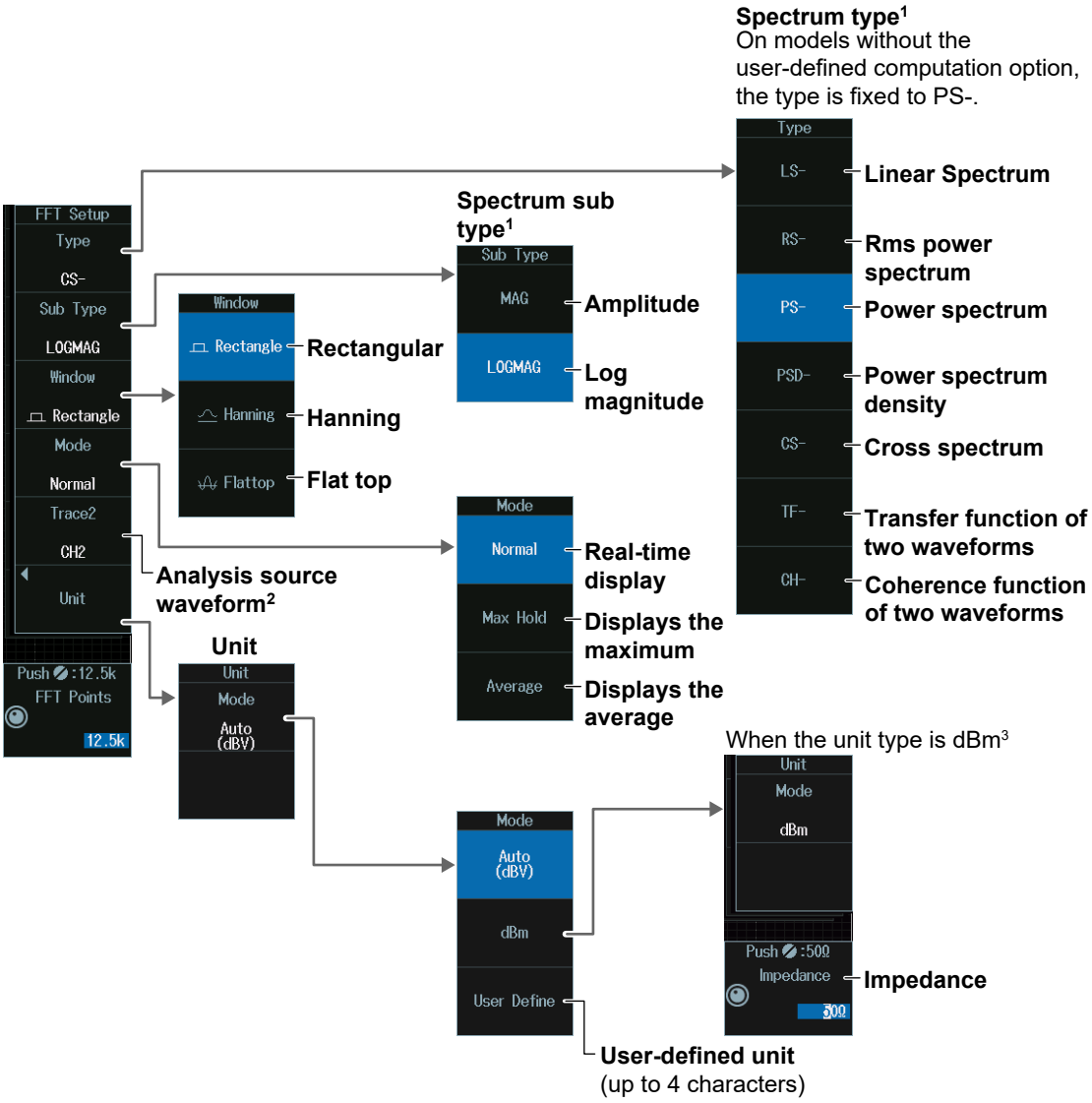
Note

The available analysis source waveform settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8
- The available settings on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4

FFT Conditions (FFT Setup)

Press the **FFT Setup** soft key to display the following menu.



1 This is available only on models with the user-defined computation option.

2 Can only be set when Type is CS-, TF-, or CH-.

3 This is available only when Type is set to PS–, Sub Type is set to LOGMAG, and the unit of the analysis source waveform (Trace) is “V.”

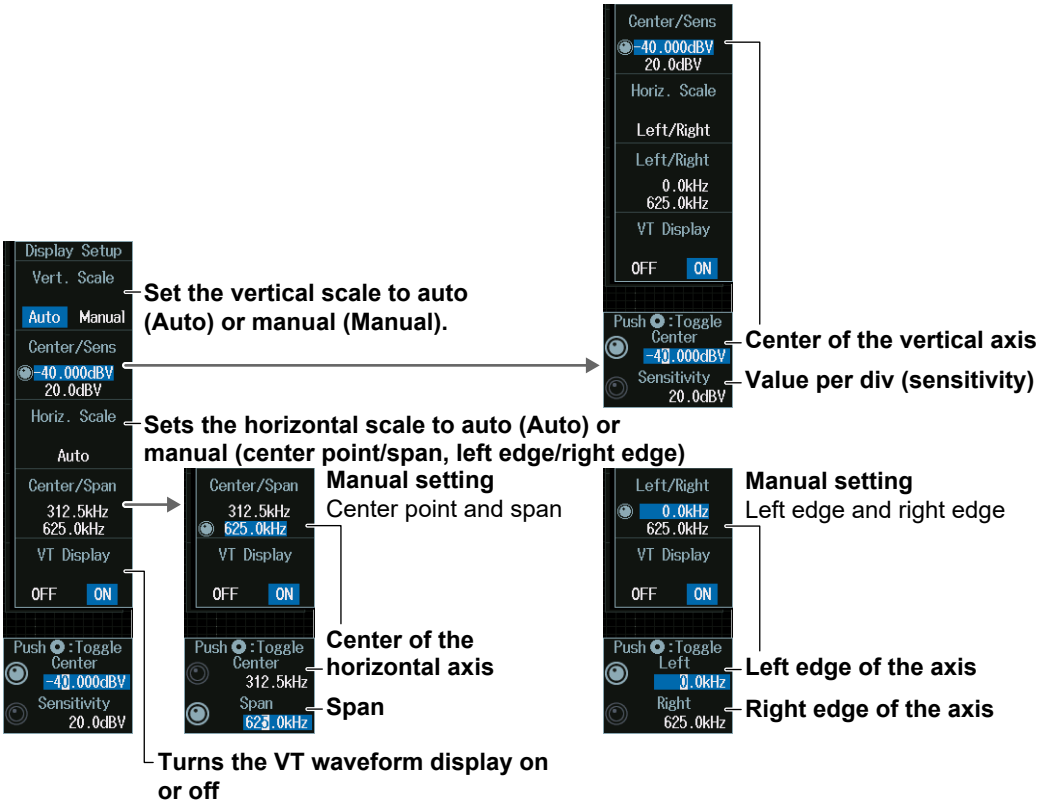
Spectrum Type (Type/Sub Type)

The sub types that you can set are as follows according to type.

Type	Sub Type
LS-, CS-, TF-	MAG, LOGMAG, PHASE, REAL, IMAG
RS-, PS-, SPD-	MAG, LOGMAG
CH-	MAG

Scale Value (Display Setup)

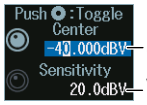
Press the **Display Setup** soft key to display the following menu.



Manually Setting the Vertical Scale (Vert. Scale)

1. Press the **Vert. Scale** soft key to select Manual.
2. Press the **Center/Sens** soft key.
3. Turn the **jog shuttle** to set the center point (Center) of the vertical scale or the value per division (Sensitivity).
   - Press **SET** (upper right on the front panel) to switch between the center point of the vertical scale and the value per division.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Manually Setting the Horizontal Scale (Horiz. Scale)

1. Press the **Horiz. Scale** soft key to select Center/Span or Left/Right.
2. Press the **Center/Span** or **Left/Right** soft key.
3. Turn the **jog shuttle** to set the center point (Center) of the horizontal scale or the left edge of the scale (Left), or the span (Span) or the right edge of the scale (Right).
   - Press **SET** (upper right on the front panel) to switch between the center point (Center) of the horizontal scale or the left edge of the scale (Left) and the span (Span) or the right edge of the scale (Right).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When horizontal scale is set to Center/Span



Center of the horizontal axis

Span

When horizontal scale is set to Left/Right



Left edge of the axis

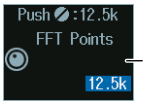
Right edge of the axis

Number of FFT Points (FFT Points)

Turn the **jog shuttle** to set the number of FFT Points (FFT Points).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



FFT points

Note

Relationship between the Number of FFT Points and Number of Displayed Points (Display Record Length)

Depending on the number of displayed points in the window that you select using the analysis range (Time Range) setting, the actual number of FFT points may be different from the number of FFT points that you selected.

- Number of FFT points < number of display points
  Display points are decimated to match the number of FFT points. The FFT may not cover the entire display range.
- Number of FFT points > number of display points
  The number of FFT points is adjusted to an appropriate number less than or equal to the number of displayed points.

7.2 Measuring FFT Waveforms

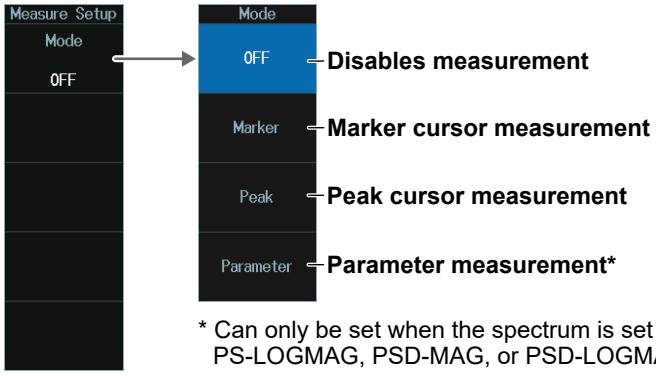
This section explains the following settings for measuring FFT waveforms:

- Measurement mode
- Marker cursor measurement
- Peak cursor measurement
- Parameter measurement

► “Measurement (Measure Setup)” in the Features Guide

FFT Measure Setup Menu

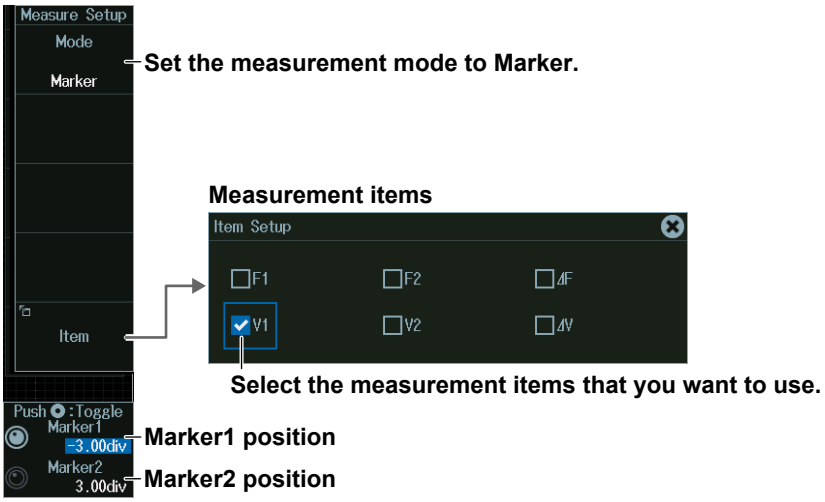
1. Press **SHIFT+MATH/REF (FFT)** to display the FFT menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the FFT menu from ANALYSIS on the top menu that is displayed.
2. Press the **Measure Setup** soft key to display the following menu.



* Can only be set when the spectrum is set to PS-MAG, PS-LOGMAG, PSD-MAG, or PSD-LOGMAG.

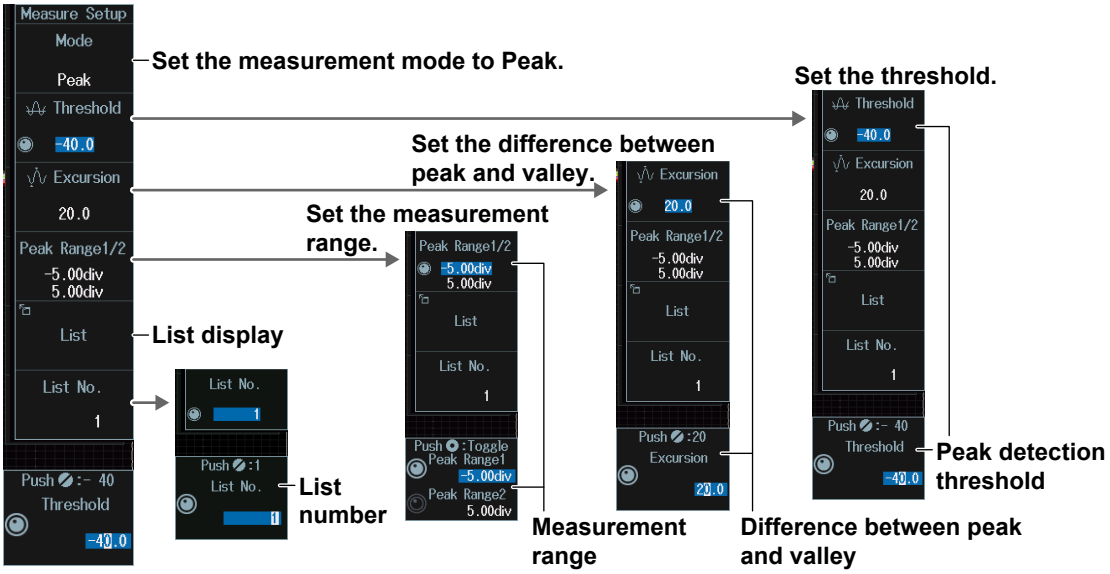
Marker Cursor Measurement (Marker)

Press the **Mode** soft key and then the **Marker** soft key to display the following menu.



Peak Cursor Measurement (Peak)

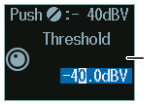
Press the **Mode** soft key and then the **Peak** soft key to display the following menu.



Peak Detection Threshold (Threshold)

1. Press the **Threshold** soft key.
2. Turn the **jog shuttle** to set the peak detection threshold (Threshold).
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Difference between Peak and Valley (Excursion)

1. Press the **Excursion** soft key.
2. Turn the **jog shuttle** to set the difference between peak and valley (excursion).
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Measurement Range (Peak Range1/2)

1. Press the **Peak Range1/2** soft key.
2. Turn the **jog shuttle** to set the start point (Peak Range1) and the end point (Peak Range2) of the measurement range.

   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Start point of the measurement range

End point of the measurement range

List Number (List No.)

1. Press the **List No.** soft key.
2. Turn the **jog shuttle** to set the list number (List No.).
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



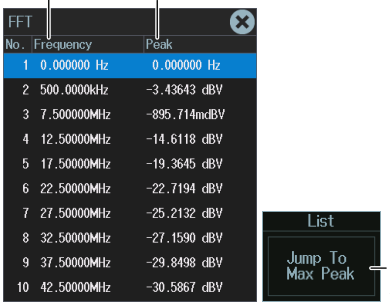
List number

List Display (List)

Press the **List** soft key to display the following screen.

Frequency of each spectrum

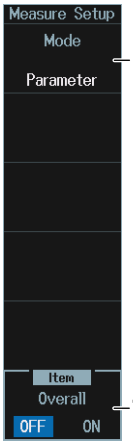
Peak value of each spectrum



Displays the spectrum at the maximum peak value with a cursor

Parameter Measurement (Parameter)

Press the **Mode** soft key and then the **Parameter** soft key. The following menu items appear.



Set the measurement mode to Parameter.

Turns the overall value on and off

8.1 Measuring with ΔT Cursors

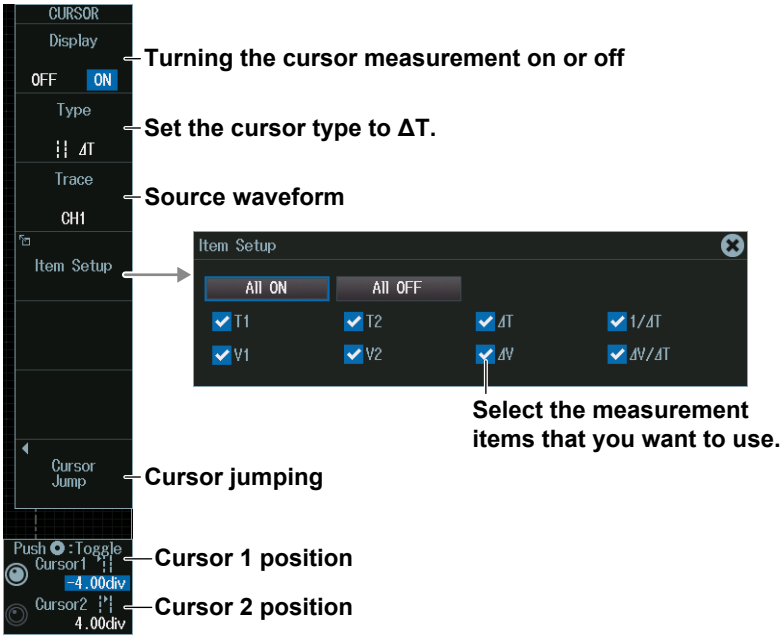
This section explains the following settings for measuring with ΔT cursors:

- Turning cursor measurement on or off
- Cursor type
- Source waveform
- Measurement items
- Cursor jumping
- Cursor position

► "ΔT Cursors (ΔT)" in the Features Guide

CURSOR Menu

1. Press **CURSOR** to display the CURSOR menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the CURSOR menu from MEASURE on the top menu that is displayed.
2. Press the **Type** soft key and then the **ΔT** soft key to display the following menu.



Note

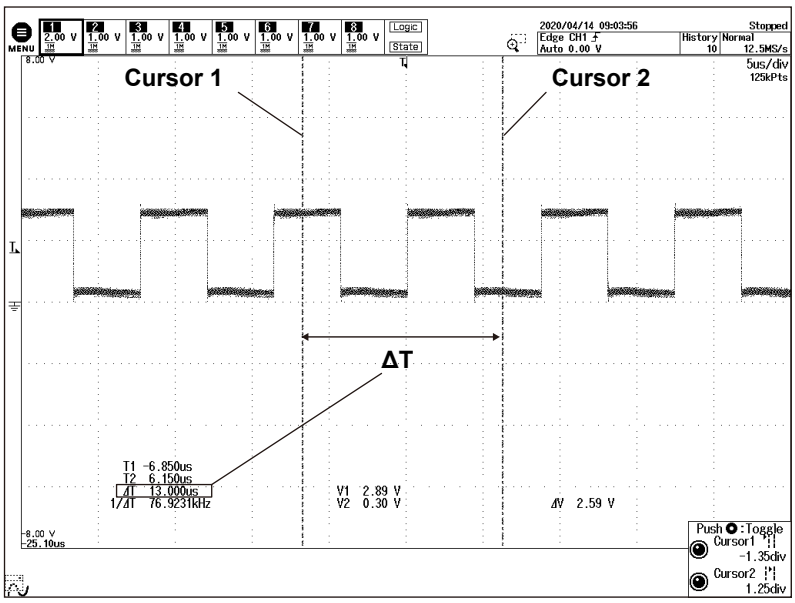
Measurement Source Waveform (Trace)

The available channel settings vary depending on the model and options.

- The available channel settings on 8ch models are as follows:
  All, CH1 to CH8, Logic, Math1 to Math8, LOGIC
- The available channel settings on 4ch models are as follows:
  All, CH1 to CH4, Logic, Math1 to Math4, LOGIC

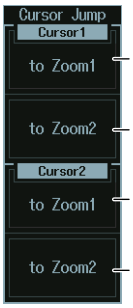
ΔT Cursor Measurement

You can measure time values using two ΔT cursors.



Cursor Jumping (Cursor Jump)

Press the **Cursor Jump** soft key to display the following menu.



Moves cursor 1 into the Zoom1 window

Moves cursor 1 into the Zoom2 window

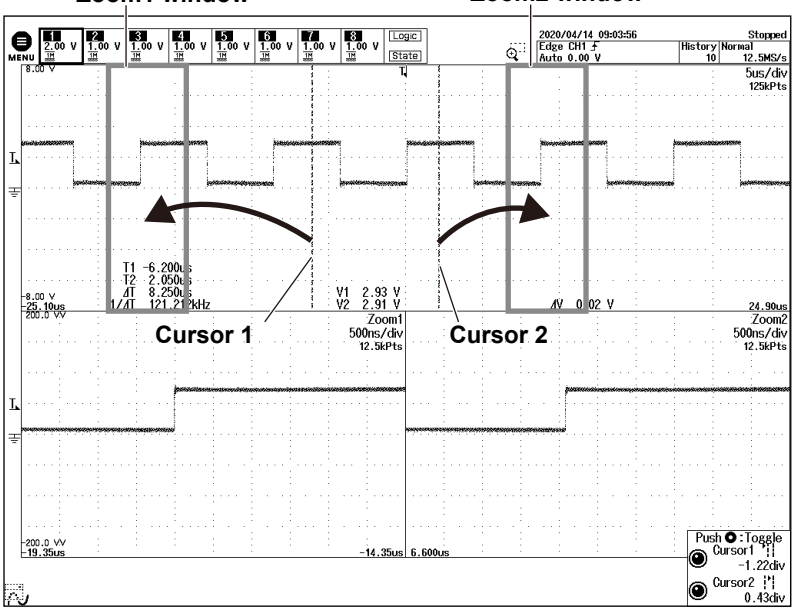
Moves cursor 2 into the Zoom1 window

Moves cursor 2 into the Zoom2 window

Cursor Jumping

Display range of the Zoom1 window

Display range of the Zoom2 window



Cursor Positions (Cursor1/Cursor2)

Turn the **jog shuttle** to set cursor 1 (Cursor1) or cursor 2 (Cursor2).

- Press **SET** (upper right on the front panel) to switch between cursor 1 and cursor 2.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Cursor 1 position

Cursor 2 position

Note

Setting the Cursor Positions

If you press SET several times and make the jog shuttle control both cursor 1 and cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen. Therefore, if you link cursor 1 and cursor 2 and make the cursor jump, the cursor may not jump properly.

8.2 Measuring with ΔV Cursors

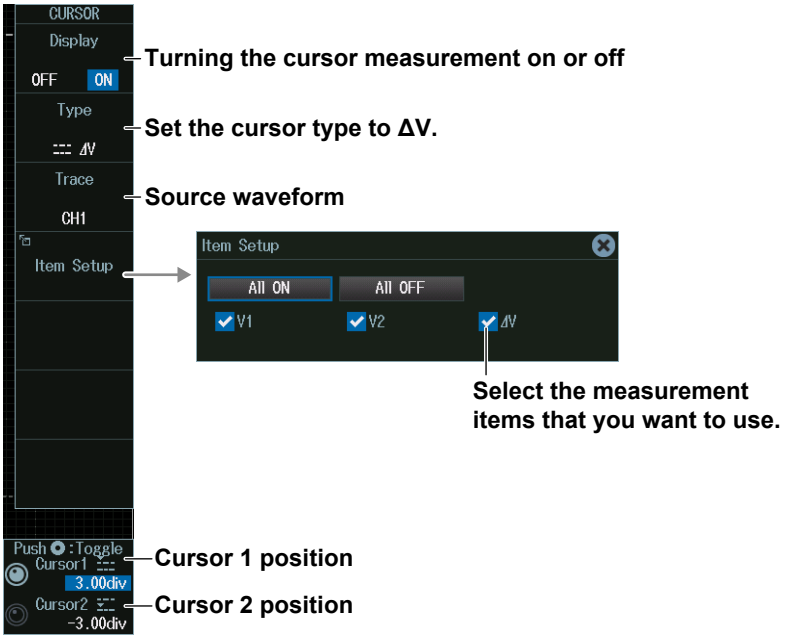
This section explains the following settings for measuring with ΔV cursors:

- Turning cursor measurement on or off
- Cursor type
- Source waveform
- Measurement items
- Cursor position

► "ΔV Cursors (ΔV)" in the Features Guide

CURSOR Menu

1. Press **CURSOR** to display the CURSOR menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the CURSOR menu from MEASURE on the top menu that is displayed.
2. Press the **Type** soft key and then the **ΔV** soft key to display the following menu.



Note

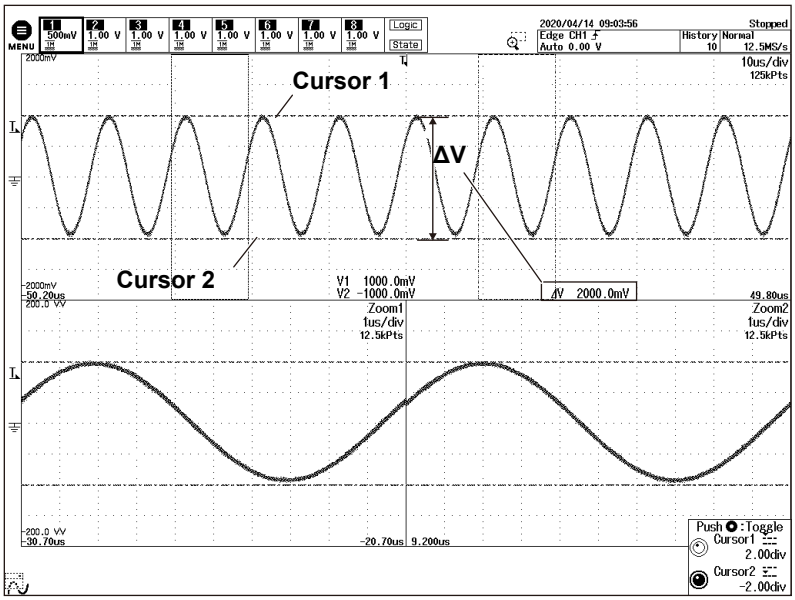
Measurement Source Waveform (Trace)

The available channel settings vary depending on the model and options.

- The available channel settings on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8
- The available channel settings on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4

ΔV Cursor Measurement

You can measure vertical values using two ΔV cursors.



Cursor Positions (Cursor1/Cursor2)

Turn the **jog shuttle** to set cursor 1 (Cursor1) or cursor 2 (Cursor2).

- Press **SET** (upper right on the front panel) to switch between cursor 1 and cursor 2.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Cursor 1 position

Cursor 2 position

Note

Setting the Cursor Positions

If you press SET several times and make the jog shuttle control both cursor 1 and cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen.

8.3 Measuring with ΔT and ΔV Cursors

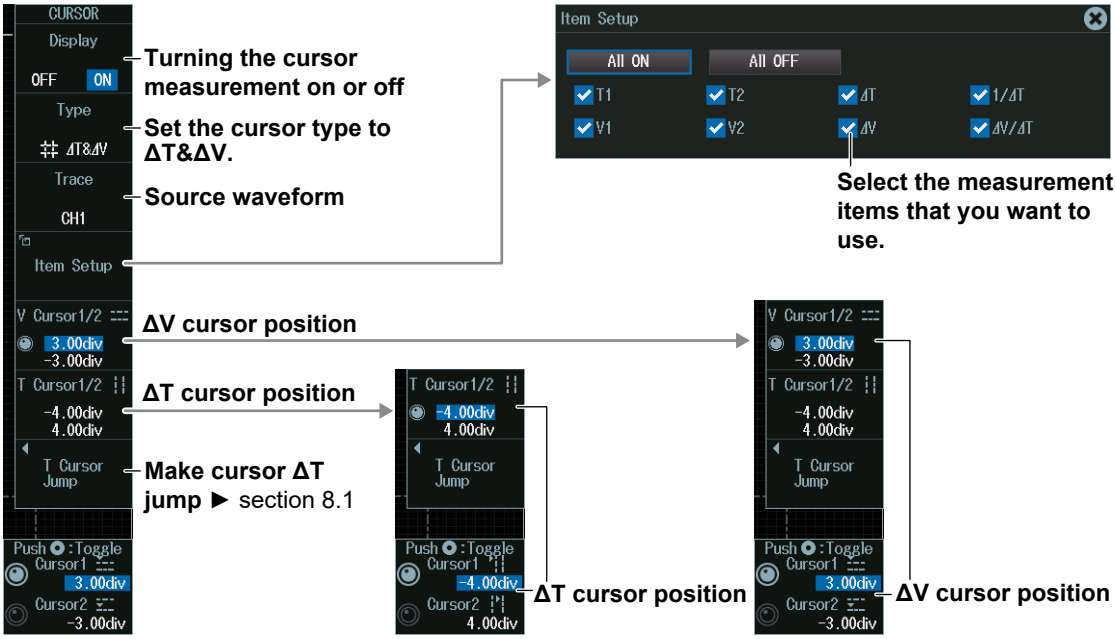
This section explains the following settings for measuring with ΔT and ΔV cursors:

- Turning cursor measurement on or off
- Cursor type
- Source waveform
- Measurement items
- Cursor position
- ΔT Cursor Jumping

► "ΔT&ΔV Cursors (ΔT&ΔV)" in the Features Guide

CURSOR Menu

1. Press **CURSOR** to display the CURSOR menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the CURSOR menu from MEASURE on the top menu that is displayed.
2. Press the **Type** soft key and then the **ΔT&ΔV** soft key to display the following menu.



Note

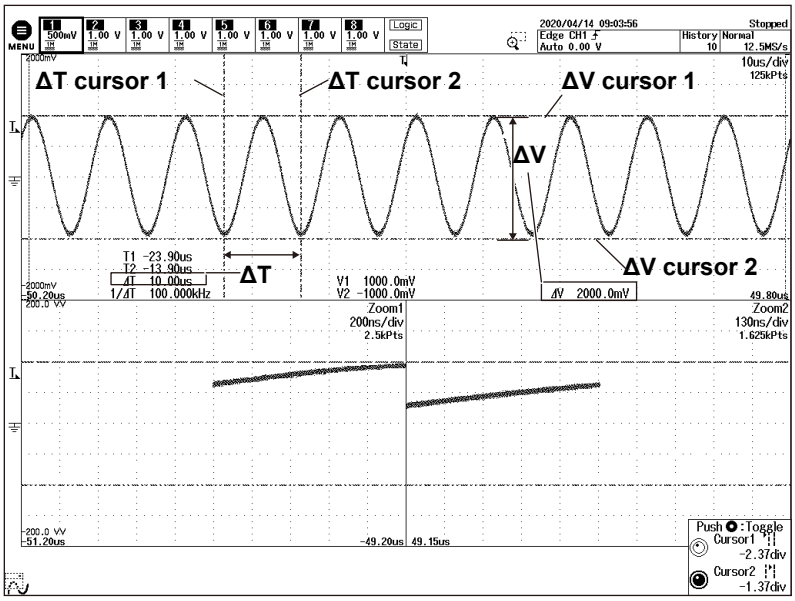
Measurement Source Waveform (Trace)

The available channel settings vary depending on the model and options.

- The available channel settings on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8
- The available channel settings on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4

ΔT and ΔV Cursor Measurement

You can measure time values and vertical values by displaying two ΔT cursors and two ΔV cursors at the same time.



ΔT Cursor Position (Cursor1/Cursor2)

1. Press the **T Cursor 1/2** soft key.
2. Turn the **jog shuttle** to set cursor 1 (Cursor1) or cursor 2 (Cursor2).
   - Press **SET** (upper right on the front panel) to switch between search start point or search end point.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Cursor 1 position

Cursor 2 position

Note

Setting the Cursor Positions

If you press SET several times and make the jog shuttle control both cursor 1 and cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen. Therefore, if you link cursor 1 and cursor 2 and make the cursor jump, the cursor may not jump properly.

ΔV Cursor Position (Cursor1/Cursor2)

1. Press the **V Cursor 1/2** soft key.
2. Turn the **jog shuttle** to set cursor 1 (Cursor1) or cursor 2 (Cursor2).
   - Press **SET** (upper right on the front panel) to switch between search start point or search end point.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Cursor 1 position

Cursor 2 position

Note

Setting the Cursor Positions

If you press SET several times and make the jog shuttle control both cursor 1 and cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen.

8.4 Measuring with Marker Cursors (Marker)

This section explains the following settings for measuring with marker cursors:

- Turning cursor measurement on or off
- Cursor type
- Marker display format
- The waveform to measure using the cursors
- Measurement items
- Cursor jumping
- Cursor position

► “Marker Cursors (Marker)” in the Features Guide

CURSOR Menu

1. Press **CURSOR** to display the CURSOR menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the CURSOR menu from MEASURE on the top menu that is displayed.
2. Press the **Type** soft key and then the **Marker** soft key to display the following menu.



Turning the cursor measurement on or off

Set the cursor type to Marker.

Marker display format

Marker1 cursor’s source waveform and measurement items

Marker2 cursor’s source waveform and measurement items

Marker3 cursor’s source waveform and measurement items

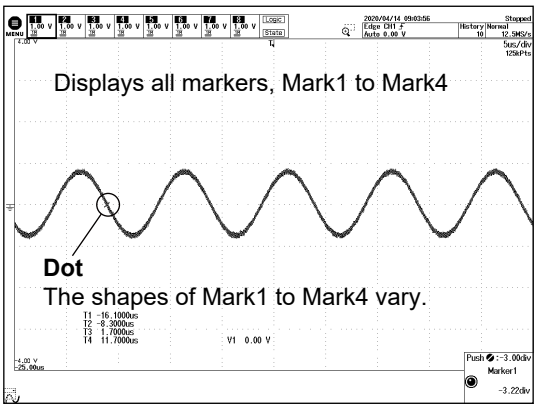
Marker4 cursor’s source waveform and measurement items

Position of the selected marker1 to marker4 cursor

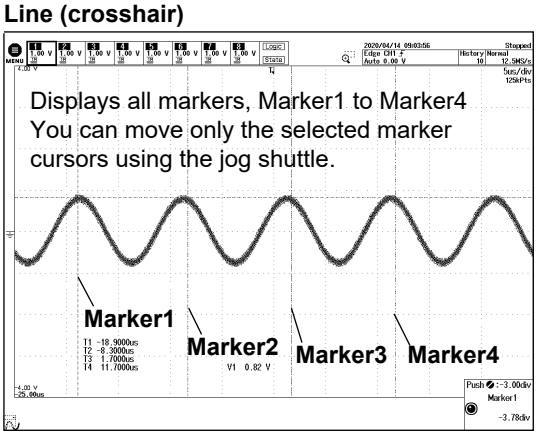
Marker Display Format

Press the **Marker Form** soft key to select the marker display format.

Mark (dot)

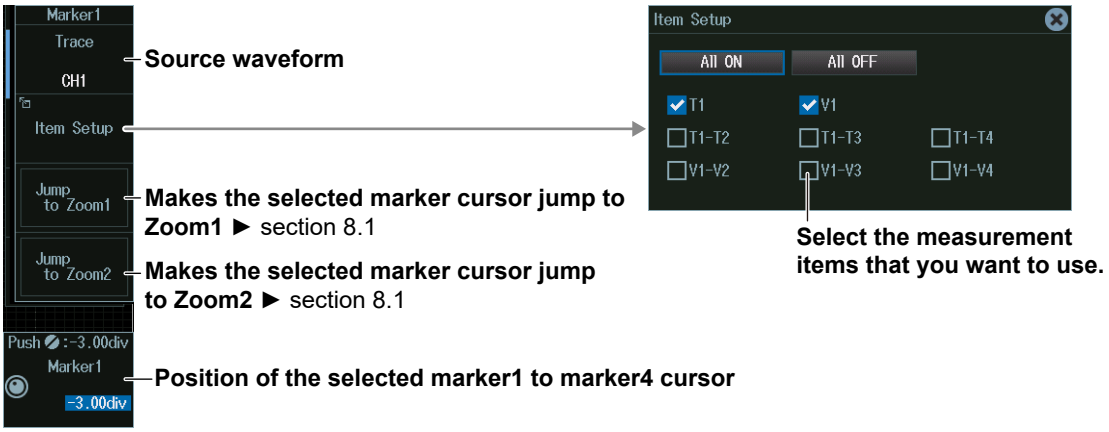


Line (crosshair)



Cursor Source Waveform and Measurement Items (Marker1, Marker2, Marker3, and Marker4)

Press a soft key from **Marker1** to **Marker4** to display the following menu.



Note

Measurement Source Waveform (Trace)

The available channel settings vary depending on the model and options.

- The available channel settings on 8ch models are as follows:
  OFF, CH1 to CH8, Math1 to Math8
- The available channel settings on 4ch models are as follows:
  OFF, CH1 to CH4, Math1 to Math4

Position of the Selected Marker1 to Marker4 Cursor

1. Press a soft key from **Marker1** to **Marker4**.
2. Turn the **jog shuttle** to set the the marker cursor (Marker1 to Marker4).
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



8.5 Measuring with Angle Cursors (Degree)

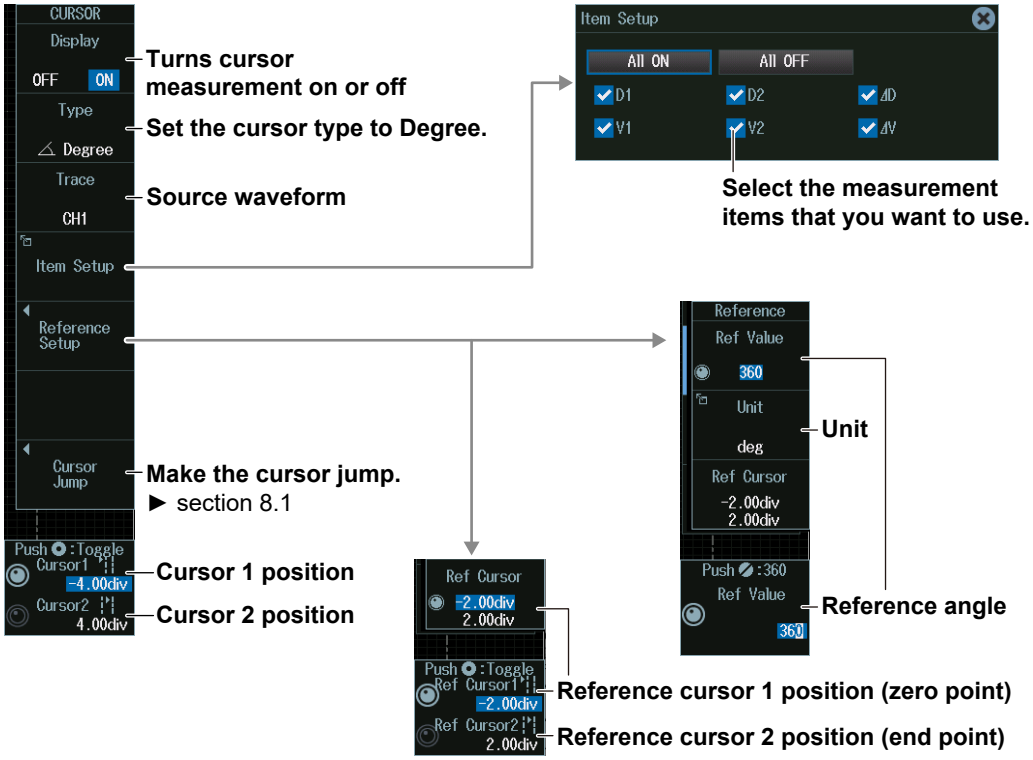
This section explains the following settings for measuring with angle cursors:

- Turning cursor measurement on or off
- Cursor type
- Source waveform
- Measurement items
- Reference setup
- Cursor jumping
- Cursor position

► "Angle Cursors (Degree)" in the Features Guide

CURSOR Menu

1. Press **CURSOR** to display the CURSOR menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the CURSOR menu from MEASURE on the top menu that is displayed.
2. Press the **Type** soft key and then the **Degree** soft key to display the following menu.



Note

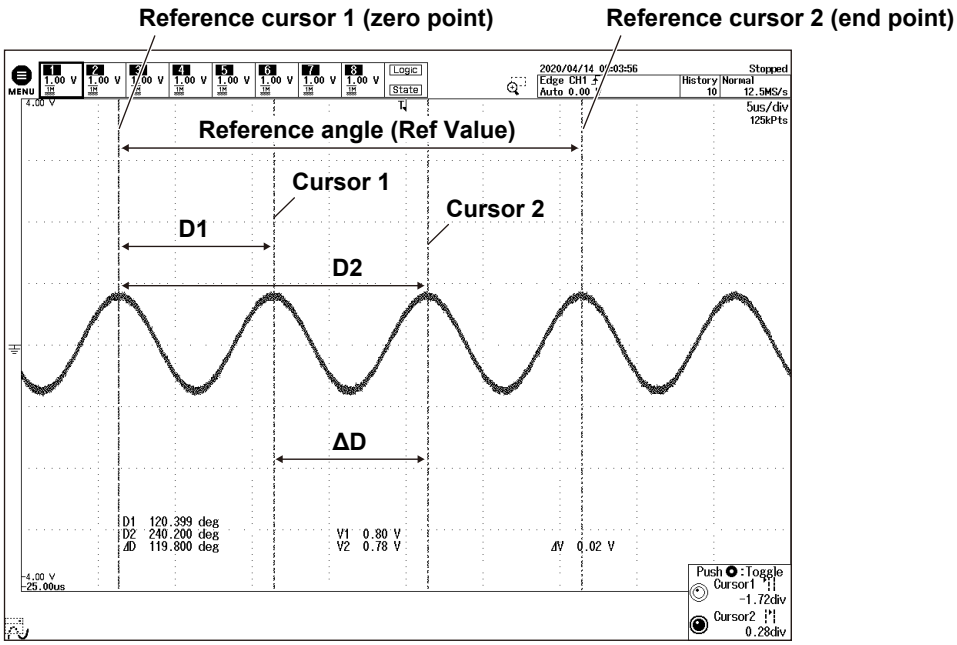
Measurement Source Waveform (Trace)

The available channel settings vary depending on the model and options.

- The available channel settings on 8ch models are as follows:
  All, CH1 to CH8, Math1 to Math8, Logic
- The available channel settings on 4ch models are as follows:
  All, CH1 to CH4, Math1 to Math4, Logic

Angle Cursor Measurement

On the time axis, set the zero point (Ref Cursor1 position), which will be the angle measurement reference, the end point (Ref Cursor2 position), and the reference angle that you want to assign to the difference between Ref Cursor1 and Ref Cursor2. Based on this reference angle, you can measure the angle between two angle cursors (Cursor1 and Cursor2).

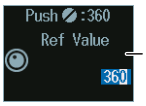


Setting the Reference (Reference Setup)

Setting the Reference Angle (Ref Value)

1. Press the **Reference Setup** soft key and then the **Ref Value** soft key.
2. Turn the **jog shuttle** to set the reference angle.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

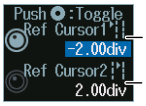


Reference angle

Reference Cursor Positions (Ref Cursor1/Ref Cursor2)

1. Press the **Reference Setup** soft key and then the **Ref Cursor** soft key.
2. Turn the **jog shuttle** to set the reference cursor.
   - Press **SET** (upper right on the front panel) to switch between reference cursor 1 (zero point) and reference cursor 2 (end point).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Reference cursor 1 position (zero point)

Reference cursor 2 position (end point)

Cursor Positions (Cursor1/Cursor2)

Turn the **jog shuttle** to set the cursor position.

- Press **SET** (upper right on the front panel) to switch between cursor 1 and cursor 2.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Cursor 1 position

Cursor 2 position

Note

Setting the Cursor Positions

If you press SET several times and make the jog shuttle control both cursor 1 and cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen. Therefore, if you link cursor 1 and cursor 2 and make the cursor jump, the cursor may not jump properly.

9.1 Automatically Measuring Waveform Parameters

This section explains the following settings for automatically measuring waveform parameters:

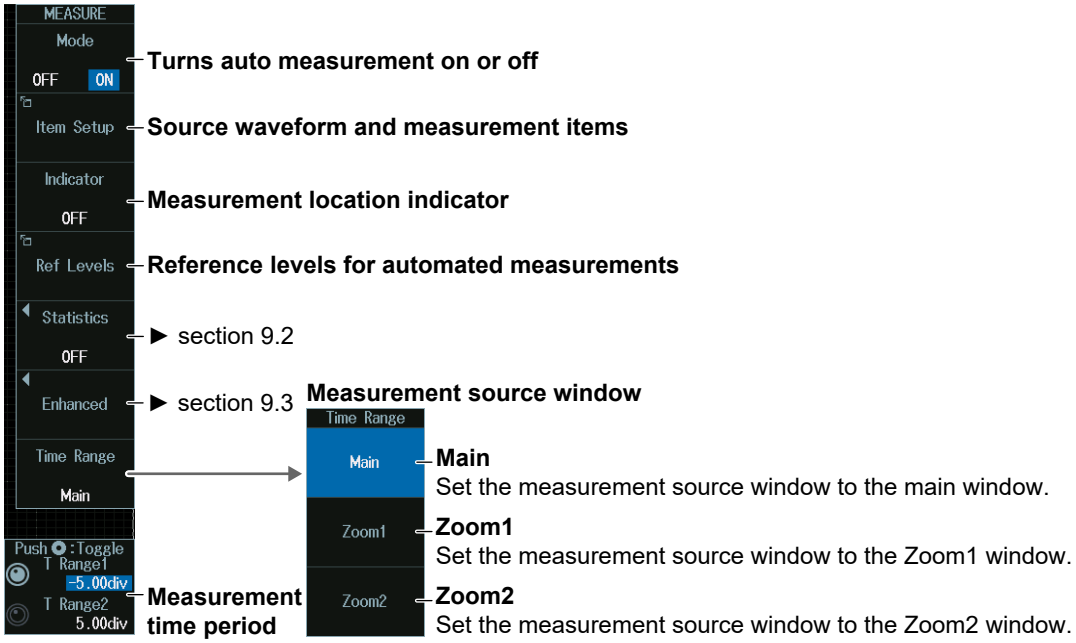
- Turning automated measurement on or off
- Measurement source waveform and measurement items
- Measurement location indicator
- Reference levels for automated measurements
- Measurement source window
- Measurement range

► "Automated Measurement of Waveform Parameters" in the Features Guide

MEASURE Menu

Press **MEASURE** to display the following menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the MEASURE menu from MEASURE on the top menu that is displayed.

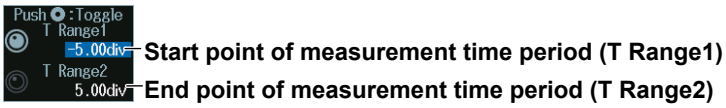


Measurement Time Period (T Range1, T Range2)

Turn the **jog shuttle** to set the measurement time period.

- Press **SET** (upper right on the front panel) to switch between the start point of the measurement time period (T Range1) or the end point of the measurement time period (T Range2).
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

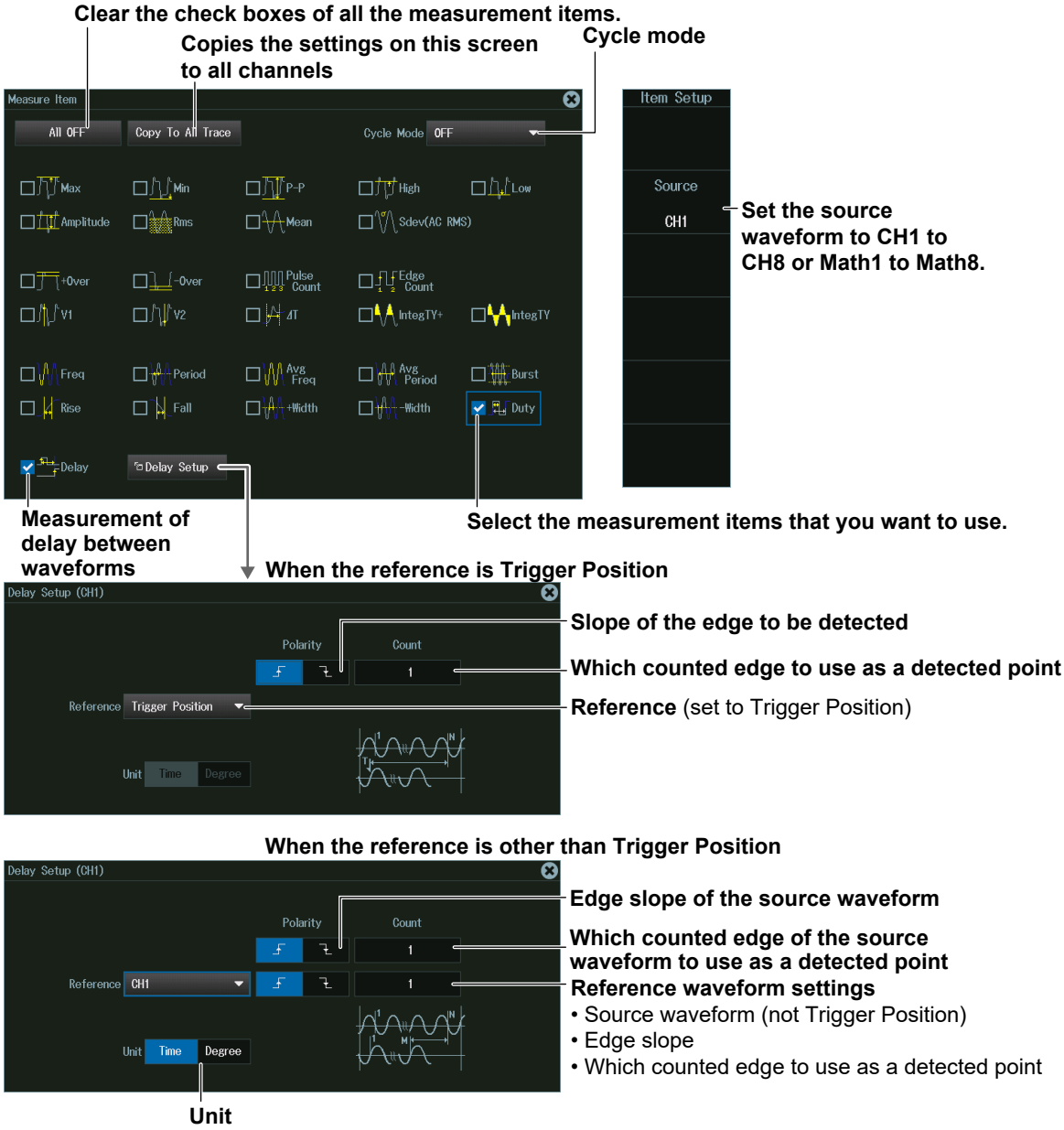
Jog shuttle setting menu



Measurement Source Waveform and Measurement Items (Item Setup)

1. Press the **Item Setup** soft key.
2. Press the **Source** soft key. Select the source waveform from the setup menu that is displayed. A menu appears according to the measurement source waveform you specified.

When the Measurement Source Waveform Is CH1 to CH8 or Math1 to Math8



Note

Cycle Mode

- When the power analysis type is switching loss, the cycle mode is fixed to SW Loss.
- When power measurement is ON, the cycle mode changes according to the setting of the cycle mode of power measurement.

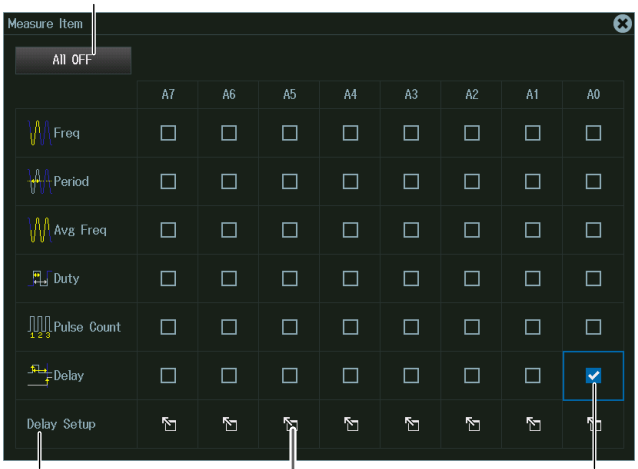
Measurement Source Waveform

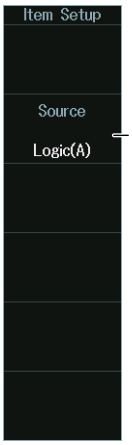
The available channel settings vary depending on the model.

- The available settings are CH1 to CH8 and Math1 to Math8 on 8ch models.
- The available settings are CH1 to CH4 and Math1 to Math4 on 4ch models.

When the Search Source Waveform Is Logic

Clear the check boxes of all the measurement items.



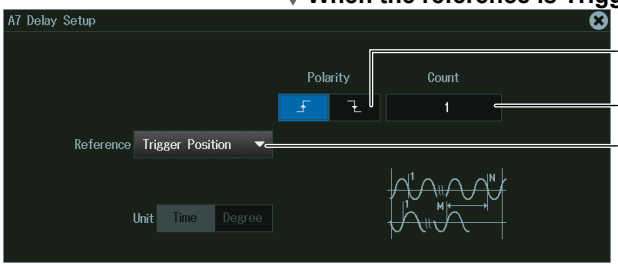


Set the measurement source waveform to Logic(A) to Logic(D).

Measurement of delay between waveforms

Select the measurement items that you want to use.

When the reference is Trigger Position

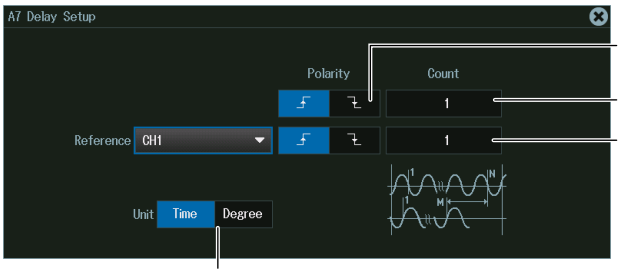


Slope of the edge to be detected

Which counted edge to use as a detected point

Reference (set to Trigger Position)

When the reference is other than Trigger Position/Logic



Edge slope of the source waveform

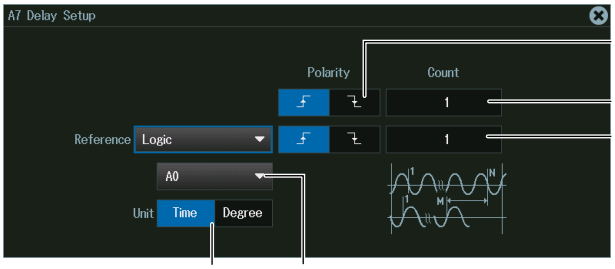
Which counted edge of the source waveform to use as a detected point

Reference waveform settings

- Source waveform (not Trigger Position/Logic)
- Edge slope
- Which counted edge to use as a detected point

Unit

When Reference is set to Logic



Edge slope of the source waveform

Which counted edge of the source waveform to use as a detected point

Reference waveform settings

- Source waveform (set to Logic)
- Edge slope
- Which counted edge to use as a detected point

Unit **Source bit**

Note

Measurement Source Waveform
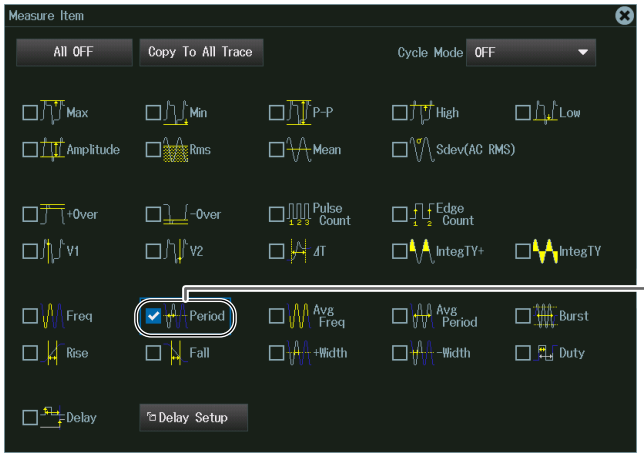
The following source bit display applies to models with the /L32 option.

- C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Measurement Location Indicator (Indicator)

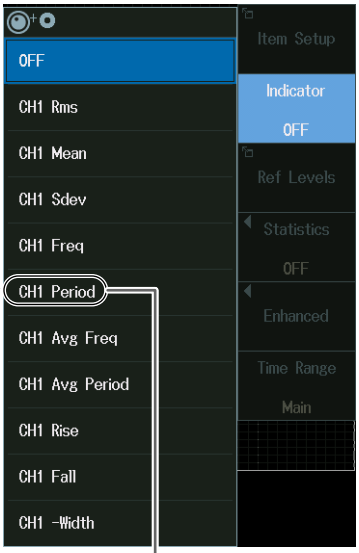
1. Press the **Indicator** soft key.
   A portion of the items selected in “Measurement Source Waveform and Measurement Items (Item Setup)” is listed in the setup menu (see Note).
2. Use the **jog shuttle** or the **SET** key to select the item whose measurement location you want to indicate.
3. Press **SET** to confirm your selection.
   The measurement location of the item you specify is indicated by a cursor.

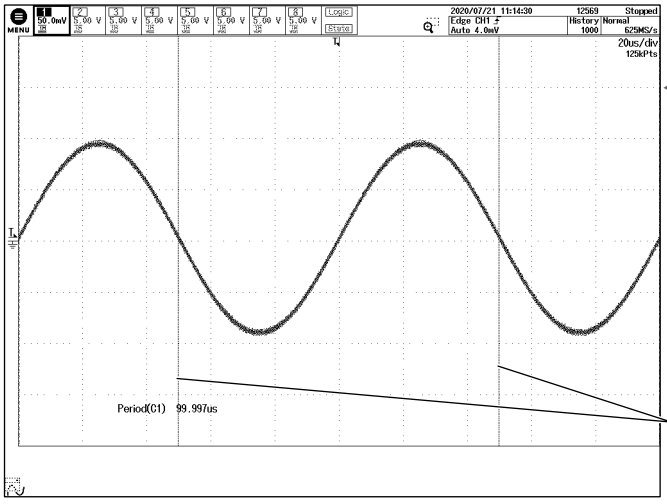
Measurement Items (Measure Item)



The selected measurement items appear in the setup menu.

Setup menu





Displays the measurement location (e.g., Period) with the cursor

Note

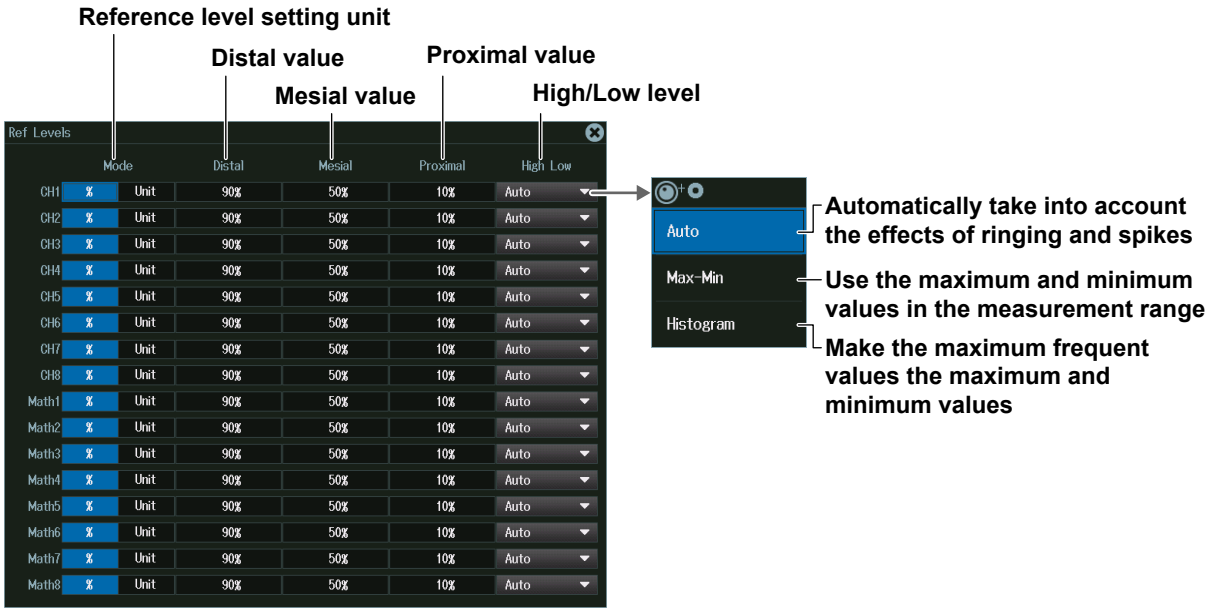
The measurement locations of the following items can be indicated.

Max, Min, P-P, High, Low, Amplitude, Rms, Mean, Sdev(AC RMS), +Over, –Over, V1, V2, IntegTY+, IntegTY, Freq, Period, Avg Freq, Avg Period, Burst, Rise, Fall, +Width, –Width, Duty, Delay

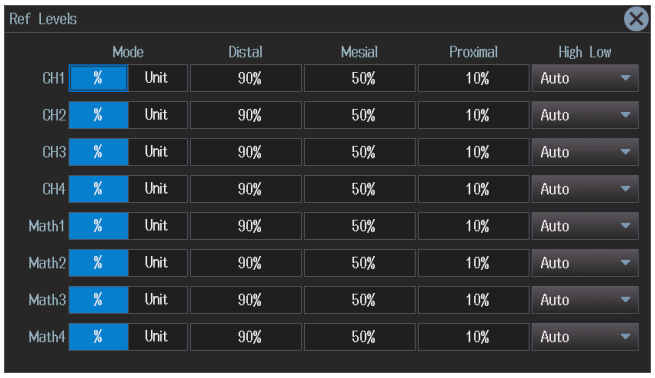
Reference Level for Automated Measurement (Ref Levels)

Press the **Ref Levels** soft key to display the following menu.

8ch model



4ch model



Note

About the Roll-Mode Display

- The instrument will not display computed waveforms that have been generated through user-defined computation while it is acquiring waveforms in roll mode. The instrument will display the computed waveforms after it stops acquiring waveforms.
- If normal statistical processing (Continuous), serial bus analysis, waveform histogram display, or harmonic analysis is being executed, automatically measured parameter values are not displayed when waveforms are being acquired in roll mode. The instrument will display the computed waveforms after it stops acquiring waveforms.
- If the record length is set such that waveform acquisition operates in single mode,* neither computed waveforms (Math waveforms) nor automated measurement values of waveform parameters are shown while waveform acquisition in roll mode is in progress. The instrument will display the computed waveforms and automatically measured values after it stops acquiring waveforms.

  * The record length that causes waveform acquisition to operate in single mode varies depending on whether a memory expansion option (/M1, /M2, /M1S, /M2S) is available. For details, see chapter 6, “Waveform Acquisition,” in the Features Guide (IM DLM5058-01EN).

9.2 Processing Statistics on Automatically Measured Values

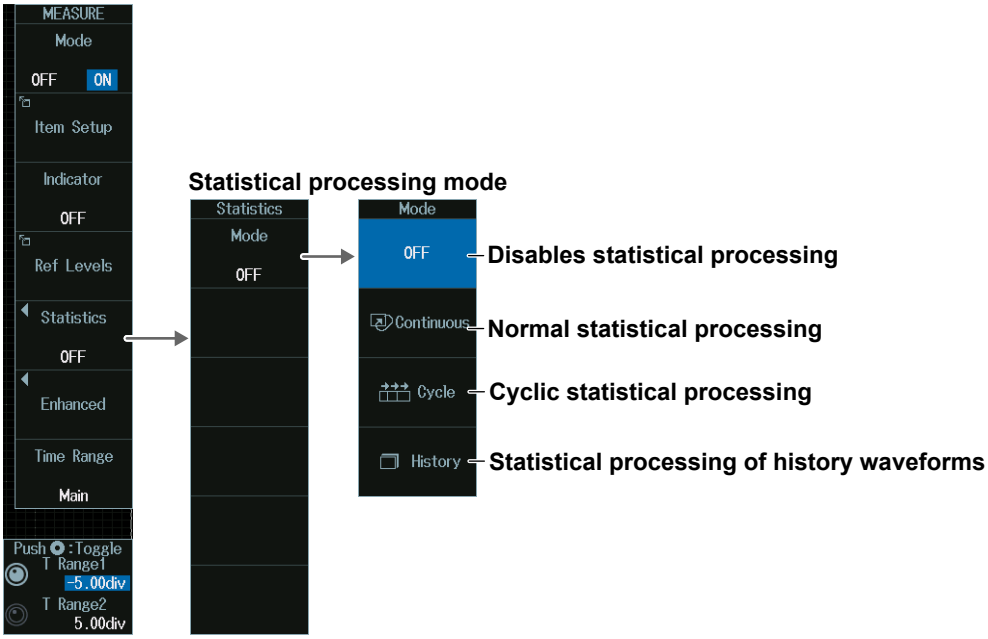
This section explains the following settings for processing statistics on automatically measured waveform parameters:

- Statistical processing mode
- Normal statistical processing
- Cyclic statistical processing
- Statistical processing of history waveforms

► "Statistics (Statistics)" in the Features Guide

MEASURE Statistics Menu

1. Press **MEASURE** to display the MEASURE menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the MEASURE menu from MEASURE on the top menu that is displayed.
2. Press the **Statistics** soft key to display the following menu.

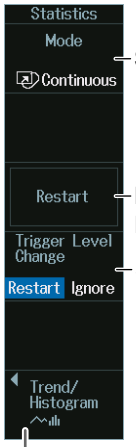


Note

If you change the statistical processing type (Statistics), the statistical processing type (Statistics) of Measure Setup for power measurement (Power Measurement menu) too changes in sync.

Normal statistical processing (Continuous)

Press the **Mode** soft key and then the **Continuous** soft key to display the following menu.



Set the statistical processing type to Continuous.

Restarts statistical processing
Restarts also when CLEAR TRACE key is pressed

Set the action to take when the trigger level changes.

Restart: If the trigger level is changed during waveform acquisition, the statistical processing performed up to that point is discarded, the waveform Count is set to 1, and statistical processing restarts.

Ignore: If the trigger level is changed during waveform acquisition, waveform acquisition and statistical processing continue without statistical processing being reset.

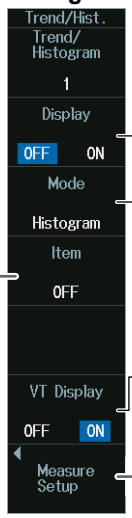
Trend display settings



Turns the graph display on or off

Set the mode to Trend.

Histogram display settings

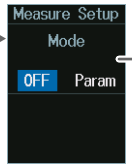


Turns the graph display on or off

Set the mode to Histogram.



Turns VT waveform display window on or off



When the measurement mode is Param



Cursor1 position

Cursor2 position

Turns cursor measurement on or off

The measurement items selected using the “Measurement Location Indicator” procedure in section 9.1 appear on the setup menu.



Executes auto scaling



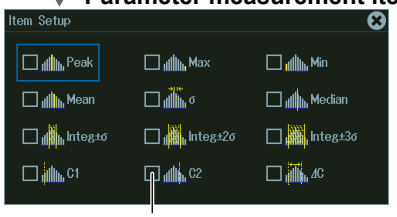


Vertical scale value

Horizontal scale value

Turns VT waveform display window on or off

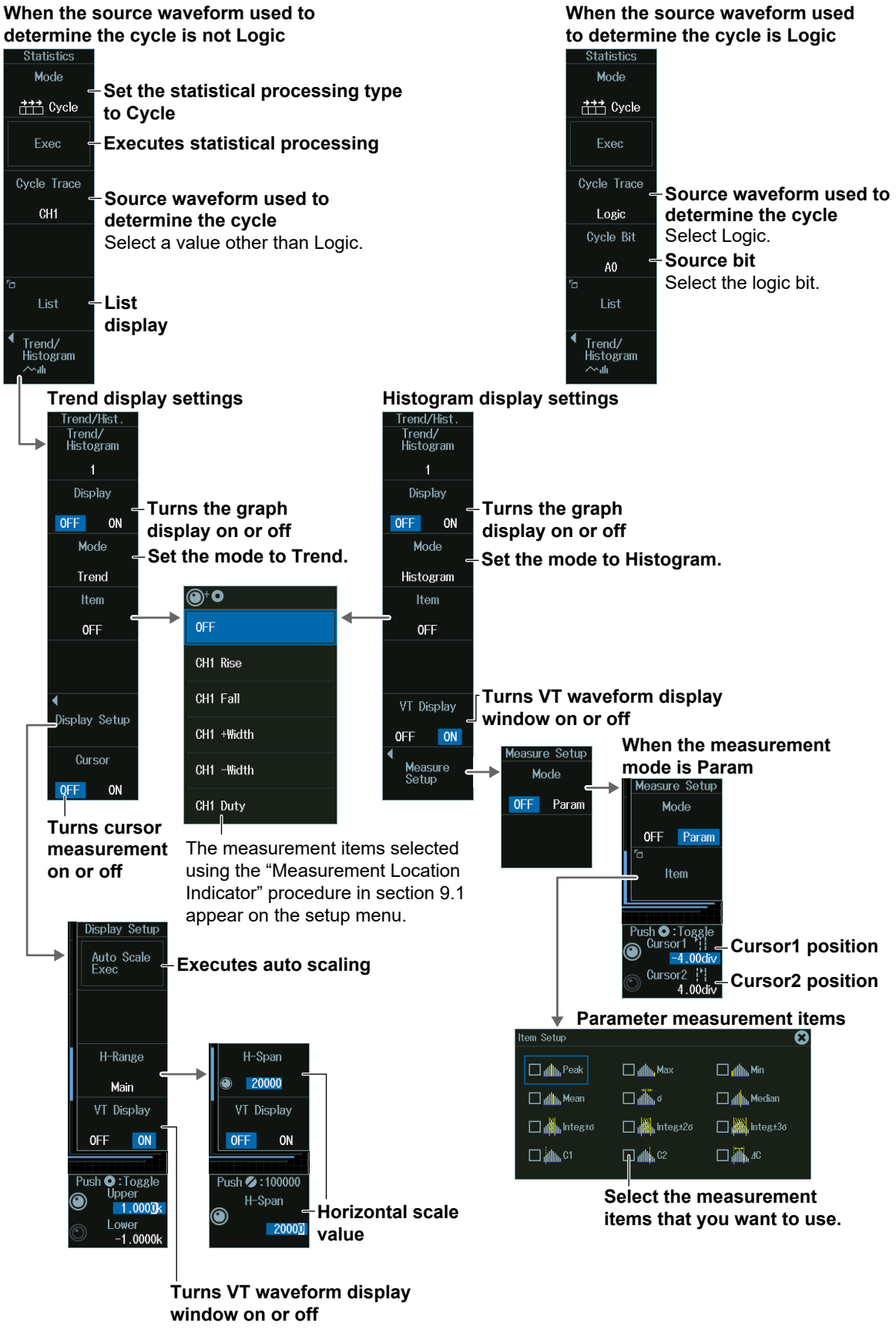
Parameter measurement items



Select the measurement items that you want to use.

Cyclic Statistical Processing (Cycle)

Press the **Mode** soft key and then the **Cycle** soft key to display the following menu.



Note

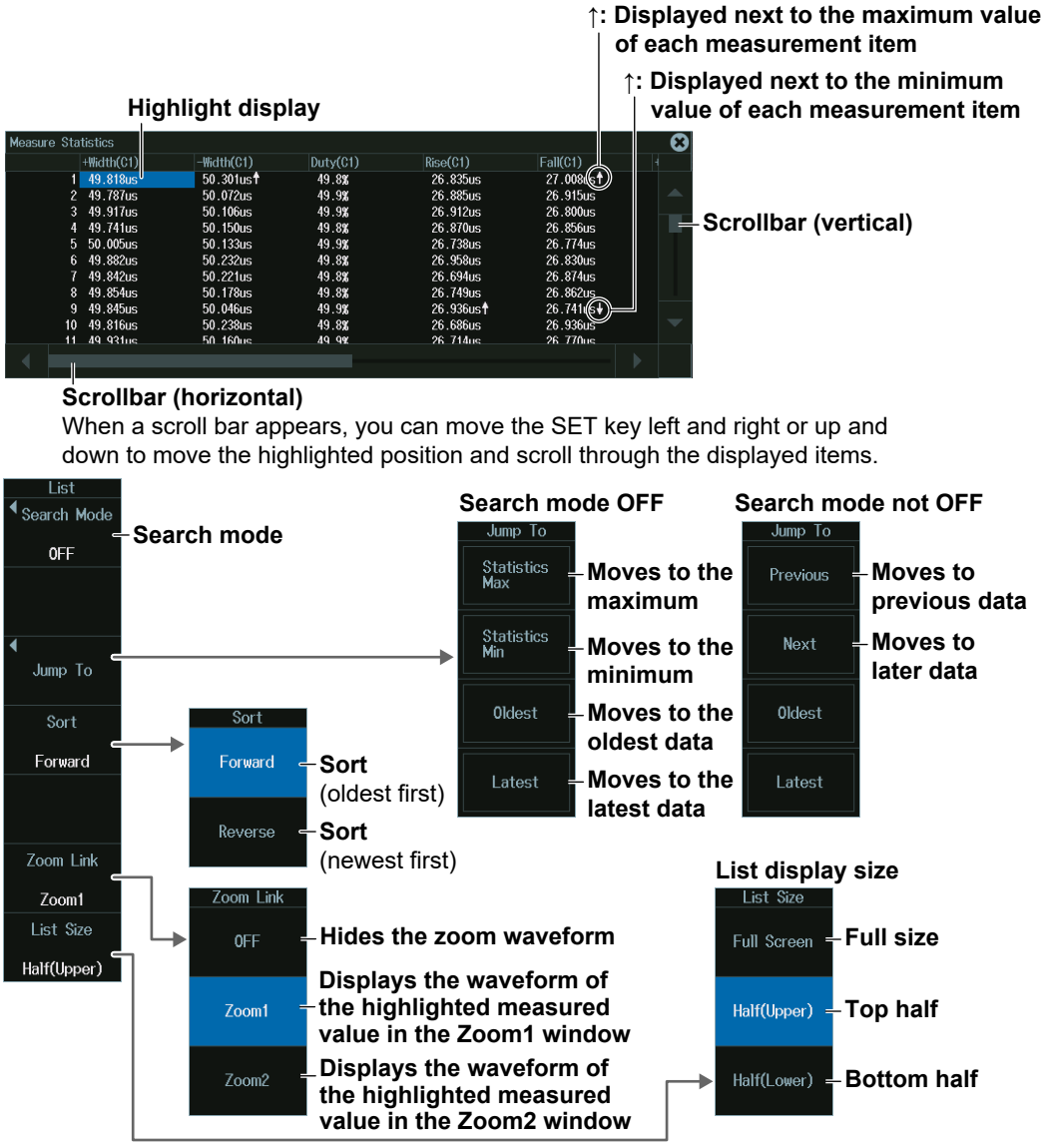
The available source waveforms used to determine the cycle vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8, Logic
- The available settings on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4, Logic

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

List Display (List)

Press the **List** soft key to display the following menu.

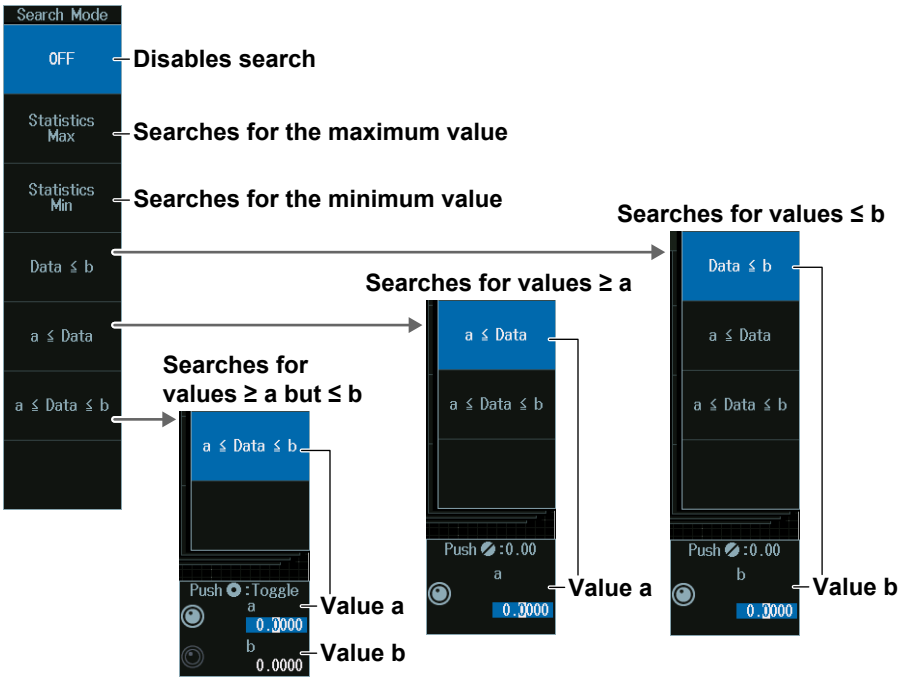


Note

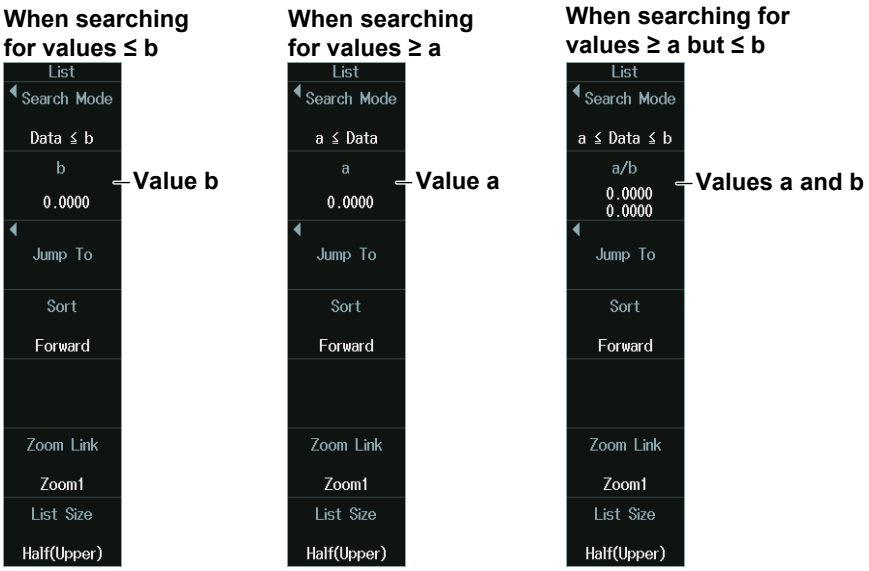
If you move the highlight display for the measured values up and down, the zoom position moves to the corresponding position of the waveform.

Search Item (Search Mode)

1. Press the **Search Mode** soft key to display the following menu.
If you select “Data ≤ b”, “a ≤ Data,” or “a ≤ Data ≤ b”, set the value of a or b with the **jog shuttle**.

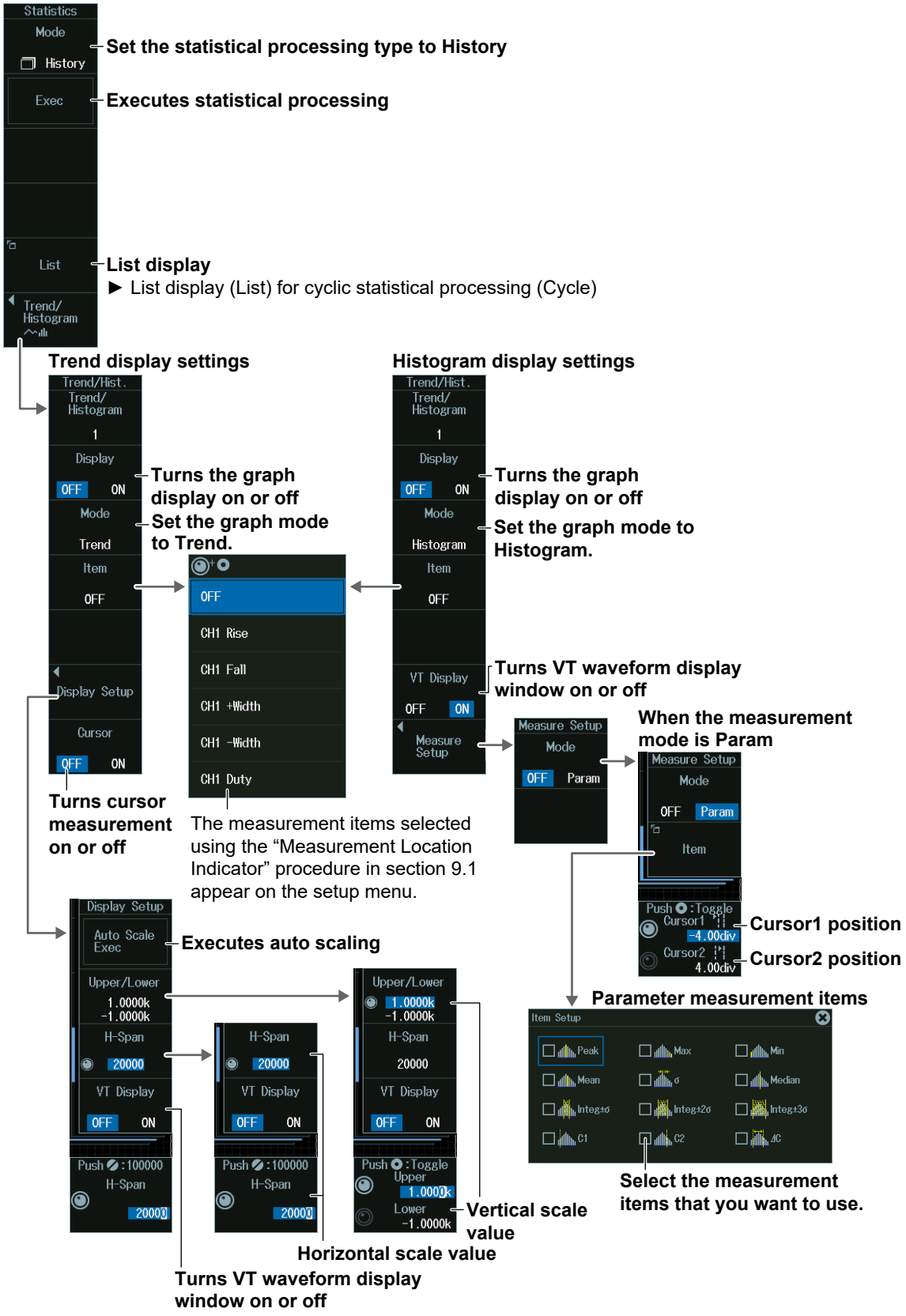


2. Select the search item, and then press **ESC**.
The menu returns to the list display menu.



Statistical Processing of History Waveforms (History)

Press the **Mode** soft key and then the **History** soft key to display the following menu.



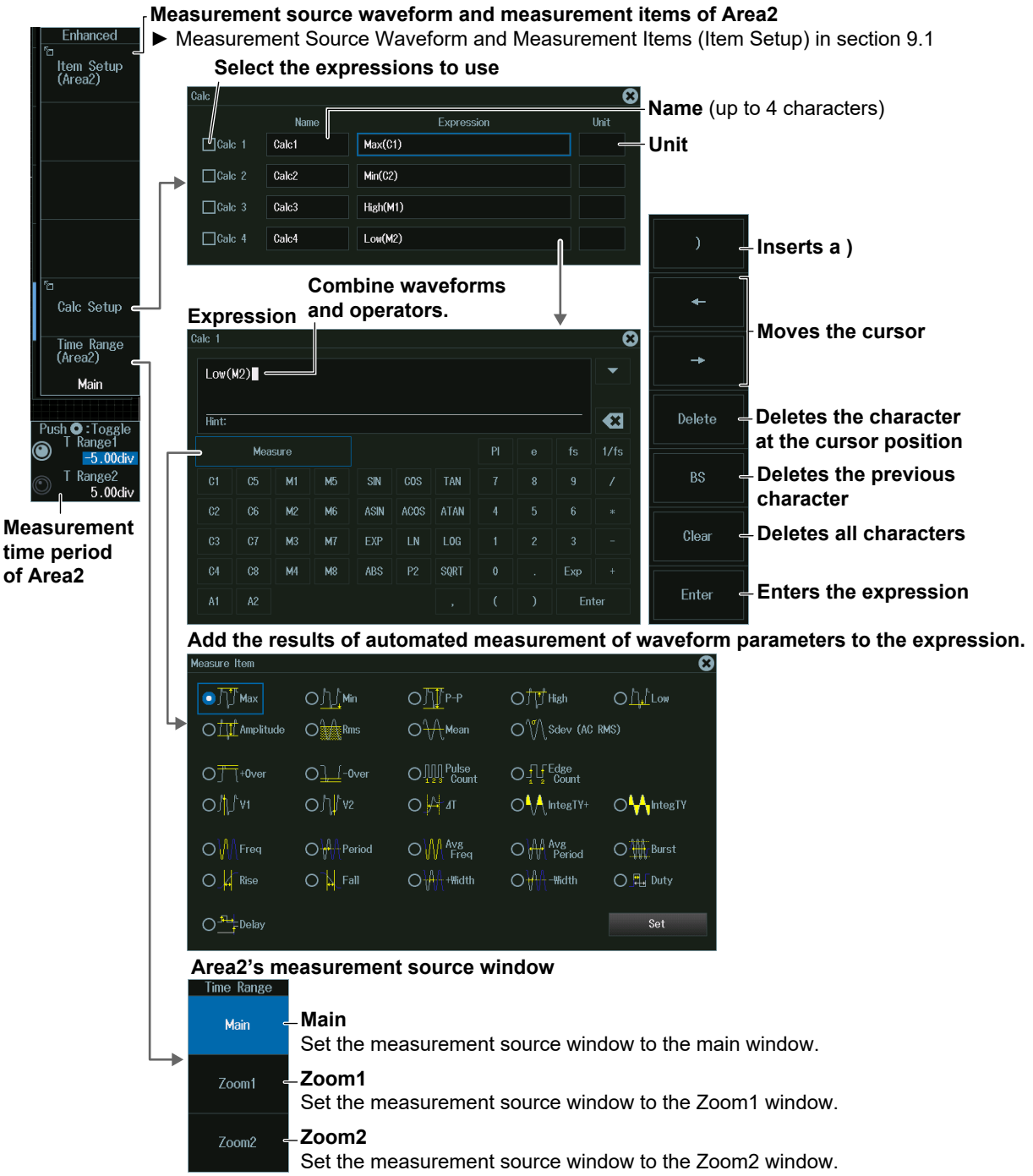
9.3 Measuring Enhanced Parameters

This section explains the settings for performing automated measurement of the waveform parameters on two areas and the settings used when performing calculations using waveform parameters.

► “Enhanced Parameter Measurement (ENHANCED)” in the Features Guide

MEASURE Enhanced Menu

1. Press **MEASURE** to display the MEASURE menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the MEASURE menu from MEASURE on the top menu that is displayed.
2. Press the **Enhanced** soft key to display the following menu.



Main
Set the measurement source window to the main window.

Zoom1
Set the measurement source window to the Zoom1 window.

Zoom2
Set the measurement source window to the Zoom2 window.

Measurement Source Waveform and Measurement Items of Area2 (Item Setup (Area2))

Press the **Item Setup (Area2)** soft key. The screen is displayed for setting the source waveform of Area2 and the measurement items. The screen is the same as the Item Setup screen shown in section 9.1.

Setting the Equation (Calc Setup)

Press the Calc Setup soft key to display a screen for setting an equation using the waveform parameters of Area2.

Note

The measurement time period (T Range1, T Range2) in the MEASURE Enhanced menu is that of Area2.

On the Calc Setup screen, you can also set an equation using the waveform parameters of the MEASURE menu (Area1). But, even in this case, the measurement time period of Area1 is the measurement time period (T Range1, T Range2) in the MEASURE menu.

10.1 Zooming In on or Out of Waveforms

This section explains the following settings for zooming in on or out of waveforms:

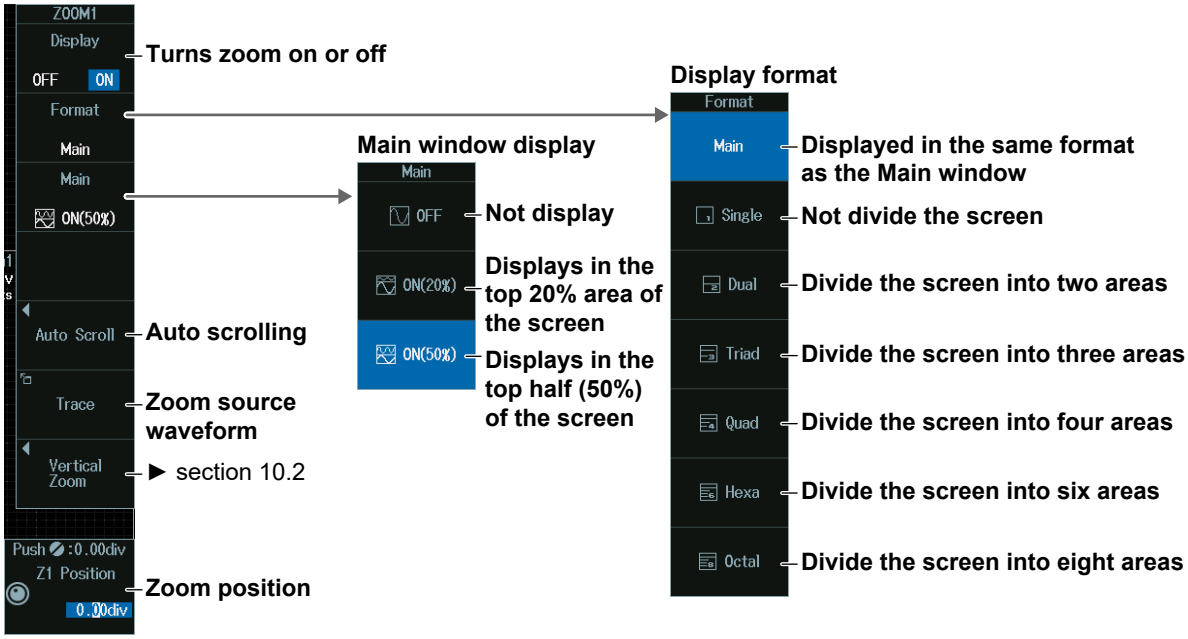
- Turning zoom on or off
- Display format
- Main window display
- Auto scrolling
- Zoom source waveform
- Zoom position
- Zoom factor

► "Zooming in on Waveforms" in the Features Guide

ZOOM Menu

Press **ZOOM1** or **ZOOM2** to display the following menu.

- You can also tap **MENU** (MENU) in the upper left of the screen and select the ZOOM1 menu or the ZOOM2 menu from ZOOM on the top menu.
- The zoomed waveform of up to two locations can be displayed. To switch the setup menu, press ZOOM1 or ZOOM2.



Note

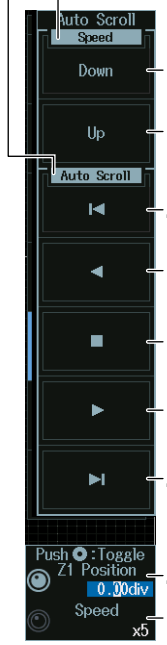
- If the main window (which displays normal waveforms) and the Zoom1 or Zoom2 window are displayed at the same time, a zoom box appears in the Main window so that you can check the zoom position.
- The ZOOM1 and ZOOM2 keys illuminate when the zoom feature is on. When both are illuminated, the ZOOM knob controls the waveform in the window corresponding to the brighter key.
- When both ZOOM1 and ZOOM2 are illuminated, if you press SET several times and make the jog shuttle control both Z1 Position and Z2 Position, you can move them together.

Auto Scrolling (Auto Scroll)

Press the **Auto Scroll** soft key to display the following menu.

Scroll control

Scroll speed (six settings)



Decreases the speed by one level

Increases the speed by one level

Zoom in on the left edge of the Main window

Scroll left

Stop auto scrolling

Scroll right

Zoom in on the right edge of the Main window

Zoom position

Scroll speed

Zoom Position and Scroll Speed (Z1/Z2Position/Speed)

Turn the **jog shuttle** to set the zoom position (Z1/Z2 Position) or scroll speed (Speed).

- You can also set the zoom position by tapping the jog shuttle setting menu in the lower right of the screen and using the numeric keypad that appears on the screen.
- You can also set the scroll speed by tapping the setup menu in the lower right of the screen and using pop-up menu menu that appears on the screen.

Jog shuttle setting menu

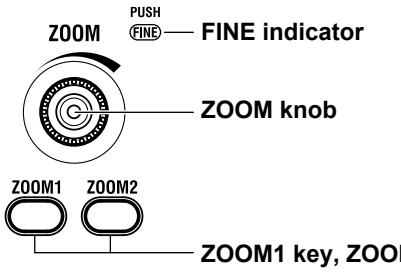


Zoom position (Z1, Z2 Position)

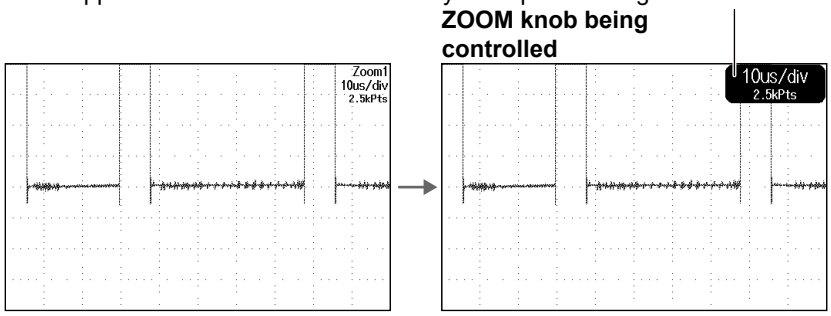
Scroll speed (Speed)

Zoom Factor (ZOOM knob)

1. Press **ZOOM1** or **ZOOM2** to select which the ZOOM knob will control.
   When both Zoom1 and Zoom2 windows are displayed, the ZOOM knob controls the waveform in the window corresponding to the brighter key.
2. Use the **ZOOM** knob to set the zoom factor.
   - If you push the ZOOM knob, the FINE indicator illuminates, and you can set the zoom factor with higher resolution. If the FINE indicator is not illuminated, the zoom time scale will be set to 1-2-5 steps.
   - To adjust the zoom position, turn the jog shuttle.



While you control the knob, the zoom value and display record length are displayed in the upper right of the zoom window. The display disappears after a few seconds when you stop controlling the knob.



Zoom Position (Z1, Z2 Position)

Turn the **jog shuttle** to set the zoom position.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

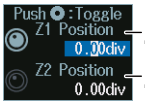
Jog shuttle setting menu

When ZOOM1 or ZOOM2 is on



Zoom position (Z1, Z2 Position)
You can control Z1 Position or Z2 Position.

When both ZOOM1 and ZOOM2 are on



ZOOM1 zoom position (Z1 Position)
ZOOM2 zoom position (Z2 Position)

Press SET (upper right on the front panel) to switch between ZOOM1 and ZOOM2.

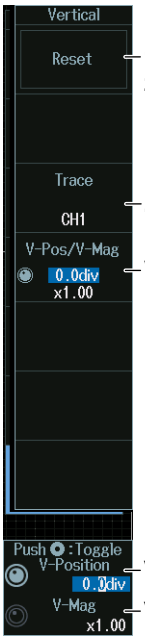
10.2 Zooming in on or out from Waveforms in the Vertical Direction

This section explains the following settings for zooming in on or out from waveforms in the vertical direction:

► “Vertical Zoom (Vertical Zoom)” in the Features Guide

ZOOM Vertical Zoom Menu

1. Press **ZOOM1** or **ZOOM2** to display the ZOOM menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ZOOM1 menu or the ZOOM2 menu from ZOOM on the top menu.
2. Press the **Vertical Zoom** soft key to display the following menu.



Collectively initializes the zoom position and zoom factor of all waveforms

Zoom source waveform

Vertical zoom position, vertical zoom factor

Vertical zoom position

Vertical zoom factor

Note

- You can initialize the zoom position and zoom factor of the target waveform by pressing RESET on the front panel.
- You can initialize the zoom position and zoom factor of all waveforms by pressing the Reset soft key.

Vertical Zoom Position and Vertical Zoom Factor (V-Position/V-Mag)

Turn the **jog shuttle** to set the vertical zoom position (V-Position) or vertical zoom factor (V-Mag).

- Press **SET** (upper right on the front panel) to switch between vertical zoom position and vertical zoom factor.
- You can also set the vertical zoom position by tapping the jog shuttle setting menu in the lower right of the screen and using the numeric keypad that appears on the screen.
- You can also set the vertical zoom factor by tapping the setup menu in the lower right of the screen and using pop-up menu menu that appears on the screen.

Jog shuttle setting menu



Vertical zoom position (V-Position)

Vertical zoom factor (V-Mag)

11.1 Basic Waveform Search Operation

This section explains the following settings for searching waveforms: For details on the different search types (edge, pattern, pulse width, timeout period), see sections 11.2 to 11.5.

- Search range
- Search skipping
- Displaying detected waveforms
- Detected waveform display
- Executing searches

Note

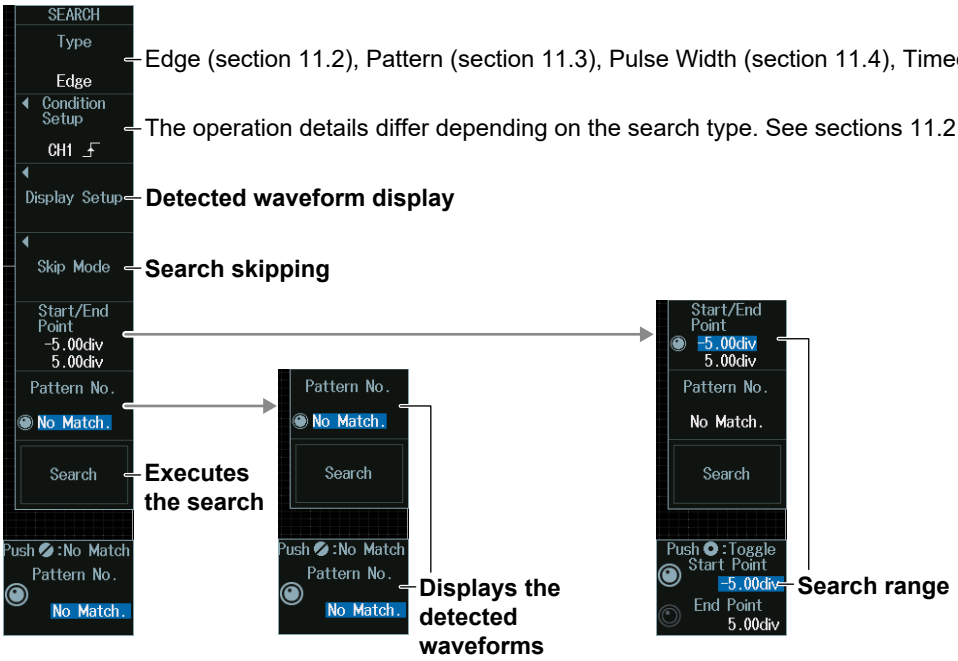
When you press SEARCH to display the SEARCH menu, the display configuration will change.
Locations (detected points) that match the search conditions are displayed in the zoom window.
The display configuration of the SEARCH menu is same as that of the ZOOM menu (waveform zoom).
For setting the display configuration, see section 10.1.

► **"Search Range (Start/End Point)," "Displaying Detected Waveforms (Display Setup)," "Search Skip (Skip Mode)," "Executing a Search (Search)," "Detected Point number (Pattern No.)," "Zooming in on Waveforms" in the Features Guide**

SEARCH Menu

Press **SEARCH** to display the following menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the SEARCH menu from ANALYSIS on the top menu that is displayed.



Search Range (Start/End Point)

1. Press the **Start/End Point** soft key.
2. Turn the **jog shuttle** to set the search start point (Start Point) or Search End Point (End Point).
   - Press **SET** (upper right on the front panel) to switch between search start point or search end point.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

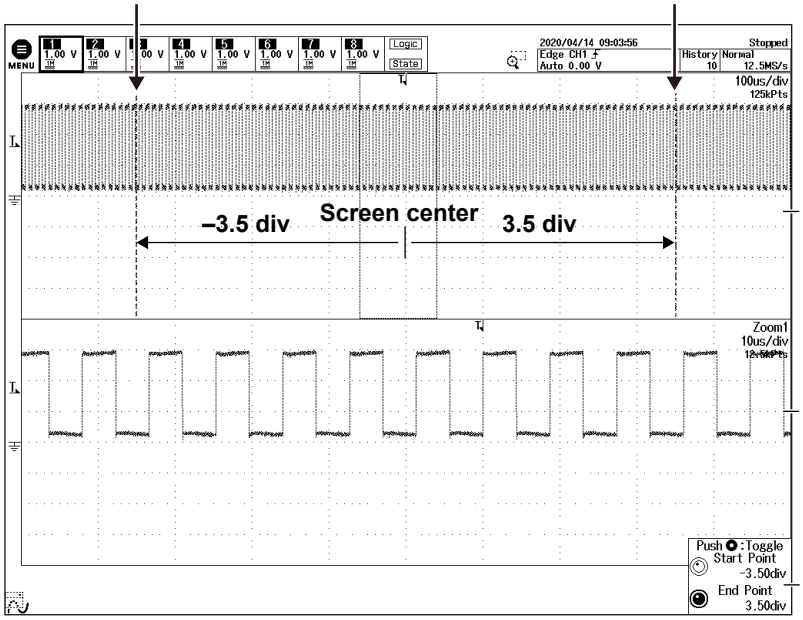
Jog shuttle setting menu



Search start point

Search end point

Search Range (Setting Example)



Main window
► section 10.1

Result window
Displays Zoom1 to Zoom2 windows
► section 10.1

Search range setting example
Search start point –3.50 div
Search end point 3.50 div

Detected Waveform Display (Display Setup)

1. Press the **Display Setup** soft key to display the following menu.



Turns the detected point mark display on or off
Displayed in the Result window being controlled

Select the Result window to control.
When both the Zoom1 and Zoom2 displays are turned on, two Result windows are displayed.
► section 10.1
You can change the zoom position and zoom in on the waveform on the selected Result window.

Note

If only Zoom1 or Zoom2 display is turned on, the one that is turned on becomes the Result window. If both the Zoom1 and Zoom2 displays are turned off, Zoom1 becomes the Result window. If you press SEARCH in this condition, the Zoom1 display will be turned on.

2. Turn the **jog shuttle** to set the position to zoom.
You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Set the Result window's zoom position.
Pressing RESET (upper right on the front panel) returns the value to 0.00 div.

Note

The zoom display positions (Z1 Position, Z2 Position) of the detected points can only be controlled when the Display Setup menu is displayed.

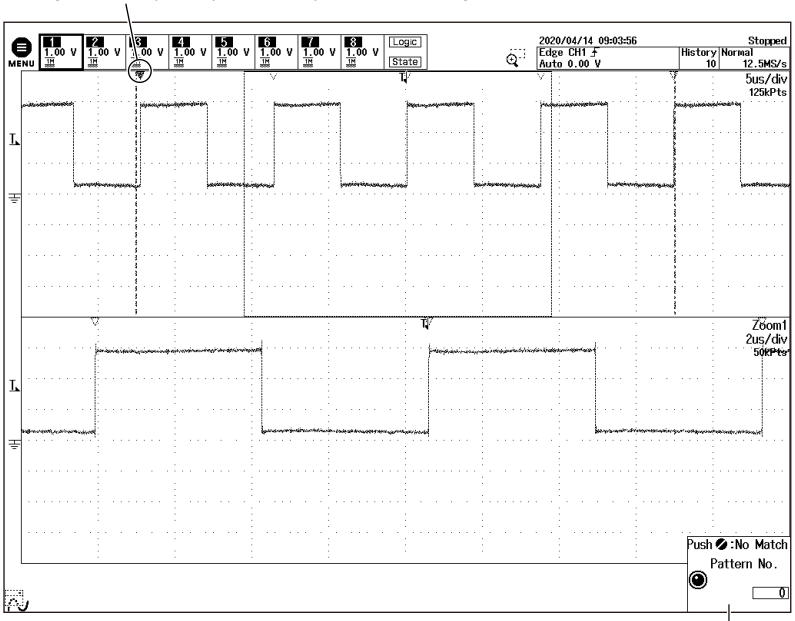
Executing a Search (Search)

Press the **Search** soft key to execute a waveform search.

When you execute a search, the detected point is displayed at the center of the Result window (zoom window).

Search Results

Detected point
When a location (detected point) that matches the search conditions is found, a triangle mark (Mark) is displayed. The triangle mark selected with Pattern No. is filled.



Pattern No.
Numbers 0, 1, 2, and so on are assigned in the detected order from the left of the waveform screen.

Note

- You cannot search while waveform acquisition is in progress (RUN).
- You cannot search accumulated waveforms.

Displaying Detected Waveforms (Pattern No.)

1. Press the **Pattern No.** soft key.
2. Turn the **jog shuttle** to display the waveforms that have been found.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



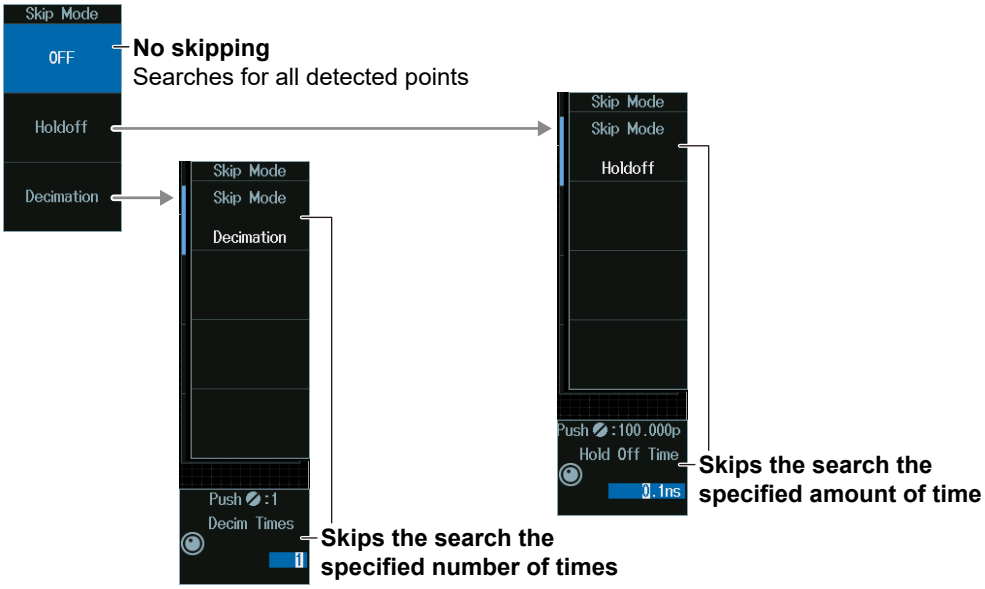
Displays the detected waveforms

Displaying Detected Waveforms

Turning the jog shuttle changes Pattern No. The waveform (detected point) selected by Pattern No. Is displayed with a filled triangle mark (Mark), and the triangle mark location is displayed at the center of the Result window (zoom window).
For details on the triangle mark, see “Search Results” above.

Search Skip Conditions (Skip Mode)

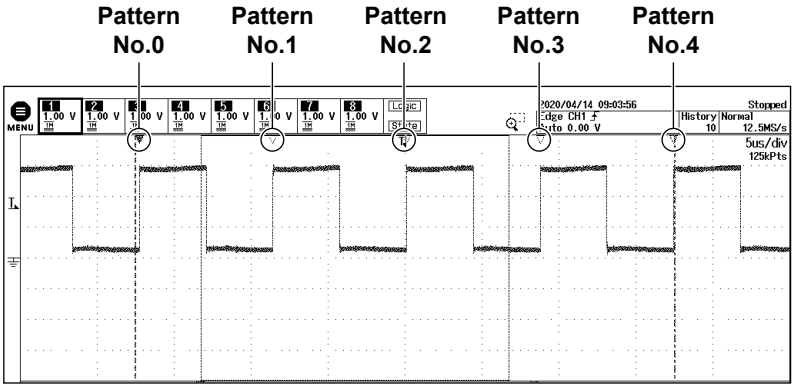
Press the **Skip Mode** soft key to display the following menu.



Skipping Search Conditions

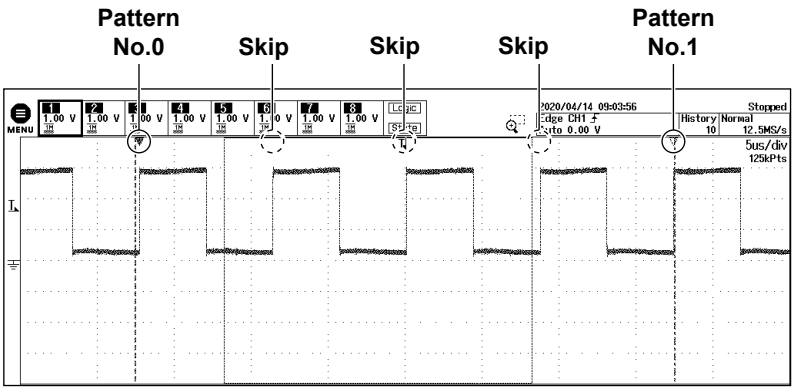
When the skip condition is off

An example of an edge search (see section 11.2). There is a detected point at each rising edge.



When the skip condition is Decimation (Decim Times = 3)

An example of an edge search. Three rising edges are skipped.



Note

The Skip Mode soft key is displayed for Timeout and Pattern.

11.2 Searching for Edges

This section explains the following settings for searching for edges:

- Search type
- Search conditions
  search source waveform, slope, level used to detect source waveform edges, hysteresis

► "Search Type (Type)," "Search Conditions (Condition Setup)" in the Features Guide

SEARCH Edge Menu

1. Press **SEARCH** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the SEARCH menu from ANALYSIS on the top menu that is displayed.
2. Press the **Type** soft key and then the **Edge** soft key to display the following menu.



Set the search type to Edge.

Edge search condition

Executes the search
► section 11.1

Search Conditions (Condition Setup)

Press the **Condition Setup** soft key. The menu that appears varies depending on the specified source.

Note

The available channel and source settings vary depending on the model and options.

- The available source displays on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8, Logic
- The available source displays on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4, Logic
- The following source bit display applies to models with the /L32 option.
  C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

When the Search Source Waveform (Source) Is Set to an Analog Channel (CH) or Computation Channel (Math)



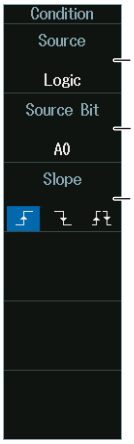
Set the search source waveform to analog channel (CH) and computation channel (Math).

Slope

Level for detecting search source waveform edges

Hysteresis

When the Search Source Waveform (Source) Is Set to a Logic Channel



Set the search source waveform to logic channel (Logic).

Source bit

Slope

Level for Detecting Search Source Waveform Edges (CH LEVEL/ Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting search source waveform edges

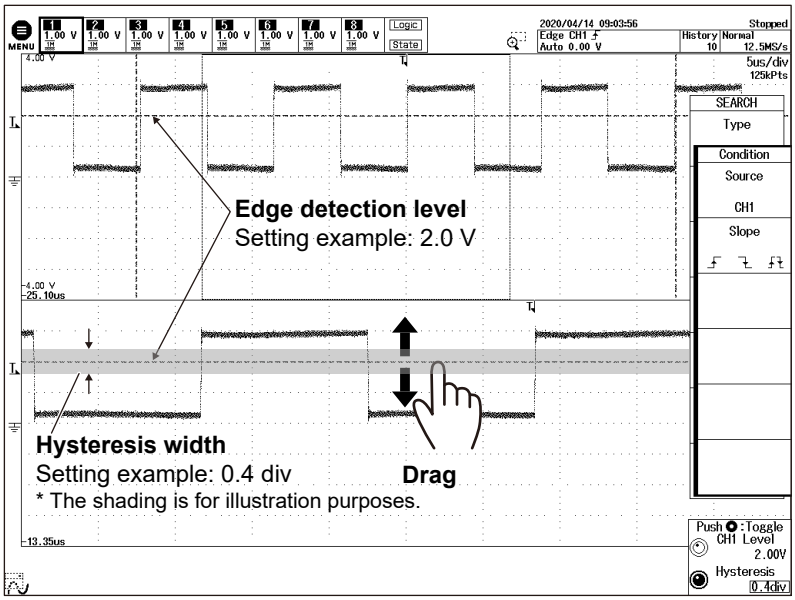
Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Note

You can control the level and hysteresis settings when you set the search source waveform to an analog channel (CH) or computation channel (Math).

Edge Detection Level and Hysteresis



11.3 Searching with Multiple Input Patterns

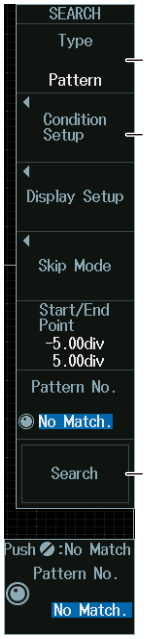
This section explains the following settings for searching with multiple input patterns.

- Search type
- Search conditions

► “Search Type (Type),” “Search Conditions (Condition Setup)” in the Features Guide

SEARCH Pattern Menu

1. Press **SEARCH** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the SEARCH menu from ANALYSIS on the top menu that is displayed.
2. Press the **Type** soft key and then the **Pattern** soft key to display the following menu.



Set the search type to Pattern.

Pattern search condition

Executes the search
► section 11.1

Search Conditions (Condition Setup)

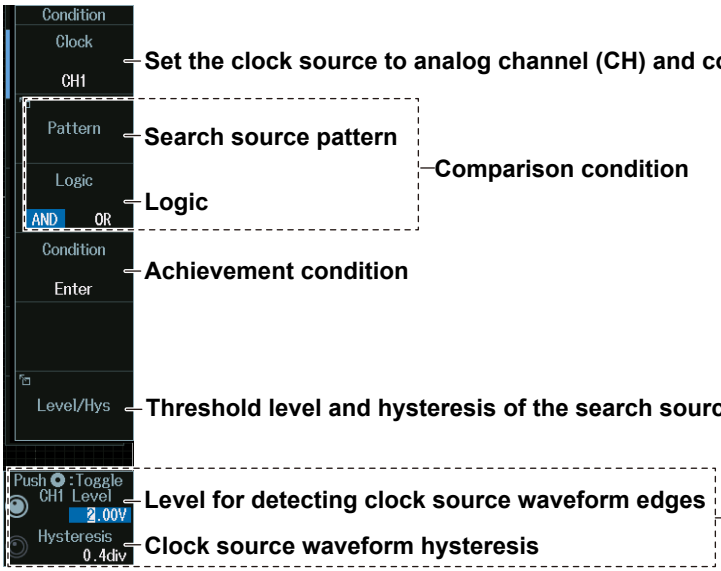
Press the **Condition Setup** soft key. The menu that appears varies depending on the specified source.

Note

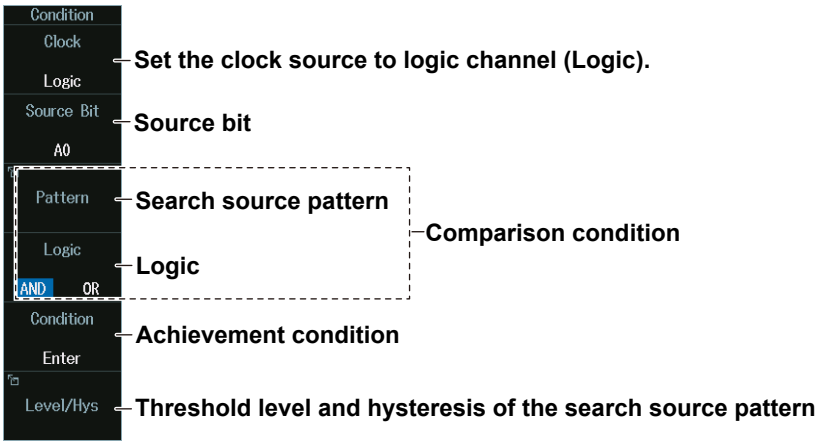
The available clock source settings vary depending on the model and options.

- The available source displays on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8, Logic, None
- The available source displays on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4, Logic, None
- The following source bit display applies to models with the /L32 option.
  C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

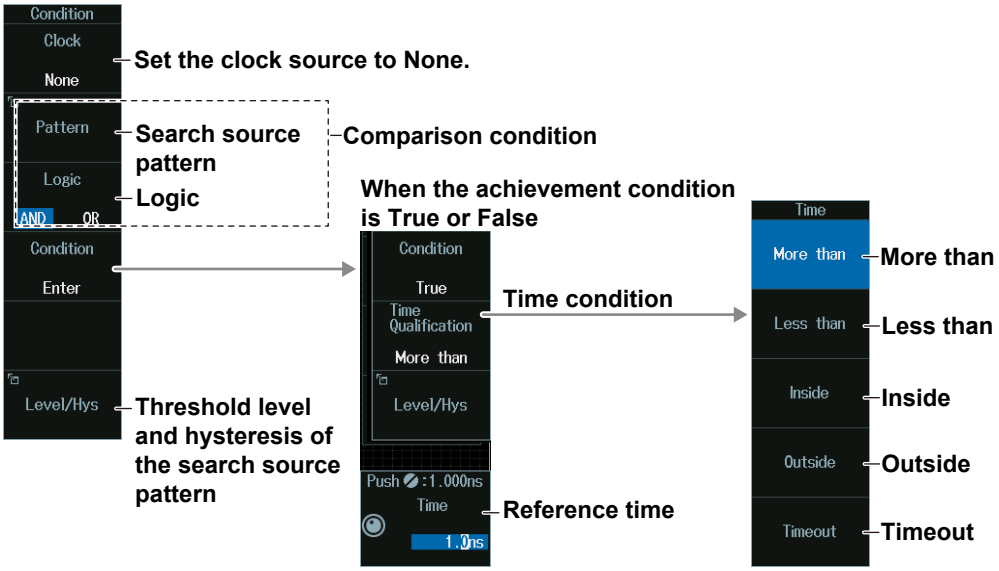
When the Clock Source (Clock) Is Set to an Analog Channel (CH) or Computation Channel (Math)



When the Clock Source (Clock) Is Set to a Logic Channel (Logic)



When a Clock Source (Clock) Is Not Available (None)



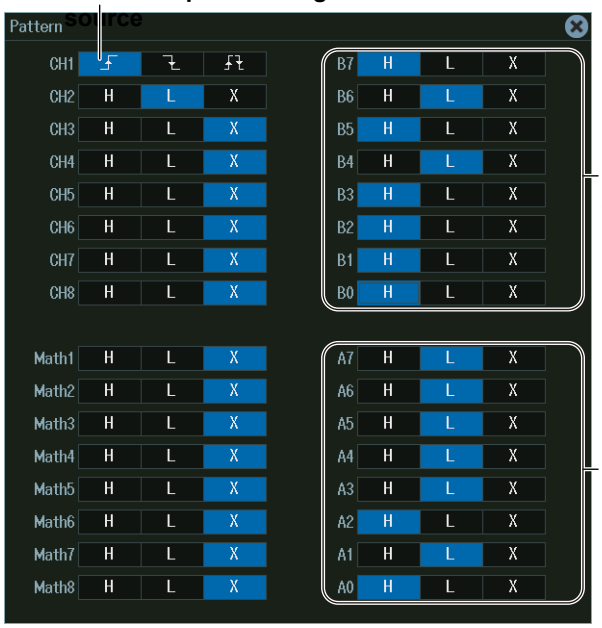
Search Source Pattern (Pattern)

Press the **Pattern** soft key to display the following menu.

- **When There Is a Clock Source**
  Set the clock source slope and pattern.

8ch model example

Set the slope of the signal set as the clock source

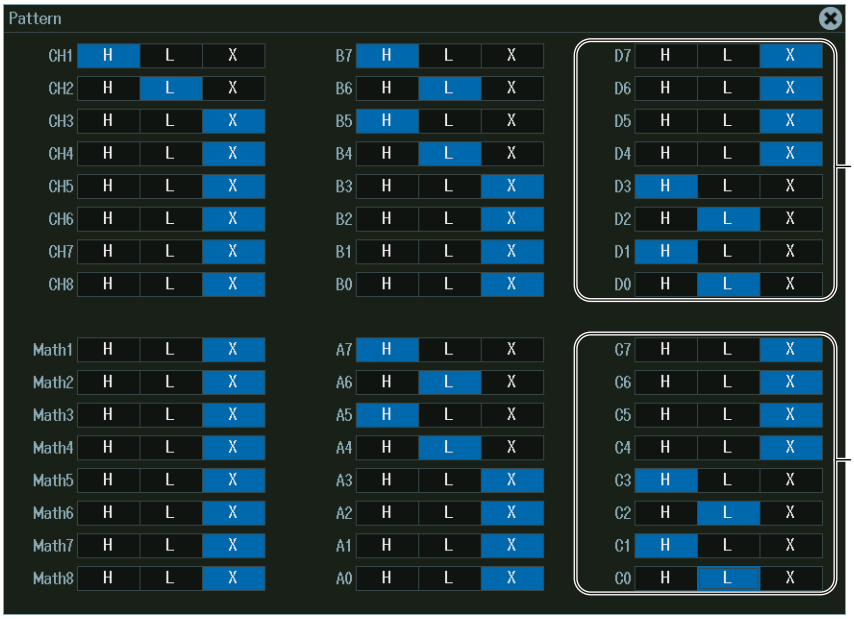


Logic port B
Setting example: 10101111 (MSB;B7)
H: High level
L: Low level
X: Don't care

Logic port A
Setting example: 00000101 (MSB;A7)

- **No Clock Source**
  The settings are the same as the pattern settings explained in "When the Clock Source Is a Channel from CH1 to CH8 or Logic" above.
  Set the pattern of the source channels (all CH1 to CH8 and Logic signals) to search for.

8ch model example (a model with the /L32 option)



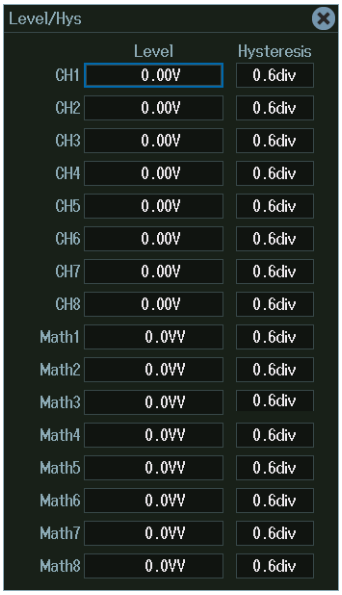
Logic port D
Setting example: xxxx1010 (MSB;D7)
H: High level
L: Low level
X: Don't care

Logic port C
Setting example: xxxx1010 (MSB;C7)

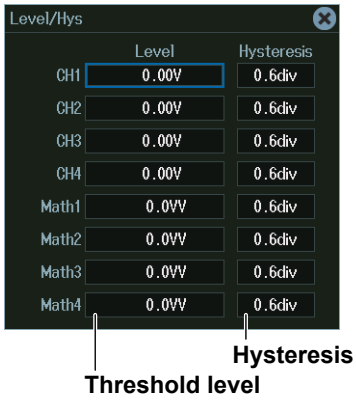
Threshold Level and Hysteresis Of The Search Source Pattern (Level/Hys)

Press the **Level/Hys** soft key to display the following menu.

8ch model



4ch model



Time Conditions (Time Qualification) and Reference Times(Time) (Procedure When a Clock Source (Clock) Is Not Available (None))

1. Press the **Condition** soft key to set the achievement condition to True or False.
2. Press the **Time Qualification** soft key to set the time conditions.
3. Turn the **jog shuttle** to set the reference times.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the time condition is More than, Less than, or Timeout



Reference time

When the time condition is Inside



Reference time 1

Reference time 2

Press SET (upper right on the front panel) to switch between reference time 1 and reference time 2.

Satisfaction of Comparison Conditions

Set what kind of relationship (True or False) must be established between the achievement time of the comparison condition and the specified reference times (Time1 and Time2) for a point to be detected.

More than	When the comparison condition achievement time is longer than the specified reference time (Time)
Less than	When the comparison condition achievement time is shorter than the specified reference time (Time)
Inside	When the comparison condition achievement time is longer than reference time Time1 but shorter than reference time Time2.
Outside	When the comparison condition achievement time is shorter than reference time Time1 or longer than reference time Time2.
Timeout	When the comparison condition achievement time exceeds the specified reference time (Time)

11.4 Searching for Pulse Width

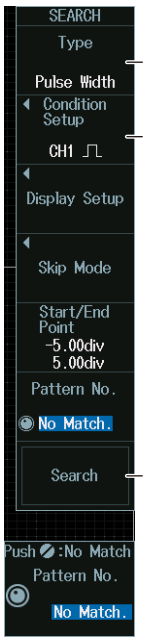
This section explains the following settings for searching for pulse width:

- Search type
- Search conditions

► "Search Type (Type)," "Search Conditions (Condition Setup)" in the Features Guide

SEARCH Pulse Width Menu

1. Press **SEARCH** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the SEARCH menu from ANALYSIS on the top menu that is displayed.
2. Press the **Type** soft key and then the **Pulse Width** soft key to display the following menu.



Set the search type to Pulse Width.

Pulse width search condition

Executes the search
► section 11.1

Search Conditions (Condition Setup)

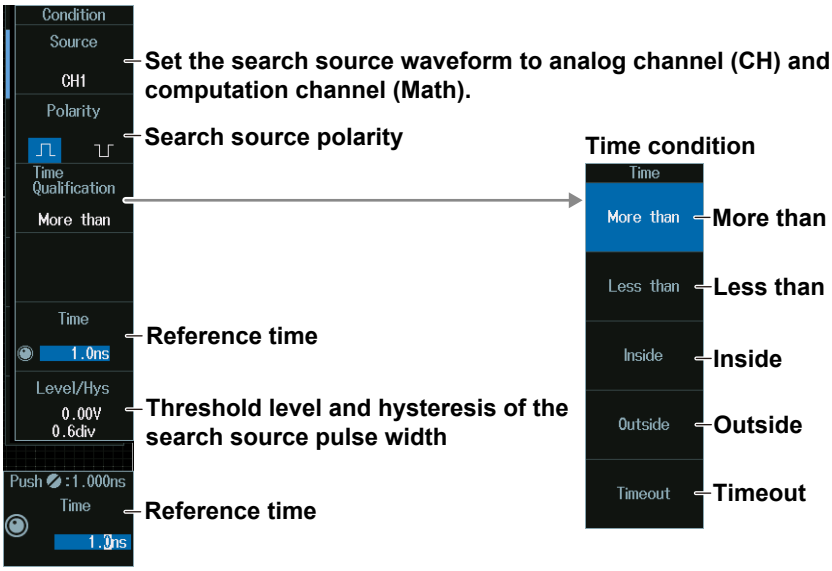
Press the **Condition Setup** soft key. The menu that appears varies depending on the specified source.

Note

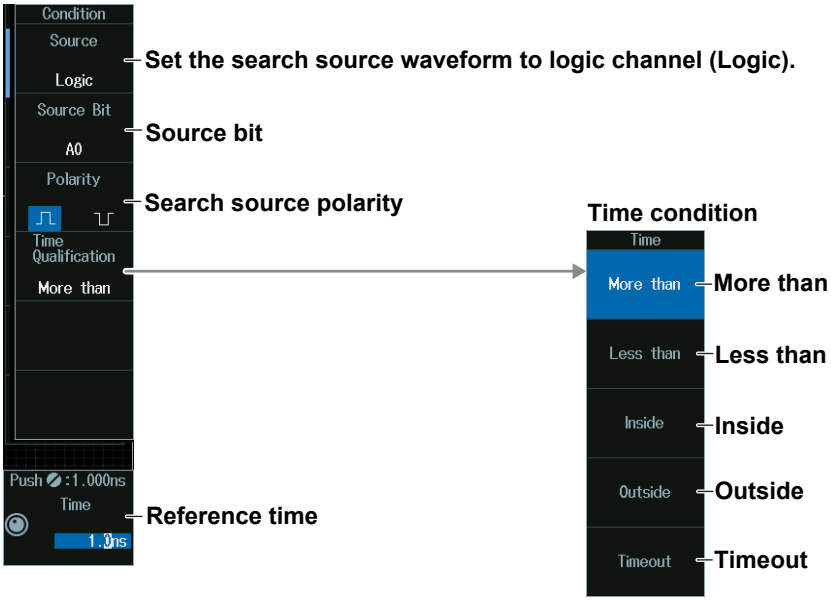
The available source settings vary depending on the model and options.

- The available source displays on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8, Logic
- The available source displays on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4, Logic
- The following source bit display applies to models with the /L32 option.
  C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

When the Search Source Waveform (Source) Is Set to an Analog Channel (CH) or Computation Channel (Math)



When the Search Source Waveform (Source) Is Set to a Logic Channel (Logic)



Threshold Level and Hysteresis of the Search Source Pulse Width (Level/Hys)

When the Search Source Waveform Is an Analog Channel or Competition Channel

1. Press the **Level/Hys** soft key.
2. Turn the **jog shuttle** to set the level or hysteresis.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - To set the level, you can drag the level display line on the screen. For details, see “Edge Detection Level and Hysteresis” in section 11.2.

Jog shuttle setting menu



Threshold level of the search source pulse width

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Time Conditions (Time Qualification) and Reference Times(Time)

When the Search Source Waveform Is an Analog Channel or Competition Channel

1. Press the **Time Qualification** soft key to set the time conditions.
2. Press the **Time** soft key.
3. Turn the **jog shuttle** to set the reference times.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

When the Search Source Waveform Is a Logic Channel

1. Press the **Time Qualification** soft key to set the time conditions.
2. Turn the **jog shuttle** to set the reference times.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When the time condition is More than, Less than, or Timeout



Reference time

When the time condition is Inside



Reference time 1

Reference time 2

Press SET (upper right on the front panel) to switch between reference time 1 and reference time 2.

Satisfaction of Conditions

Set what kind of relationship (True or False) must be established between the achievement time of the comparison condition and the specified reference times (Time1 and Time2) for a point to be detected.

More than	When the comparison condition achievement time is longer than the specified reference time (Time)
Less than	When the comparison condition achievement time is shorter than the specified reference time (Time)
Inside	When the comparison condition achievement time is longer than reference time Time1 but shorter than reference time Time2.
Outside	When the comparison condition achievement time is shorter than reference time Time1 or longer than reference time Time2.
Timeout	When the comparison condition achievement time exceeds the specified reference time (Time)

11.5 Searching for Timeout Periods

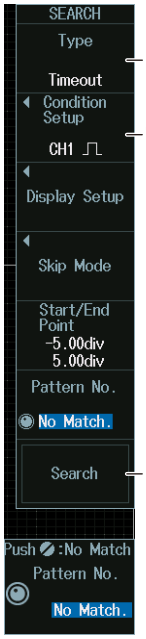
This section explains the following settings for searching for timeouts:

- Search type
- Search conditions

► “Search Type (Type),” “Search Conditions (Condition Setup)” in the Features Guide

SEARCH Timeout Menu

1. Press **SEARCH** to display the following menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the SEARCH menu from ANALYSIS on the top menu that is displayed.
2. Press the **Type** soft key and then the **Timeout** soft key to display the following menu.



Set the search type to Timeout.

Timeout search condition

Executes the search
► section 11.1

Search Conditions (Condition Setup)

Press the **Condition Setup** soft key. The menu that appears varies depending on the specified source.

When the Search Source Waveform (Source) Is Set to an Analog Channel (CH) or Computation Channel (Math)



Set the search source waveform to analog channel (CH) and computation channel (Math).

Search source polarity

Timeout period

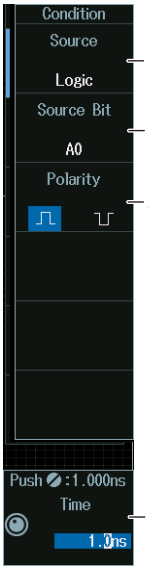
Threshold level and hysteresis of the search source state

Note

The available source settings vary depending on the model and options.

- The available source displays on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8, Logic
- The available source displays on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4, Logic

When the Search Source Waveform (Source) Is Set to a Logic Channel (Logic)



Set the search source waveform to logic channel (Logic).

Source bit

Search source polarity

Timeout period

Note

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Threshold Level and Hysteresis of the Search Source State (Level/Hys)

When the Search Source Waveform Is an Analog Channel or Competition Channel

1. Press the **Level/Hys** soft key.
2. Turn the **jog shuttle** to set the level or hysteresis.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - To set the level, you can drag the level display line on the screen. For details, see “Edge Detection Level and Hysteresis” in section 11.2.

Jog shuttle setting menu



Threshold level of the search source state

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Timeout Period (Timeout)

When the Search Source Waveform Is an Analog Channel or Competition Channel

1. Press the **Time** soft key.
2. Turn the **jog shuttle** to set the timeout period.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

When the Search Source Waveform Is a Logic Channel

Turn the **jog shuttle** to set the timeout period.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Timeout period

12.1 Analyzing and Searching FlexRay Bus Signals (Option)

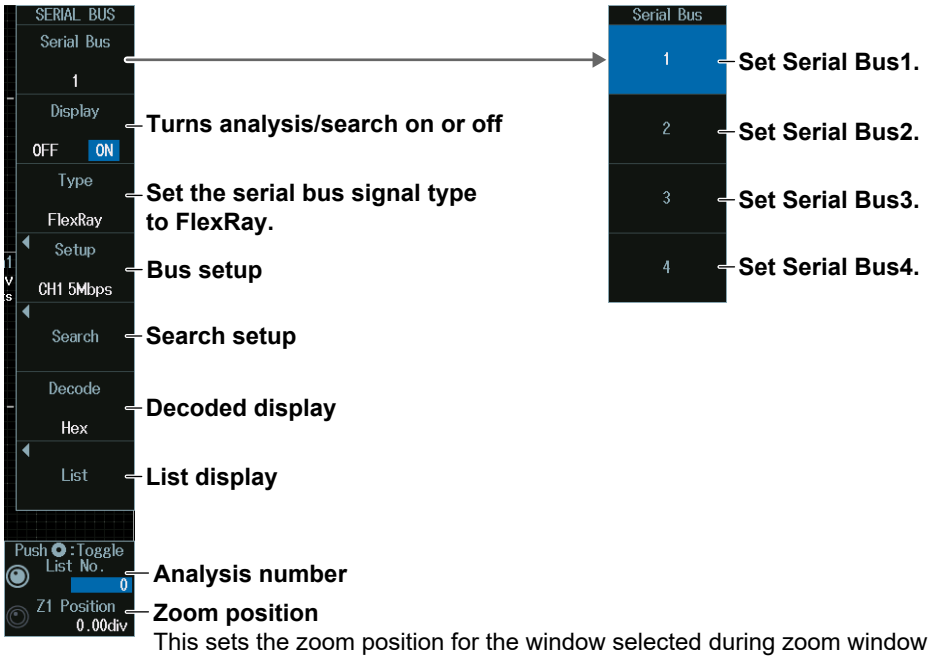
This section explains the following settings for analyzing or searching FlexRay bus signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Auto setup, analysis/search source waveform, bit rate, bus channel, level and hysteresis for detecting analysis/search source waveform states
- Decoded display
- List display
  List size, display position, and zoom linking
- Analysis number
- Zoom position
- Search settings
  Jumping to a specified field, zoom window, search type, and search execution

► **"Analyzing and Searching Serial Bus Signals," "Analyzing and Searching FlexRay Bus Signals (Option)" in the Features Guide**

SERIAL BUS FlexRay Menu

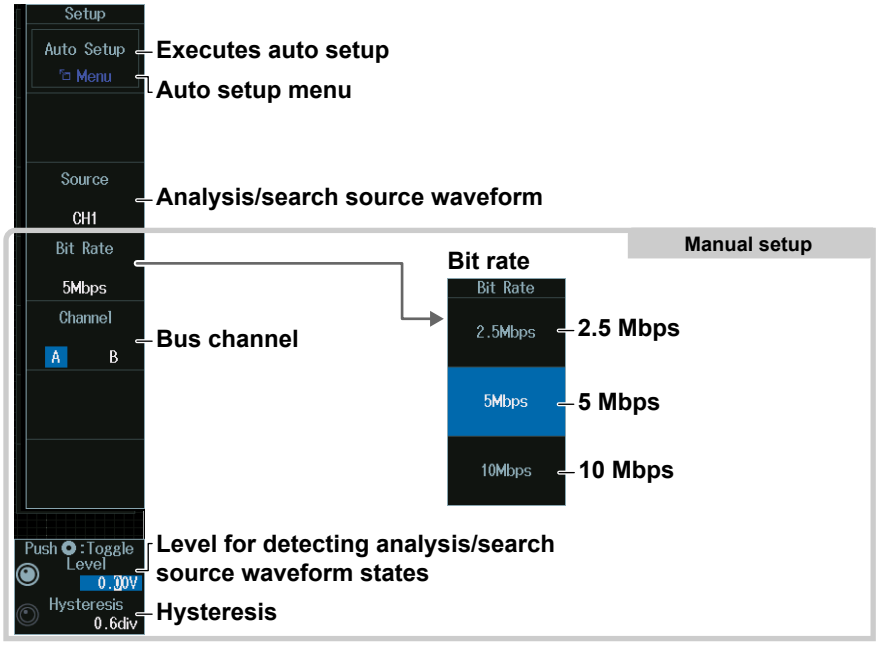
1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the **Serial Bus** soft key and select a number from 1 to 4.
2. Press the **Type** soft key. Select **FlexRay** from the setup menu that is displayed. The following menu appears.



Zoom position
This sets the zoom position for the window selected during zoom window configuration (described later).

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



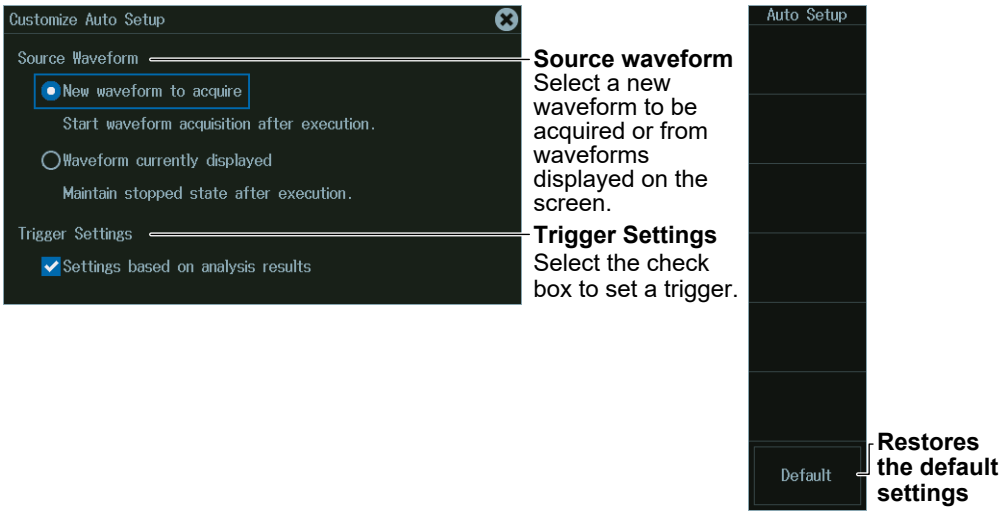
Executing Auto Setup (Auto Setup)

1. Set the analysis/search source waveform.
   Auto setup cannot be performed when the source is set to Math1 to Math8.
2. Press the **Auto Setup** soft key to execute auto setup.
   - The instrument automatically sets the bit rate, bus channel, level, and hysteresis and triggers on the start of frame (Frame Start) of the FlexRay bus signal. Triggers are not set if you unselect the Trigger Settings check box on the auto setup menu explained later.
   - While the serial bus is being configured, Auto Setup changes to Abort. If you want to stop, press the **Abort** soft key.

Auto Setup Menu (Menu)

You can set the analysis/search source waveform and select whether to set a trigger.

1. Press **SHIFT+F1**. The following screen and menu appear.
   You can also display them by pressing **SHIFT** and then the **Auto Setup** soft key.



2. Tap the screen to set the source waveform and trigger.
   - When waveform acquisition is in progress, the source waveform is fixed to a new waveform to be acquired.
   - If you clear the trigger setting check box, the trigger is not set even when auto setup is performed.

3. Press **ESC**. The menu returns to the bus setup menu.
   Press the **Auto Setup** soft key to execute auto setup. If you change the source waveform or the trigger setting from its default value, the soft key changes from Auto Setup to Auto Setup (Customized).

Note

- The auto setup feature will not work properly on some input signals.
- The available source waveforms vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8, Math1 to Math8
  - The available settings on 4ch models are as follows:
    CH1 to CH4, Math1 to Math4

Manual Setup

After running auto setup, you can change the following settings and display decoded results.

- Bit rate
- Bus channel
- Level for detecting analysis/search source waveform states
- Hysteresis

Level for Detecting Analysis/Search Source Waveform States (Level/Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



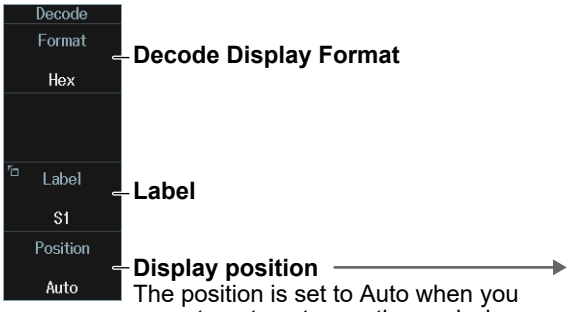
Level for detecting analysis/search source waveform states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



Decode Display Format

Label

Display position

The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

When the display position is set to Manual



Display position

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

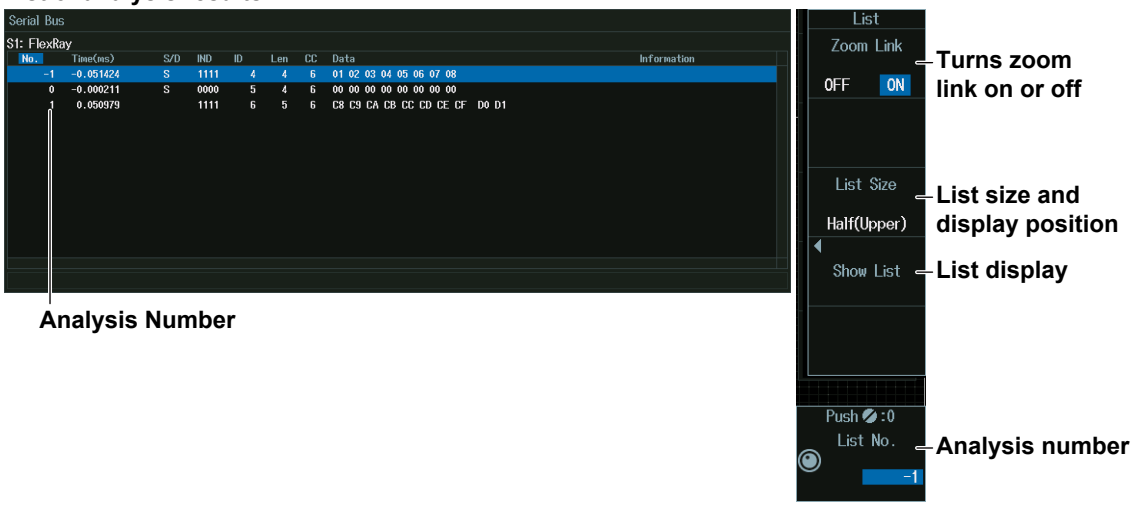


Display position

List Display (List)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List** soft key and then the **Show List** soft key.
   - The list of analysis results and the next menu appear.
   - If several display settings of Serial Bus 1 to 4 are on, all the lists of analysis results of the serial buses whose display setting is on are displayed. For details, see section 12.12.

List of analysis results



Note

Analysis Number

Data before the trigger position (on the left side of the waveform display) is assigned analysis numbers in descending order (–1, –2, and so on). Data after the trigger position (on the right side of the waveform display) is assigned analysis numbers in ascending order (0, 1, 2, and so on).

Analysis Number (List No.)

Turn the **jog shuttle** to set the analysis number (List No.).

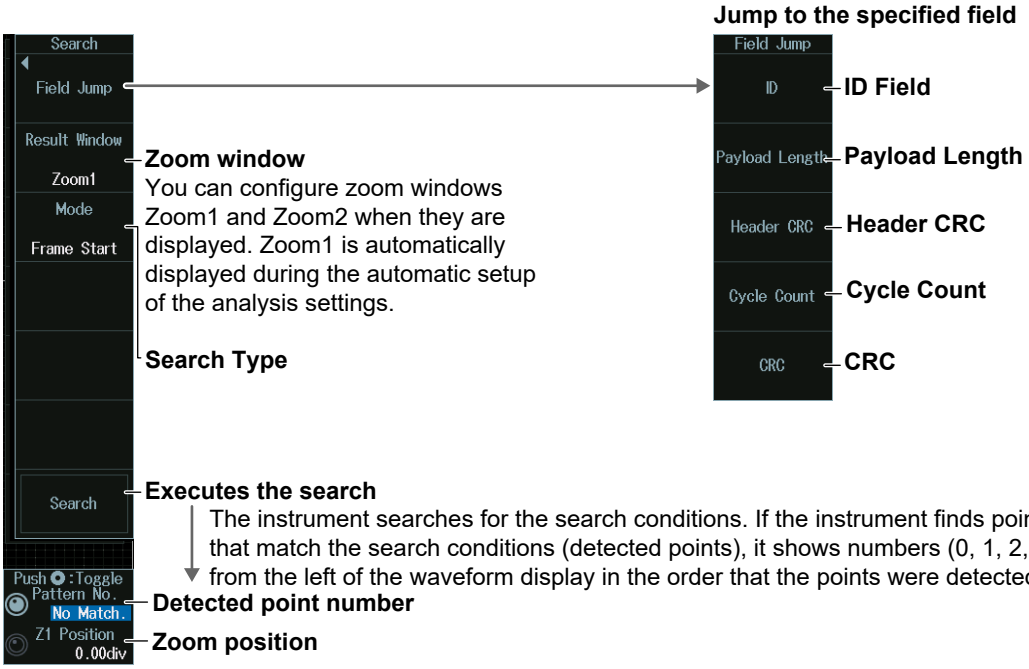
You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Search Setup (Search)

Press the **Search** soft key to display the following menu.

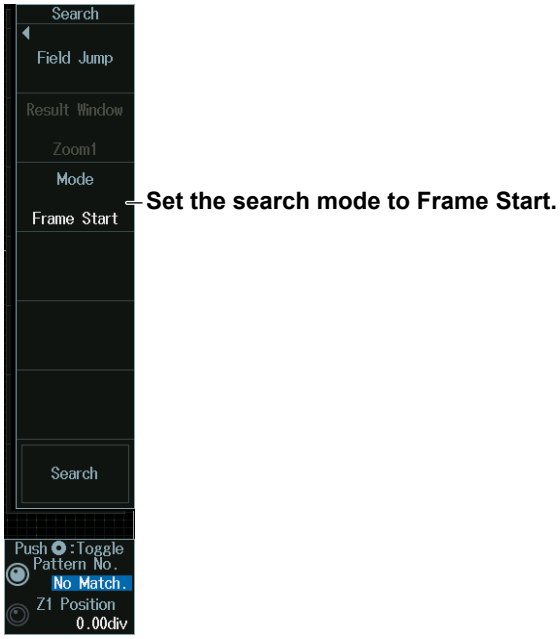


Search Type (Mode)

Frame Start Mode (Frame Start)

Press the **Mode** soft key and then the **Frame Start** soft key to display the following menu.

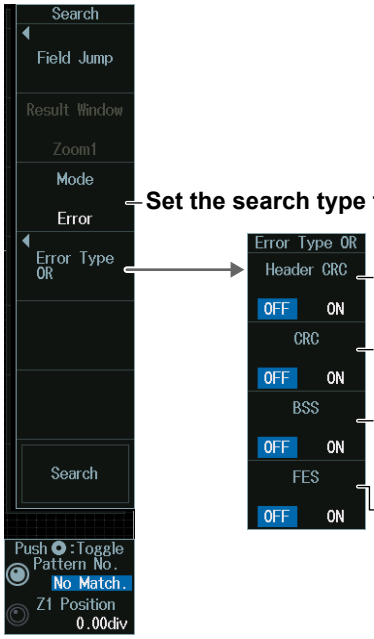
The instrument searches for the start position of FlexRay bus signal frames.



Error Mode (Error)

Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument searches for FlexRay bus signal errors.



Set the search type to Error

Turns header CRC error detection on or off
When a header CRC error is detected

Turns CRC error detection on or off
When a CRC error is detected

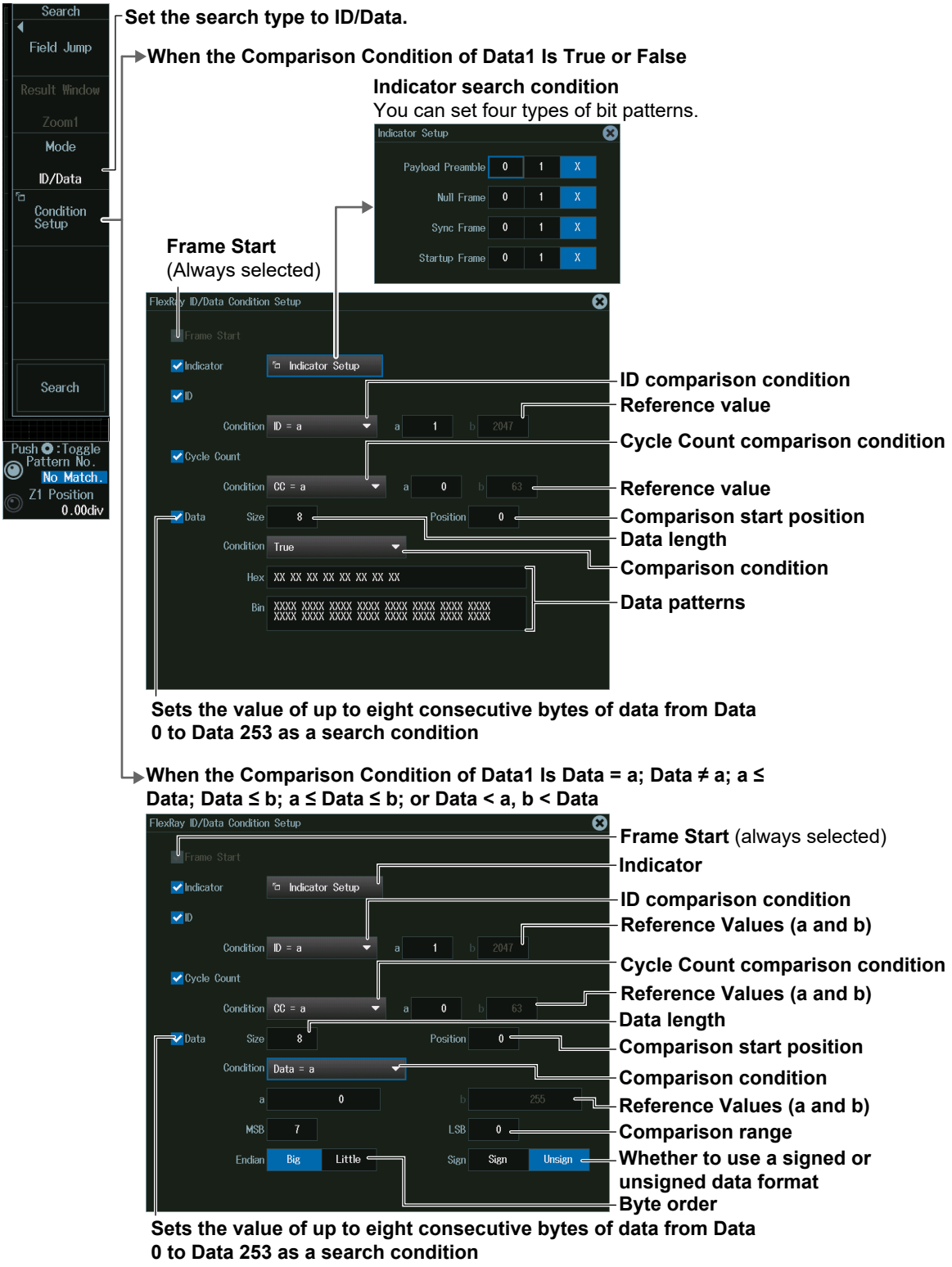
Turns BSS error detection on or off
When the falling edge of the first byte sequence is not at the specified position

Turns FES error detection on or off
When the rising edge of the frame end sequence is not at the specified position

ID/Data Mode (ID/Data)

1. Press the **Mode** soft key and then the **ID/Data** soft key.
2. Press the **Condition Setup** soft key. The following menu appears.

   The instrument searches for the position where the AND condition of the Frame Start, Indicator, ID, Cycle Count, and Data is met.



Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



Detected point number

Zoom position

12.2 Analyzing and Searching CAN Bus Signals (Option)

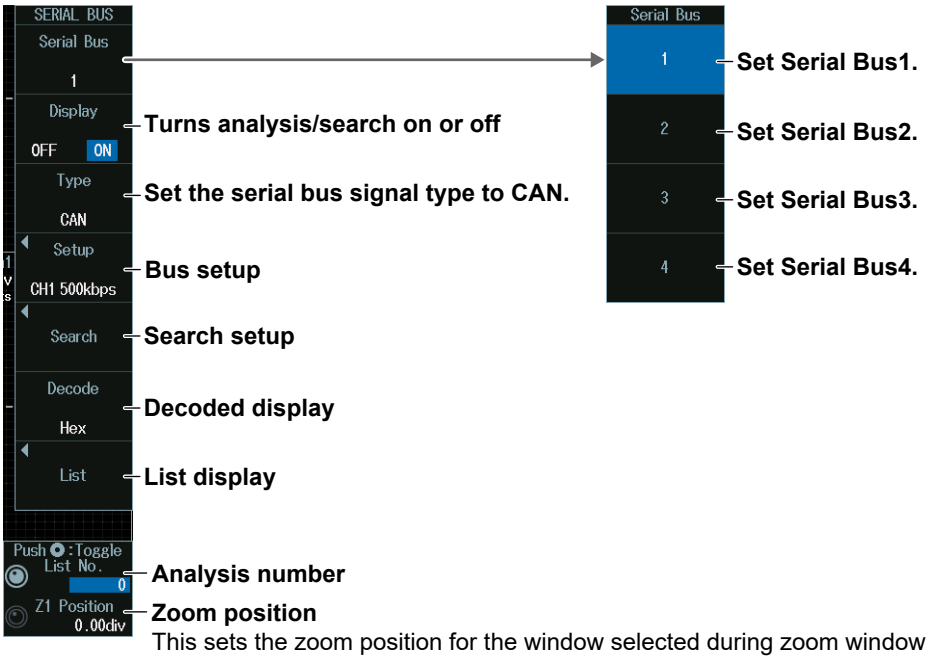
This section explains the following settings for analyzing or searching CAN bus signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Auto setup, analysis/search source waveform, bit rate, recessive level, sample point, level and hysteresis for detecting analysis/search source waveform states
- Decoded display
- List display
  List size, display position, zoom linking, filter (list display filtering)
- Analysis number
- Zoom position
- Search settings
  Jumping to a specified field, zoom window, search type, and search execution

► **"Analyzing and Searching Serial Bus Signals," "Analyzing and Searching CAN Bus Signals (Option)" in the Features Guide**

SERIAL BUS CAN Menu

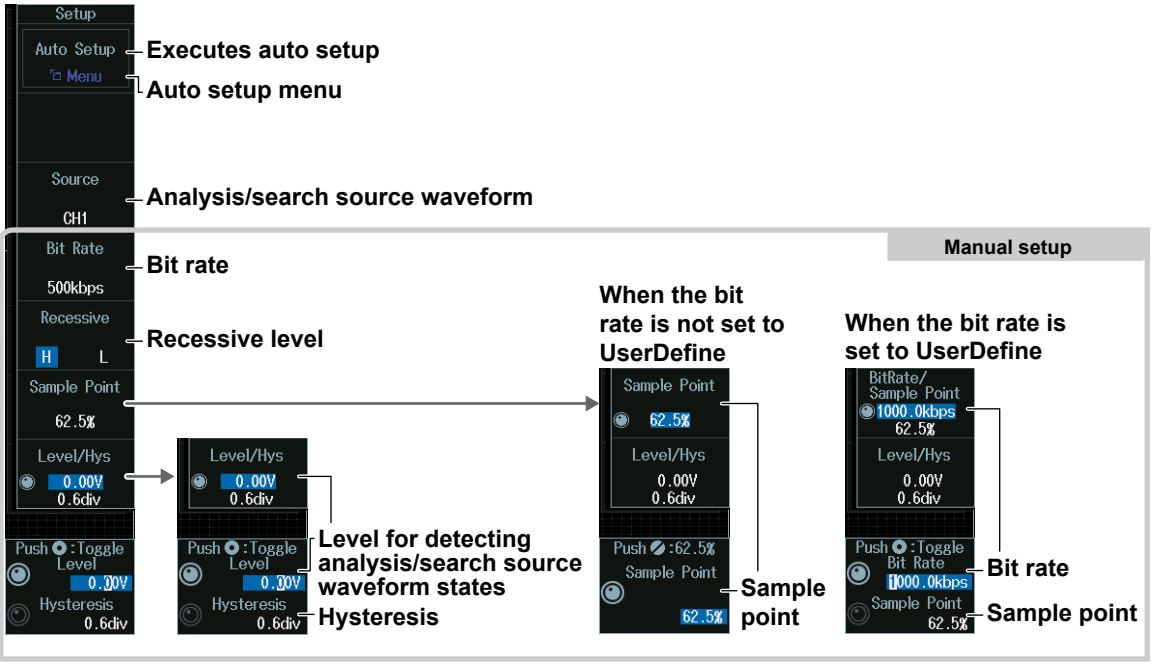
1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the Serial Bus soft key and select a number from 1 to 4.
2. Press the **Type** soft key. From the setup menu that appears, select **CAN** to display the following menu.



Zoom position
This sets the zoom position for the window selected during zoom window configuration (described later).

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



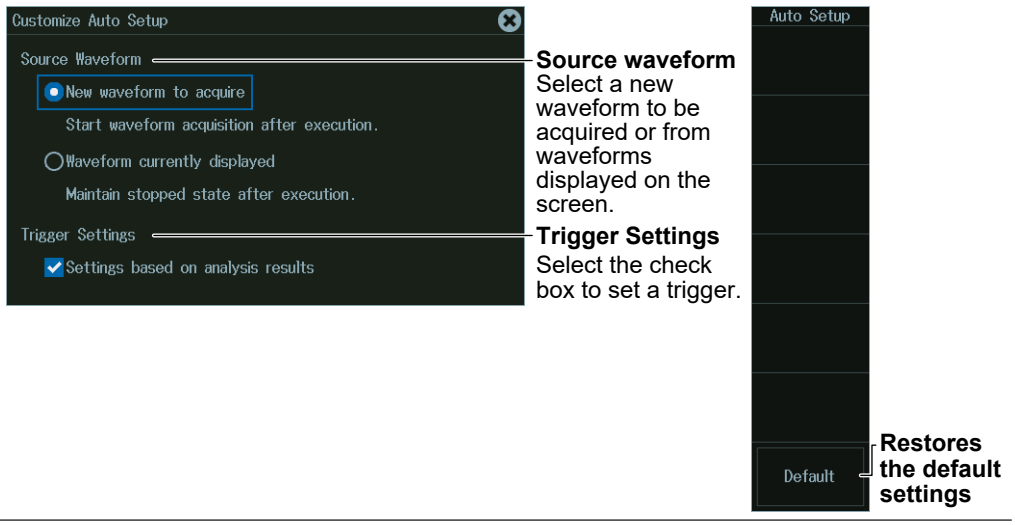
Executing Auto Setup (Auto Setup)

1. Set the analysis/search source waveform.
   Auto setup cannot be performed when the source is set to Math1 to Math8.
2. Press the **Auto Setup** soft key to execute auto setup.
   - The instrument automatically configures the bit rate, recessive level, sample point, level, and hysteresis and triggers on the start of frame (SOF) of the CAN bus signal. Triggers are not set if you unselect the Trigger Settings check box on the auto setup menu explained later.
   - While the serial bus is being configured, Auto Setup changes to Abort. If you want to stop, press the **Abort** soft key.

Auto Setup Menu (Menu)

You can set the analysis/search source waveform and select whether to set a trigger.

1. Press **SHIFT+F1**. The following screen and menu appear.
   You can also display them by pressing **SHIFT** and then the **Auto Setup** soft key.



2. Tap the screen to set the source waveform and trigger.
   - When waveform acquisition is in progress, the source waveform is fixed to a new waveform to be acquired.
   - If you clear the trigger setting check box, the trigger is not set even when auto setup is performed.

3. Press **ESC**. The menu returns to the bus setup menu.
   Press the **Auto Setup** soft key to execute auto setup. If you change the source waveform or the trigger setting from its default value, the soft key changes from Auto Setup to Auto Setup (Customized).

Note

- The auto setup feature will not work properly on some input signals.
- The available source waveforms vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8, Math1 to Math8
  - The available settings on 4ch models are as follows:
    CH1 to CH4, Math1 to Math4

Manual Setup

After running auto setup, you can change the following settings and display decoded results.

- Bit rate
- Recessive level
- Sample point
- Level for detecting analysis/search source waveform states
- Hysteresis

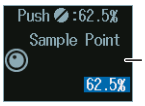
Sample Point (Sample Point) and Bit Rate (Bit Rate)

When the bit rate is not set to User Define

Turn the **jog shuttle** to set the sample point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up list that appears on the screen.

Jog shuttle setting menu



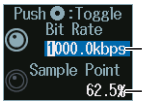
Sample point

When the bit rate is set to User Define

Turn the **jog shuttle** to set the sample point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up list that appears on the screen.

Jog shuttle setting menu



Bit rate

Sample point

Press SET (upper right on the front panel) to switch between bit rate and sample point.

Level for Detecting Analysis/Search Source Waveform States (Level/Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



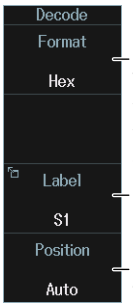
Level for detecting analysis/search source waveform states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



Decode Display Format
When you set decode display to Symbol, you can select display CANdB symbols if you load the physical value/symbol definition file (.sbl).

Label

Display position
The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

When the display position is set to Manual



Display position

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

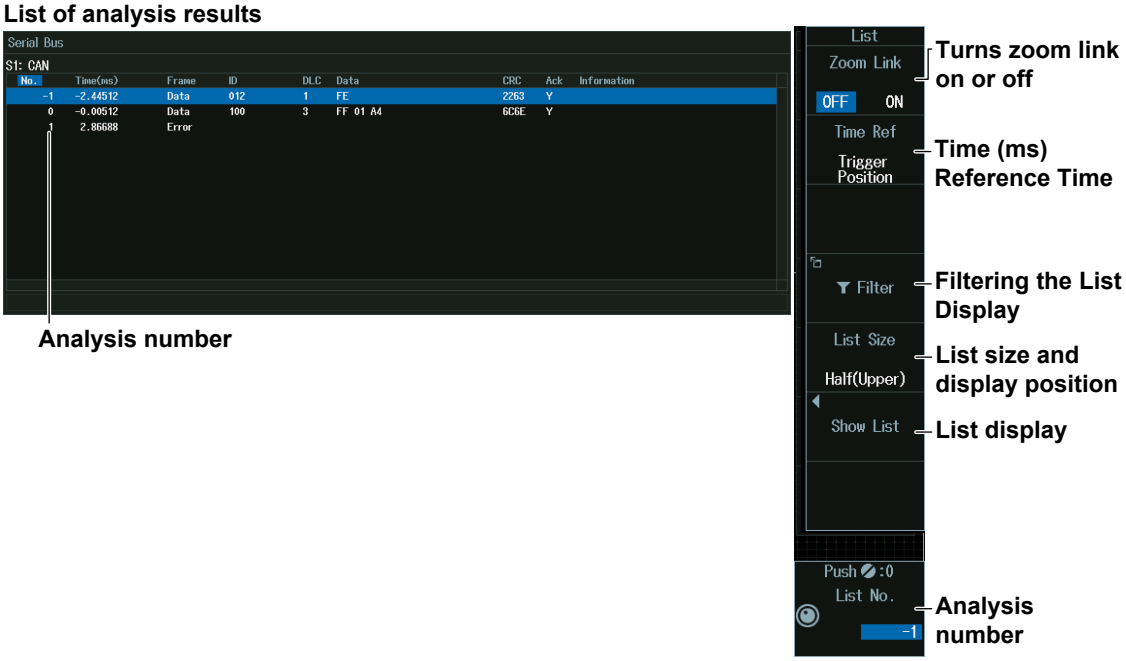


Display position

List Display (List)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List** soft key and then the **Slow List** soft key.
   - The list of analysis results and the next menu appear.
   - If several display settings of Serial Bus 1 to 4 are on, all the lists of analysis results of the serial buses whose display setting is on are displayed. For details, see section 12.12.

List of analysis results



Note

Analysis Number

Data before the trigger position (on the left side of the waveform display) is assigned analysis numbers in descending order (–1, –2, and so on). Data after the trigger position (on the right side of the waveform display) is assigned analysis numbers in ascending order (0, 1, 2, and so on).

Time (ms) Reference Time

Press the **Time Ref** soft key to select **Trigger Position** or **Previous Row**.

Time (ms) Reference Time

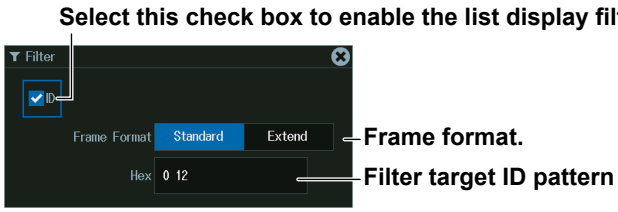
Select the reference for determining the time to the start of the frame to be analyzed.

Trigger Position: The reference time is set to the trigger point.

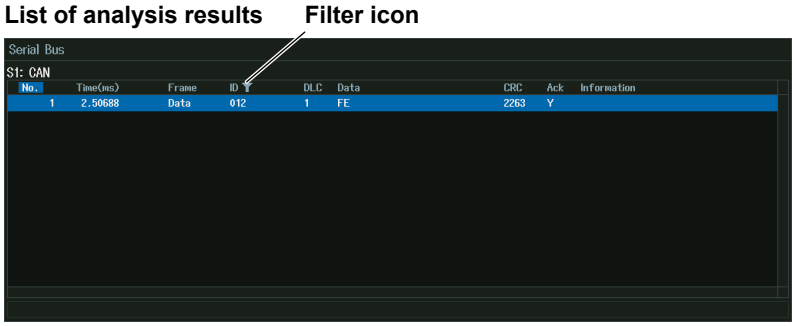
Previous Row: The reference time is set to the start position (SOF) of the frame previous to the frame to be analyzed.

Filtering the List Display

1. Press the **Filter** soft key to display the following screen.



2. Set the hexadecimal value of the ID to search for. Only the frames that contain the filter target ID pattern are listed.



Analysis Number (List No.)

Turn the **jog shuttle** to set the analysis number (List No.).

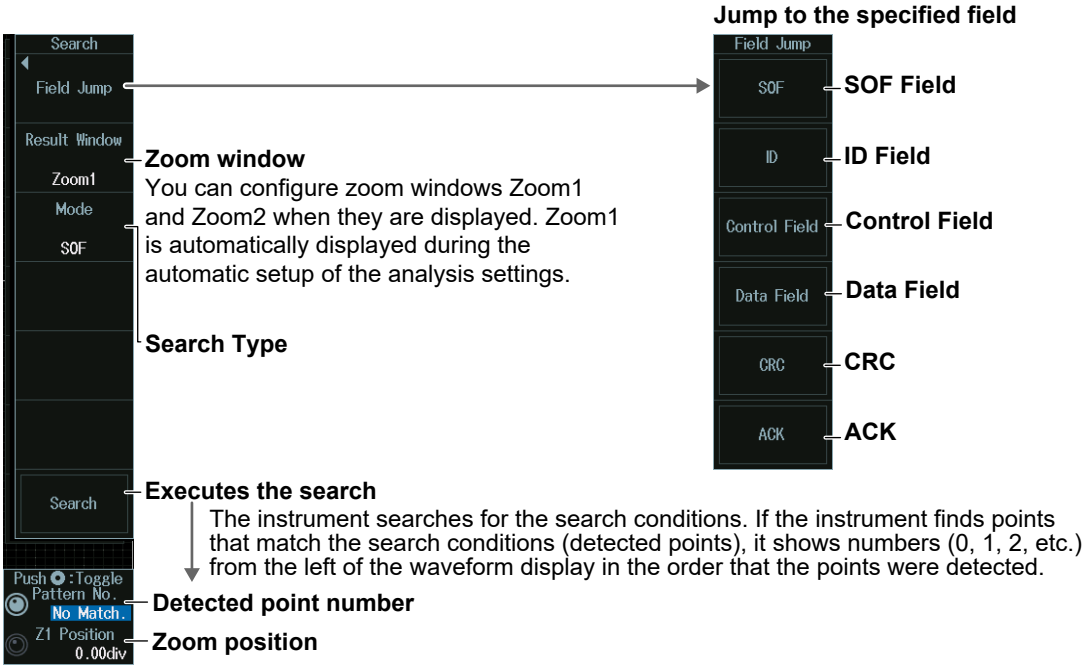
You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Search Setup (Search)

Press the **Search** soft key to display the following menu.

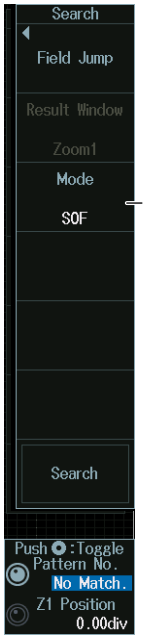


Search Type (Mode)

SOF Mode (Start of Frame)

Press the **Mode** soft key and then the **SOF** soft key to display the following menu.

The instrument searches for the start position of CAN bus signal frames.

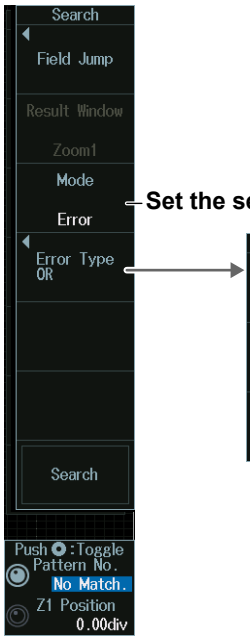


Set the search type to SOF

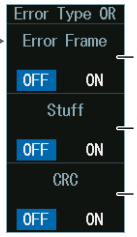
Error Mode (Error)

Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument searches for error frames (when the error flag is active) or various errors.



Set the search type to Error



Turns error frame detection on or off
When an active error flag is detected

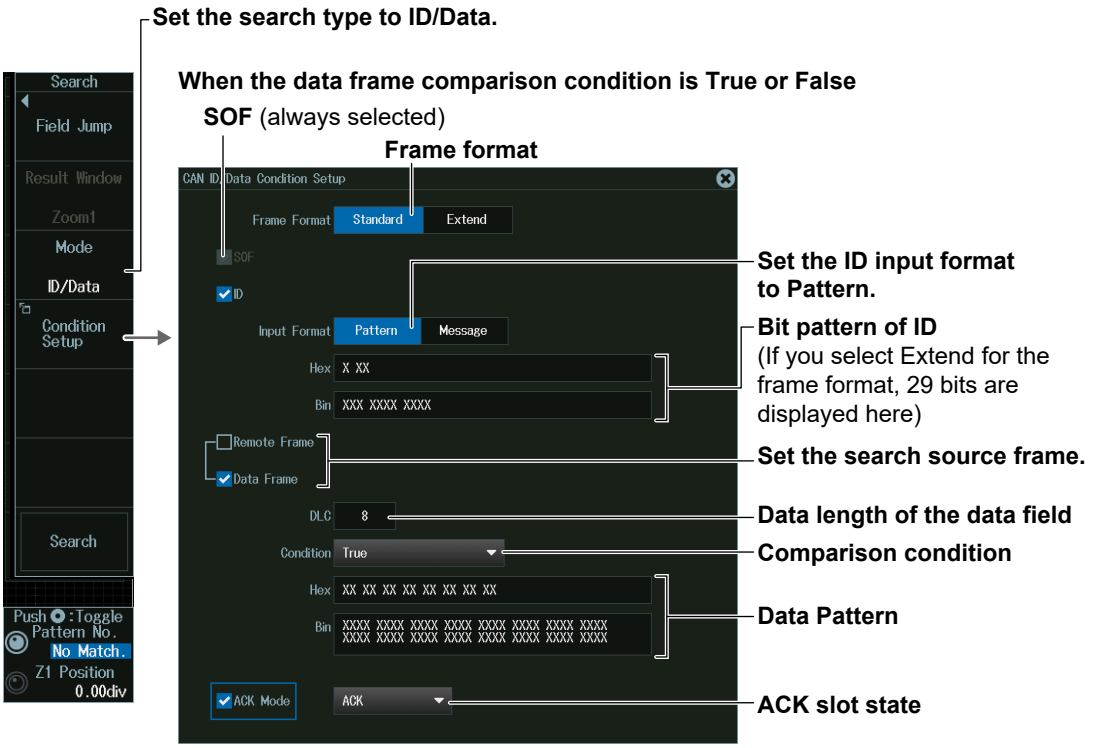
Turns stuff error detection on or off
When stuff bits are not inserted properly

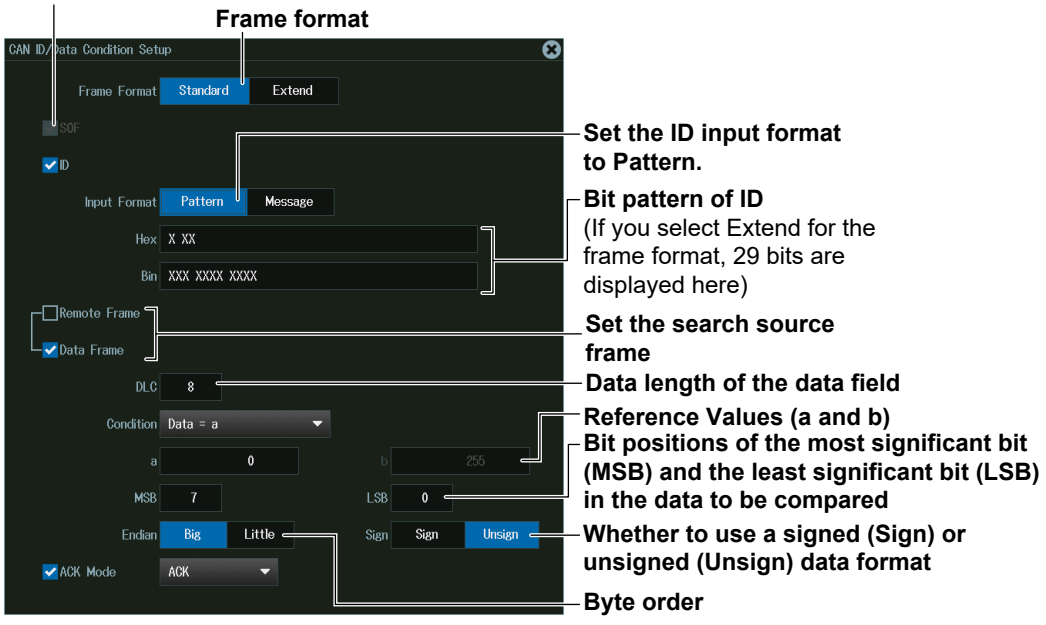
Turns CRC error detection on or off
When a CRC error is detected

ID/Data Mode (ID/Data)

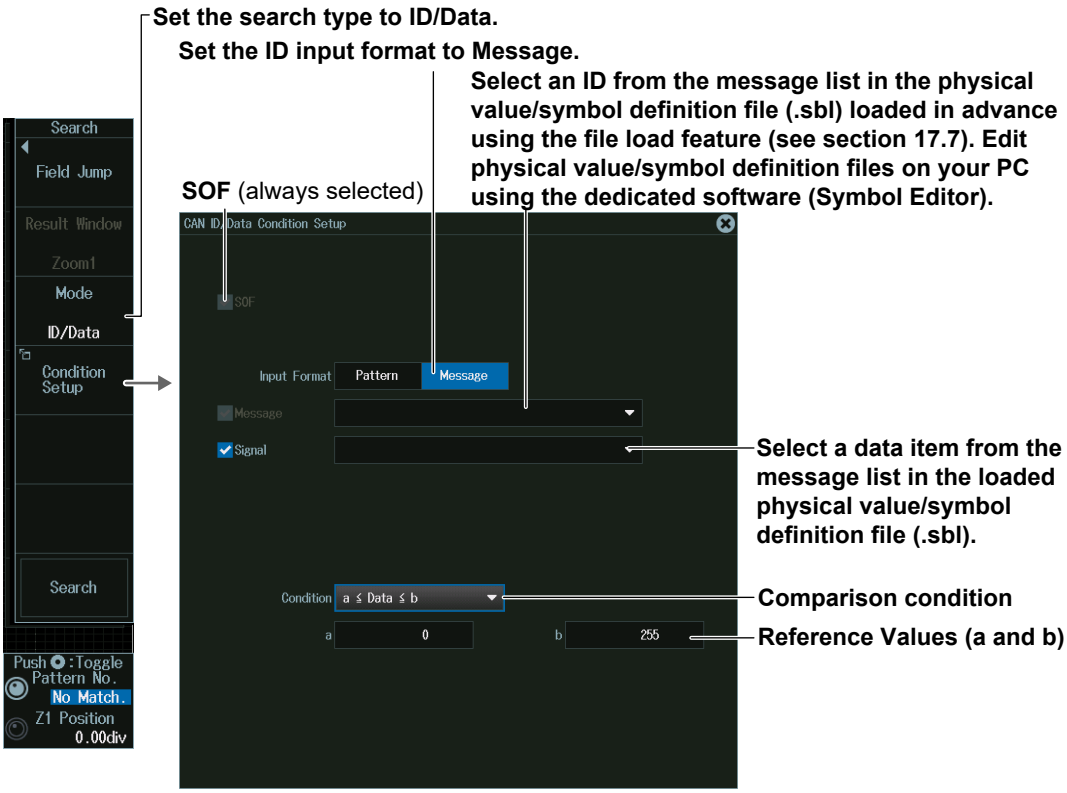
1. Press the **Mode** soft key and then the **ID/Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument searches for the position where the AND condition of the SOF, ID, Frame type, (Remote Frame/Data Frame), Data and ACK Mode is met.

- **When ID Input Format Is Pattern**





- **When ID Input Format Is Message**



Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



12.3 Analyzing and Searching CAN FD Bus Signals (Option)

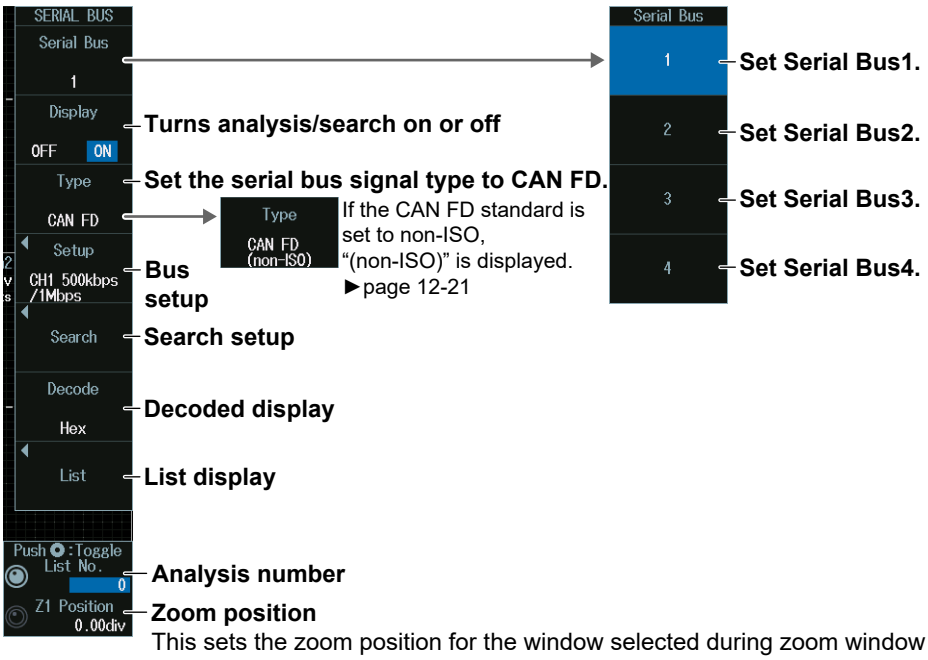
This section explains the following settings for analyzing or searching CAN FD bus signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Auto setup, analysis/search source waveform, bit rate, sample point, data phase bit rate, data phase sample point, recessive level, CAN FD standard, level and hysteresis for detecting analysis/search source waveform states
- Decoded display
- List display
  List size, display position, zoom linking, filter (list display filtering)
- Analysis number
- Zoom position
- Search settings
  Jumping to a specified field, zoom window, search type, and search execution

► **"Analyzing and Searching Serial Bus Signals," "Analyzing and Searching CAN FD Bus Signals (Option)" in the Features Guide**

SERIAL BUS CAN FD Menu

1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the Serial Bus soft key and select a number from 1 to 4.
2. Press the **Type** soft key. From the setup menu that appears, select **CAN FD** to display the following menu.



Zoom position
This sets the zoom position for the window selected during zoom window configuration (described later).

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



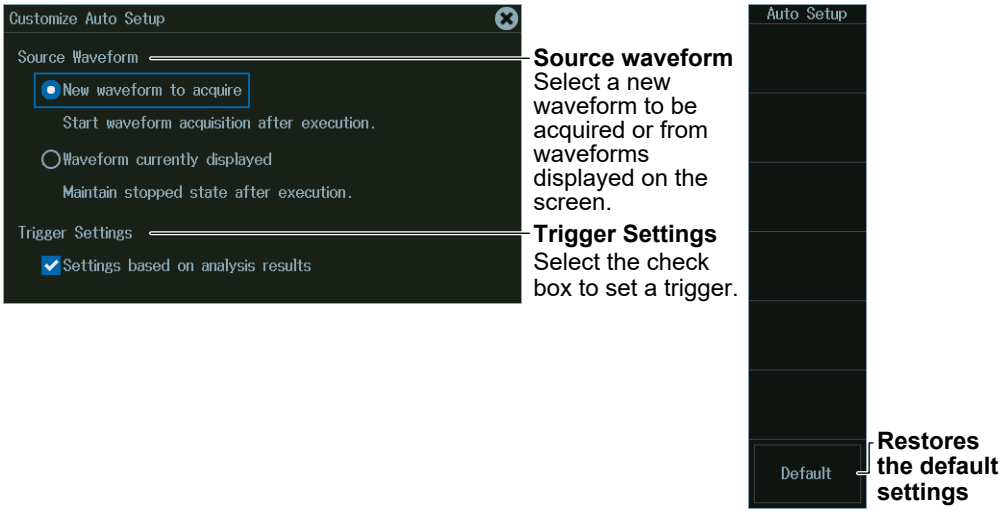
Executing Auto Setup (Auto Setup)

1. Set the analysis/search source waveform and the CAN FD standard.
   Auto setup cannot be performed when the source is set to Math1 to Math8.
2. Press the **Auto Setup** soft key to execute auto setup.
   - The instrument automatically sets the bit rate, sample point, data phase bit rate, data phase sample point, recessive level, level, and hysteresis and triggers on the start of frame (SOF) of the CAN FD bus signal. Triggers are not set if you unselect the Trigger Settings check box on the auto setup menu explained later.
   - While the serial bus is being configured, Auto Setup changes to Abort. If you want to stop, press the **Abort** soft key.

Auto Setup Menu (Menu)

You can set the analysis/search source waveform and select whether to set a trigger.

1. Press **SHIFT+F1**. The following screen and menu appear.
   You can also display them by pressing **SHIFT** and then the **Auto Setup** soft key.



2. Tap the screen to set the source waveform and trigger.
   - When waveform acquisition is in progress, the source waveform is fixed to a new waveform to be acquired.
   - If you clear the trigger setting check box, the trigger is not set even when auto setup is performed.
3. Press **ESC**. The menu returns to the bus setup menu.
   Press the **Auto Setup** soft key to execute auto setup. If you change the source waveform or the trigger setting from its default value, the soft key changes from Auto Setup to Auto Setup (Customized).

Note

- The auto setup feature will not work properly on some input signals.
- The available source waveforms vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8, Math1 to Math8
  - The available settings on 4ch models are as follows:
    CH1 to CH4, Math1 to Math4

Manual Setup

After running auto setup, you can change the following settings and display decoded results.

- Bit rate
- Sample point
- Data phase bit rate
- Data phase sample point
- Recessive level
- CAN FD Standard
- Level for detecting analysis/search source waveform states
- Hysteresis

Level for Detecting Analysis/Search Source Waveform States (Level/Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting analysis/search source waveform states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



Decode Display Format
When you set decode display to Symbol, you can select display CANdB symbols if you load the physical value/symbol definition file (.sbl).

Label

Display position
The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

When the display position is set to Manual



Display position

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



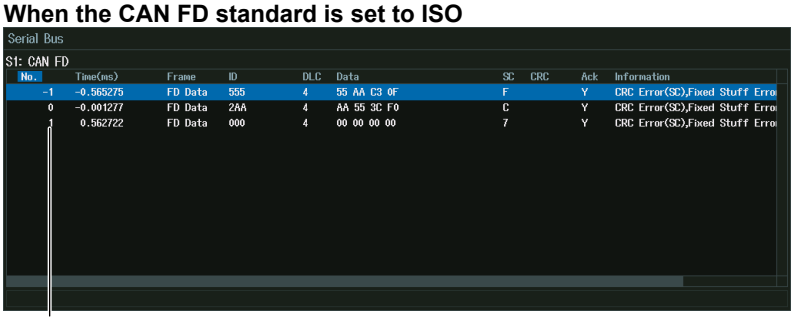
Display position

List Display (List)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List** soft key and then the **Show List** soft key.
   - The list of analysis results and the next menu appear.
   - If several display settings of Serial Bus 1 to 4 are on, all the lists of analysis results of the serial buses whose display setting is on are displayed. For details, see section 12.12.

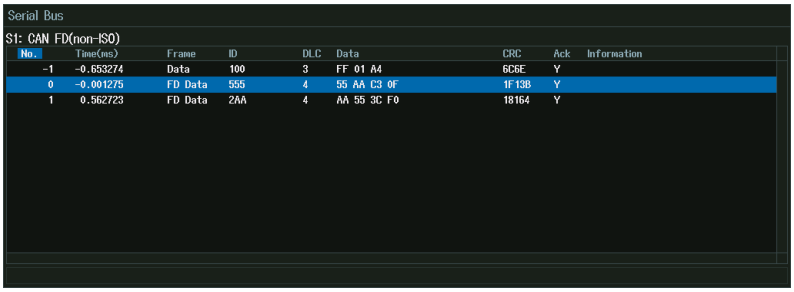
List of analysis results

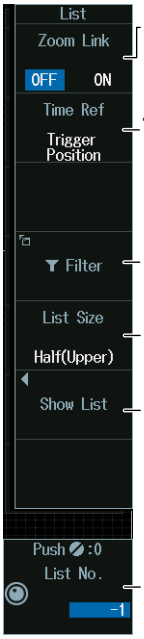
When the CAN FD standard is set to ISO



Analysis number

When the CAN FD standard is set to non-ISO





Turns zoom link on or off

Time (ms) Reference Time

Filtering the List Display

List size and display position

List display

Analysis number

Note

Analysis Number

Data before the trigger position (on the left side of the waveform display) is assigned analysis numbers in descending order (–1, –2, and so on). Data after the trigger position (on the right side of the waveform display) is assigned analysis numbers in ascending order (0, 1, 2, and so on).

Time (ms) Reference Time

Press the **Time Ref** soft key to select **Trigger Position** or **Previous Row**.

Time (ms) Reference Time

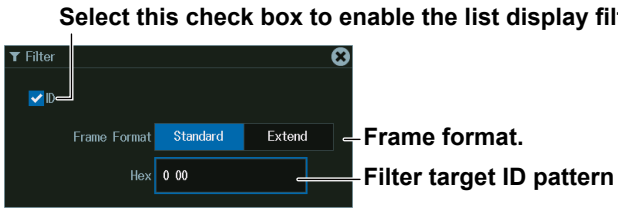
Select the reference for determining the time to the start of the frame to be analyzed.

Trigger Position: The reference time is set to the trigger point.

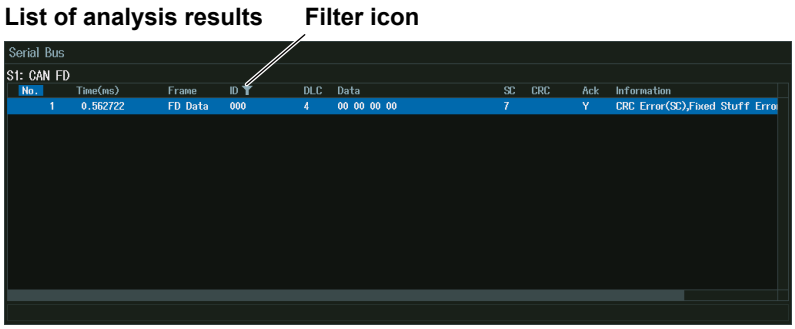
Previous Row: The reference time is set to the start position (SOF) of the frame previous to the frame to be analyzed.

Filtering the List Display

1. Press the **Filter** soft key to display the following screen.



2. Set the hexadecimal value of the ID to search for. Only the frames that contain the filter target ID pattern are listed.



Analysis Number (List No.)

Turn the **jog shuttle** to set the analysis number (List No.).

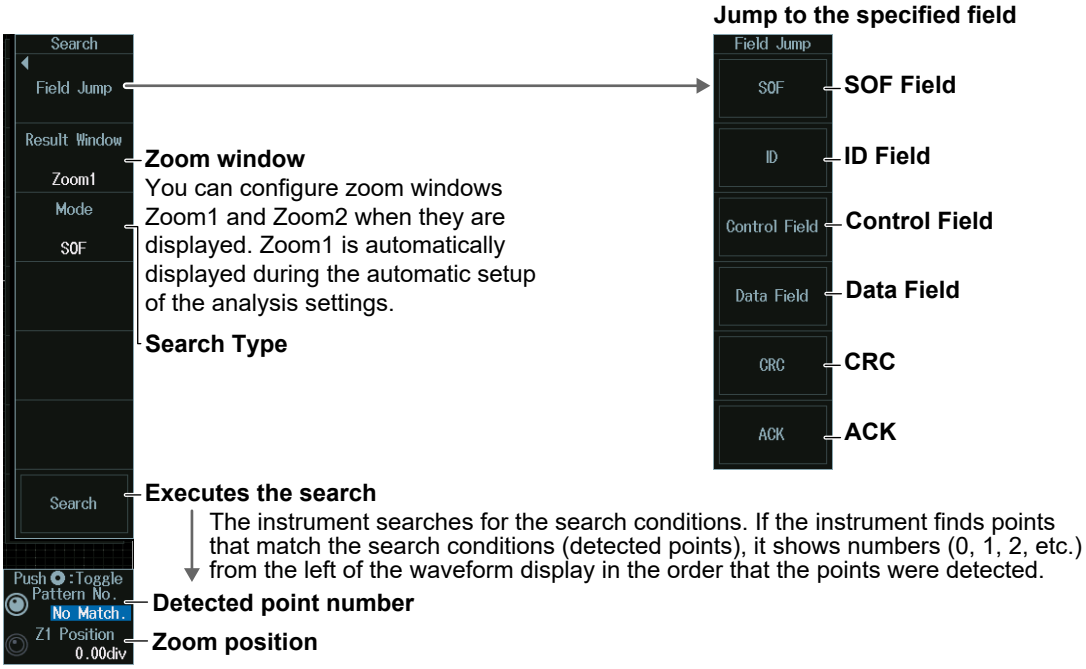
You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Search Setup (Search)

Press the **Search** soft key to display the following menu.

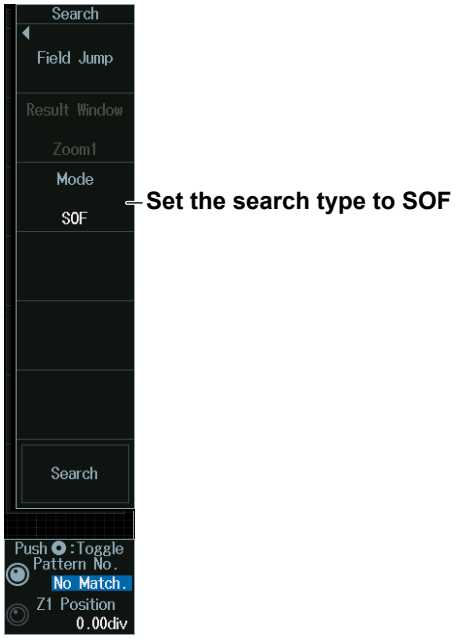


Search Type (Mode)

SOF Mode (Start of Frame)

Press the **Mode** soft key and then the **SOF** soft key to display the following menu.

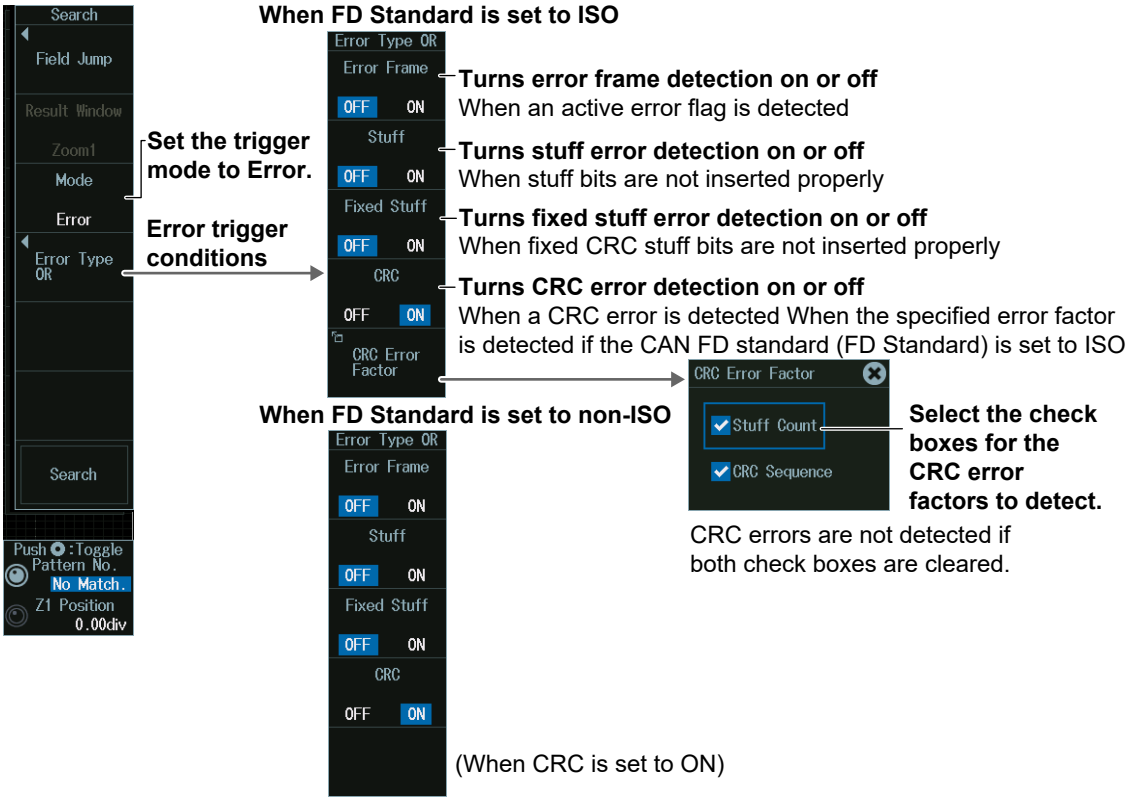
The instrument searches for the start position of CAN FD bus signal frames.



Error Mode (Error)

Press the **Mode** soft key and then the **Error** soft key to display the following menu.

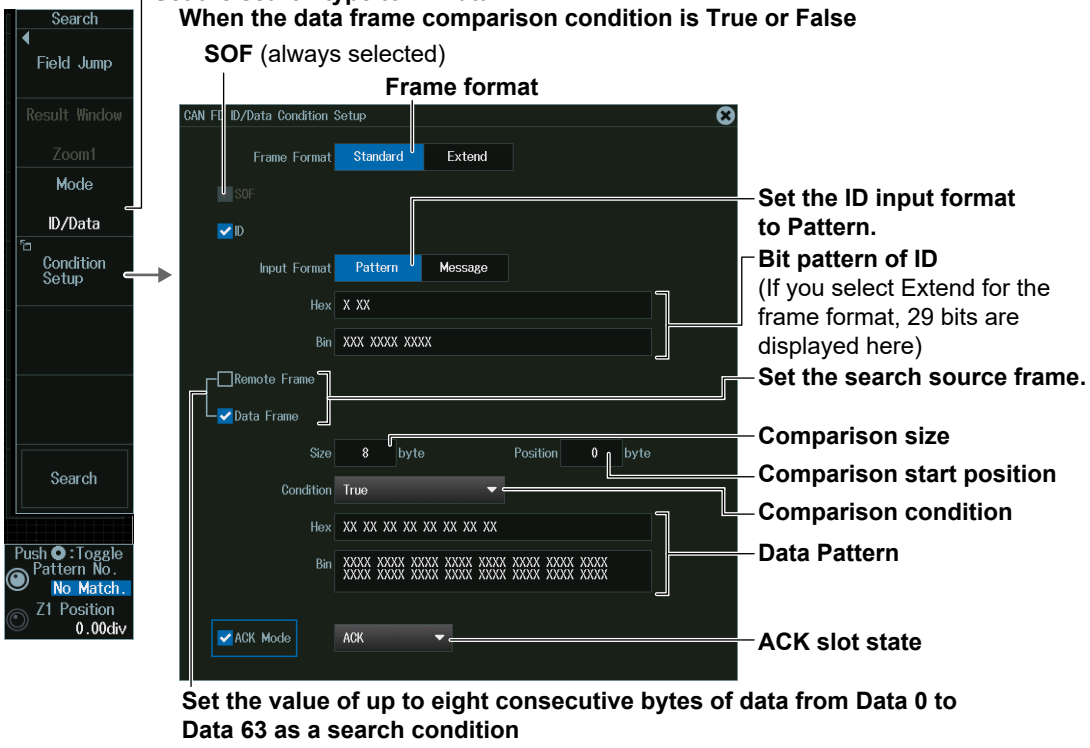
The instrument searches for error frames (when the error flag is active) or various errors.



ID/Data Mode (ID/Data)

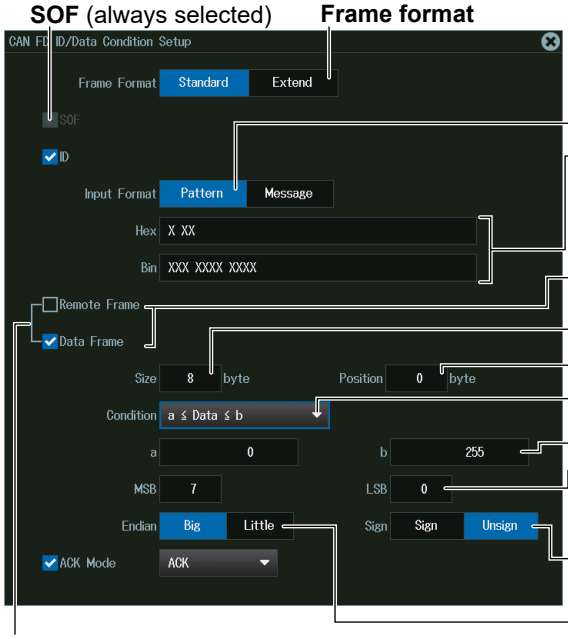
1. Press the **Mode** soft key and then the **ID/Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument searches for the position where the AND condition of the SOF, ID, Frame type (Remote Frame/Data Frame), Data and ACK Mode is met.

- **When ID Input Format Is Pattern**



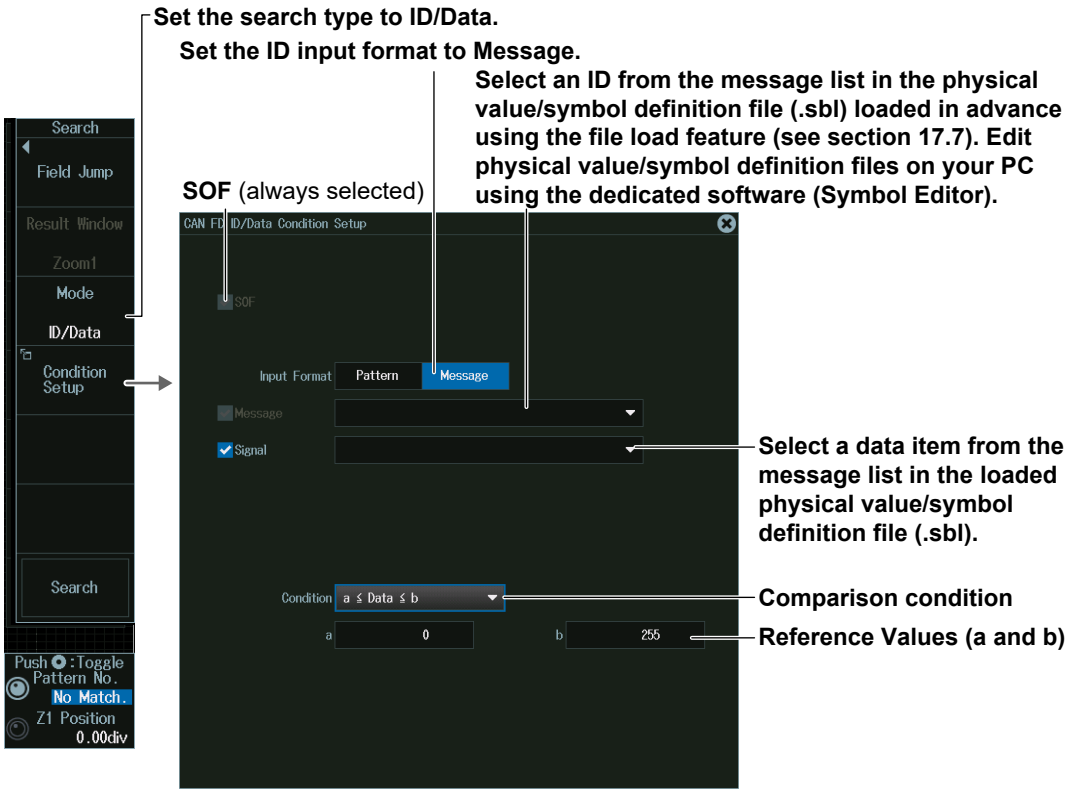
Set the search type to ID/Data.
When the data frame comparison condition is True or False
SOF (always selected)
Frame format
Set the ID input format to Pattern.
Bit pattern of ID
(If you select Extend for the frame format, 29 bits are displayed here)
Set the search source frame.
Comparison size
Comparison start position
Comparison condition
Data Pattern
ACK slot state
Set the value of up to eight consecutive bytes of data from Data 0 to Data 63 as a search condition

When the data frame condition is Data = a; Data ≠ a; a ≤ Data; Data ≤ b; a ≤ Data ≤ b; or Data < a, b < Data



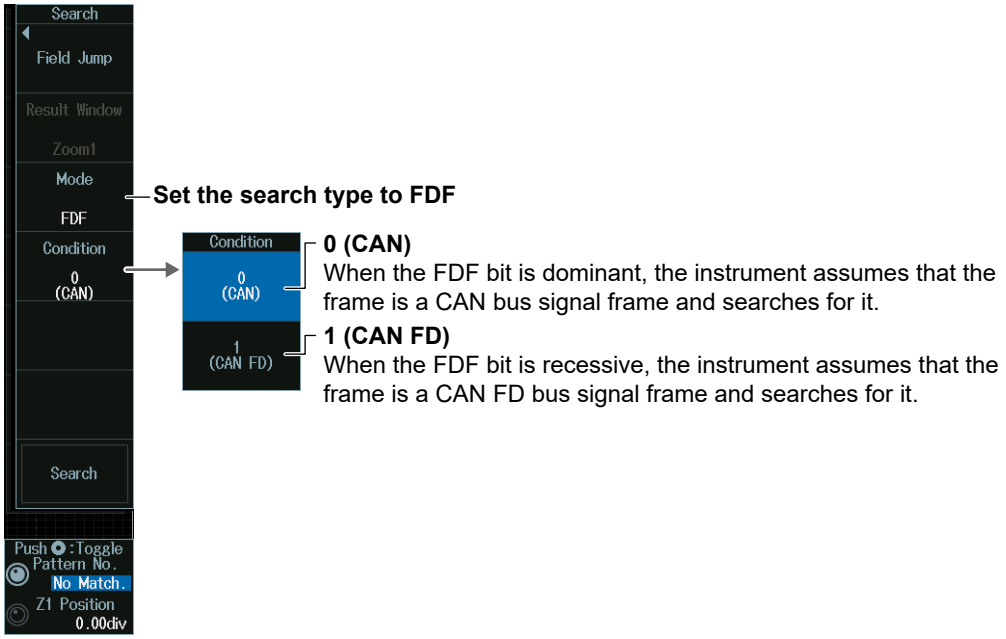
SOF (always selected)
Frame format
Set the ID input format to Pattern.
Bit pattern of ID
(If you select Extend for the frame format, 29 bits are displayed here)
Set the search source frame
Comparison size
Comparison start position
Comparison condition
Reference Values (a and b)
Bit positions of the most significant bit (MSB) and the least significant bit (LSB) in the data to be compared
Whether to use a signed (Sign) or unsigned (Unsign) data format
Byte order
Set the value of up to eight consecutive bytes of data from Data 0 to Data 63 as a search condition

- **When ID Input Format Is Message**



FDF Mode (FDF)

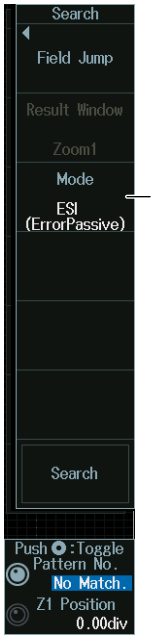
1. Press the **Mode** soft key and then the **FDF** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   Set the FDF bit state as a search condition.



ESI Mode (ESI (Error Passive))

Press the **Mode** soft key and then the **ESI (ErrorPassive)** soft key.

The instrument searches for frames whose ESI bit is recessive (error passive).



Set the search type to ESI (ErrorPassive).

Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



Detected point number

Zoom position

12.4 Analyzing and Searching LIN Bus Signals (Option)

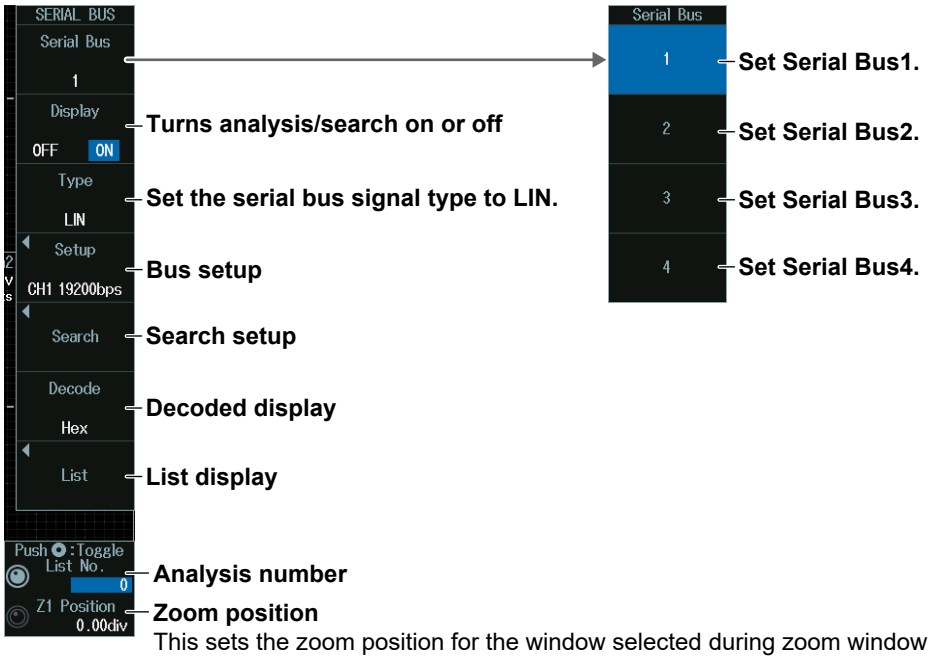
This section explains the following settings for analyzing or searching LIN bus signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Auto setup, analysis/search source waveform, bit rate, revision, sample point, level and hysteresis for detecting analysis/search source waveform states
- Decoded display
- List display
  List size, display position, and zoom linking
- Analysis number
- Zoom position
- Search settings
  Jumping to a specified field, zoom window, search type, and search execution

► **"Analyzing and Searching Serial Bus Signals," "Analyzing and Searching LIN Bus Signals (Option)" in the Features Guide**

SERIAL BUS LIN Menu

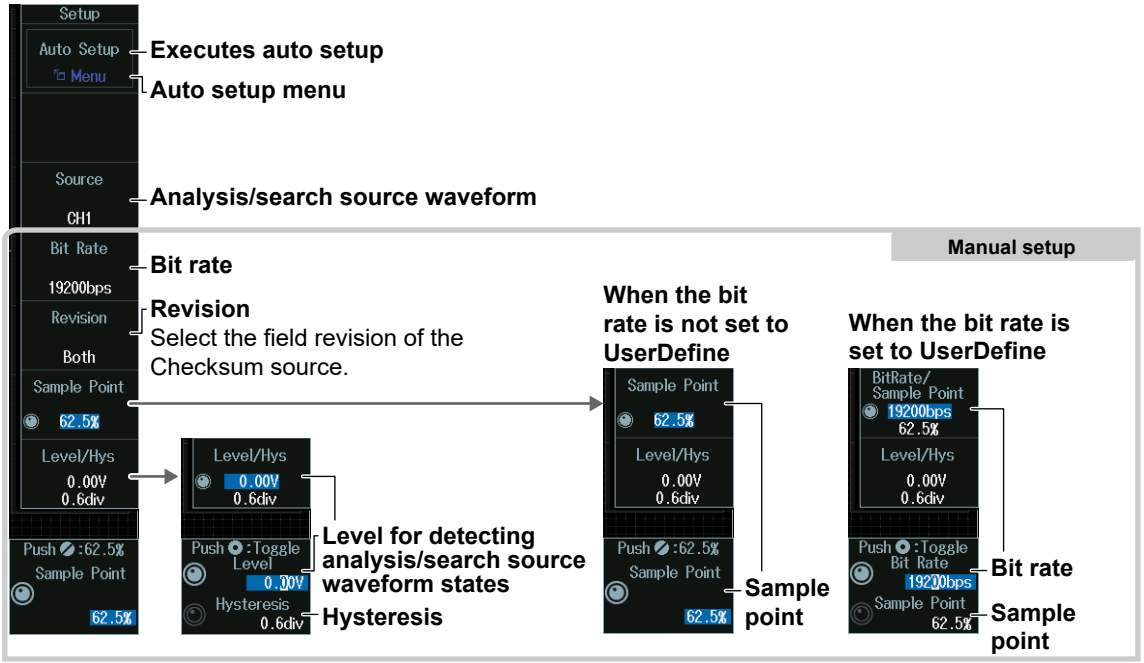
1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the Serial Bus soft key and select a number from 1 to 4.
2. Press the **Type** soft key. From the setup menu that appears, select **LIN** to display the following menu.



Zoom position
This sets the zoom position for the window selected during zoom window configuration (described later).

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



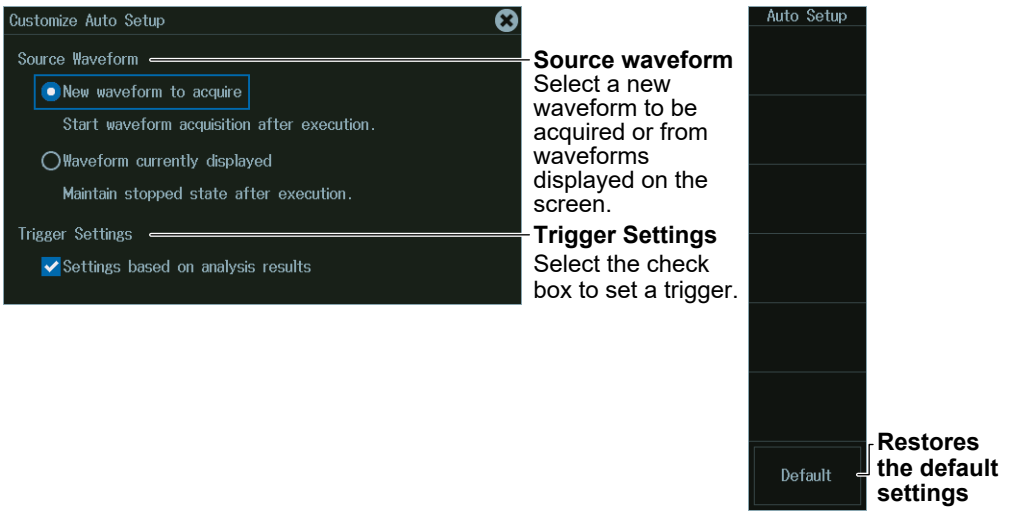
Executing Auto Setup (Auto Setup)

1. Set the analysis/search source waveform.
   Auto setup cannot be performed when the source is set to Math1 to Math8.
2. Press the **Auto Setup** soft key to execute auto setup.
   - The Instrument automatically configures the bit rate, revision, sample point, level, and hysteresis and triggers on the LIN bus signal's Break Synch. Triggers are not set if you unselect the Trigger Settings check box on the auto setup menu explained later.
   - While the serial bus is being configured, Auto Setup changes to Abort. If you want to stop, press the **Abort** soft key.

Auto Setup Menu (Menu)

You can set the analysis/search source waveform and select whether to set a trigger.

1. Press **SHIFT+F1**. The following screen and menu appear.
   You can also display them by pressing **SHIFT** and then the **Auto Setup** soft key.



2. Tap the screen to set the source waveform and trigger.
   - When waveform acquisition is in progress, the source waveform is fixed to a new waveform to be acquired.
   - If you clear the trigger setting check box, the trigger is not set even when auto setup is performed.
3. Press **ESC**. The menu returns to the bus setup menu.
   Press the **Auto Setup** soft key to execute auto setup. If you change the source waveform or the trigger setting from its default value, the soft key changes from Auto Setup to Auto Setup (Customized).

Note

- The auto setup feature will not work properly on some input signals.
- The available source waveforms vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8, Math1 to Math8
  - The available settings on 4ch models are as follows:
    CH1 to CH4, Math1 to Math4

Manual Setup

After running auto setup, you can change the following settings and display decoded results.

- Bit rate
- Revision
- Sample point
- Level for detecting analysis/search source waveform states
- Hysteresis

Level for Detecting Analysis/Search Source Waveform States (Level/Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



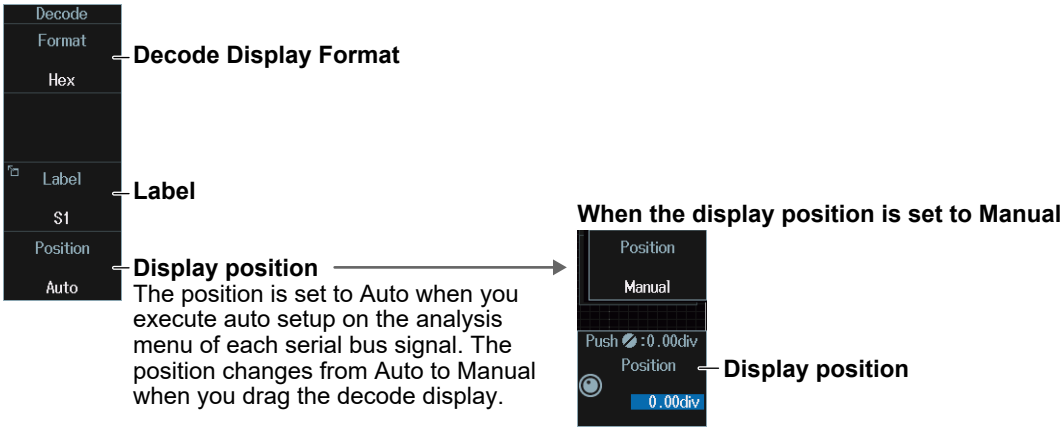
Level for detecting analysis/search source waveform states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

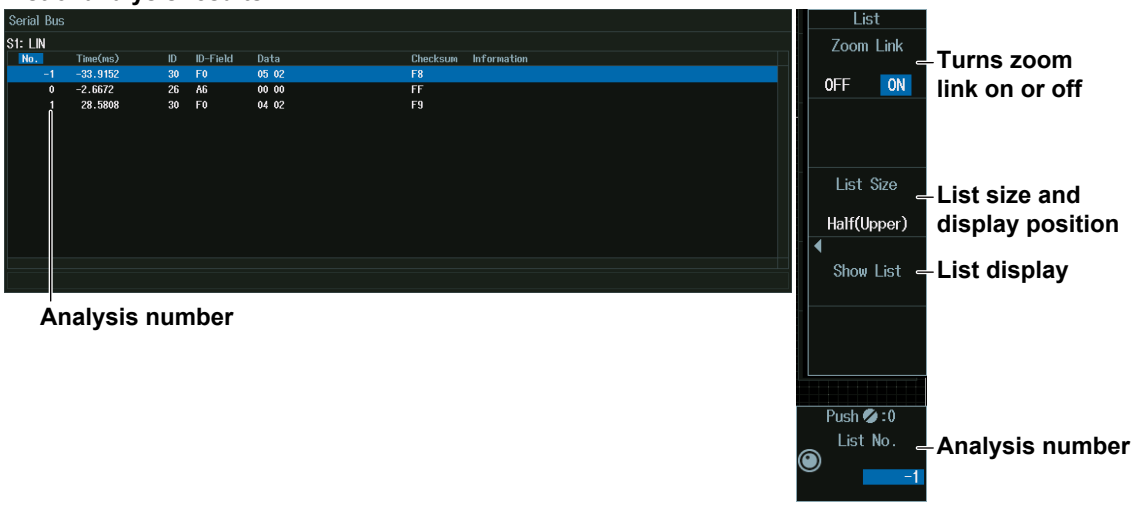
Jog shuttle setting menu



List Display (List)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List** soft key and then the **Show List** soft key.
   - The list of analysis results and the next menu appear.
   - If several display settings of Serial Bus 1 to 4 are on, all the lists of analysis results of the serial buses whose display setting is on are displayed. For details, see section 12.12.

List of analysis results



Note

Analysis Number

Data before the trigger position (on the left side of the waveform display) is assigned analysis numbers in descending order (–1, –2, and so on). Data after the trigger position (on the right side of the waveform display) is assigned analysis numbers in ascending order (0, 1, 2, and so on).

Analysis Number (List No.)

Turn the **jog shuttle** to set the analysis number (List No.).

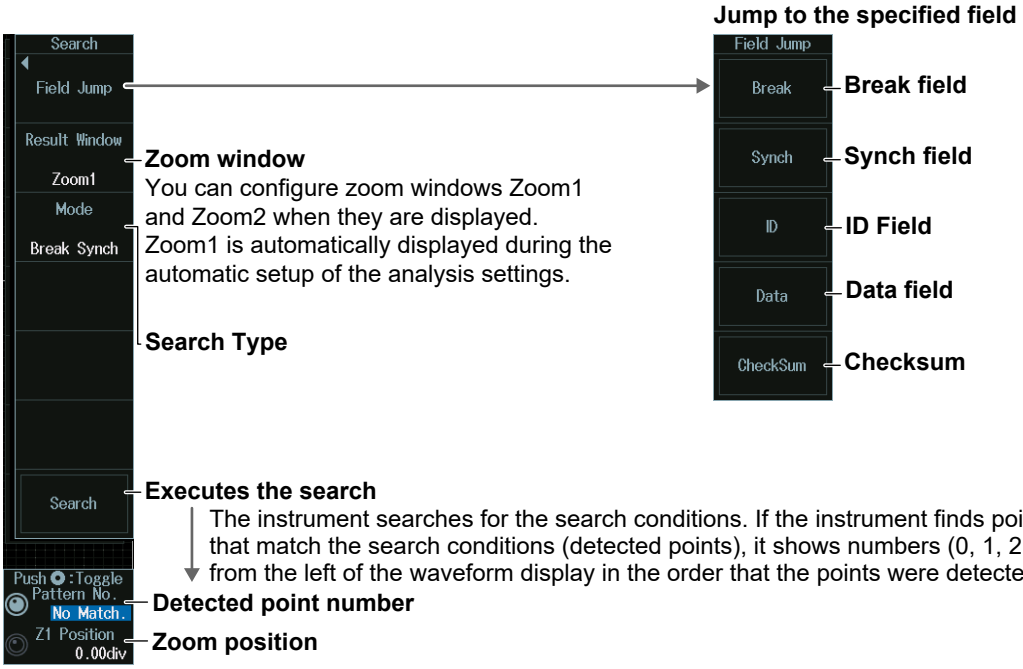
You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Search Setup (Search)

Press the **Search** soft key to display the following menu.

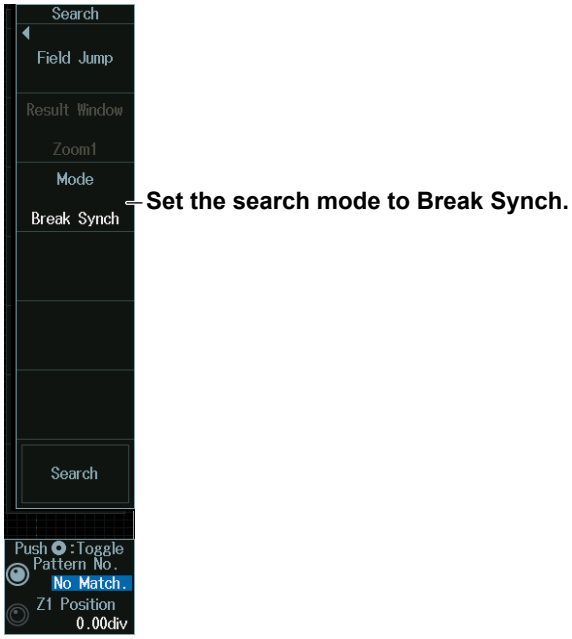


Search Type (Mode)

Break Synch Mode

Press the Mode soft key and then the **Break Synch** soft key to display the following menu.

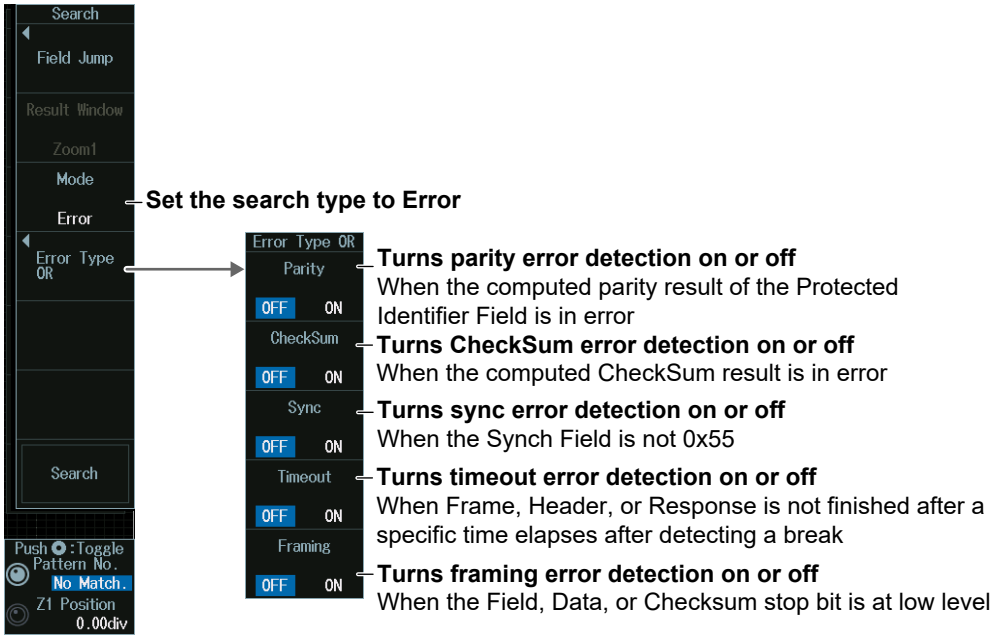
The instrument searches for a position where a break field and then a synch field (Break Field + Synch Field) is detected.



Error Mode

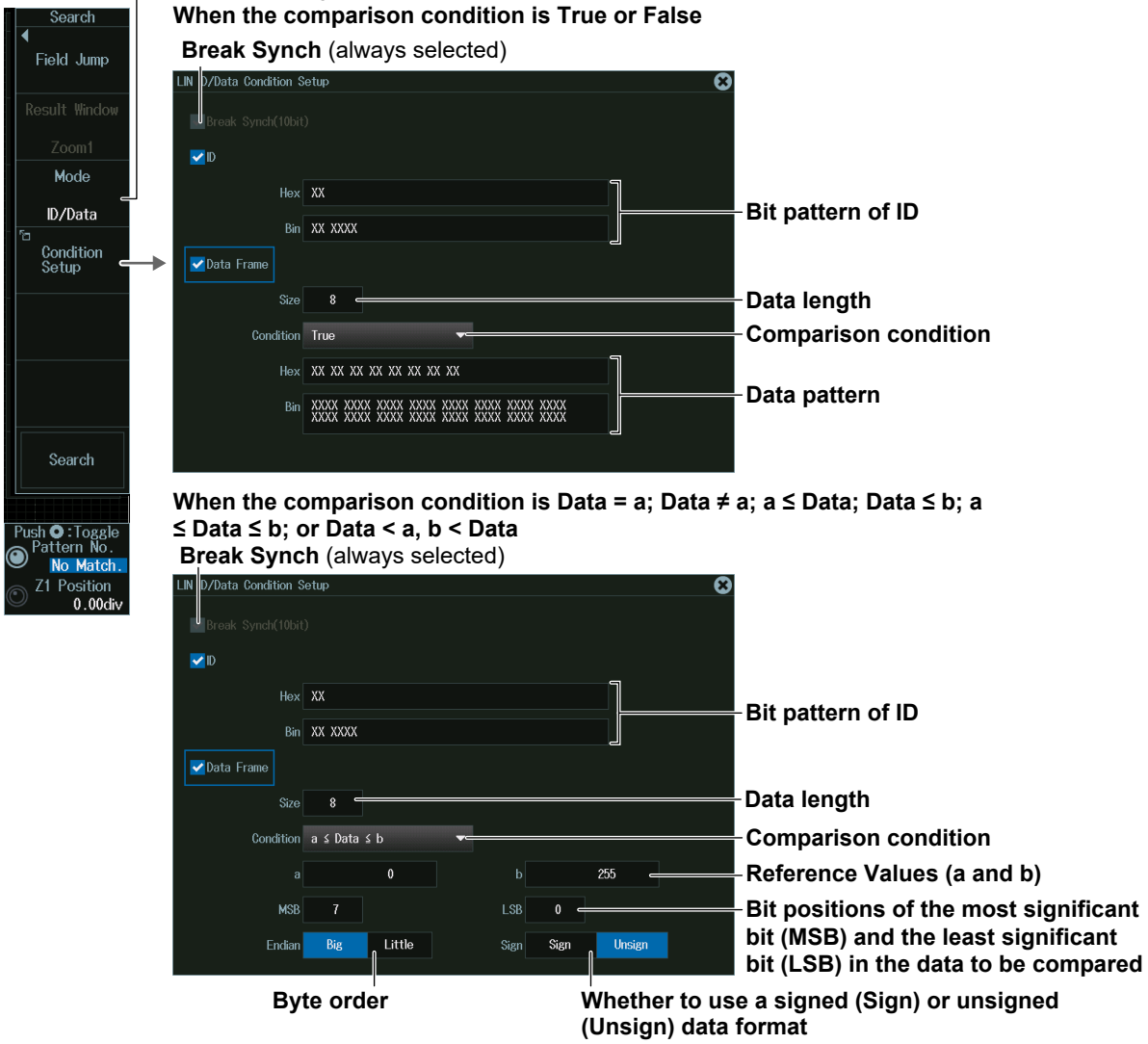
Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument searches for errors.



ID/Data mode

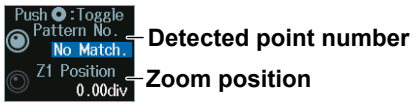
1. Press the **Mode** soft key and then the **ID/Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument searches for the position where the AND condition of the Break Synch, ID bit pattern and Data pattern is met.



Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



12.5 Analyzing and Searching CXPI Bus Signals (Option)

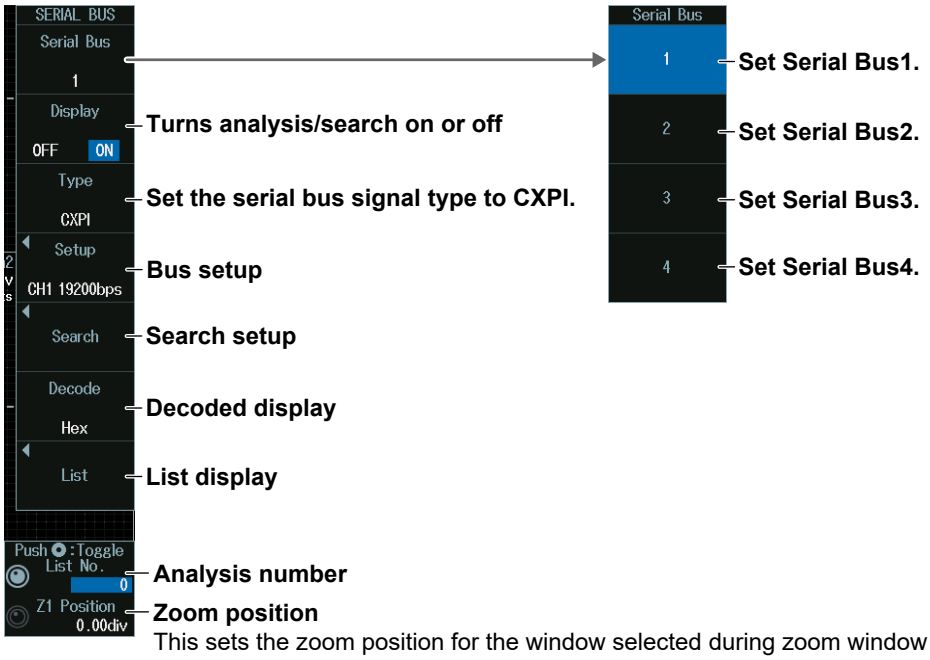
This section explains the following settings for analyzing or searching CXPI bus signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Auto setup, analysis/search source waveform, bit rate, T Sample, clock tolerance, counter error detection, level and hysteresis for detecting analysis/search source waveform states
- Decoded display
- List display
  List size, display position, and zoom linking
- Analysis number
- Zoom position
- Search settings
  Jumping to a specified field, zoom window, search type, and search execution

► **"Analyzing and Searching Serial Bus Signals," "Analyzing and Searching CXPI Bus Signals (Option)" in the Features Guide**

SERIAL BUS CXPI Menu

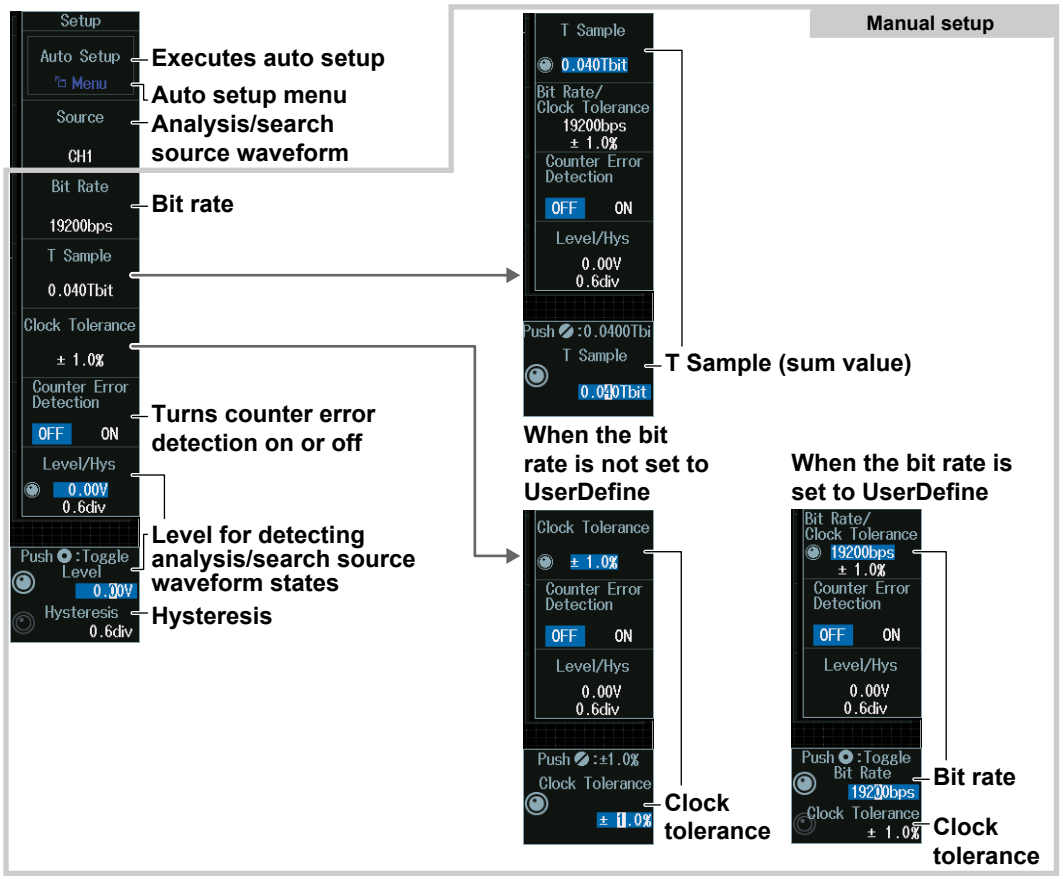
1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the Serial Bus soft key and select a number from 1 to 4.
2. Press the **Type** soft key. From the setup menu that appears, select **CXPI** to display the following menu.



Zoom position
This sets the zoom position for the window selected during zoom window configuration (described later).

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



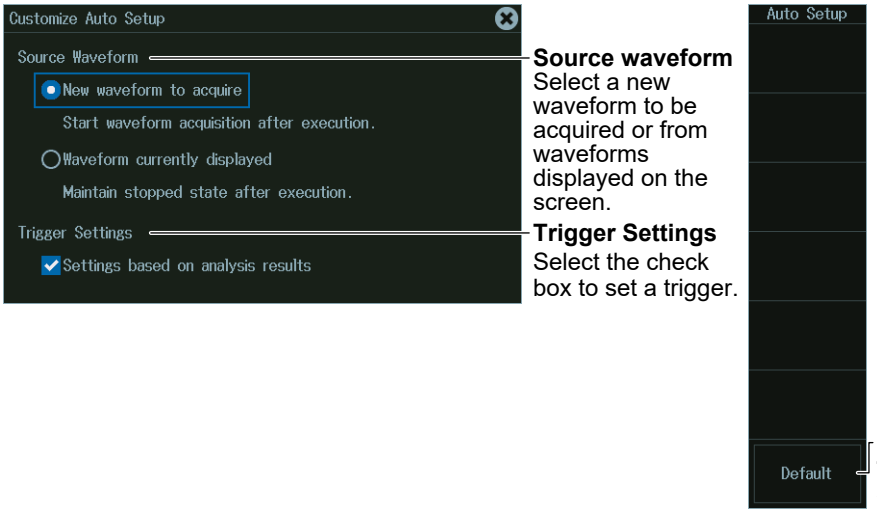
Executing Auto Setup (Auto Setup)

1. Set the analysis/search source waveform.
   Auto setup cannot be performed when the source is set to Math1 to Math8.
2. Press the **Auto Setup** soft key to execute auto setup.
   - The instrument automatically sets the bit rate, level, and hysteresis and triggers on the start position (SOF) of the CXPI bus signal. Triggers are not set if you unselect the Trigger Settings check box on the auto setup menu explained later.
   - While the serial bus is being configured, Auto Setup changes to Abort. If you want to stop, press the **Abort** soft key.

Auto Setup Menu (Menu)

You can set the analysis/search source waveform and select whether to set a trigger.

1. Press **SHIFT+F1**. The following screen and menu appear.
   You can also display them by pressing **SHIFT** and then the **Auto Setup** soft key.



2. Tap the screen to set the source waveform and trigger.
   - When waveform acquisition is in progress, the source waveform is fixed to a new waveform to be acquired.
   - If you clear the trigger setting check box, the trigger is not set even when auto setup is performed.
3. Press **ESC**. The menu returns to the bus setup menu.
   Press the **Auto Setup** soft key to execute auto setup. If you change the source waveform or the trigger setting from its default value, the soft key changes from Auto Setup to Auto Setup (Customized).

Note

- The auto setup feature will not work properly on some input signals.
- The available source waveforms vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8, Math1 to Math8
  - The available settings on 4ch models are as follows:
    CH1 to CH4, Math1 to Math4

Manual Setup

After running auto setup, you can change the following settings and display decoded results.

- Bit rate
- T Sample
- Clock tolerance
- Counter error detection
- Level for detecting analysis/search source waveform states
- Hysteresis

Sum Value (T Sample)

Turn the **jog shuttle** to set the sum value.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Sum value

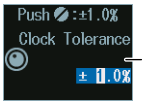
Clock Tolerance (Clock Tolerance) and Bit Rate (Bit Rate)

When the bit rate is not set to User Define

Turn the **jog shuttle** to set the clock tolerance.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



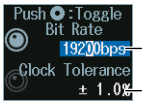
Clock tolerance

When the bit rate is set to User Define

Turn the **jog shuttle** to set the bit rate or clock tolerance.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Bit rate

Clock tolerance

Press SET (upper right on the front panel) to switch between bit rate and clock tolerance.

Level for Detecting Analysis/Search Source Waveform States (Level/Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



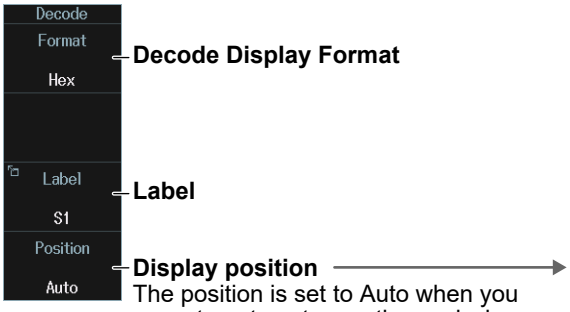
Level for detecting analysis/search source waveform states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



Decode Display Format

Label

Display position

The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

When the display position is set to Manual



Display position

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

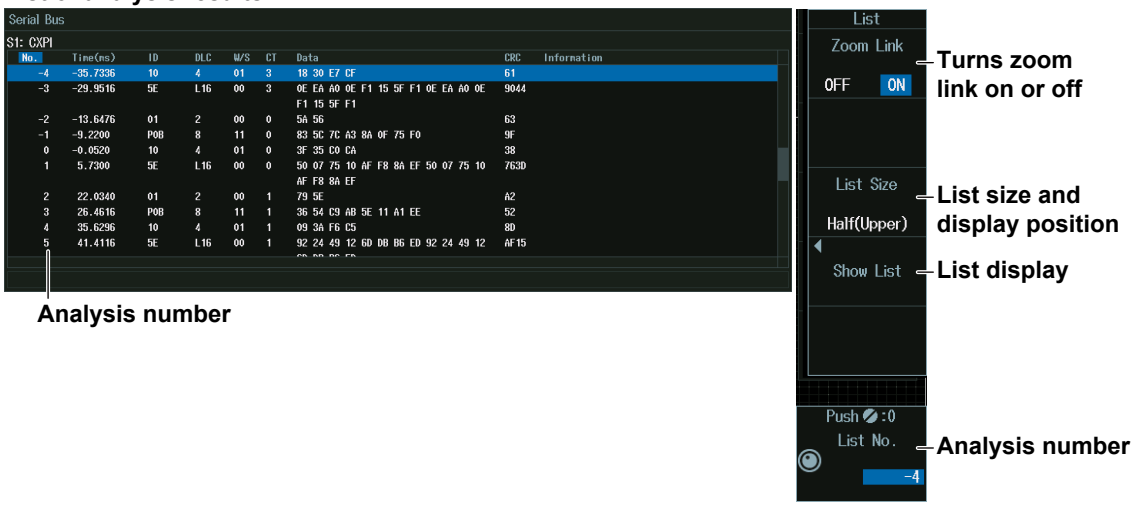


Display position

List Display (List)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List** soft key and then the **Show List** soft key.
   - The list of analysis results and the next menu appear.
   - If several display settings of Serial Bus 1 to 4 are on, all the lists of analysis results of the serial buses whose display setting is on are displayed. For details, see section 12.12.

List of analysis results



Note

Analysis Number

Data before the trigger position (on the left side of the waveform display) is assigned analysis numbers in descending order (–1, –2, and so on). Data after the trigger position (on the right side of the waveform display) is assigned analysis numbers in ascending order (0, 1, 2, and so on).

Analysis Number (List No.)

Turn the **jog shuttle** to set the analysis number (List No.).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Search Setup (Search)

Press the **Search** soft key to display the following menu.



Zoom window
You can configure zoom windows Zoom1 and Zoom2 when they are displayed. Zoom1 is automatically displayed during the automatic setup of the analysis settings.

Search type

Executes the search
The instrument searches for the search conditions. If the instrument finds points that match the search conditions (detected points), it shows numbers (0, 1, 2, etc.) from the left of the waveform display in the order that the points were detected.

Detected point number

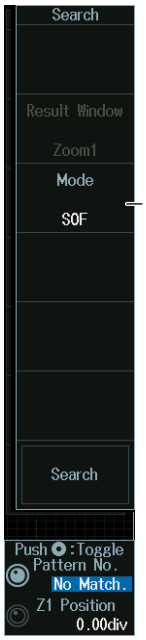
Zoom position

Search Type (Mode)

SOF Mode (Start of Frame)

Press the **Mode** soft key and then the **SOF** soft key to display the following menu.

The instrument searches for the start position of CXPI bus signal frames.

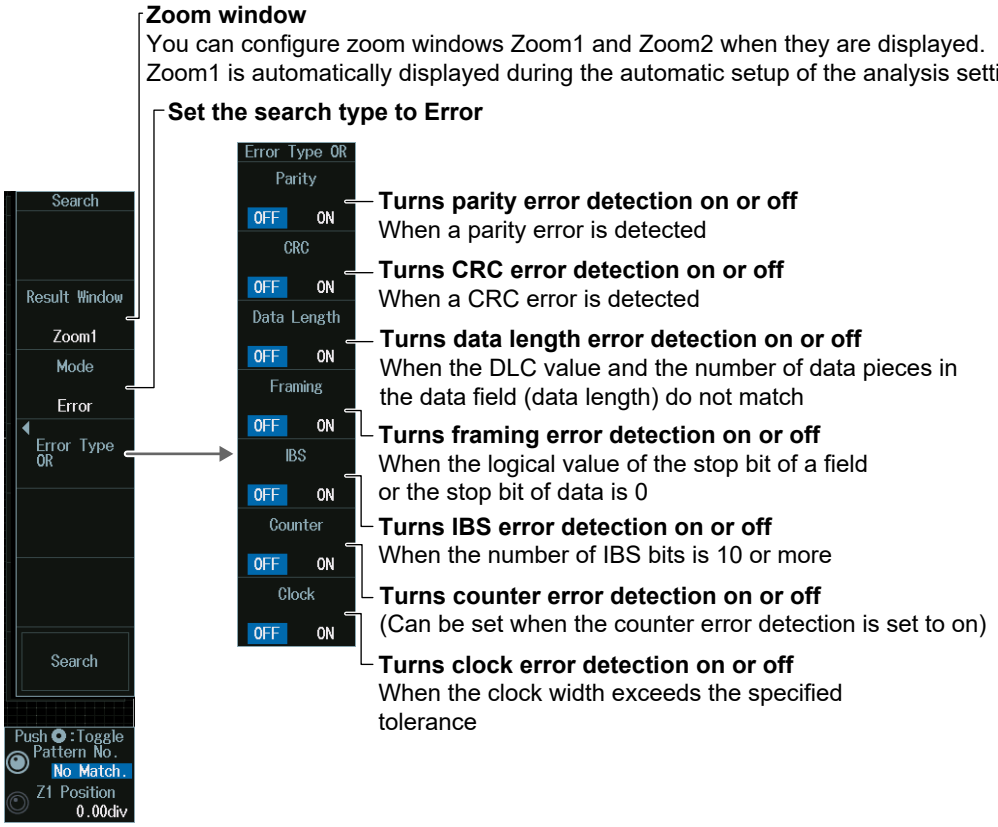


Set the search type to SOF

Error Mode

Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument searches for various errors.



Zoom window
You can configure zoom windows Zoom1 and Zoom2 when they are displayed.
Zoom1 is automatically displayed during the automatic setup of the analysis settings.

Set the search type to Error

Turns parity error detection on or off
When a parity error is detected

Turns CRC error detection on or off
When a CRC error is detected

Turns data length error detection on or off
When the DLC value and the number of data pieces in the data field (data length) do not match

Turns framing error detection on or off
When the logical value of the stop bit of a field or the stop bit of data is 0

Turns IBS error detection on or off
When the number of IBS bits is 10 or more

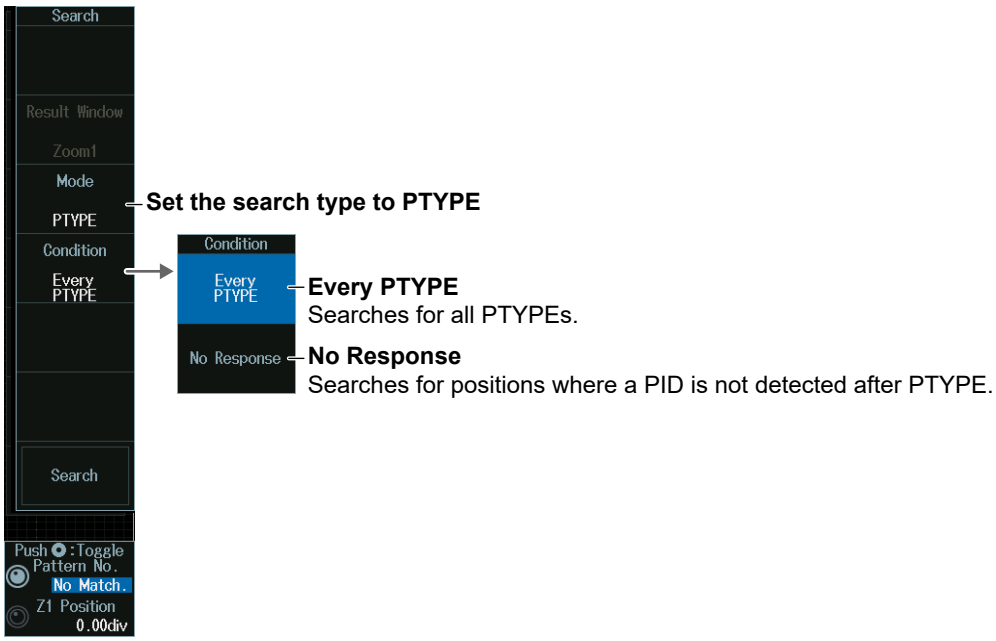
Turns counter error detection on or off
(Can be set when the counter error detection is set to on)

Turns clock error detection on or off
When the clock width exceeds the specified tolerance

PTYPE Mode

Press the **Mode** soft key and then the **PTYPE** soft key to display the following menu.

The instrument searches for the PTYPE of the CXPI bus signal.



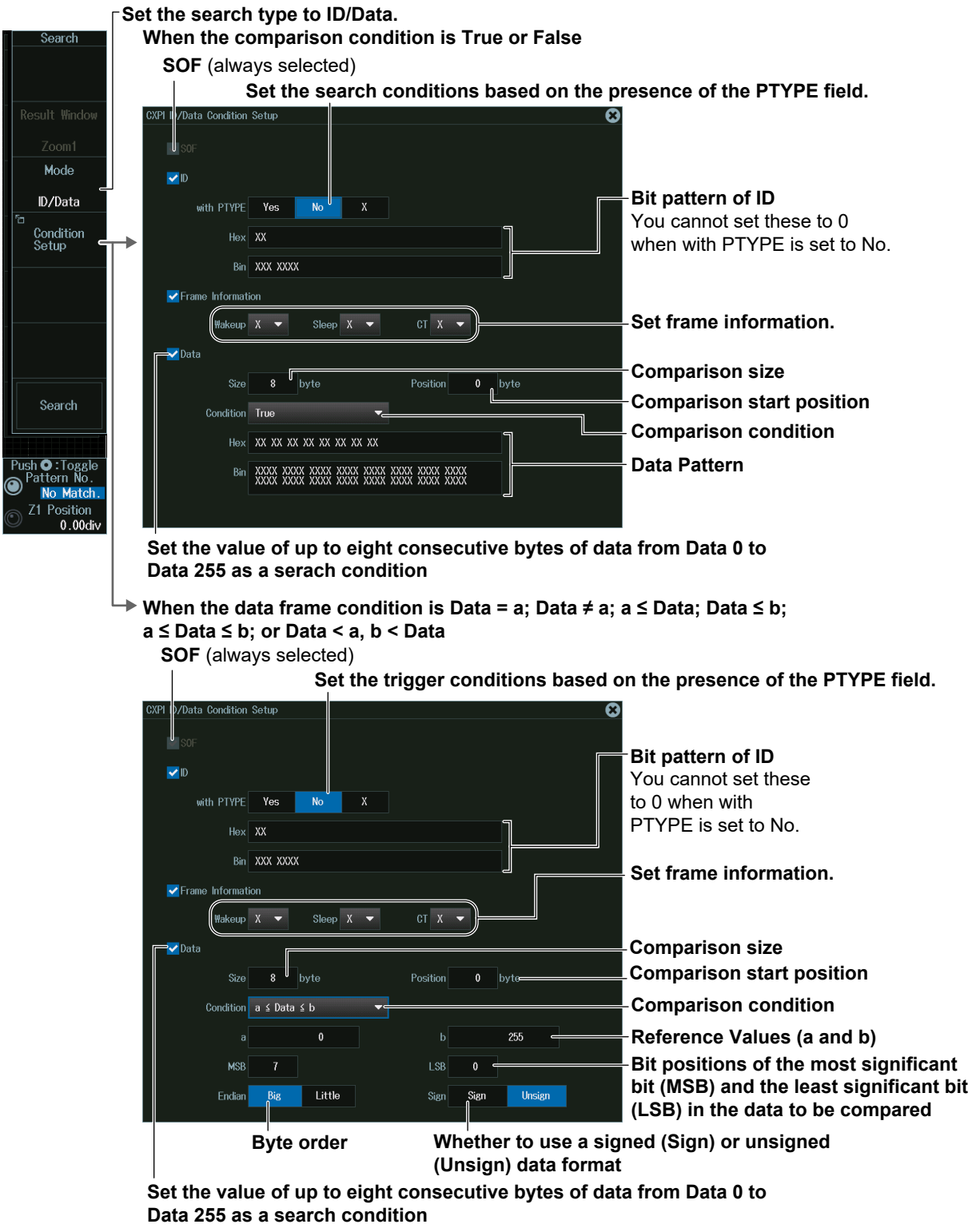
Set the search type to PTYPE

Every PTYPE
Searches for all PTYPEs.

No Response
Searches for positions where a PID is not detected after PTYPE.

ID/Data Mode

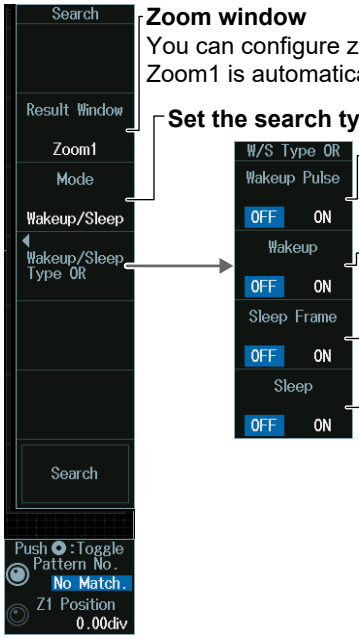
1. Press the **Mode** soft key and then the **ID/Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument searches for the position where the AND condition of the SOF, ID bit pattern, frame information, and Data pattern is met.



Wakeup/Sleep Mode

Press the **Mode** soft key and then the **Wakeup/Sleep** soft key to display the following menu.

The instrument searches for wakeup pulses, wakeup states, sleep frames, or sleep states.



Zoom window
You can configure zoom windows Zoom1 and Zoom2 when they are displayed. Zoom1 is automatically displayed during the automatic setup of the analysis settings.

Set the search type to Wakeup/Sleep

Turns wakeup pulse search on or off
Searches for pulses in the dominant period between 250 µs and 2500 µs

Turns wakeup search on or off
Searches for transitions from a state in which there is no clock after a sleep detection to a state in which there is a clock

Turns sleep frame search on or off
When the sleep frame ID value is 1F (hexadecimal)

Turns sleep search on or off
When 5 ms elapses after a transition is made from a state in which there is a clock to a state in which there is no clock

Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



Detected point number

Zoom position

12.6 Analyzing and Searching SENT Signals (Option)

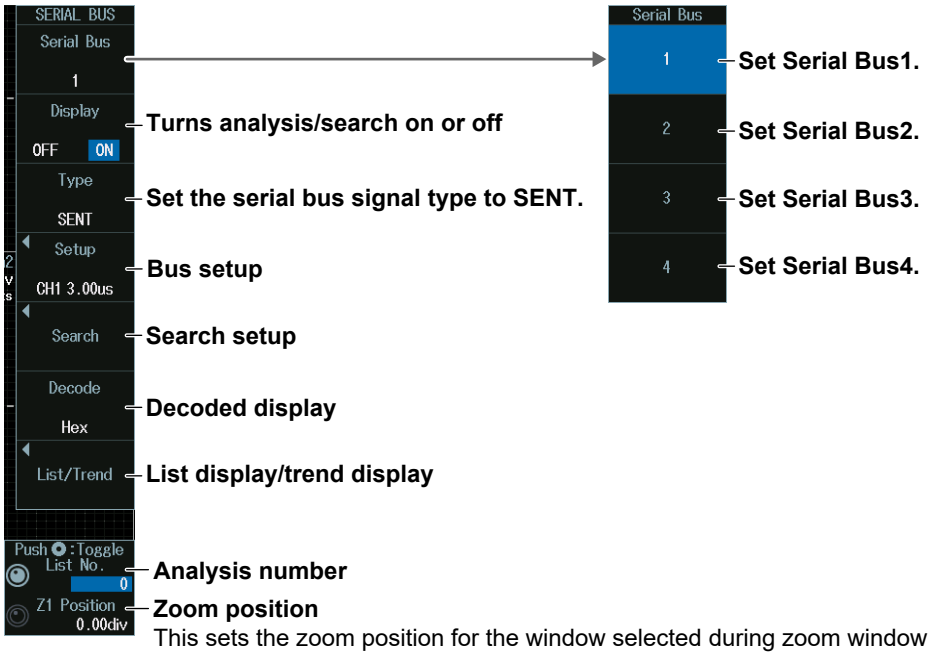
This section explains the following settings for analyzing or searching SENT signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Auto setup, analysis/search source waveform, format, display channel, fast channel data type, slow channel message type, level and hysteresis for detecting analysis/search source waveform states
- Decoded display
- List display
  List size, display position, and zoom linking
- Trend Display
  Display source, User Data, display settings, cursor measurement on/off, message ID
- Analysis number
- Zoom position
- Search settings
  Zoom window, search type, and search execution

► "Analyzing and Searching Serial Bus Signals,"
"Analyzing and Searching SENT Signals (Option)" in the Features Guide

SERIAL BUS SENT Menu

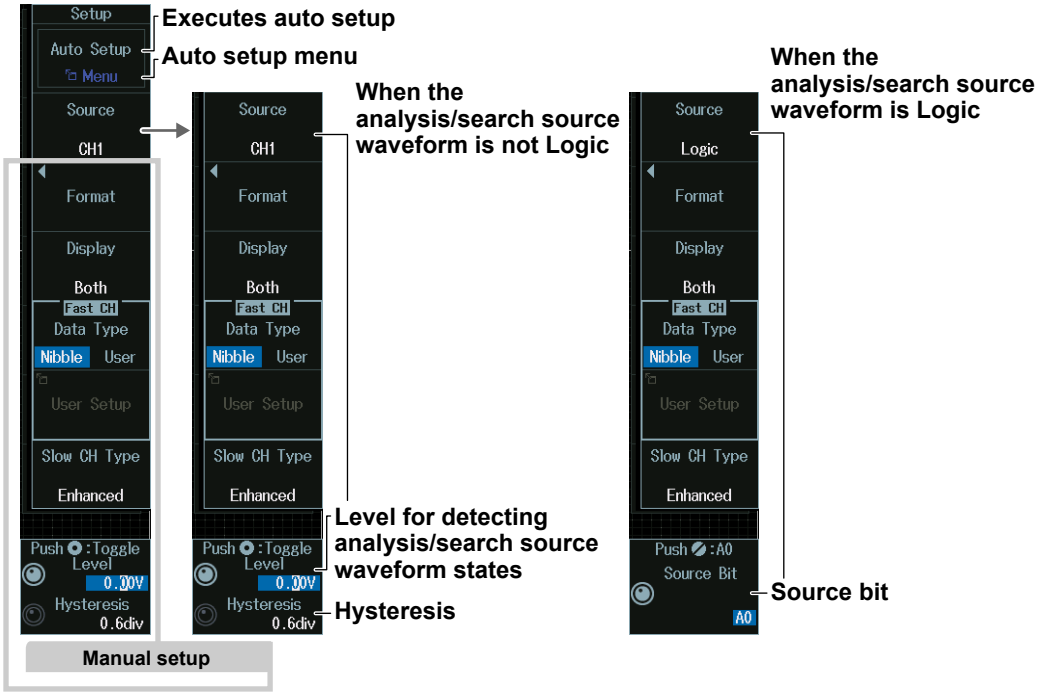
1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the Serial Bus soft key and select a number from 1 to 4.
2. Press the **Type** soft key. From the setup menu that appears, select **SENT** to display the following menu.



Zoom position
This sets the zoom position for the window selected during zoom window configuration (described later).

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



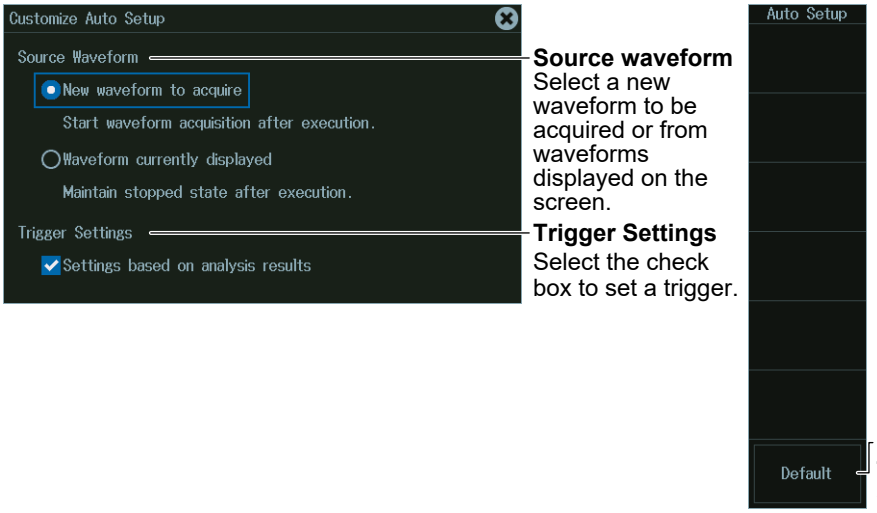
Executing Auto Setup (Auto Setup)

1. Set the analysis/search source waveform.
   You cannot use auto setup under the following circumstances.
   - When the Analysis/Search Source Waveform Is Math1 to Math8
   - When state display is applied to a LOGIC bit that is set as the analysis/search source waveform.
2. If you set the trigger source to Logic, set the source bit.
3. Press the **Auto Setup** soft key to execute auto setup.
   - The instrument automatically sets the format, level, and hysteresis and then triggers at the end of S&C of the fast channel. Triggers are not set if you unselect the Trigger Settings check box on the auto setup menu explained later.
   - While the serial bus is being configured, Auto Setup changes to Abort. If you want to stop, press the **Abort** soft key.

Auto Setup Menu (Menu)

You can set the analysis/search source waveform and select whether to set a trigger.

1. Press **SHIFT+F1**. The following screen and menu appear.
   You can also display them by pressing **SHIFT** and then the **Auto Setup** soft key.



2. Tap the screen to set the source waveform and trigger.
   - When waveform acquisition is in progress, the source waveform is fixed to a new waveform to be acquired.
   - If you clear the trigger setting check box, the trigger is not set even when auto setup is performed.

3. Press **ESC**. The menu returns to the bus setup menu.
   Press the **Auto Setup** soft key to execute auto setup. If you change the source waveform or the trigger setting from its default value, the soft key changes from Auto Setup to Auto Setup (Customized).

Note

- The auto setup feature will not work properly on some input signals.
- The available source waveforms vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8, Logic, Math1 to Math8
  - The available settings on 4ch models are as follows:
    CH1 to CH4, Logic, Math1 to Math4

Source Bit

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Level for Detecting Analysis/Search Source Waveform States (Level/Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting analysis/search source waveform states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Source Bit (Source Bit)

Turn the **jog shuttle** to set the source bit.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up menu that appears on the screen.

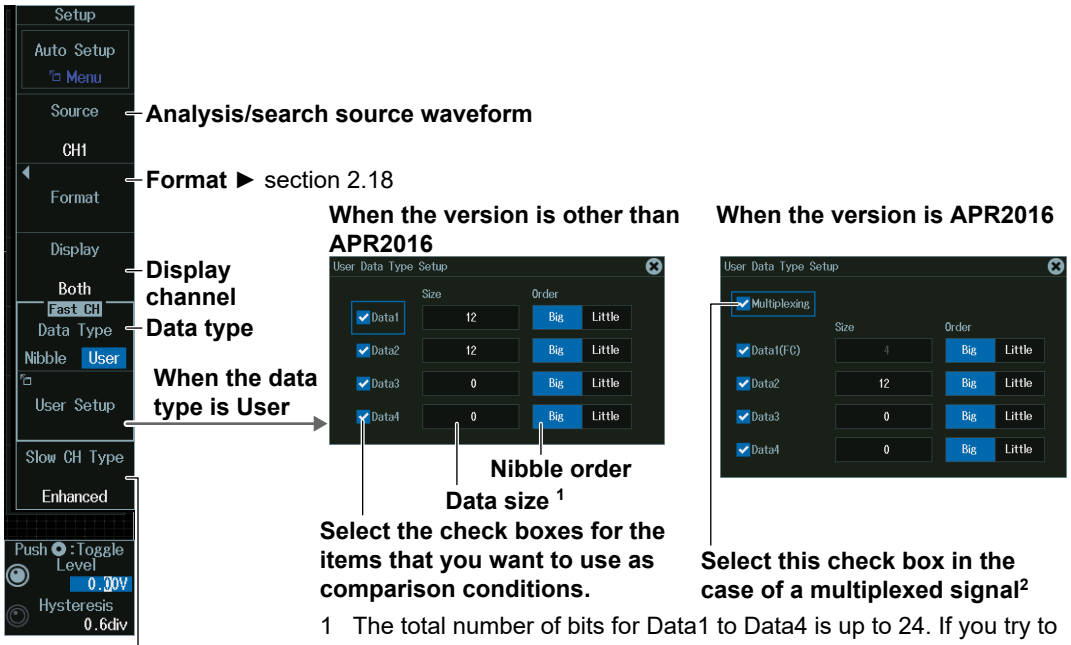
Jog shuttle setting menu



Source bit

Manual Setup

Manually set the format, data type, and so on.

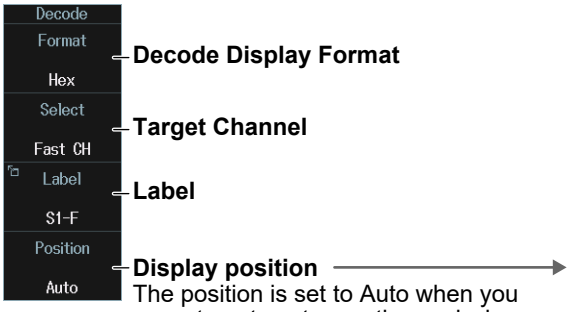


1 The total number of bits for Data1 to Data4 is up to 24. If you try to exceed the total number of bits, the data size of other pieces of Data is reduced.

2 When the check box for Multiplexing is selected, the Size of Data1 is fixed to 4 to correspond to FC.

Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



Decode Display Format

Target Channel

Label

Display position

The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

When the display position is set to Manual



Display position

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

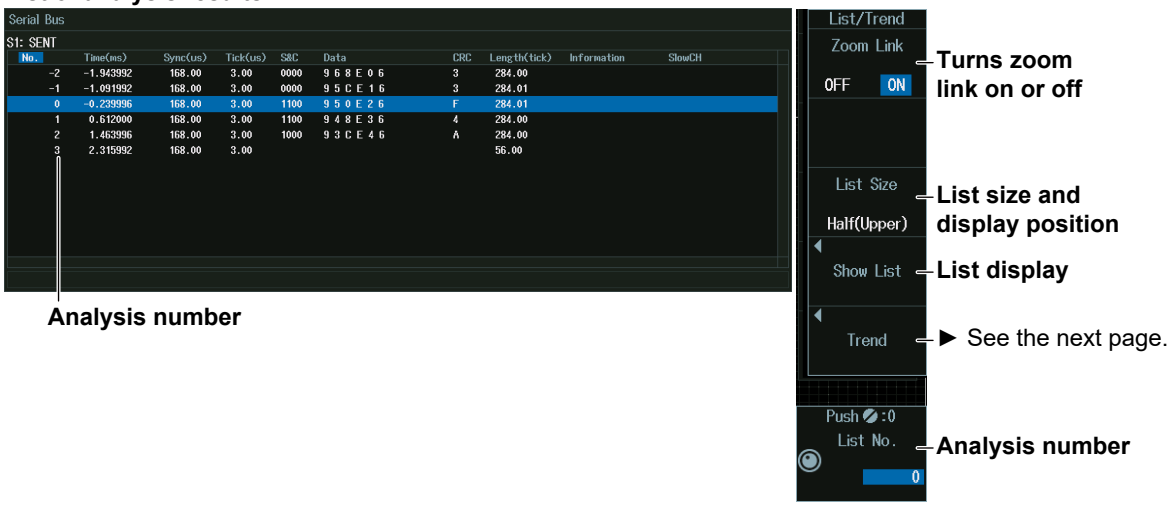


Display position

List Display (List/Trend_List)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List/Trend** soft key and then the **Show List** soft key.
   - The list of analysis results and the next menu appear.
   - If several display settings of Serial Bus 1 to 4 are on, all the lists of analysis results of the serial buses whose display setting is on are displayed. For details, see section 12.12.

List of analysis results



Note

Analysis Number

Data before the trigger position (on the left side of the waveform display) is assigned analysis numbers in descending order (–1, –2, and so on). Data after the trigger position (on the right side of the waveform display) is assigned analysis numbers in ascending order (0, 1, 2, and so on).

Analysis Number (List No.)

Turn the **jog shuttle** to set the analysis number (List No.).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



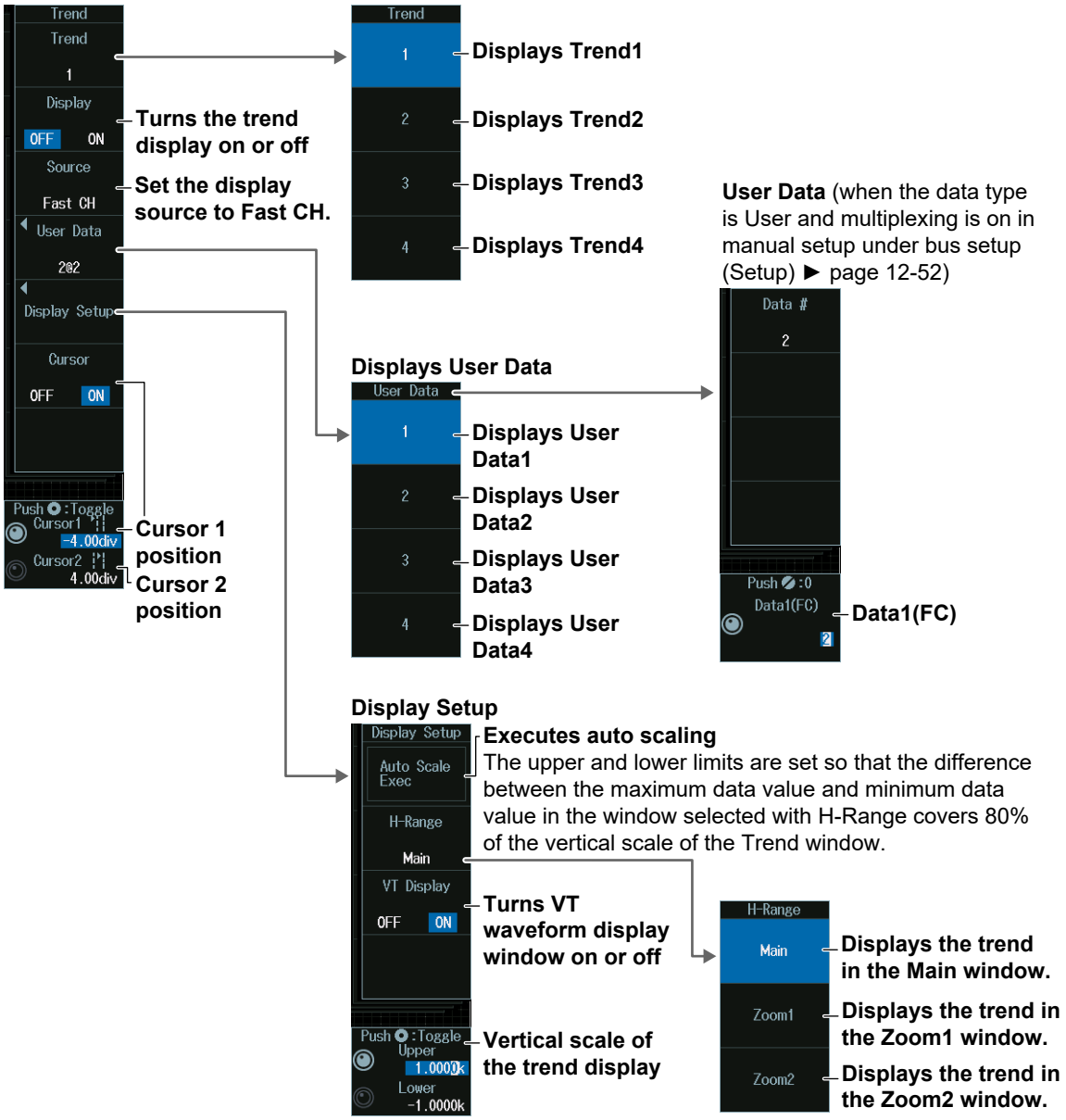
Trend Display (List/Trend_Trend)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List/Trend** soft key and then the **Trend** soft key.
   - Up to four trends can be displayed. To switch to the setup menu, press the **Trend** soft key and select a number from 1 to 4.

When the Display Source Is Set to Fast Channel

Press the **Source** soft key and then the **Fast CH** soft key to display the following menu.

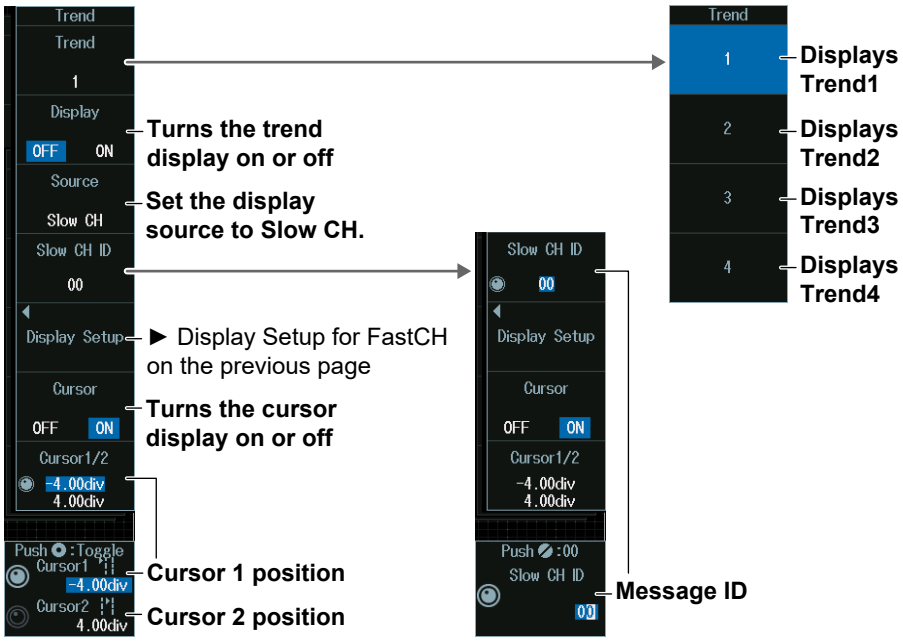
Up to four trends can be displayed. To switch to the setup menu, press the **Trend** soft key and select a number from 1 to 4.



When the Display Source Is Set to Slow Channel

Press the **Source** soft key and then the **Slow CH** soft key to display the following menu.

Up to four trends can be displayed. To switch to the setup menu, press the **Trend** soft key and select a number from 1 to 4.



Message ID (Slow CH ID)

1. Press the **Slow CH ID** soft key.
2. Turn the **jog shuttle** to set the message ID (Slow CH ID).
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Message ID (Slow CH ID)

Set the message ID of the data you want to display the trend of. The selectable ID range varies depending on the decode display setting in the SERIAL BUS_SENT Menu (page 12-49), format version in the bus setup (Setup) (page 12-50), and the slow channel message type.

Version	FEB2008 and older		—	
	APR2016, JAN2010			
Slow channel message type	Short		Enhanced	
Decode display setting	Hex	Dec	Hex	Dec
Range	0 to F	0 to 15	00 to FF	0 to 255

Cursor Positions (Cursor1/Cursor2)

1. Press the **Cursor1/2** soft key.
2. Turn the **jog shuttle** to set cursor 1 (Cursor1) or cursor 2 (Cursor2).
   - Press **SET** (upper right on the front panel) to switch between cursor 1 and cursor 2.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Cursor 1 position

Cursor 2 position

Note

Setting the Cursor Positions

If you press SET several times and make the jog shuttle control both cursor 1 and cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen.

Search Setup (Search)

Press the **Search** soft key to display the following menu.



Zoom window

You can configure zoom windows Zoom1 and Zoom2 when they are displayed.
Zoom1 is automatically displayed during the automatic setup of the analysis settings.

Search type

Executes the search

The instrument searches for the search conditions. If the instrument finds points that match the search conditions (detected points), it shows numbers (0, 1, 2, etc.) from the left of the waveform display in the order that the points were detected.

Detected point number

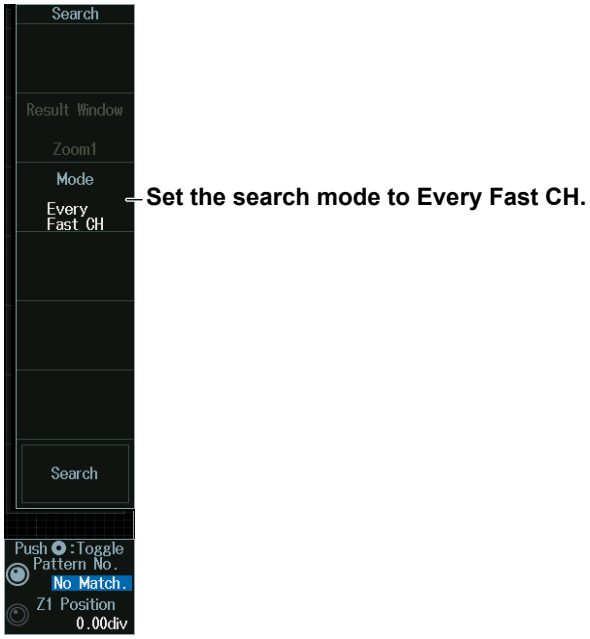
Zoom position

Search Type (Mode)

Every Fast CH mode

Press the **Mode** soft key and then the **Every Fast CH** soft key to display the following menu.

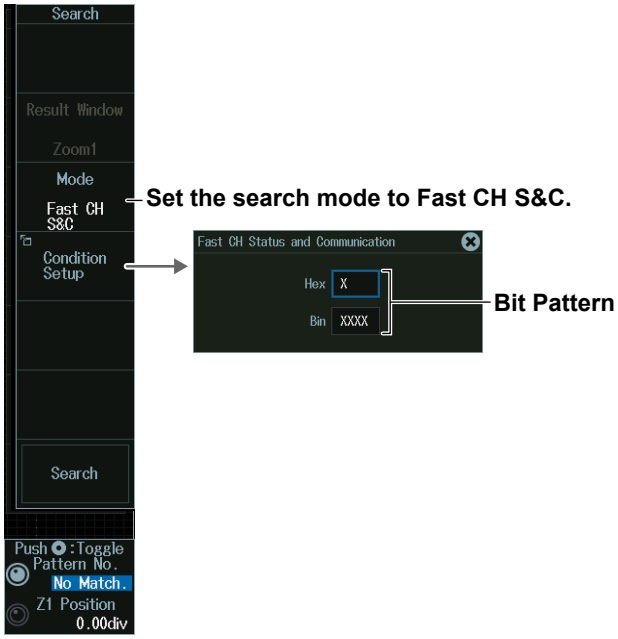
The instrument searches when it detects a fast channel message.



Fast CH S&C mode

Press the **Mode** soft key and then the **Fast CH S&C** soft key to display the following menu.

The instrument searches on the status and communication bit pattern.

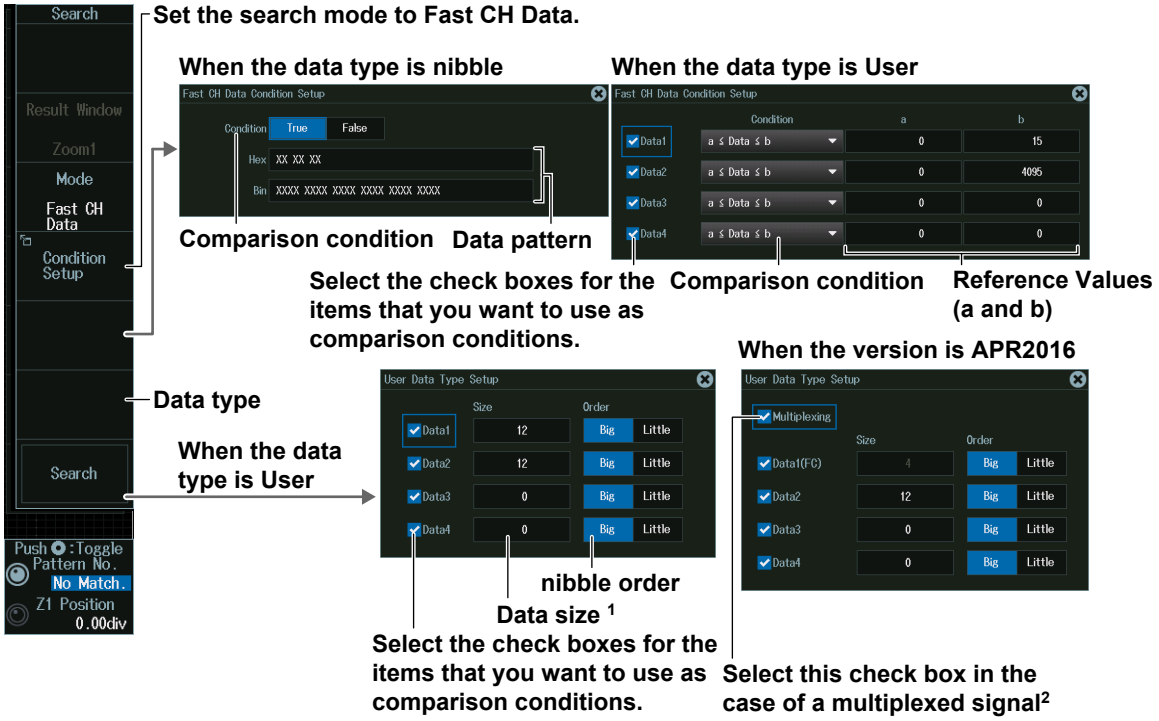


Fast CH Data mode

1. Press the **Mode** soft key and then the **Fast CH Data** soft key to display the following menu.

2. Press the **Condition Setup** soft key. The screen that appears varies depending on the specified fast channel data type.

   The instrument searches on the AND of fast channel Data conditions. Items whose check boxes are selected are used as trigger conditions.



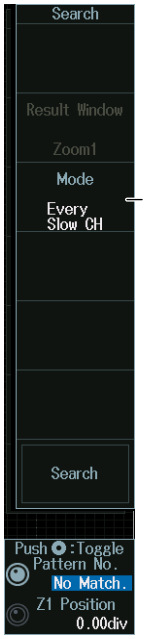
1 The total number of bits for Data1 to Data4 is up to 24. If you try to exceed the total number of bits, the data size of other pieces of Data is reduced.

2 When the check box for Multiplexing is selected, the Size of Data1 is fixed to 4 to correspond to FC.

Every Slow CH mode

Press the **Mode** soft key and then the **Every Slow CH** soft key to display the following menu.

The instrument searches when it detects an “Every Slow CH” message.



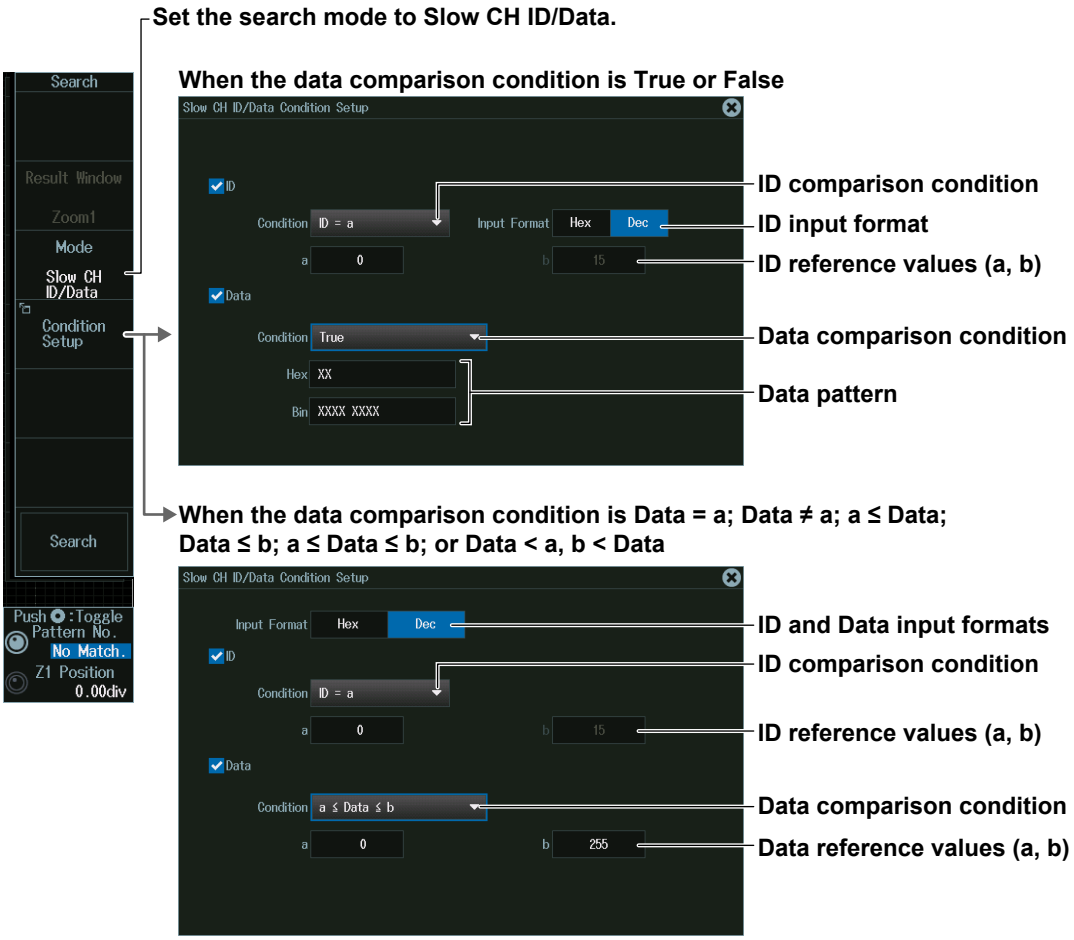
Set the search mode to Every Slow CH.

Slow CH ID/Data mode

1. Press the **Mode** soft key and then the **Slow CH ID/Data** soft key.
2. Press the **Condition Setup** soft key. The menu that appears varies depending on the specified slow channel message type.

   The instrument seraches on the AND of the slow channel ID and Data conditions. Items whose check boxes are selected are used as trigger conditions. Set ID and data reference values a and b in Hex (hexadecimal) or Dec (decimal) according to the input format setting.

- **When the Message Type Is Short**



Setting ID/Data Reference Values a and b

Input format setting		Hex	Dec
Selectable range for reference values a and b	ID	0 to F	0 to 15
	Data	00 to FF	00 to 255

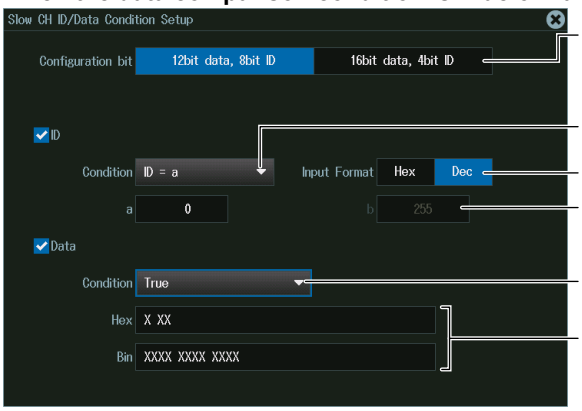
- **When the Message Type Is Enhanced**

  - **When the ID and Data Message Formats Are Set to "12bit data, 8bit ID"**

Set the search mode to Slow CH ID/Data.

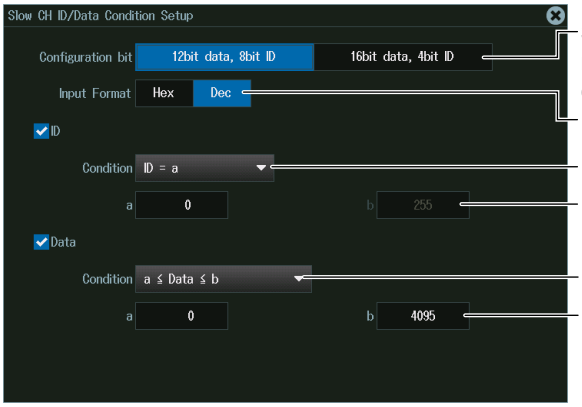


When the data comparison condition is True or False



Set the ID and data message formats to 12bit data and 8bit ID.
ID comparison condition
ID input format
ID reference values (a, b)
Data comparison condition
Data pattern

When the data comparison condition is Data = a; Data ≠ a; a ≤ Data; Data ≤ b; a ≤ Data ≤ b; or Data < a, b < Data



Set the ID and data message formats to 12bit data and 8bit ID.
ID and Data input formats
ID comparison condition
ID reference values (a, b)
Data comparison condition
Data reference values (a, b)

Setting ID/Data Reference Values a and b

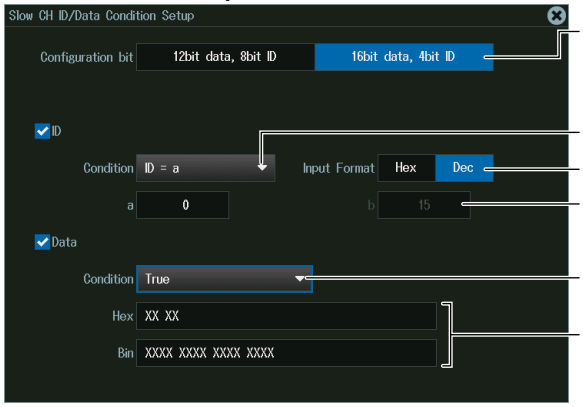
Input format setting		Hex	Dec
Selectable range for reference values a and b	ID	00 to FF	0 to 255
	Data	000 to FFF	0 to 4095

• When the ID and Data Message Formats Are Set to “16bit data, 4bit ID”

Set the search mode to Slow CH ID/Data.



When the data comparison condition is True or False



Set the ID and data message formats to 16bit data and 4bit ID.
ID comparison condition
ID input format
ID reference values (a, b)
Data comparison condition
Data pattern

When the data comparison condition is Data = a; Data ≠ a; a ≤ Data; Data ≤ b; a ≤ Data ≤ b; or Data < a, b < Data



Set the ID and data message formats to 16bit data and 4bit ID.
ID and Data input formats
ID comparison condition
ID reference values (a, b)
Data comparison condition
Data reference values (a, b)

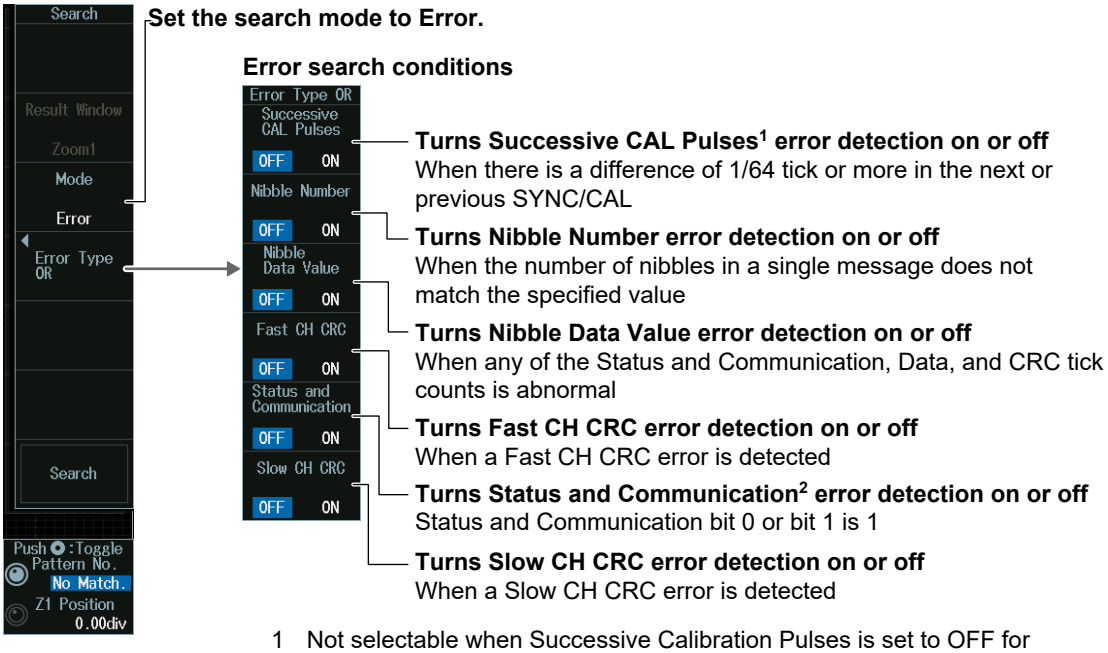
Setting ID/Data Reference Values a and b

Input format setting		Hex	Dec
Selectable range for reference values a and b	ID	0 to F	0 to 15
	Data	0000 to FFFF	0 to 65535

Error Mode

Press the **Mode** soft key and then the **Error** soft key to display the following menu.

The instrument searches when it detects various types of errors.



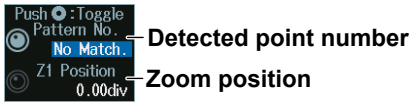
1 Not selectable when Successive Calibration Pulses is set to OFF for Customize Error Factor in “Setting the Format (Format) (page 2-68)

2 Selectable when the Bit 0 or Bit 1 check box is selected under Status and Communication for Customize Error Factor in “Setting the Format (Format) (page 2-68)

Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



12.7 Analyzing and Searching PSI5 Airbag Signals (Option)

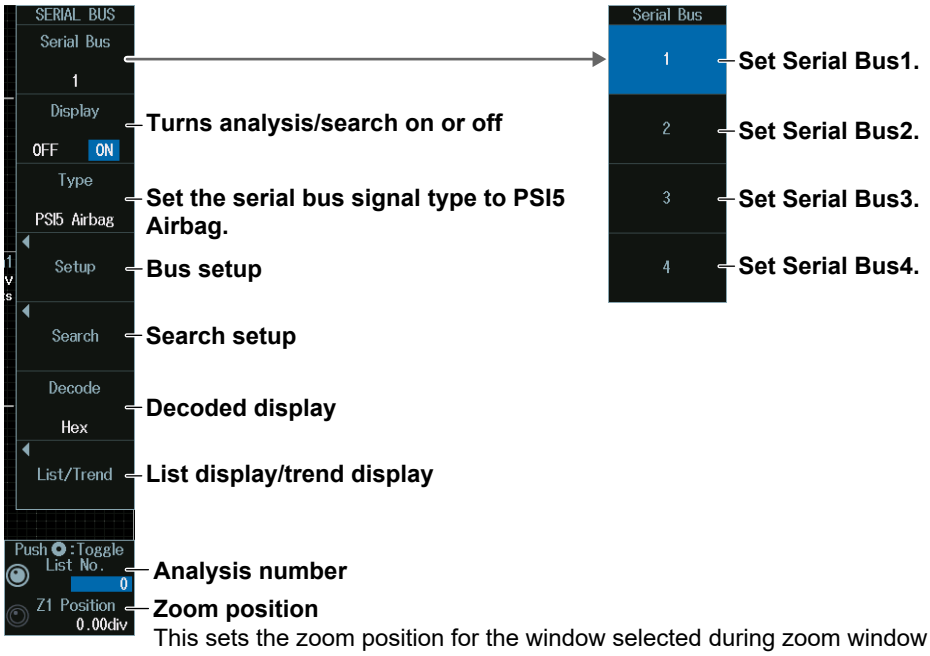
This section explains the following settings for analyzing or searching PSI5 Airbag signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Auto setup, sync signal, data frame source, bit rate, data length, error detection method, sync noise rejection, clock tolerance, and the level and hysteresis used to detect the sync signal or data frame source state
- Decoded display
- List display
  List size, display position, and zoom linking
- Trend Display
  Display source, display settings, cursor measurement on/off, auto scale
- Analysis number
- Zoom position
- Search settings
  Zoom window, search type, and search execution

► "Analyzing and Searching Serial Bus Signals,"
"Analyzing and Searching PSI5 Airbag Signals (Option)" in the Features Guide

SERIAL BUS PSI5 Airbag Menu

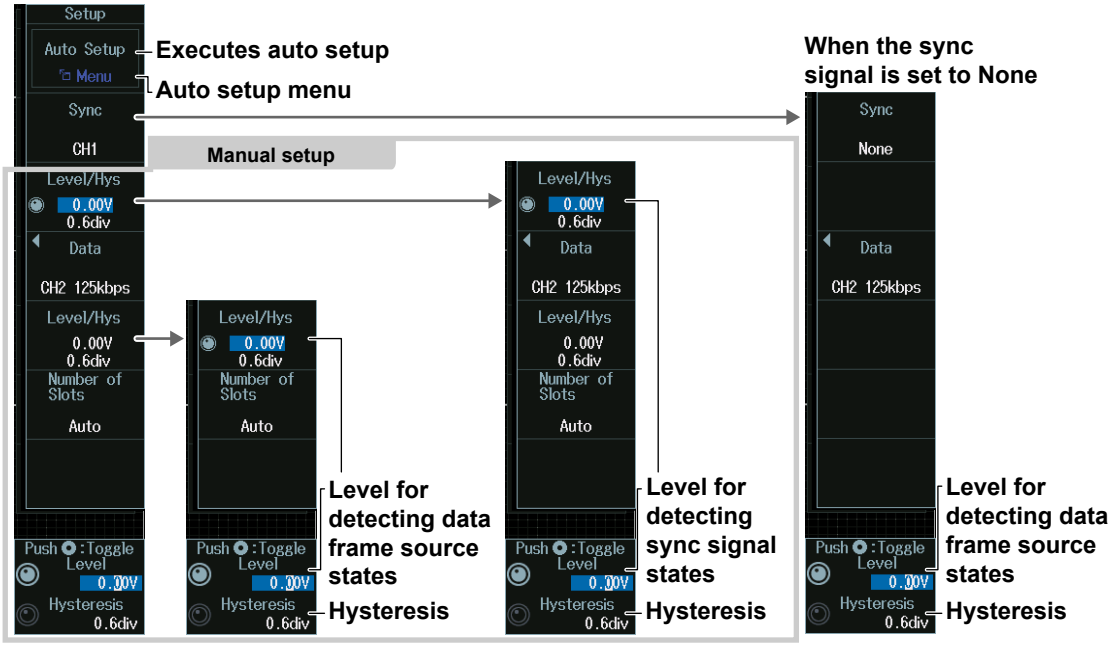
1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the Serial Bus soft key and select a number from 1 to 4.
2. Press the **Type** soft key. From the setup menu that appears, select **PSI5 Airbag** to display the following menu.



Zoom position
This sets the zoom position for the window selected during zoom window configuration (described later).

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



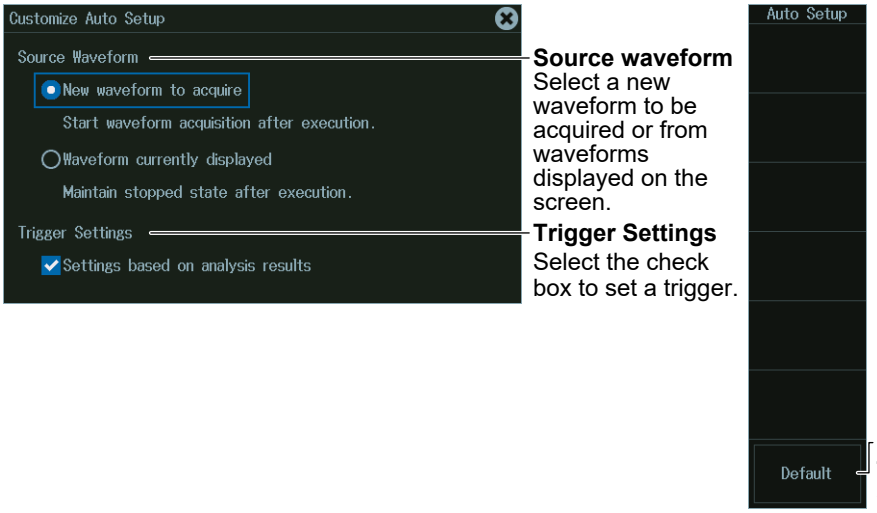
Auto Setup (Auto Setup)

1. Set the sync signal.
   - Auto setup cannot be performed when the source is set to Math1 to Math8.
   - If you select None, sync signal is not detected. Therefore, sync signal noise rejection is set to OFF.
2. Set the data frame source.
   Auto setup cannot be performed when the source is set to Math1 to Math8.
3. Press the **Auto Setup** soft key to execute auto setup.
   - Bit rate, data length, error detection method, sync signal noise rejection, clock tolerance, number of slots, level, and hysteresis are set automatically.
   - When the sync signal (Sync) source is CH1 to CH8, the instrument triggers on the rising edge of the sync pulse. When the sync signal source is None, the instrument triggers on the start bit of data frames. Triggers are not set if you unselect the Trigger Settings check box on the auto setup menu explained later.
   - While the serial bus is being configured, Auto Setup changes to Abort. If you want to stop, press the **Abort** soft key.

Auto Setup Menu (Menu)

You can set the analysis/search source waveform and select whether to set a trigger.

1. Press **SHIFT+F1**. The following screen and menu appear.
   You can also display them by pressing **SHIFT** and then the **Auto Setup** soft key.



2. Tap the screen to set the source waveform and trigger.
   - When waveform acquisition is in progress, the source waveform is fixed to a new waveform to be acquired.
   - If you clear the trigger setting check box, the trigger is not set even when auto setup is performed.

3. Press **ESC**. The menu returns to the bus setup menu.
   Press the **Auto Setup** soft key to execute auto setup. If you change the source waveform or the trigger setting from its default value, the soft key changes from Auto Setup to Auto Setup (Customized).

Note

- The auto setup feature will not work properly on some input signals.
- The available sync signal settings vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8, Math1 to Math8, None
  - The available settings on 4ch models are as follows:
    CH1 to CH4, Math1 to Math4, None

Level for Detecting Sync Signal States (Level, Hysteresis)

1. Press the **Level/Hys** soft key.
   This is the soft key displayed under the Sync soft key.
2. Turn the **jog shuttle** to set the level or hysteresis.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting sync signal states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Level for Detecting Data Frame Source States (Level, Hysteresis)

- **When the Sync Signal Is Not Set to None**

1. Press the **Level/Hys** soft key.
   This is the soft key displayed under the Data soft key.
2. Turn the **jog shuttle** to set the level or hysteresis.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting data frame source states

Hysteresis

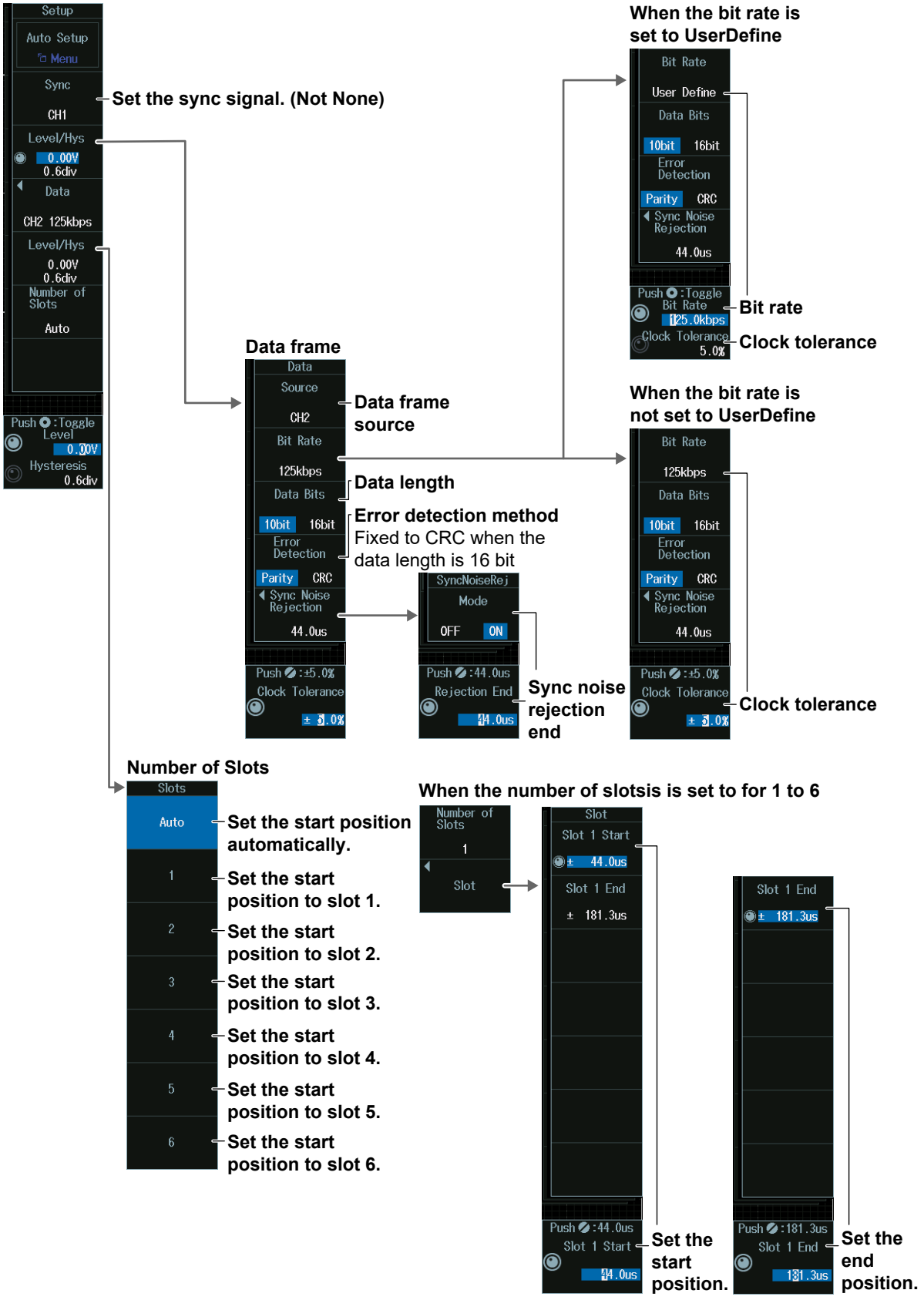
Press SET (upper right on the front panel) to switch between level and hysteresis.

- **When the Sync Signal Is Set to None**

  Turn the **jog shuttle** to set the level or hysteresis.
  - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
  - To set the level, you can drag the level display line on the screen.

Manual Setup

Manually set the data frames and number of slots.



Clock Tolerance (Clock Tolerance) and Bit Rate (Bit Rate)

When the bit rate is not set to User Define

Turn the **jog shuttle** to set the clock tolerance.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



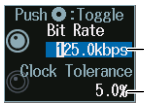
Clock tolerance

When the bit rate is set to User Define

Turn the **jog shuttle** to set the bit rate or clock tolerance.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Bit rate

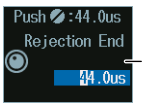
Clock tolerance

Press SET (upper right on the front panel) to switch between bit rate and clock tolerance.

Sync Noise Rejection End (Rejection End)

1. Press the **Sync Noise Rejection** soft key and then the **Mode** soft key to select ON. The Rejection End jog shuttle menu appears.
2. Turn the **jog shuttle** to set the sync noise rejection (Rejection End).
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Sync noise rejection end

Set the start position (Start) of each slot and the end position (End) of the last slot.

Setting the Start Position

1. Press the **Slot n Start** soft key to display the Slot n Start jog shuttle menu (where n is the number of slots).
2. Turn the **jog shuttle** to set the start position (Start).
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

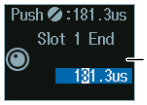


Start position

Setting the End Position

1. Press the **Slot n End** soft key to display the Slot n End jog shuttle menu (where n is the number of slots).
2. Turn the **jog shuttle** to set the end position (End).
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

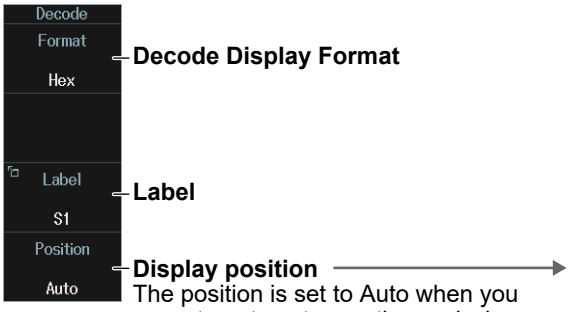
Jog shuttle setting menu



End position

Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



Decode Display Format

Label

Display position
The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

When the display position is set to Manual



Display position

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

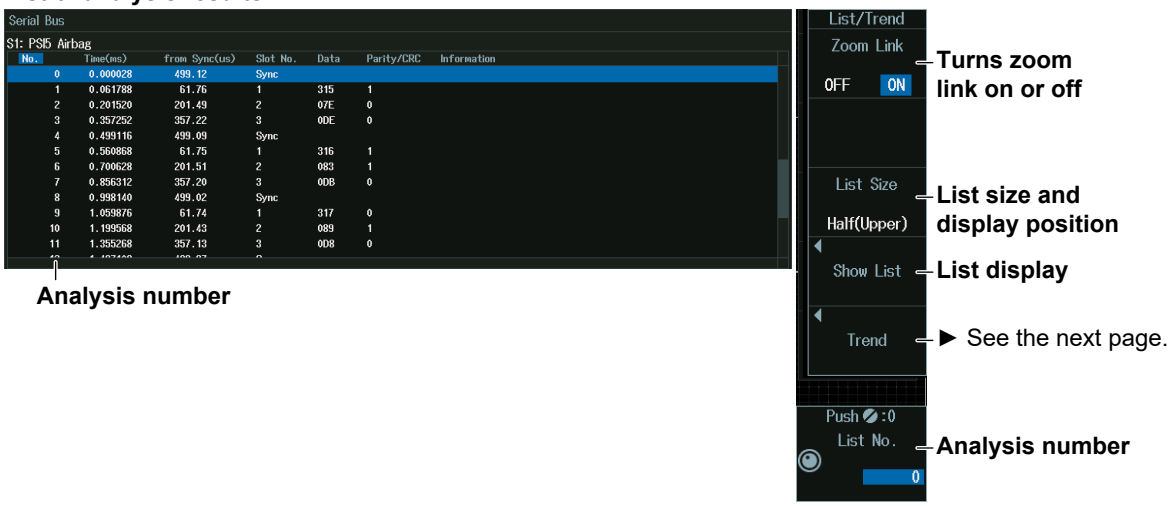


Display position

List Display (List/Trend_List)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List/Trend** soft key and then the **Show List** soft key.
   - The list of analysis results and the next menu appear.
   - If several display settings of Serial Bus 1 to 4 are on, all the lists of analysis results of the serial buses whose display setting is on are displayed. For details, see section 12.12.

List of analysis results



Note

Analysis Number

Data before the trigger position (on the left side of the waveform display) is assigned analysis numbers in descending order (–1, –2, and so on). Data after the trigger position (on the right side of the waveform display) is assigned analysis numbers in ascending order (0, 1, 2, and so on).

Analysis Number (List No.)

Turn the **jog shuttle** to set the analysis number (List No.).

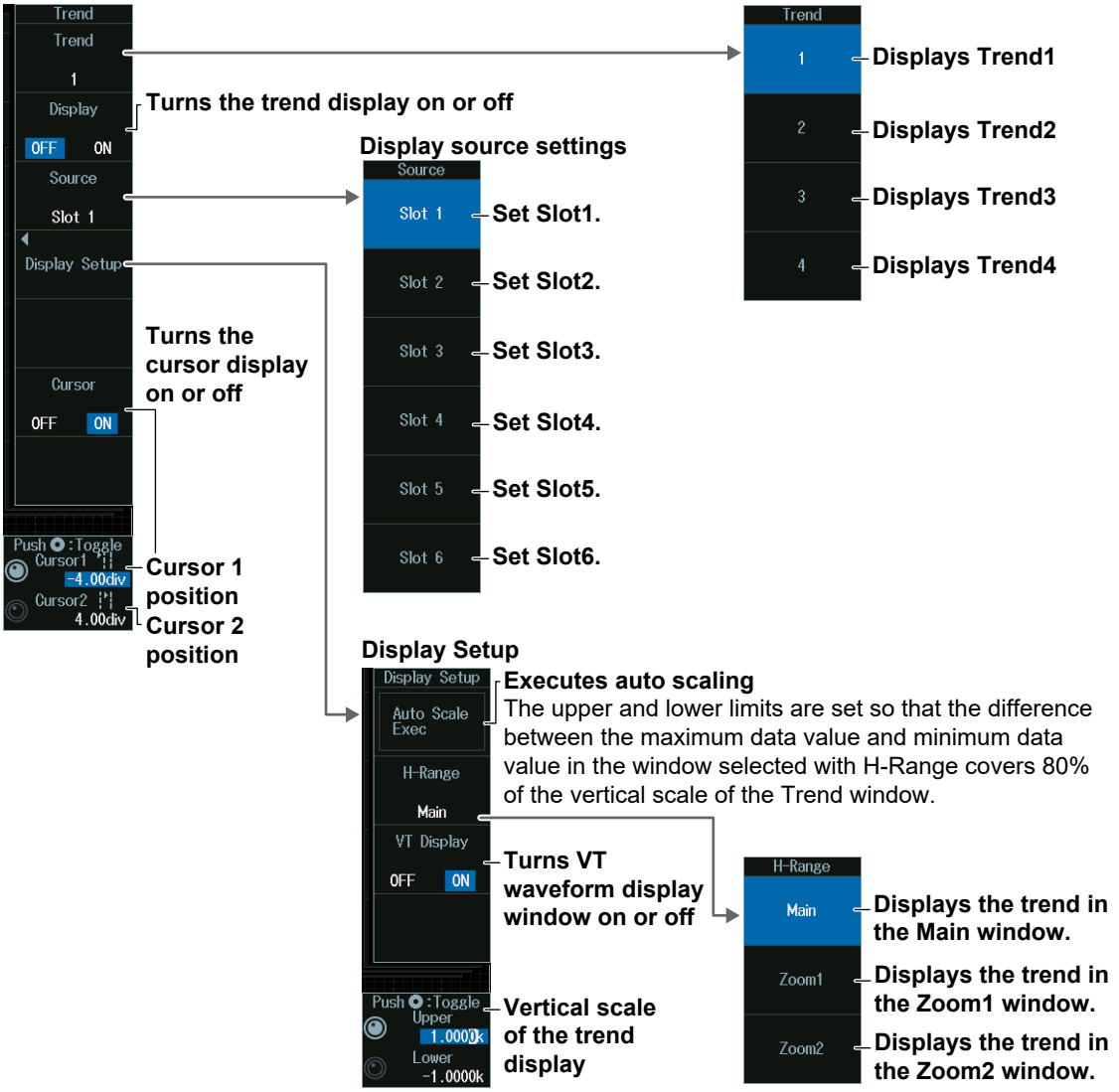
You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Trend Display (List/Trend_Trend)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List/Trend** soft key and then the **Trend** soft key.
   - Up to four trends can be displayed. To switch to the setup menu, press the **Trend** soft key and select a number from 1 to 4.



Cursor Positions (Cursor1/Cursor2)

1. Turn the **Cursor** soft key to select ON.
2. Turn the **jog shuttle** to set cursor 1 (Cursor1) or cursor 2 (Cursor2).
   - Press **SET** (upper right on the front panel) to switch between cursor 1 and cursor 2.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Cursor 1 position

Cursor 2 position

Note

Setting the Cursor Positions

If you press SET several times and make the jog shuttle control both cursor 1 and cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen.

Vertical Scale of the Trend Display (Upper/Lower)

1. Press the **Display Setup** soft key.
2. Turn the **jog shuttle** to set the upper boundary (Upper) or lower boundary (Lower).
   - Press **SET** (upper right on the front panel) to switch between upper and lower boundaries.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Up boundary

Down boundary

Search Setup (Search)

Press the **Search** soft key to display the following menu.



Zoom window
You can configure zoom windows Zoom1 and Zoom2 when they are displayed.
Zoom1 is automatically displayed during the automatic setup of the analysis settings.

Search type

Executes the search
The instrument searches for the search conditions. If the instrument finds points that match the search conditions (detected points), it shows numbers (0, 1, 2, etc.) from the left of the waveform display in the order that the points were detected.

Detected point number

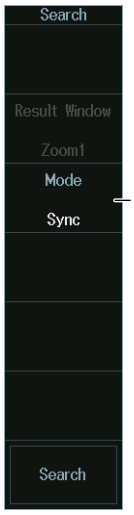
Zoom position

Search Type (Mode)

Sync mode

Press the **Mode** soft key and then the **Sync** soft key to display the following menu.

The instrument searches for sync pulses.



Set the search mode to Sync.

Start Bit mode

Press the **Mode** soft key and then the **Start Bit** soft key to display the following menu.

The instrument searches for start bits of data frames.

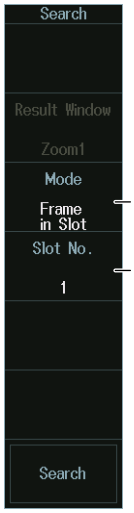


Set the search mode to Start Bit.

Frame in Slot mode

Press the **Mode** soft key and then the **Frame in Slot** soft key to display the following menu.

The instrument searches for data frames included in the specified slot. Frame in Slot mode will not be available if the sync signal (Sync) is set to None.



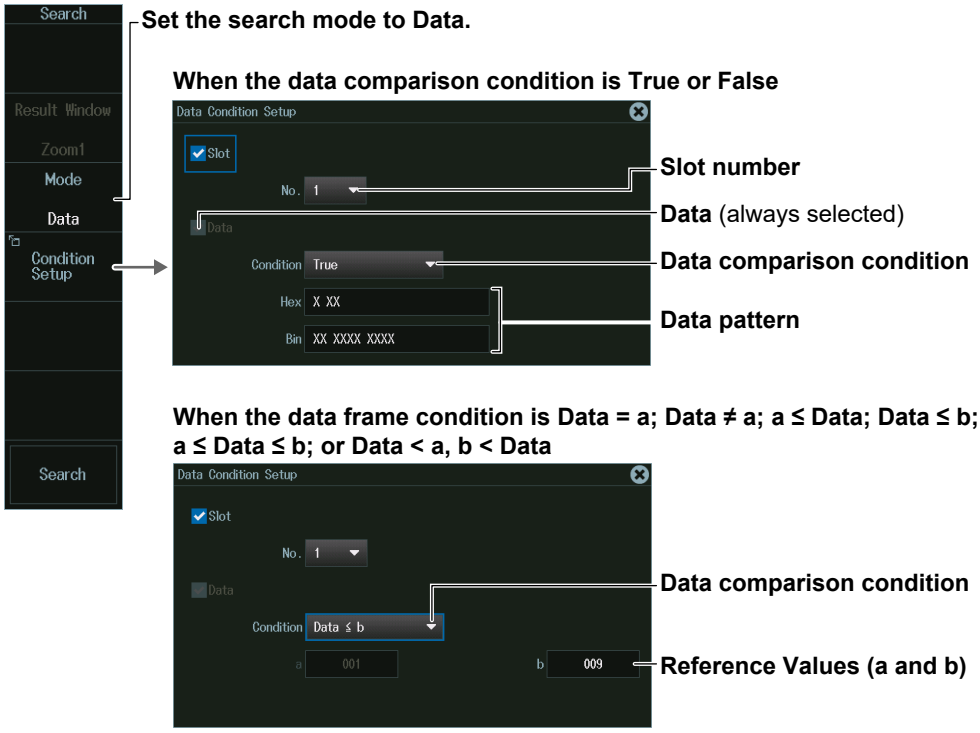
Set the search mode to Frame in Slot.

Set the slot number.

- 1 to N (the number of slots) when the number of slots* on the Setup menu is set to a number from 1 to 6
- 1 to 6 when the number of slots on the Setup menu is set to Auto

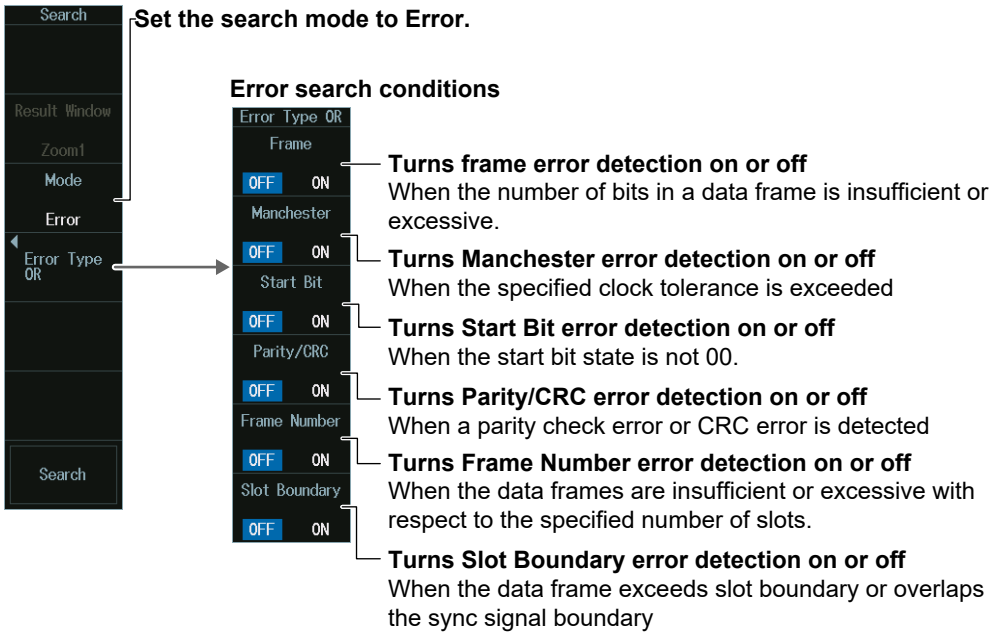
Data mode

1. Press the **Mode** soft key and then the **Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument searches for a data pattern or a data value. You can also specify a slot number.



Error mode

Press the **Mode** soft key and then the **Error** soft key to display the following menu.
The instrument searches when it detects various types of errors.



Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



Detected point number

Zoom position

12.8 Analyzing and Searching UART Signals (Option)

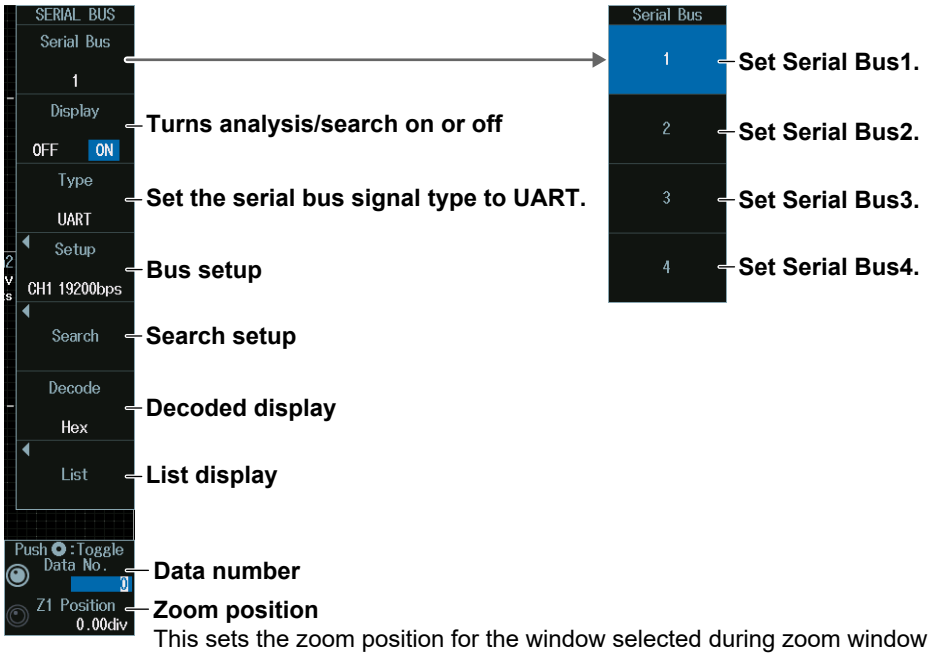
This section explains the following settings for analyzing or searching UART signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Auto setup, analysis/search source waveform, data format, parity, grouping, level and hysteresis for detecting analysis/search source waveform states
- Decoded display
- List display
  List size, display position, grouping, detailed display, and zoom linking
- Analysis and data numbers
- Zoom position
- Search settings
  Zoom window, search type, and search execution

► **"Analyzing and Searching Serial Bus Signals," "Analyzing and Searching UART Signals (Option)" in the Features Guide**

SERIAL BUS UART Menu

1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the Serial Bus soft key and select a number from 1 to 4.
2. Press the **Type** soft key. From the setup menu that appears, select **UART** to display the following menu.



This sets the zoom position for the window selected during zoom window configuration (described later).

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



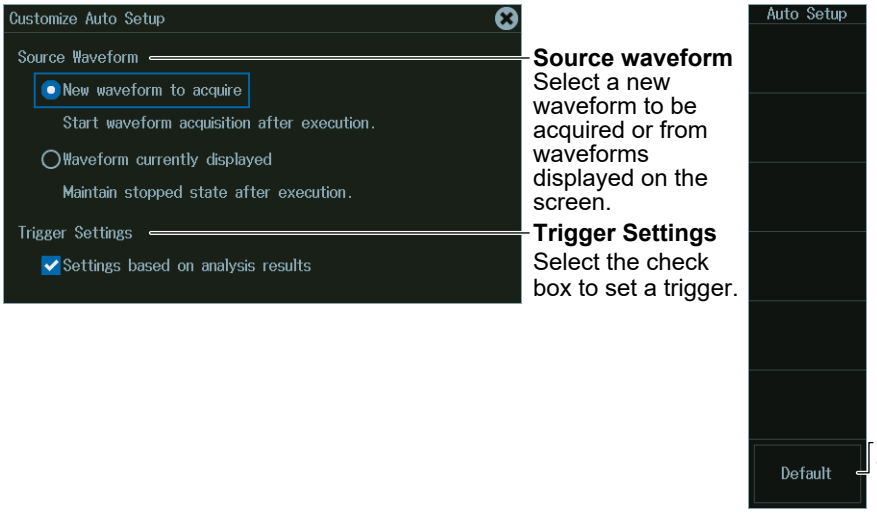
Executing Auto Setup (Auto Setup)

1. Set the analysis/search source waveform.
   You cannot use auto setup under the following circumstances.
   - When the Analysis/Search Source Waveform Is Math1 to Math8
   - When state display is applied to a Logic bit that is set as the analysis/search source waveform.
2. If you set the trigger source to Logic, set the source bit.
3. Press **ESC**. The menu returns to the bus setup menu.
4. Press the **Auto Setup** soft key to execute auto setup.
   - The Instrument automatically configures the bit rate, sample point, level, and hysteresis and then triggers on the UART signal's Stop Bit. Triggers are not set if you unselect the Trigger Settings check box on the auto setup menu explained later.
   - While the serial bus is being configured, Auto Setup changes to Abort. If you want to stop, press the **Abort** soft key.

Auto Setup Menu (Menu)

You can set the analysis/search source waveform and select whether to set a trigger.

1. Press **SHIFT+F1**. The following screen and menu appear.
   You can also display them by pressing **SHIFT** and then the **Auto Setup** soft key.



2. Tap the screen to set the source waveform and trigger.
   - When waveform acquisition is in progress, the source waveform is fixed to a new waveform to be acquired.
   - If you clear the trigger setting check box, the trigger is not set even when auto setup is performed.

3. Press **ESC**. The menu returns to the bus setup menu.
   Press the **Auto Setup** soft key to execute auto setup. If you change the source waveform or the trigger setting from its default value, the soft key changes from Auto Setup to Auto Setup (Customized).

Note

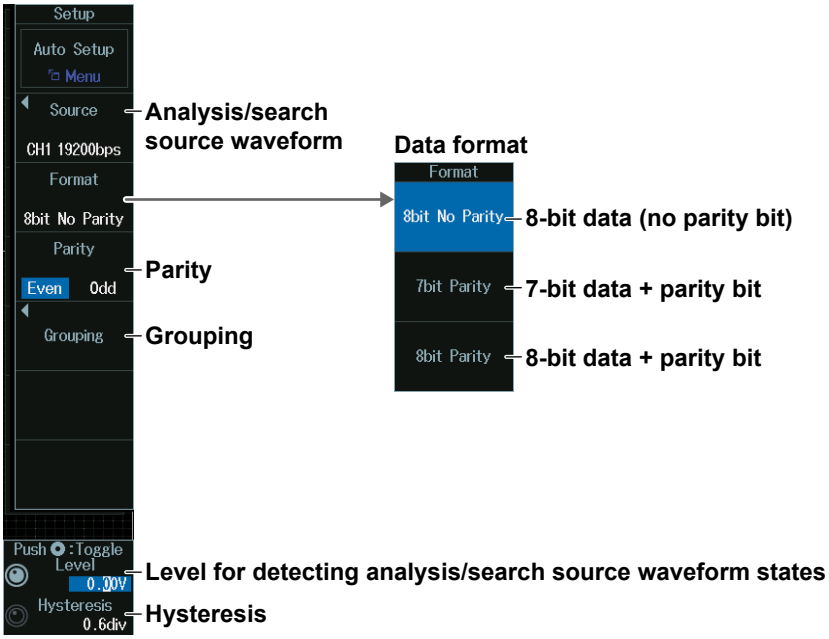
- The auto setup feature will not work properly on some input signals.
- The available source waveforms vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8, Logic, Math1 to Math8
  - The available settings on 4ch models are as follows:
    CH1 to CH4, Logic, Math1 to Math4

Source Bit

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

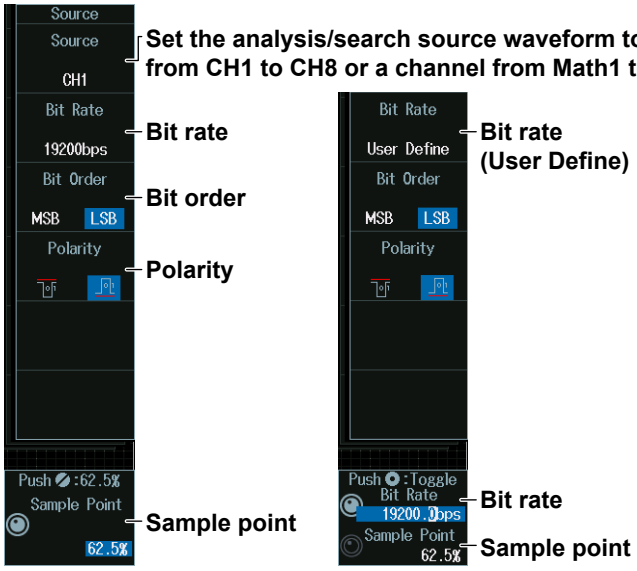
Manual Setup

Manually set the bus format, parity, and so on.



- **Analysis/Search Source Waveform (when the source is CH1 to CH8, Math1 to Math8)**

  Press the **Source** soft key to display the following menu.

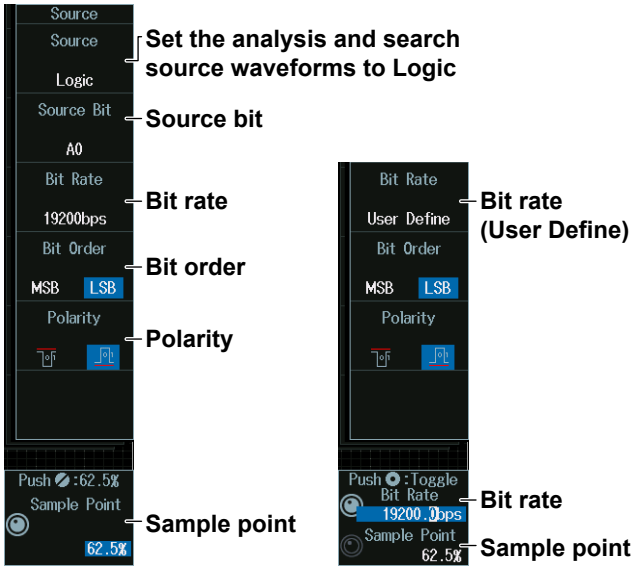


Note

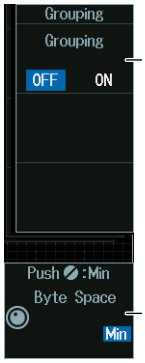
The available source waveforms vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8, Logic, Math1 to Math8
- The available settings on 4ch models are as follows:
  CH1 to CH4, Logic, Math1 to Math4

- **Analysis/Search Source Waveform (when Source is Logic)**
  Press the **Source** soft key to display the following menu.



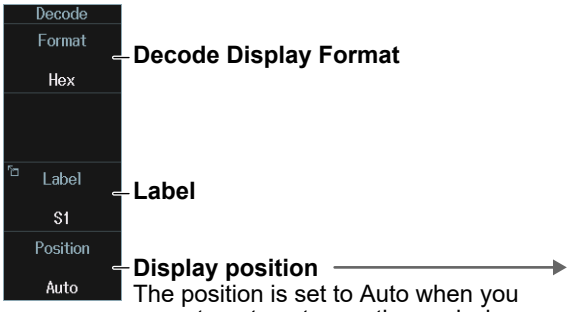
- **Grouping (Grouping)**
  Press the **Grouping** soft key to display the following menu.



When you turn grouping on, data whose time is shorter than the specified byte space (Byte Space) is decoded and displayed in a single group.

Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



Decode Display Format

Label

Display position

The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

When the display position is set to Manual



Display position

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



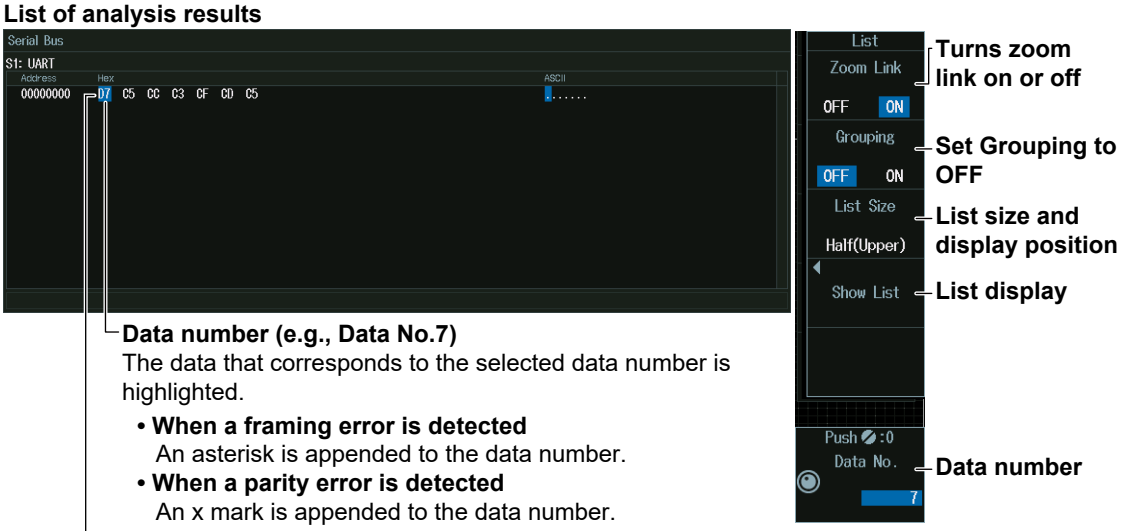
Display position

List Display (List)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List** soft key and then the **Show List** soft key.
   - The list of analysis results and the next menu appear.
   - If several display settings of Serial Bus 1 to 4 are on, all the lists of analysis results of the serial buses whose display setting is on are displayed. For details, see section 12.12.

When Grouping Is Set to OFF

List of analysis results



Turns zoom link on or off

Set Grouping to OFF

List size and display position

List display

Data number

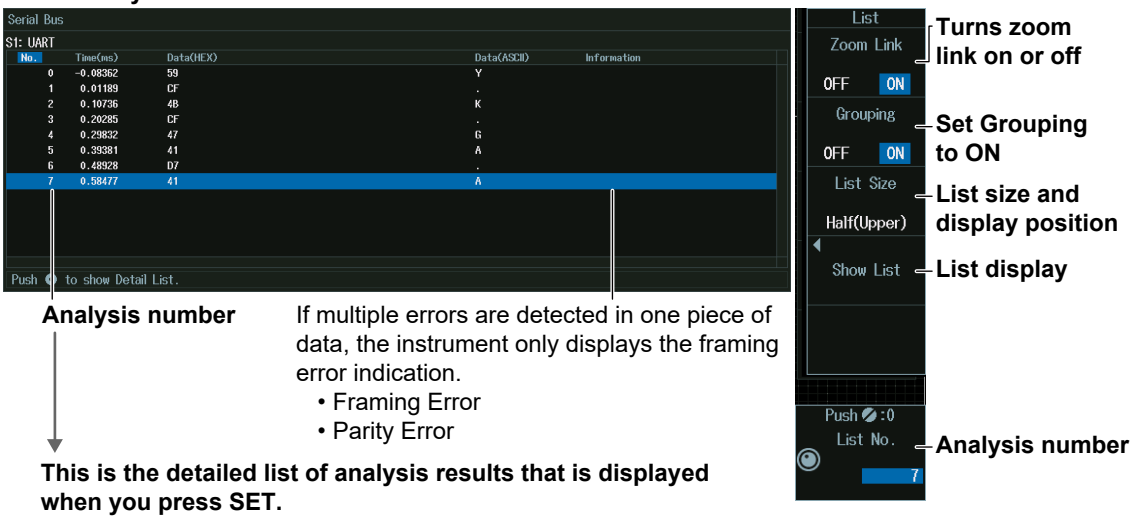
Data number (e.g., Data No.7)
The data that corresponds to the selected data number is highlighted.

- **When a framing error is detected**
  An asterisk is appended to the data number.
- **When a parity error is detected**
  An x mark is appended to the data number.
- **When both a framing error and a parity error are detected**
  The asterisk used for marking framing errors is appended to the data number.

Data from the leftmost side of the waveform display

When Grouping Is Set to ON

List of analysis results



Turns zoom link on or off

Set Grouping to ON

List size and display position

List display

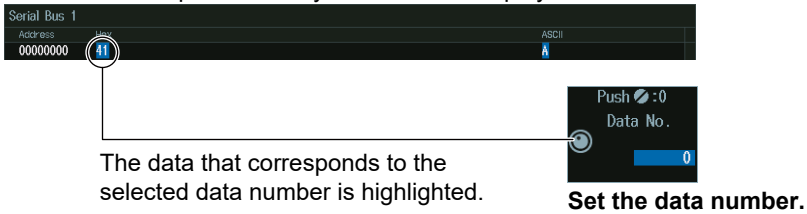
Analysis number

Analysis number

If multiple errors are detected in one piece of data, the instrument only displays the framing error indication.

- Framing Error
- Parity Error

This is the detailed list of analysis results that is displayed when you press SET.
All data for the specified analysis number is displayed.



The data that corresponds to the selected data number is highlighted.

Set the data number.

Note

Analysis number

Data before the trigger position (on the left side of the waveform display) is assigned analysis numbers in descending order (–1, –2, and so on). Data after the trigger position (on the right side of the waveform display) is assigned analysis numbers in ascending order (0, 1, 2, and so on).

Analysis Number (List No.), Data Number (Data No.)

Turn the **jog shuttle** to set the analysis number (List No.) or data number (Data No.).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When grouping is set to ON



Analysis number

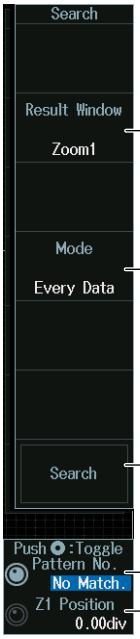
Detail display when grouping is set to OFF or when grouping is set to ON and SET is pressed



Data number

Search Setup (Search)

Press the **Search** soft key to display the following menu.



Zoom window

You can configure zoom windows Zoom1 and Zoom2 when they are displayed. Zoom1 is automatically displayed during the automatic setup of the analysis settings.

Search type

Executes the search

The instrument searches for the search conditions. If the instrument finds points that match the search conditions (detected points), it shows numbers (0, 1, 2, etc.) from the left of the waveform display in the order that the points were detected.

Detected point number

Zoom position

Search Type (Mode)

Every Data mode

Press the **Mode** soft key and then the **Every Data** soft key to display the following menu.

The instrument searches on all data.



Set the search mode to Every Data.

Error Mode

Press the **Mode** soft key and then the **Error** soft key to display the following menu.

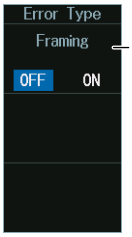
The instrument searches when it detects various types of errors.



Set the search mode to Error.

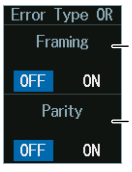
Error search conditions

When the format is 8bit No Parity



Turns framing error detection on or off
When the logical value of the stop bit is 0

When the format is 7bit Parity or 8bit Parity

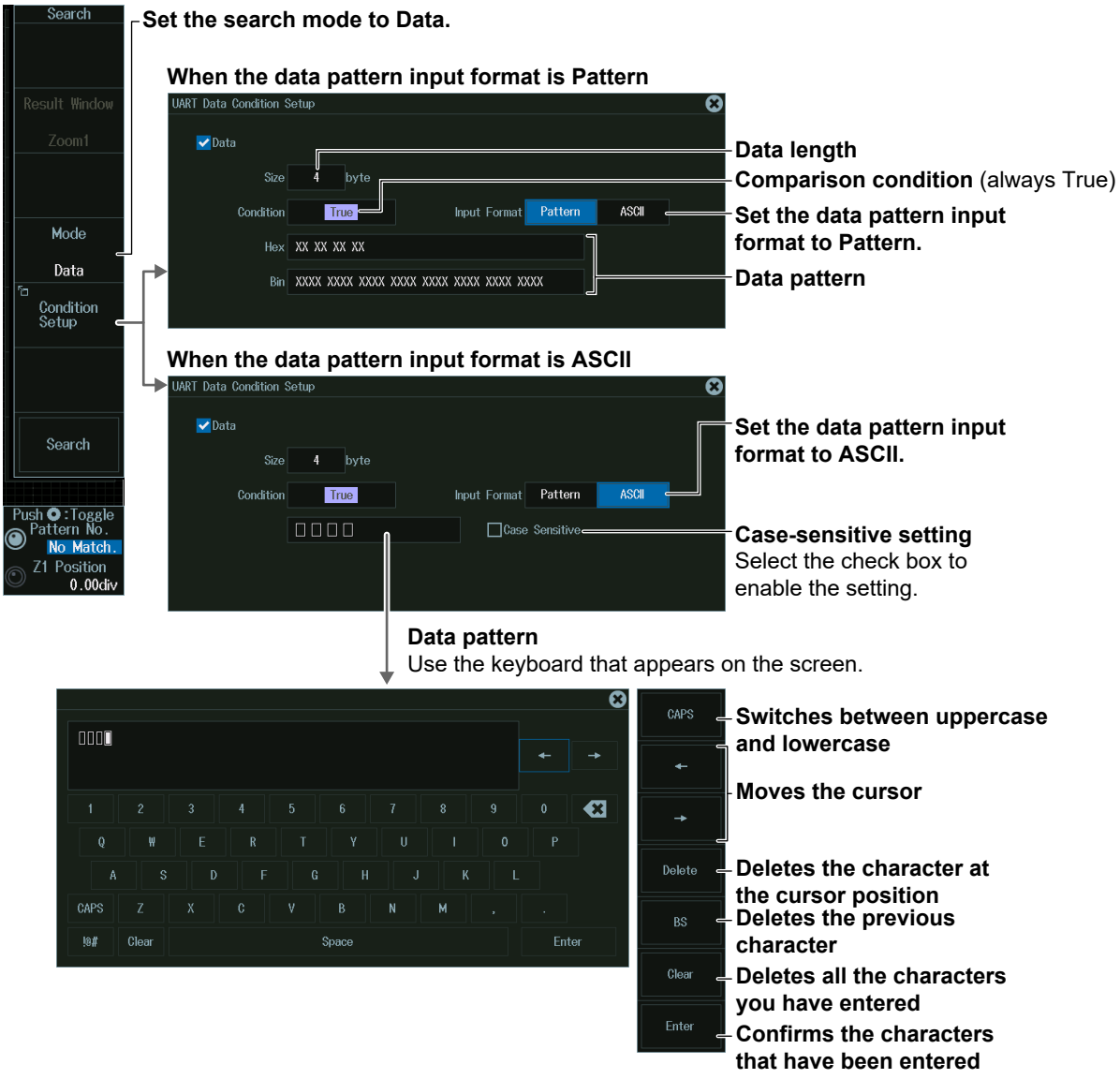


Turns framing error detection on or off
When the logical value of the stop bit is 0

Turns parity error detection on or off
When a parity error is detected in the received character

Data Mode

1. Press the **Mode** soft key and then the **Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument searches when the data pattern is matched.



Data Pattern

You can enter up to 4 characters.

- You can switch between uppercase and lowercase to enter alphabet characters. However, case is distinguished only when the Case Sensitive check box is selected.
- The special characters CR, LF, SP, and NUL are shown in single quotation marks. These special characters are counted as one character including the single quotation marks. Example: AB'CR'D (four characters), XY'SP' (three characters), P'NUL'WU (four characters)
- The entered string, including the character codes for the case, is retained even if the input format is changed to Bin or Hex. It is also retained when the format is changed from Bin or Hex to ASCII.
- If a character code that does not exist on the keyboard is entered when the input format is Bin or Hex and then the input format is changed to ASCII, a white square is displayed in the corresponding position.

Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



Detected point number

Zoom position

12.9 Analyzing and Searching I²C Bus Signals (Option)

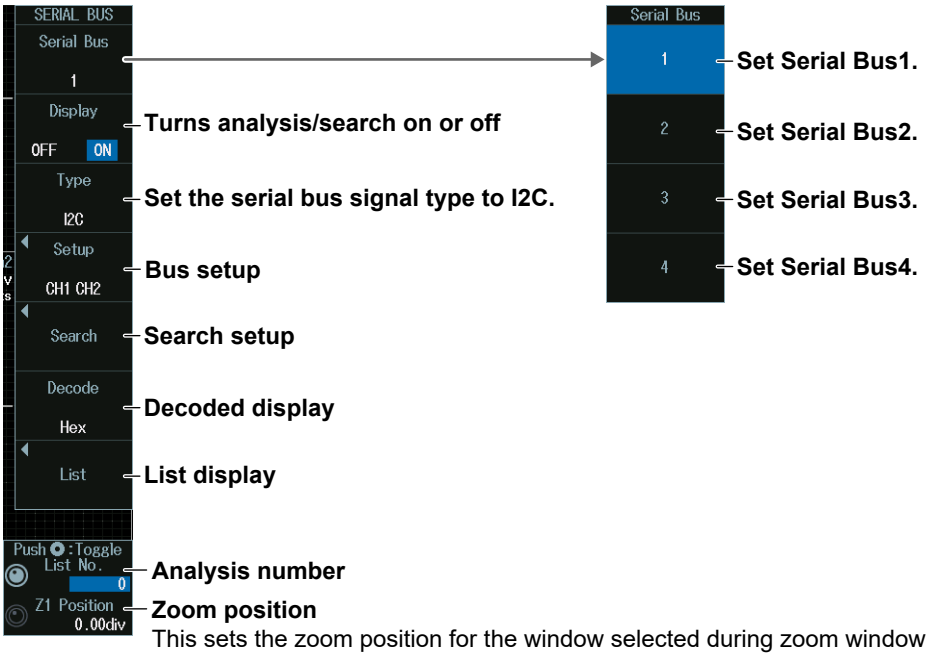
This section explains the following settings for analyzing or searching I²C bus signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Auto setup, SCL source, SDA source, level and hysteresis for detecting SCL and SDA source states
- Decoded display
- List display
  List size, display position, detailed display, and zoom linking
- Analysis and data numbers
- Zoom position
- Search settings
  Zoom window, search type, and search execution

► **"Analyzing and Searching Serial Bus Signals," "Analyzing and Searching I²C Bus Signals (Option)" in the Features Guide**

SERIAL BUS I2C Menu

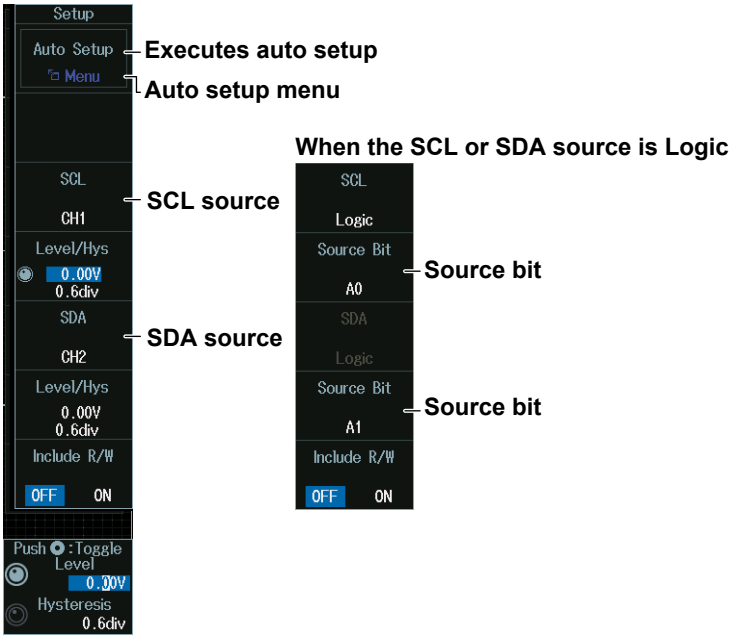
1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the Serial Bus soft key and select a number from 1 to 4.
2. Press the **Type** soft key. From the setup menu that appears, select **I2C** to display the following menu.



Zoom position
This sets the zoom position for the window selected during zoom window configuration (described later).

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



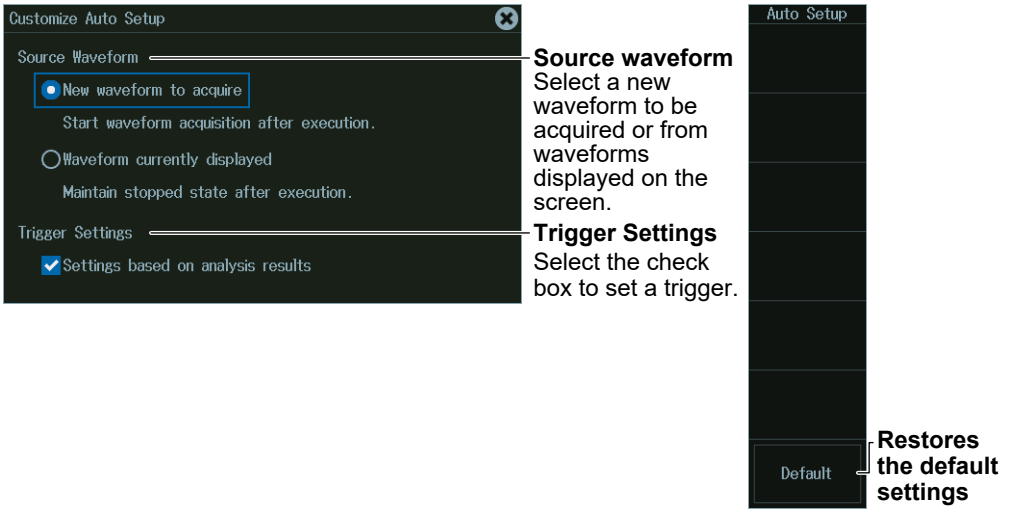
Executing Auto Setup (Auto Setup)

1. Set the SCL and SDA sources.
   You cannot use auto setup under the following circumstances.
   - When the SCL or SDA source is set to Math1 to Math8
   - When state display is applied to a LOGIC bit that is set as the SCL or SDA source.
2. If you set the SCL or SDA source to Logic (L), set the source bit.
3. Press the **Auto Setup** soft key to execute auto setup.
   - The instrument automatically configures the level and hysteresis and triggers on the start condition of the I^2C bus signal. Triggers are not set if you unselect the Trigger Settings check box on the auto setup menu explained later.
   - While the serial bus is being configured, Auto Setup changes to Abort. If you want to stop, press the **Abort** soft key.

Auto Setup Menu (Menu)

You can set the analysis/search source waveform and select whether to set a trigger.

1. Press **SHIFT+F1**. The following screen and menu appear.
   You can also display them by pressing **SHIFT** and then the **Auto Setup** soft key.



2. Tap the screen to set the source waveform and trigger.
   - When waveform acquisition is in progress, the source waveform is fixed to a new waveform to be acquired.
   - If you clear the trigger setting check box, the trigger is not set even when auto setup is performed.
3. Press **ESC**. The menu returns to the bus setup menu.
   Press the **Auto Setup** soft key to execute auto setup. If you change the source waveform or the trigger setting from its default value, the soft key changes from Auto Setup to Auto Setup (Customized).

Note

- The auto setup feature will not work properly on some input signals.
- The available source waveforms vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8, Logic, Math1 to Math8
  - The available settings on 4ch models are as follows:
    CH1 to CH4, Logic, Math1 to Math4

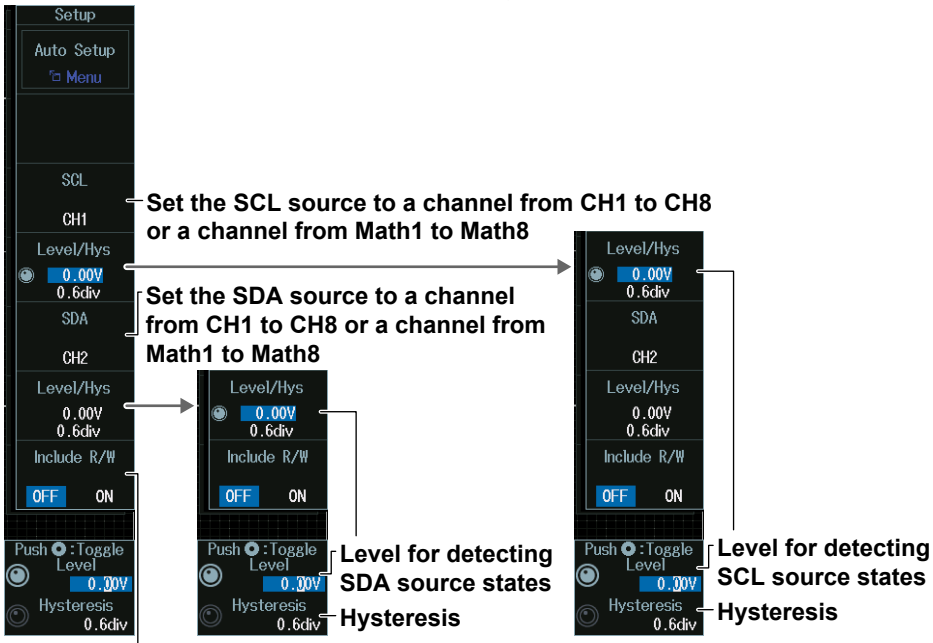
Source Bit

The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Manual Setup

Manually set the level and hysteresis.

When the SCL or SDA source is CH1 to CH8, Math1 to Math8



Whether to include the R/W bit

Specify whether to include the R/W bit when setting or displaying the address pattern. This setting affects the configuration or display of the address pattern in the following situations.

- Search condition when the search mode is Address Data (Address in the Condition Setup screen)
- Decoded display
- Address boxes in the list display (1st, 2nd)

When the SCL or SDA source is Logic

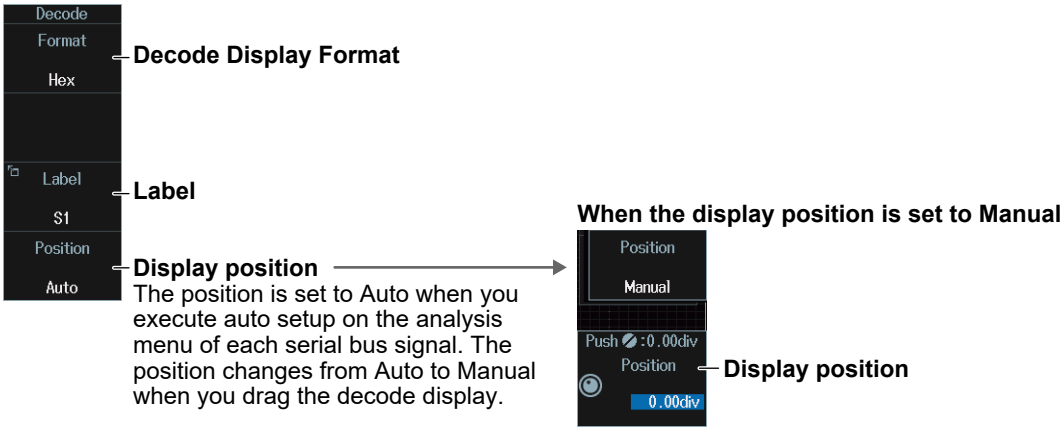


Note

R/W bit inclusion (Include R/W) can also be set by selecting I2C bus signal trigger, Trigger Type, and then Address Data mode. The settings are synchronized. For details on I2C bus signal trigger, see section 2.21.

Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

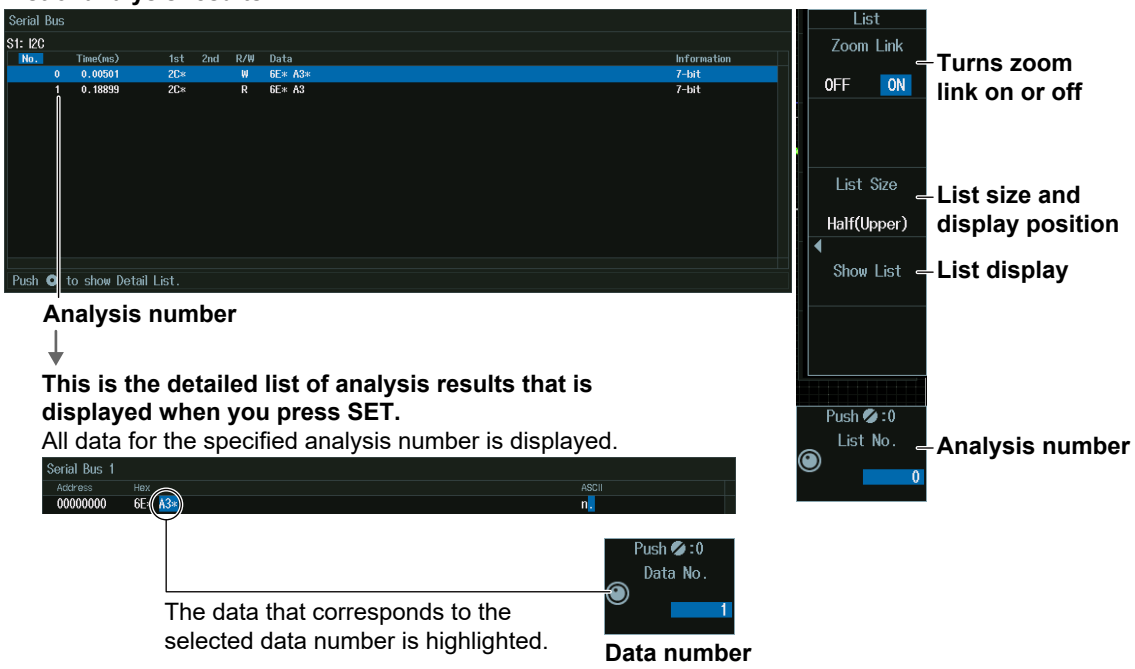
Jog shuttle setting menu



List Display (List)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List** soft key and then the **Show List** soft key.
   - The list of analysis results and the next menu appear.
   - If several display settings of Serial Bus 1 to 4 are on, all the lists of analysis results of the serial buses whose display setting is on are displayed. For details, see section 12.12.

List of analysis results



Note

Analysis Number

Data before the trigger position (on the left side of the waveform display) is assigned analysis numbers in descending order (–1, –2, and so on). Data after the trigger position (on the right side of the waveform display) is assigned analysis numbers in ascending order (0, 1, 2, and so on).

Analysis Number (List No.), Data Number (Data No.)

Turn the **jog shuttle** to set the analysis number (List No.) or data number (Data No.).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When selecting from the list of analysis results



When selecting from the detailed display of the analysis results list (when SET is pressed)



Search Setup (Search)

Press the **Search** soft key to display the following menu.



Zoom window
You can configure zoom windows Zoom1 and Zoom2 when they are displayed.
Zoom1 is automatically displayed during the automatic setup of the analysis settings.

Search type

Executes the search
The instrument searches for the search conditions. If the instrument finds points that match the search conditions (detected points), it shows numbers (0, 1, 2, etc.) from the left of the waveform display in the order that the points were detected.

Detected point number

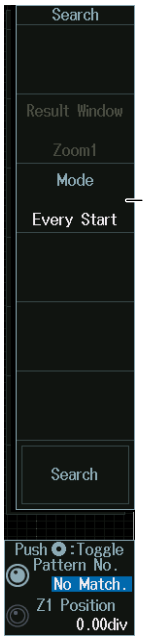
Zoom position

Trigger Mode (Mode)

Every Start Mode

Press the **Mode** soft key and then the **Every Start** soft key to display the following menu.

The instrument searches when it detects a start condition.

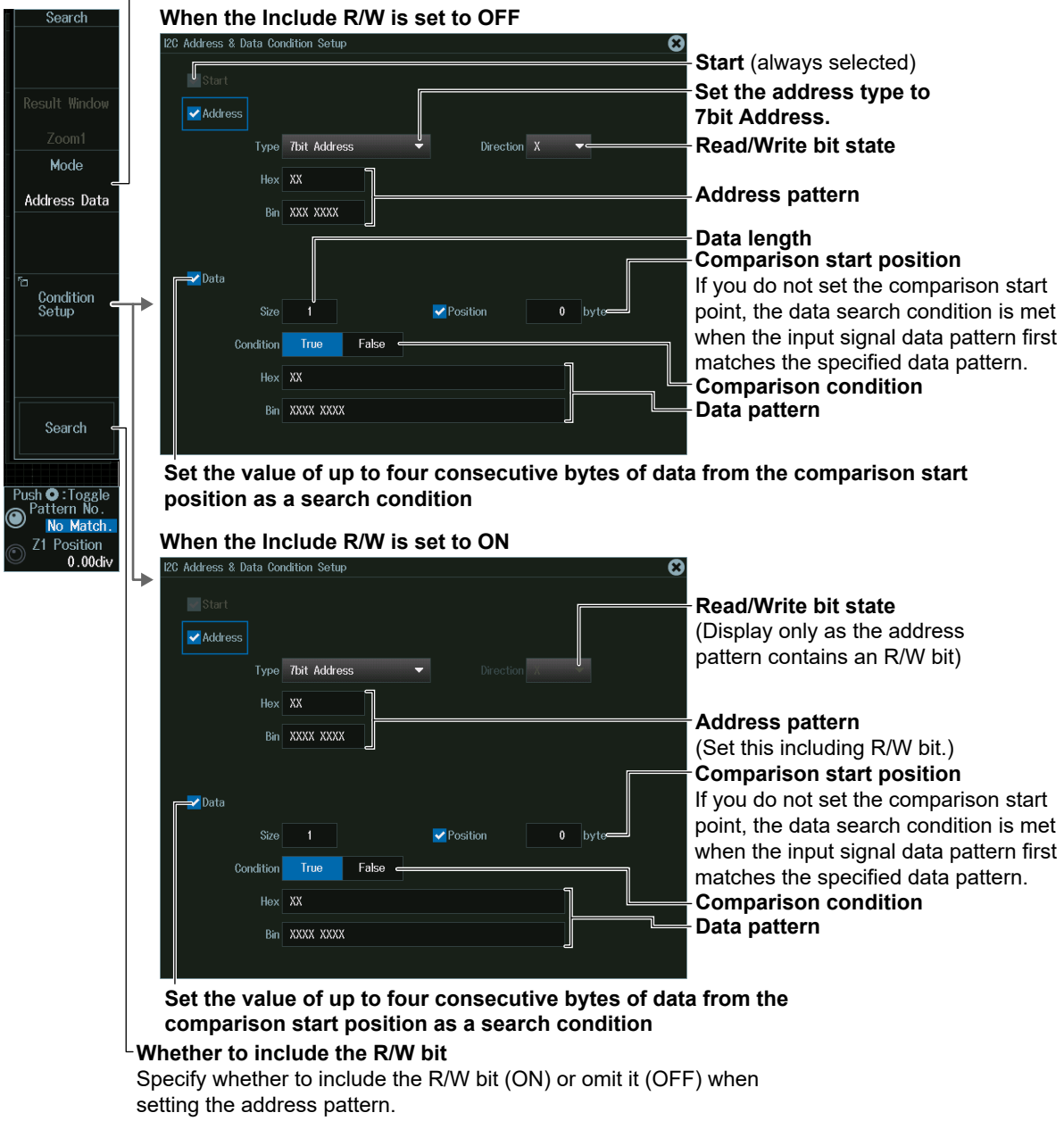


Set the search mode to Every Start.

Address Data mode

1. Press the **Mode** soft key and then the **Address Data** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   The instrument searches on the AND of the start, address pattern, data pattern, and comparison start position conditions. Items whose check boxes are selected are used as trigger conditions.

- **When Address Type Is 7bit Address**



Set the search mode to AddressData.

When the Include R/W is set to OFF

Start (always selected)

Set the address type to 7bit Address.

Read/Write bit state

Address pattern

Data length

Comparison start position

If you do not set the comparison start point, the data search condition is met when the input signal data pattern first matches the specified data pattern.

Comparison condition

Data pattern

Set the value of up to four consecutive bytes of data from the comparison start position as a search condition

When the Include R/W is set to ON

Read/Write bit state

(Display only as the address pattern contains an R/W bit)

Address pattern

(Set this including R/W bit.)

Comparison start position

If you do not set the comparison start point, the data search condition is met when the input signal data pattern first matches the specified data pattern.

Comparison condition

Data pattern

Set the value of up to four consecutive bytes of data from the comparison start position as a search condition

Whether to include the R/W bit

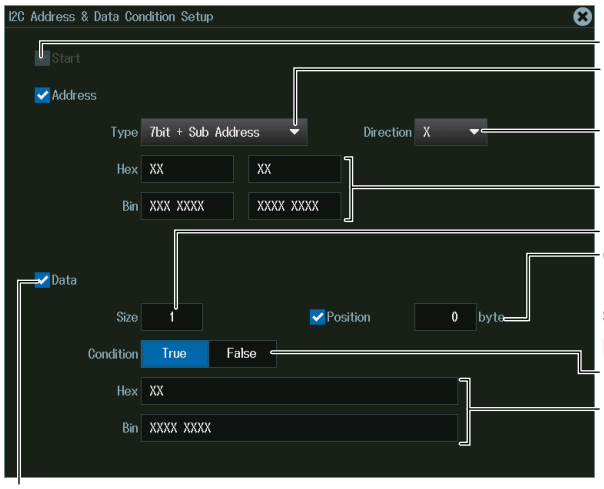
Specify whether to include the R/W bit (ON) or omit it (OFF) when setting the address pattern.

Note

R/W bit inclusion (Include R/W) can also be set by using Analyzing and Searching I^2C Bus Signals and then Bus Setup (Setup). Settings are synchronized. For details on I^2C bus signal analysis, see section 12.9.

- **When Address Type Is 7bit+Sub Address**

When the Include R/W is set to OFF



Start (always selected)

Set the address type to 7bit + Sub Address.

Read/Write bit state

Address pattern

Data length

Comparison start position

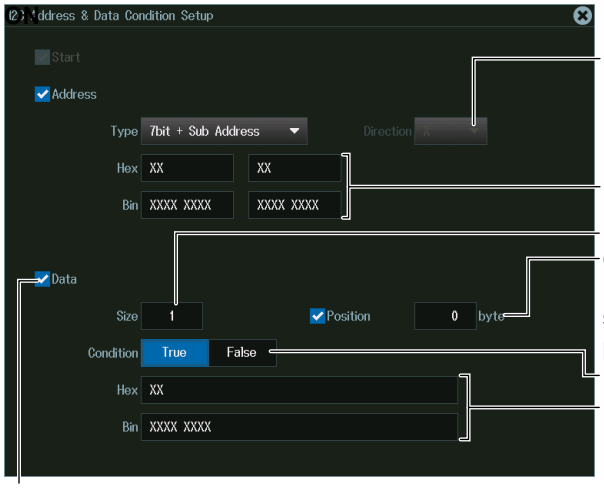
If you do not set the comparison start point, the data search condition is met when the input signal data pattern first matches the specified data pattern.

Comparison condition

Data pattern

Set the value of up to four consecutive bytes of data from the comparison start position as a search condition

When the Include R/W is set to



Read/Write bit state
(Display only as the address pattern contains an R/W bit)

Address pattern
(Set this including R/W bit.)

Data length

Comparison start position

If you do not set the comparison start point, the data search condition is met when the input signal data pattern first matches the specified data pattern.

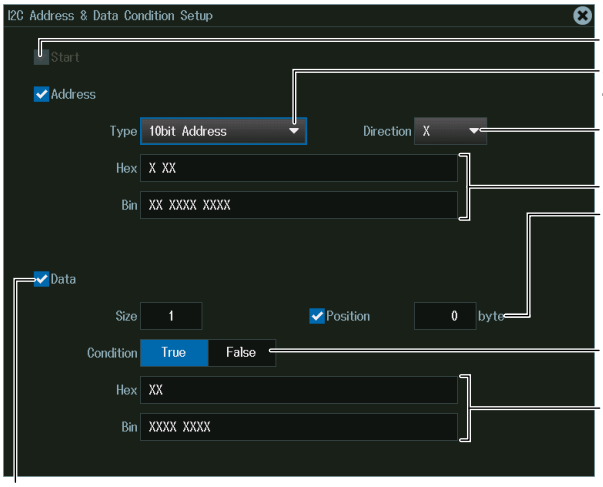
Comparison condition

Data pattern

Set the value of up to four consecutive bytes of data from the comparison start position as a search condition

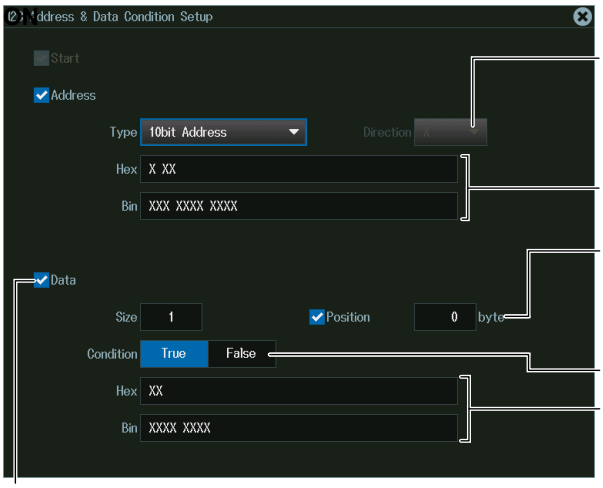
- **When Address Type Is 10bit Address**

When the Include R/W is set to OFF



Start (always selected)
Set the address type to 10bit Address.
Read/Write bit state
Address pattern
Comparison start position
If you do not set the comparison start point, the data search condition is met when the input signal data pattern first matches the specified data pattern.
Comparison condition
Data pattern
Set the value of up to four consecutive bytes of data from the comparison start position as a search condition

When the Include R/W is set to



Read/Write bit state
(Display only as the address pattern contains an R/W bit)
Address pattern
(Set this including R/W bit.)
Comparison start position
If you do not set the comparison start point, the data search condition is met when the input signal data pattern first matches the specified data pattern.
Comparison condition
Data pattern
Set the value of up to four consecutive bytes of data from the comparison start position as a search condition

NON ACK Mode

Press the **Mode** soft key and then the **NON ACK** soft key. The following menu appears.

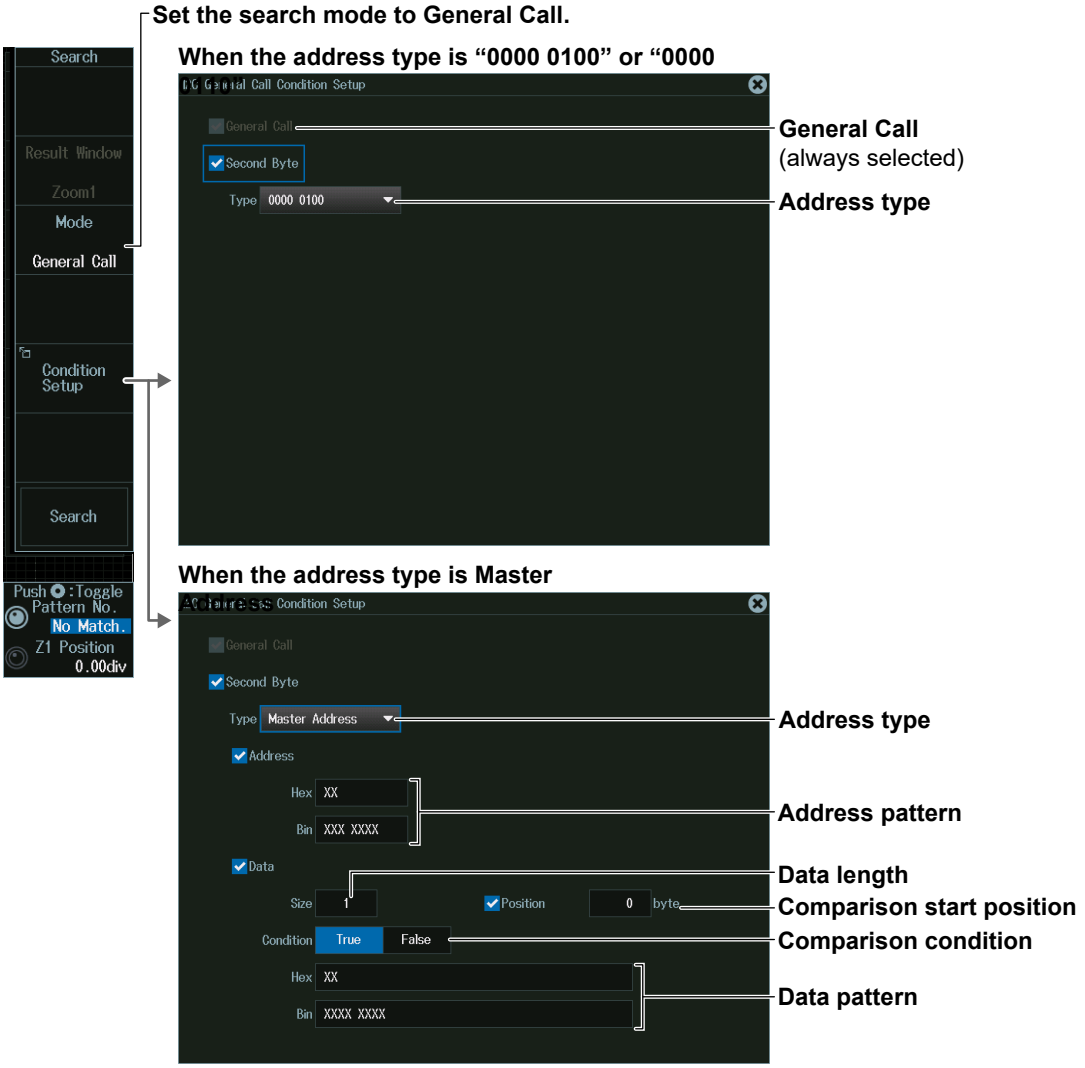
The instrument searches when the acknowledgment bit is Nack.



Set the search mode to NON ACK.

General Call Mode

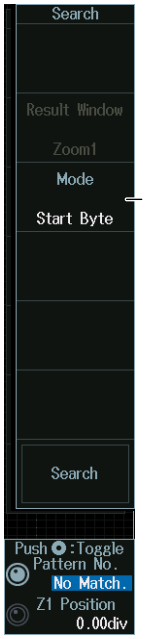
1. Press the **Mode** soft key and then the **General Call** soft key.
2. Press the **Condition Setup** soft key to display the following menu.
   When Second Byte is set to Master Address, the instrument triggers on the AND of the general call address (0000 0000), second byte address pattern, data pattern, and comparison start position conditions.
   Otherwise, the instrument searches on the AND of general call address (0000 0000) and Second Byte address pattern conditions. Items whose check boxes are selected are used as trigger conditions.



Start Byte Mode

Press the **Mode** soft key and then the **Start Byte** soft key to display the following menu.

The instrument searches when it detects the start byte master code.

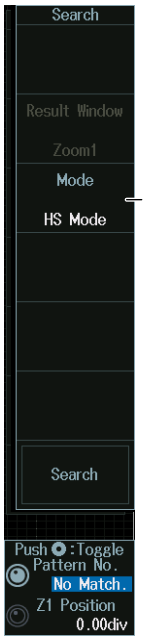


Set the search mode to Start Byte.

HS mode

Press the **Mode** soft key and then the **HS Mode** soft key to display the following menu.

The instrument searches when it detects a high speed mode master code.



Set the search mode to HS Mode.

Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



Detected point number

Zoom position

12.10 Analyzing and Searching SPI Bus Signals (Option)

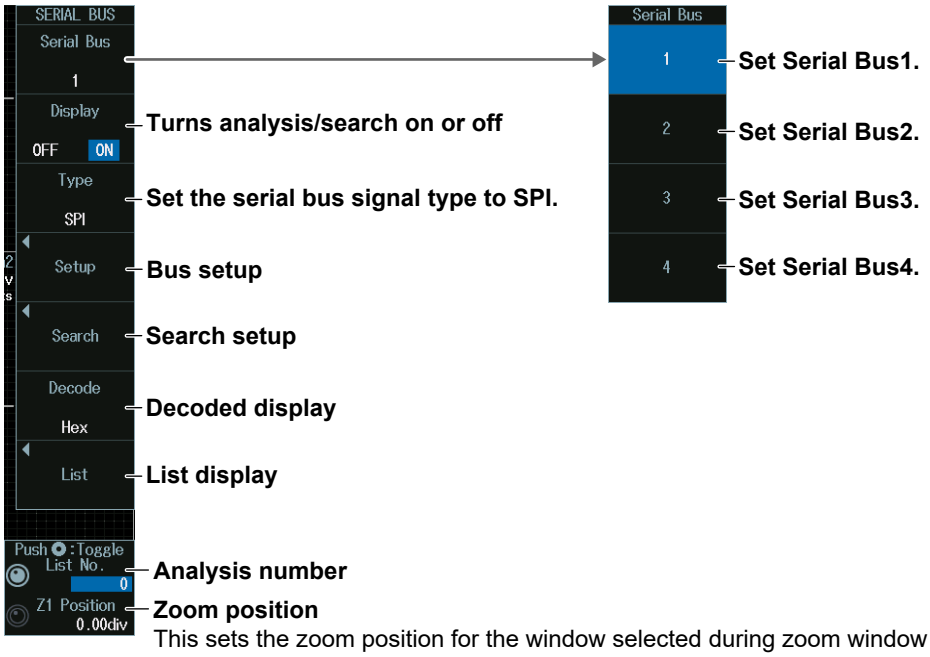
This section explains the following settings for analyzing or searching SPI bus signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Auto setup, wiring system, clock source, data source, chip select source, bit order
- Decoded display
- List display
  List size, display position, detailed display, and zoom linking
- Analysis and data numbers
- Zoom position
- Search settings
  Zoom window, search type, and search execution

► **"Analyzing and Searching Serial Bus Signals," "Analyzing and Searching SPI Bus Signals (Option)" in the Features Guide**

SERIAL BUS SPI Menu

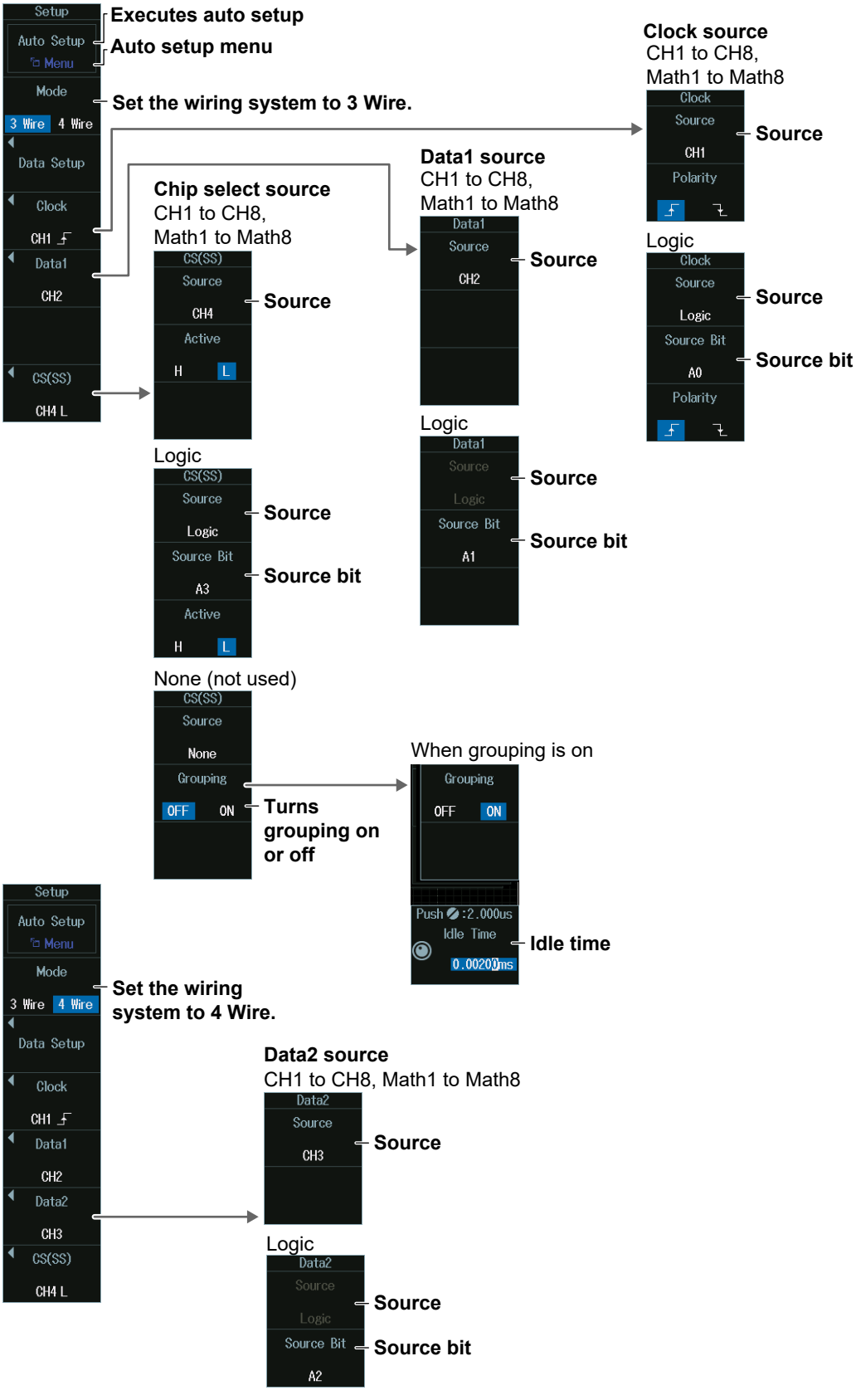
1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the Serial Bus soft key and select a number from 1 to 4.
2. Press the **Type** soft key. Select **SPI** from the setup menu that is displayed. The following menu appears.



Zoom position
This sets the zoom position for the window selected during zoom window configuration (described later).

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



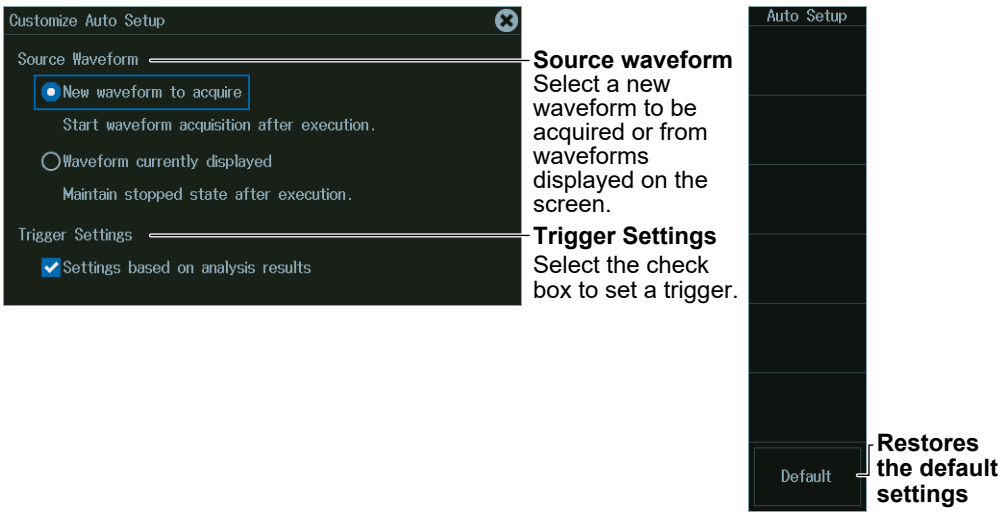
Executing Auto Setup (Auto Setup)

1. Set the wiring system and the clock, data, and chip select sources.
   You cannot use auto setup under the following circumstances.
   - When the clock, Data1, Data2, or chip select source is set to Math1 to Math8
   - When state display is applied to any of the Logic bits set as the clock, Data1, Data2, or chip select source
   - When the chip select source is set to None (Ignore)
2. If you set a source to Logic, set the source bit.
3. Press the **Auto Setup** soft key to execute auto setup.
   - The instrument automatically configures the level and hysteresis and then triggers on the SPI bus signal's first data byte. Triggers are not set if you unselect the Trigger Settings check box on the auto setup menu explained later.
   - While the serial bus is being configured, Auto Setup changes to Abort. If you want to stop, press the **Abort** soft key.

Auto Setup Menu (Menu)

You can set the analysis/search source waveform and select whether to set a trigger.

1. Press **SHIFT+F1**. The following screen and menu appear.
   You can also display them by pressing **SHIFT** and then the **Auto Setup** soft key.



2. Tap the screen to set the source waveform and trigger.
   - When waveform acquisition is in progress, the source waveform is fixed to a new waveform to be acquired.
   - If you clear the trigger setting check box, the trigger is not set even when auto setup is performed.
3. Press **ESC**. The menu returns to the bus setup menu.
   Press the **Auto Setup** soft key to execute auto setup. If you change the source waveform or the trigger setting from its default value, the soft key changes from Auto Setup to Auto Setup (Customized).

Note

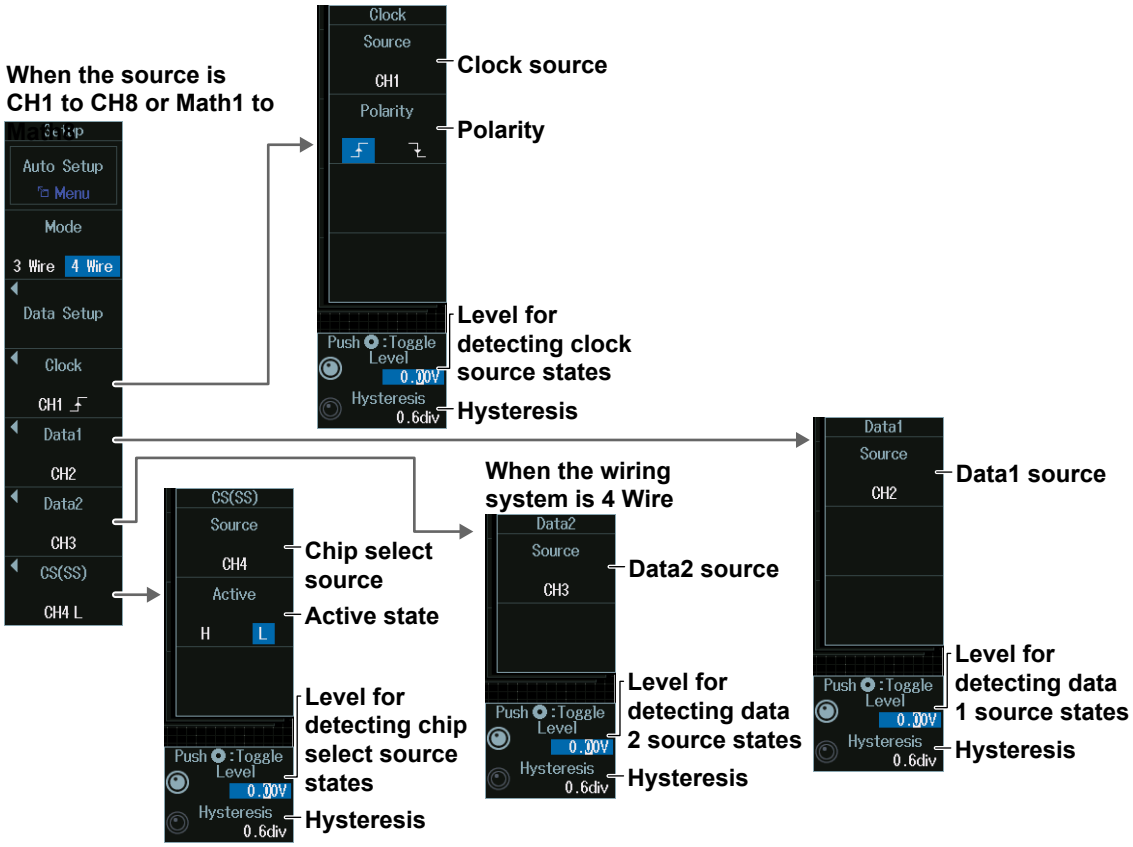
- The auto setup feature will not work properly on some input signals.
- The available source waveforms vary depending on the model.
  - The available settings on 8ch models are as follows:
    CH1 to CH8, Logic, Math1 to Math8
  - The available settings on 4ch models are as follows:
    CH1 to CH4, Logic, Math1 to Math4

Source Bit

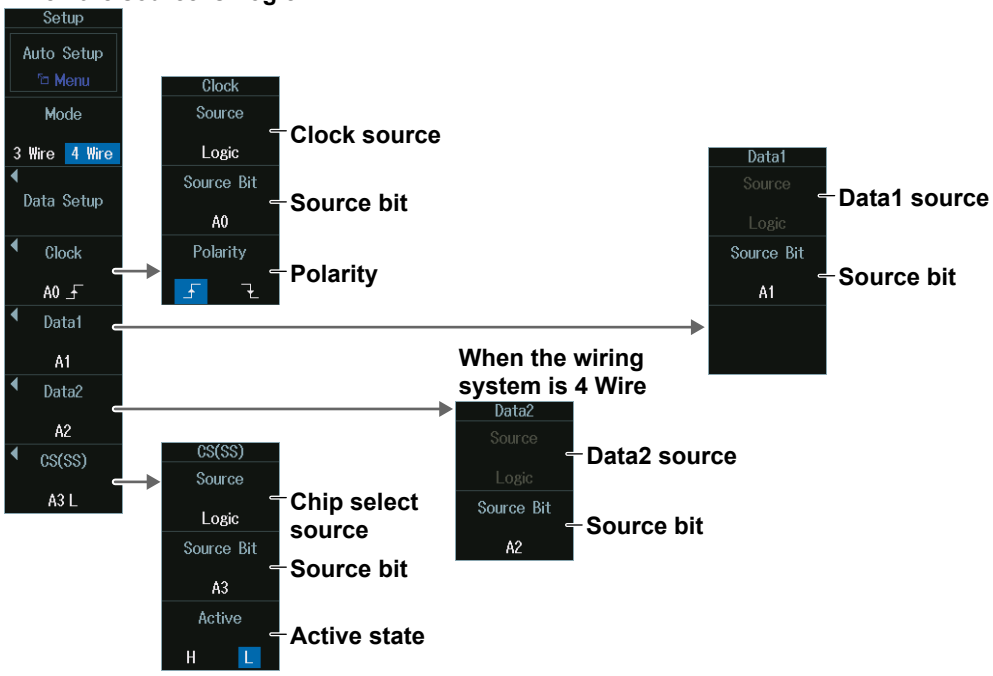
The following source bit display applies to models with the /L32 option.
C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

Manual Setup

Manually set the level, hysteresis, and bit order.

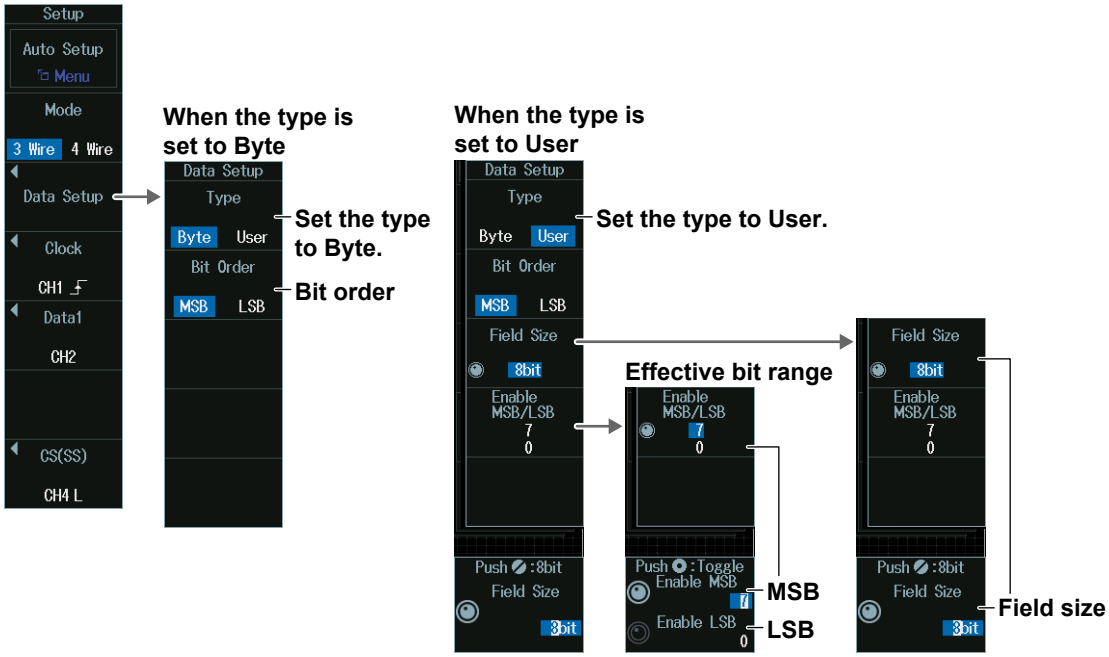


When the source is Logic



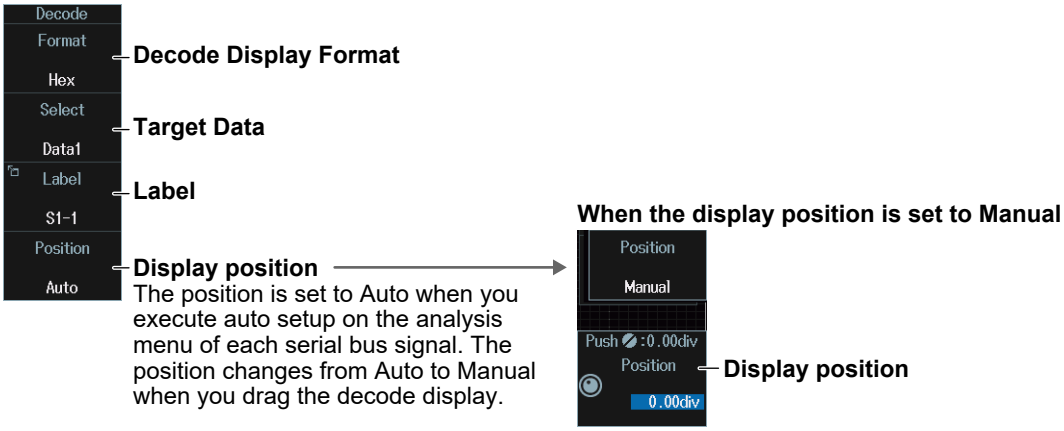
Setting the Data Format (Data Setup)

Press the Data Setup soft key to display the following menu.



Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

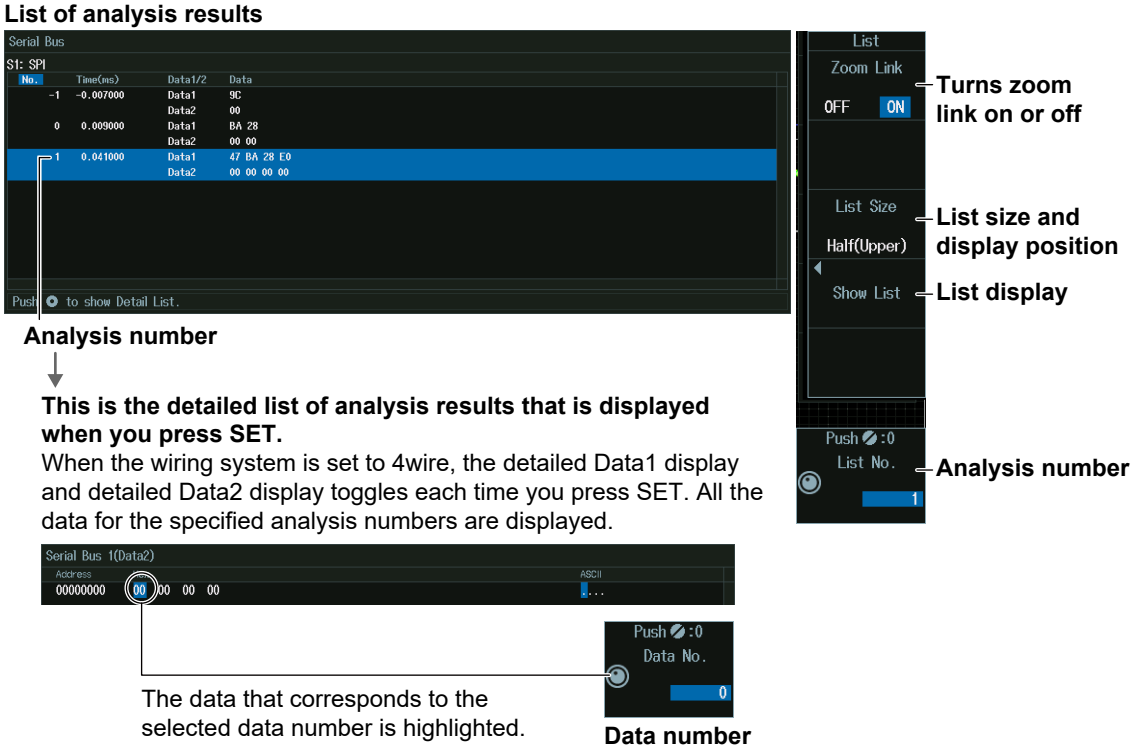
Jog shuttle setting menu



List Display (List)

1. Press the **Display** soft key, and turn on the analysis and search displays.
2. Press the **List** soft key and then the **Show List** soft key.
   - The list of analysis results and the next menu appear.
   - When the wiring system is set to 3 Wire, the contents of Data 1 are displayed in a list. When the wiring system is set to 4 Wire, the contents of Data 1 and Data 2 are displayed in a list.
   - If several display settings of Serial Bus 1 to 4 are on, all the lists of analysis results of the serial buses whose display setting is on are displayed. For details, see section 12.12.

List of analysis results



This is the detailed list of analysis results that is displayed when you press SET.
When the wiring system is set to 4wire, the detailed Data1 display and detailed Data2 display toggles each time you press SET. All the data for the specified analysis numbers are displayed.

Note

Analysis number

Data before the trigger position (on the left side of the waveform display) is assigned analysis numbers in descending order (–1, –2, and so on). Data after the trigger position (on the right side of the waveform display) is assigned analysis numbers in ascending order (0, 1, 2, and so on).

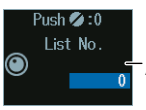
Analysis Number (List No.), Data Number (Data No.)

Turn the **jog shuttle** to set the analysis number (List No.) or data number (Data No.).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

When selecting from the list of analysis results



When selecting from the detailed display of the analysis results list (when SET is pressed)



Search Setup (Search)

Press the **Search** soft key to display the following menu.



Zoom window
You can configure zoom windows Zoom1 and Zoom2 when they are displayed.
Zoom1 is automatically displayed during the automatic setup of the analysis settings.

Search conditions

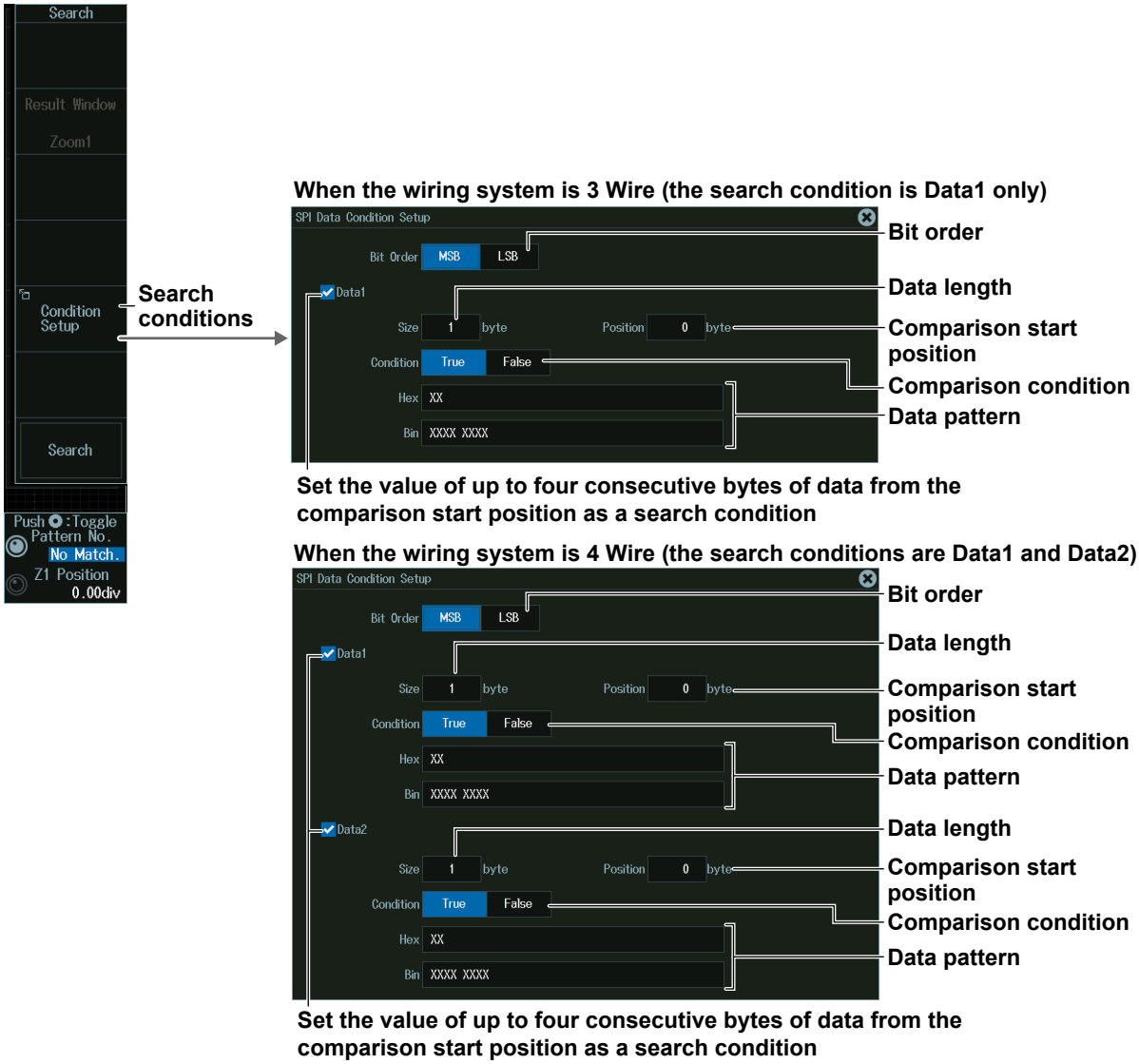
Executes the search
The instrument searches for the search conditions. If the instrument finds points that match the search conditions (detected points), it shows numbers (0, 1, 2, etc.) from the left of the waveform display in the order that the points were detected.

Detected point number

Zoom position

Search Conditions (Condition Setup)

Press the **Condition Setup** soft key to display the following menu.



Note

If the field size or effective bit range is set to a value other than the default value in the data format setting (Data Setup), the search conditions will change as follows:

- Setting of the data length (Size) will not be available.
- The setting range of the comparison start position (Position) will be 0 to 9999 fields.
- The number of bits in the data pattern (Hex/Bin) will be the number of bits (1 to 64 bits) in the data range set in the effective bit range.

Note that the default value of the field size is 8, and the default value of the effective bit range is 7 for MSB and 0 for LSB.

Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



Detected point number

Zoom position

12.11 Analyzing and Searching User-Defined Serial Bus Signals

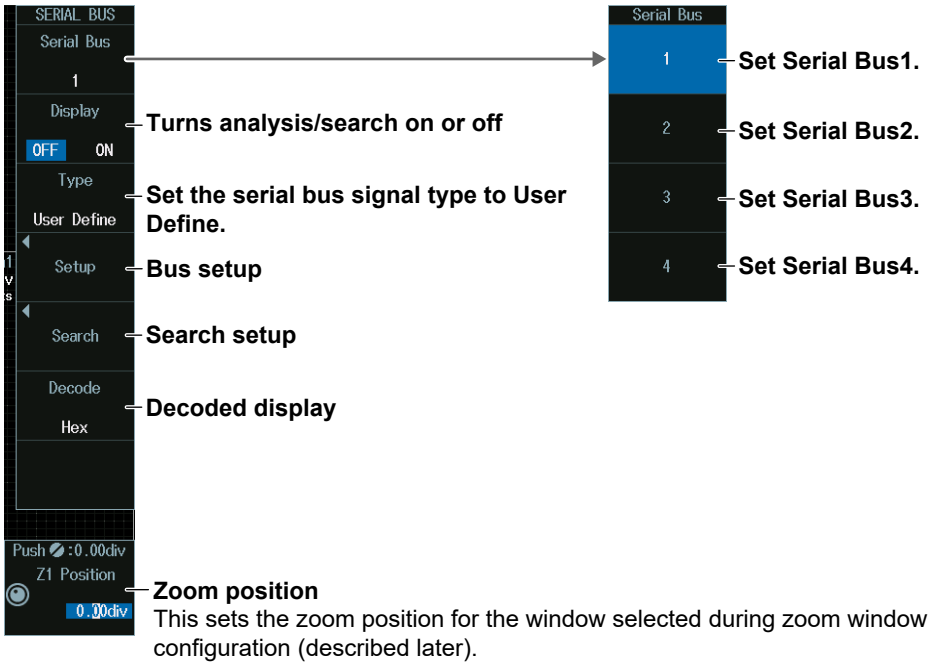
This section explains the following settings for analyzing or searching user-defined serial bus signals:

- Turning analysis and search displays on or off
- Serial bus signal types
- Bus setup
  Data source, bit rate, decoding start point, clock source, enable source, latch source
- Decoded display
- Zoom position
- Search settings
  Zoom window, search type, and search execution

► **"Analyzing and Searching Serial Bus Signals," "Analyzing and Searching User-Defined Serial Bus Signals (User Define)" in the Features Guide**

SERIAL BUS User Define Menu

1. Press **SHIFT+SEARCH** (SERIAL BUS) to display the SERIAL BUS menu.
   - You can also tap **MENU** (MENU) in the upper left of the screen and select the SERIAL BUS menu from ANALYSIS on the top menu that is displayed.
   - You can also press **ANALYSIS** and then the **To SERIAL BUS** soft key to display the SERIAL BUS menu.
   - The instrument can analyze and search up to four serial bus signals. To switch to the setup menu, press the Serial Bus soft key and select a number from 1 to 4.
2. Press the **Type** soft key. From the setup menu that appears, select **User Define** to display the following menu.



Zoom position
This sets the zoom position for the window selected during zoom window configuration (described later).

Zoom Position (Z1 Position or Z2 Position)

Turn the **jog shuttle** to set the zoom position (Z1 Position or Z2 Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

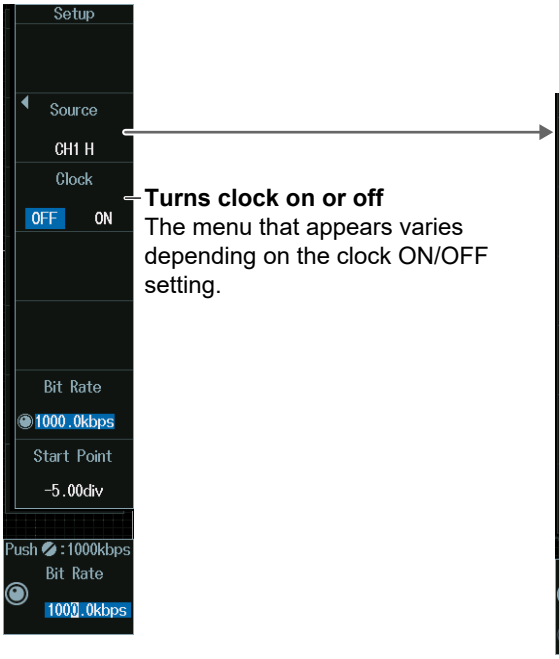
Jog shuttle setting menu



Zoom position

Bus Setup (Setup)

Press the **Setup** soft key to display the following menu.



Turns clock on or off
The menu that appears varies depending on the clock ON/OFF setting.

Set the data source state to be recognized as 1

Level for detecting data source states

Hysteresis

Level for Detecting Data Source States (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



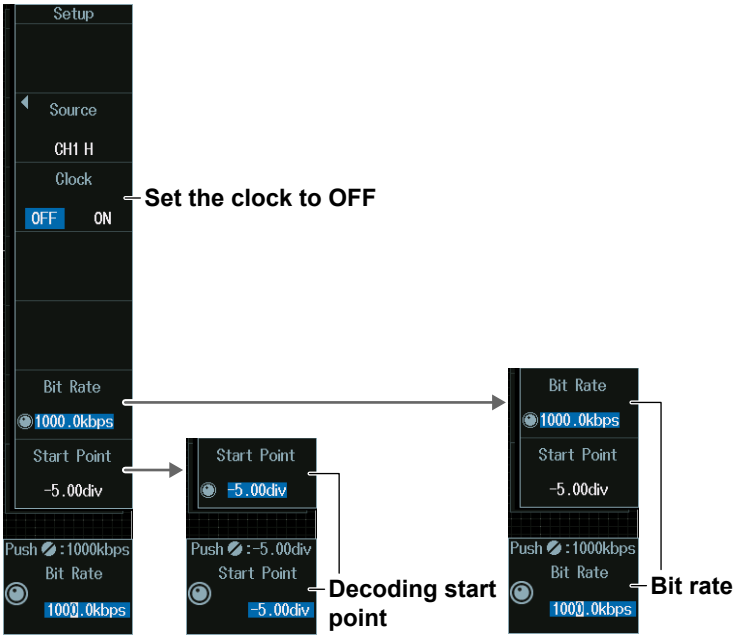
Level for detecting data source states

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

When Not Using the Clock (OFF)

Press the **Clock** soft key to select OFF. The following menu appears.



Decoding Start Point (Start Point)

Turn the **jog shuttle** to set the decoding start point.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

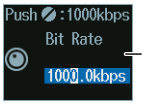


Bit Rate (Bit Rate)

Turn the **jog shuttle** to set the bit rate.

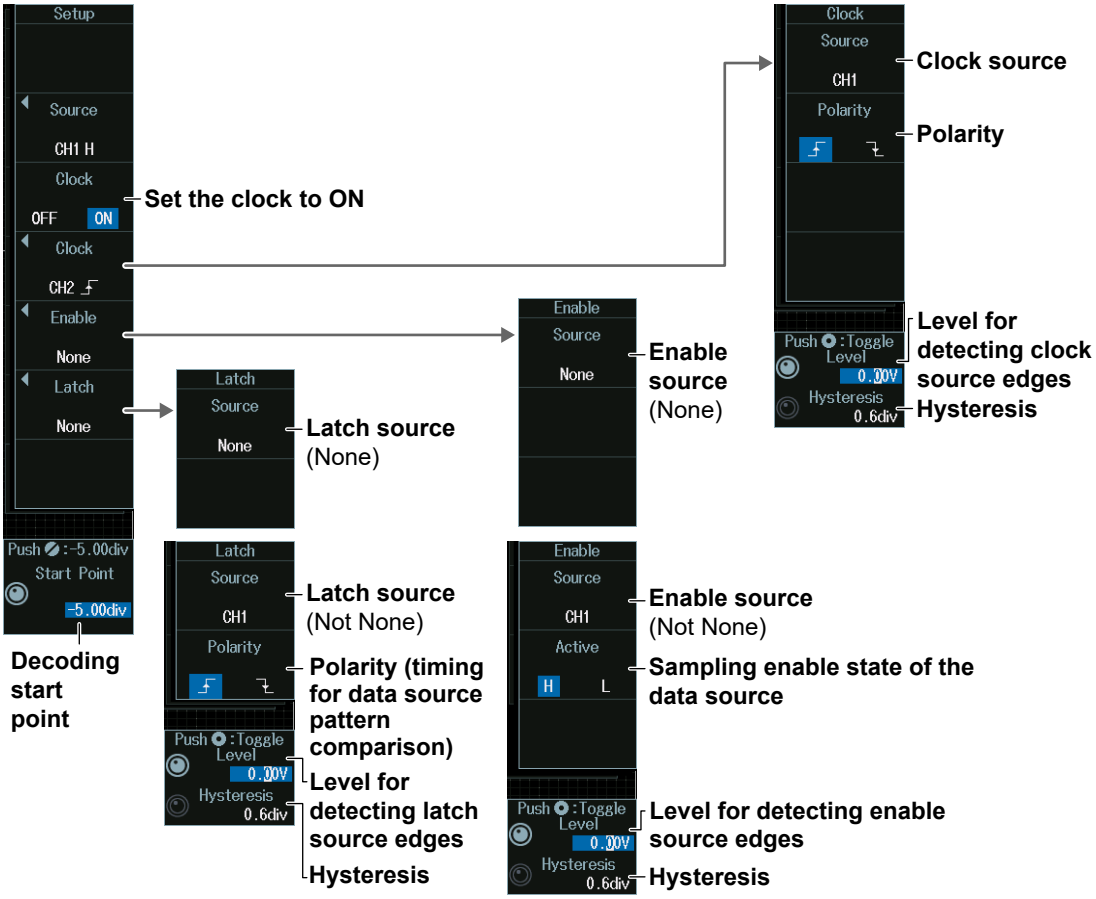
You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



When Using the Clock (ON)

Press the **Clock** soft key to select ON. The following menu appears.



Level for Detecting Clock Source Edges (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Press SET (upper right on the front panel) to switch between level and hysteresis.

Note

Clock Source Polarity

Specify which clock source edge causes the data source to be sampled.

Level for Detecting Enable Source Edges (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting enable source edges

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

Note

Enable Source State

When the data source is sampled in sync with the clock source, the period for which data source sampling is enabled is controlled using the enable source.

Level for Detecting Latch Source Edges (Level, Hysteresis)

Turn the **jog shuttle** to set the level or hysteresis.

- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
- To set the level, you can drag the level display line on the screen.

Jog shuttle setting menu



Level for detecting latch source edges

Hysteresis

Press SET (upper right on the front panel) to switch between level and hysteresis.

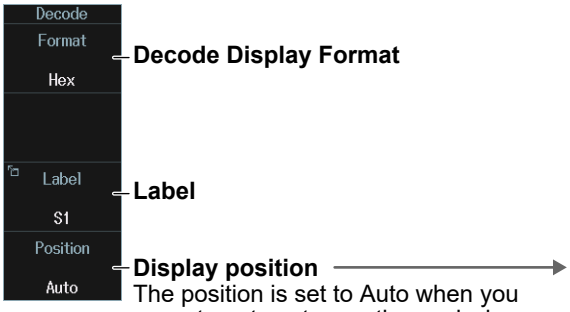
Note

Latch Source Polarity

Specify the timing at which the data source pattern sampled in sync with the clock source is latched. The latched data pattern is compared to the pattern specified for the search condition.

Decoded Display (Decode)

Press the **Decode** soft key. The following menu items appear.



Decode Display Format

Label

Display position

The position is set to Auto when you execute auto setup on the analysis menu of each serial bus signal. The position changes from Auto to Manual when you drag the decode display.

When the display position is set to Manual



Display position

Display Position (Position)

When the display position is set to Manual, turn the **jog shuttle** to set the display position (Position).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Display position

Search Setup (Search)

Press the **Search** soft key to display the following menu.



Zoom window
You can configure zoom windows Zoom1 and Zoom2 when they are displayed.
Zoom1 is automatically displayed during the automatic setup of the analysis settings.

Search conditions

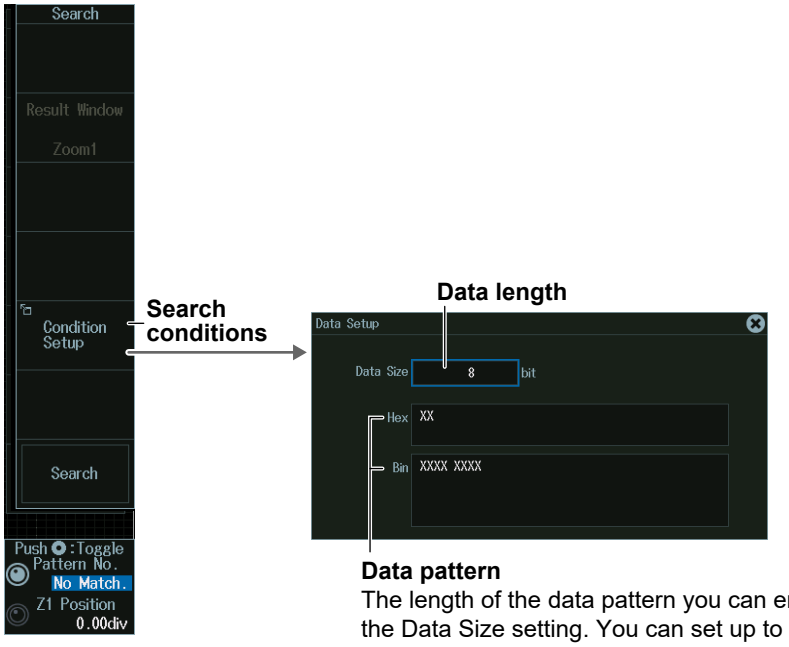
Executes the search
The instrument searches for the search conditions. If the instrument finds points that match the search conditions (detected points), it shows numbers (0, 1, 2, etc.) from the left of the waveform display in the order that the points were detected.

Detected point number

Zoom position

Search Conditions (Condition Setup)

Press the **Condition Setup** soft key to display the following menu.



Data pattern
The length of the data pattern you can enter is determined by the Data Size setting. You can set up to 128 bits.

Detected Point Number and Zoom Position (Pattern No. /Z1 Position or Z2 Position)

1. Execute a search. Check that a location matching the search conditions is found.
2. Turn the **jog shuttle** to set the detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.
   - Press **SET** (upper right on the front panel) to switch between detected point number (Pattern No.) and zoom position (Z1 Position or Z2 Position).

Jog shuttle setting menu



Detected point number

Zoom position

12.12 Displaying Multiple Lists

This section explains how to list the decoded results of multiple serial bus signals simultaneously.

► “Analyzing and Searching Serial Bus Signals,” “List Display (List)” in the Features Guide

Selecting Each Serial Bus Signal

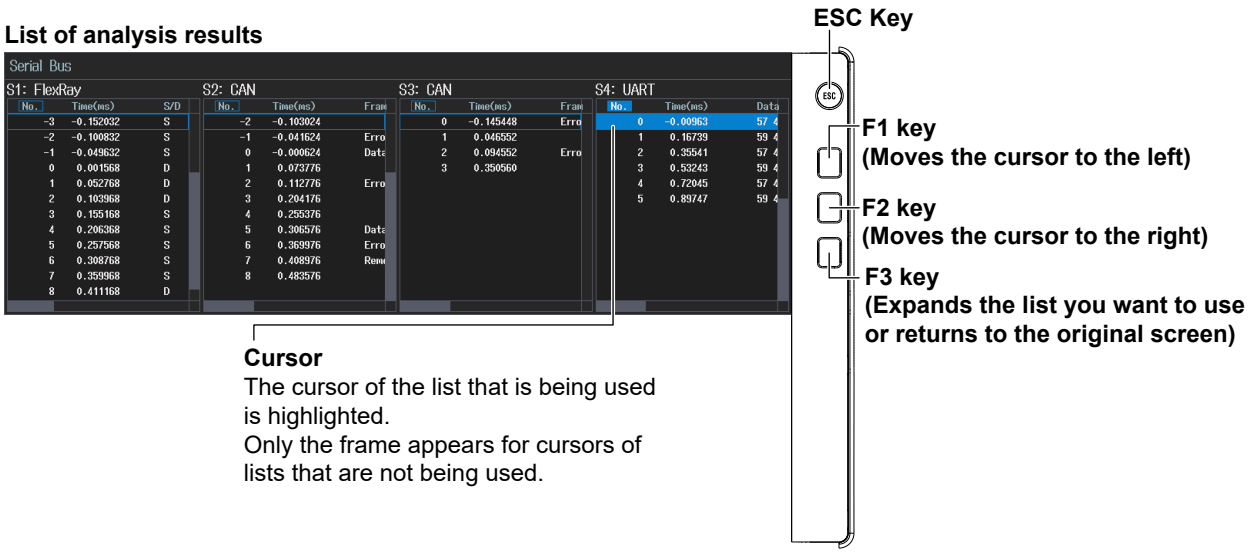
1. Select the serial bus signal number from **Serial Bus1** to **Serial Bus4**.
2. Press the **Type** soft key to select the serial bus signal type.
   For instructions on how to set up serial bus signals, see sections 12.1 to 12.11.
3. Press the **Display** soft key to select ON.
   The analysis results of the serial bus signals that are turned on are displayed in the list at step 4.

Showing the List of Analysis Results (List)

4. Press the **List** or **List/Trend** soft key and then the **Show List** soft key.
   - The soft key names differ depending on the type of serial bus signal.
   - The list of serial bus signals cannot be displayed if the analysis in search display (Display) is turned off.

Example:

When List Size is set to Half(Upper), and the serial bus signal types are set as follows
Serial Bus1 (S1): FlexRay, Serial Bus2 (S2): CAN, Serial Bus3 (S3): CAN, Serial Bus4 (S4): UART



13.1 Displaying Waveform Histograms

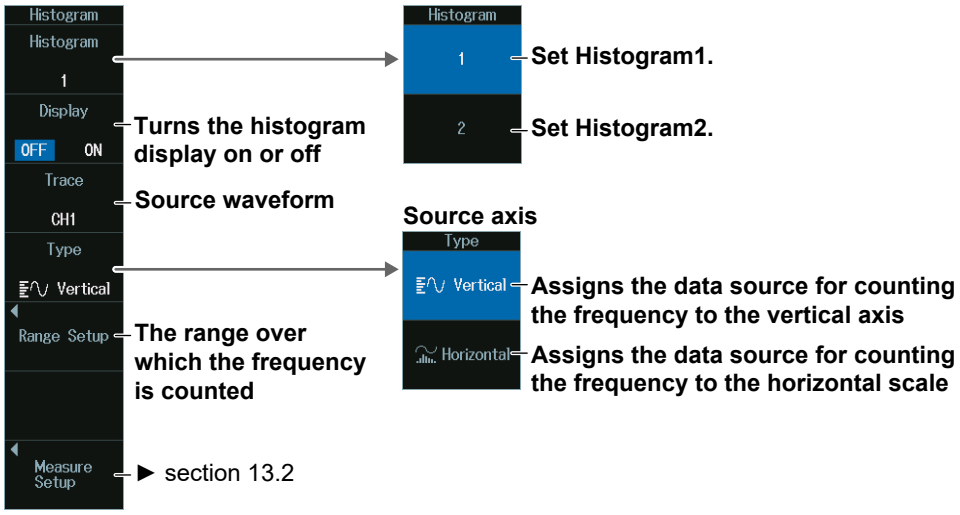
This section explains the following settings for displaying a histogram of the frequency of data occurrence in a specified area:

- Turning the histogram on or off
- Source waveform
- Source axis
- The range over which the frequency is counted

► "Waveform Histogram Display" in the Features Guide

ANALYSIS Histogram Menu

1. Press **ANALYSIS** to display the ANALYSIS menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ANALYSIS menu from ANALYSIS on the top menu that is displayed.
2. Press the **Histogram** soft key to display the following menu.
   Up to two histograms can be displayed. To switch the setup menu, press the Histogram soft key.



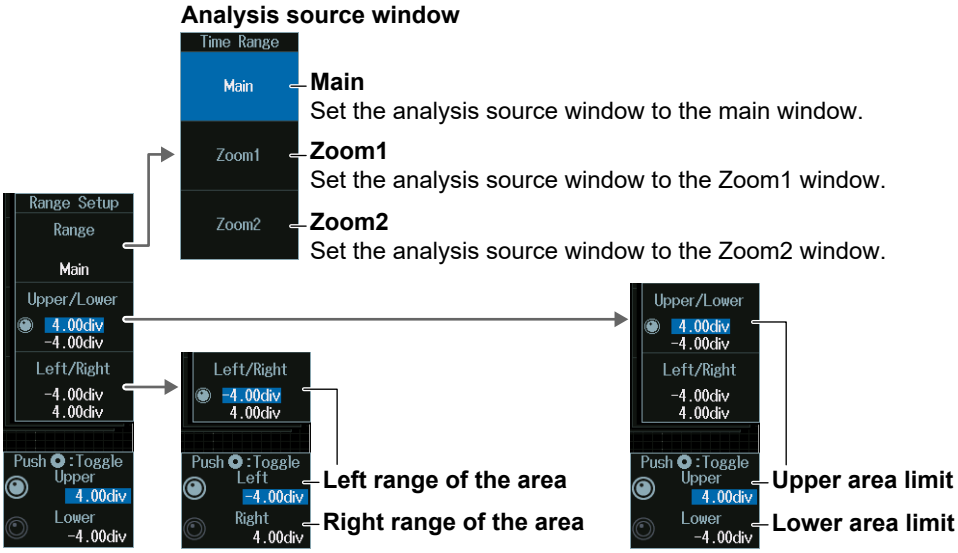
Note

The available display source waveform settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8
- The available settings on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4

Range over Which to Count the Frequency (Range Setup)

Press the **Range Setup** soft key to display the following menu.



Upper and Lower Range Limits (Upper/Lower)

1. Press the **Upper/Lower** soft key.
2. Turn the **jog shuttle** to set the upper range limit (Upper) or lower range limit (Lower).
   - Press **SET** (upper right on the front panel) to switch between upper and lower range limits.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Left and Right Range Limits (Left/Right)

1. Press the **Left/Right** soft key.
2. Turn the **jog shuttle** to set the left range limit (Left) or right range limit (Right).
   - Press **SET** (upper right on the front panel) to switch between left and right range limits.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



13.2 Measuring Histogram Parameters

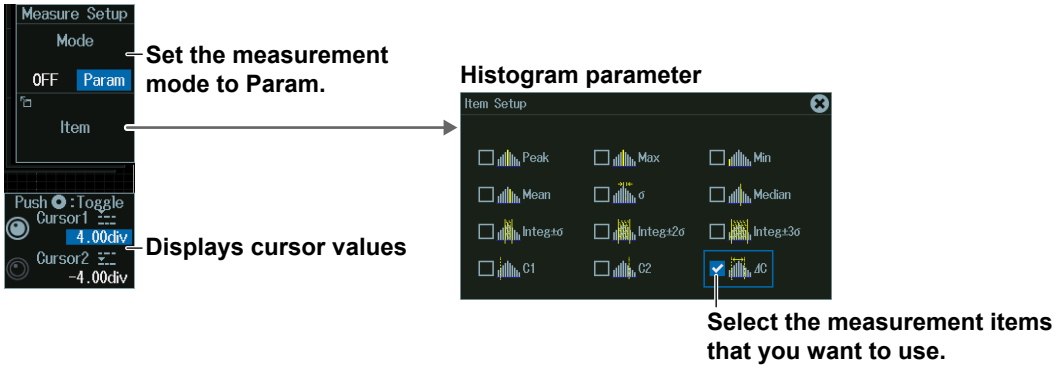
This section explains the following settings for measuring histogram parameters:

- Measurement mode
- Measurement items
- Cursor measurement

► “Measurement (Measure Setup)” in the Features Guide

ANALYSIS Histogram Measure Setup Menu

1. Press **ANALYSIS** to display the ANALYSIS menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ANALYSIS menu from ANALYSIS on the top menu that is displayed.
2. Press **Histogram** and then the **Measure Setup** soft key to display the following menu.

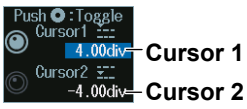


Displaying Cursor Values (Cursor1/Cursor2)

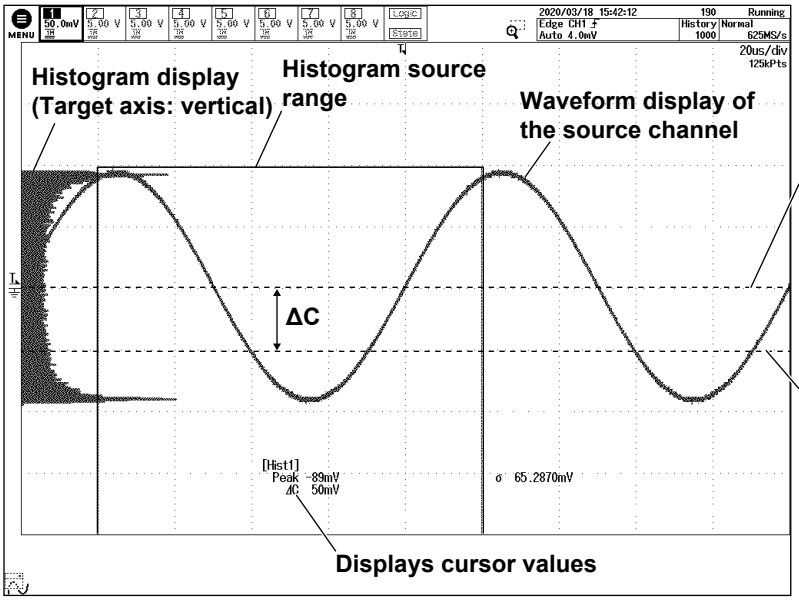
Turn the **jog shuttle** to set cursor 1 (Cursor1) or cursor 2 (Cursor2).

- Press **SET** (upper right on the front panel) to switch between cursor 1 and cursor 2.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Histogram Parameter Measurement



Cursor 1
The position when the item is set to C1. When the item is set to ΔC, the position is on the C1 side.

Cursor 2
The position when the item is set to C2. When the item is set to ΔC, the position is on the C2 side.

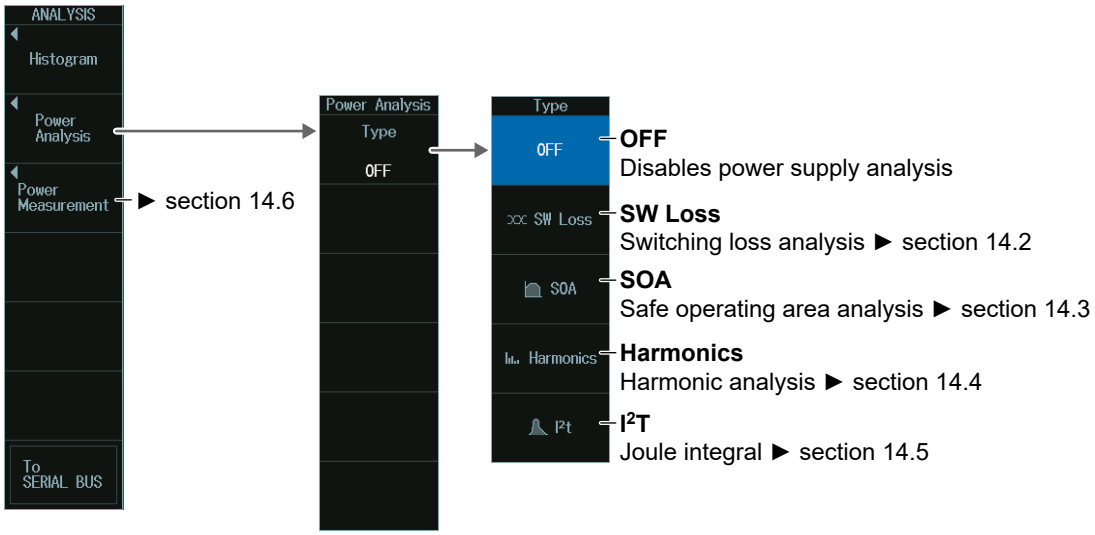
14.1 Power Supply Analysis Types

This section explains how to set the power supply analysis type.

► "Power Supply Analysis" in the Features Guide

ANALYSIS Power Analysis Menu

1. Press **ANALYSIS** to display the ANALYSIS menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ANALYSIS menu from ANALYSIS on the top menu that is displayed.
2. Press the **Power Analysis** soft key to display the following menu.



Note

Power supply analysis and power measurement of the power supply analysis feature cannot be executed simultaneously.

- On 8ch models, if any of the power measurement items, Power Measurement1 to Power Measurement4, is set to ON, the power supply analysis is set to OFF. If power supply analysis is set to something other than OFF, all power measurements are set to OFF.
- On 4ch models, if any of the power measurement items, Power Measurement1 to Power Measurement2, is set to ON, the power supply analysis is set to OFF. If power supply analysis is set to something other than OFF, all power measurements are set to OFF.

14.2 Analyzing Switching Loss

This section explains the following settings for analyzing switching loss:

- Probe
- Measurement content
  Loss type, level setup, reference levels for voltage channels, measurement items, turning measurement location indicator on or off, statistical processing, measurement source window, measurement range
- Turning power trace display on or off
- Scaling
- Center point and sensitivity

► **"Switching Loss Analysis (SW Loss)" in the Features Guide**

ANALYSIS Power Analysis Menu

1. Press **ANALYSIS** to display the ANALYSIS menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ANALYSIS menu from ANALYSIS on the top menu that is displayed.
2. Press the **Power Analysis** soft key, the **Type** soft key, and then the **SW Loss** soft key to display the following menu.



Set Type to SW Loss.

Probe

Measurement content

Turns the power waveform display on or off

Scaling ►section 6.6

Center point

Sensitivity

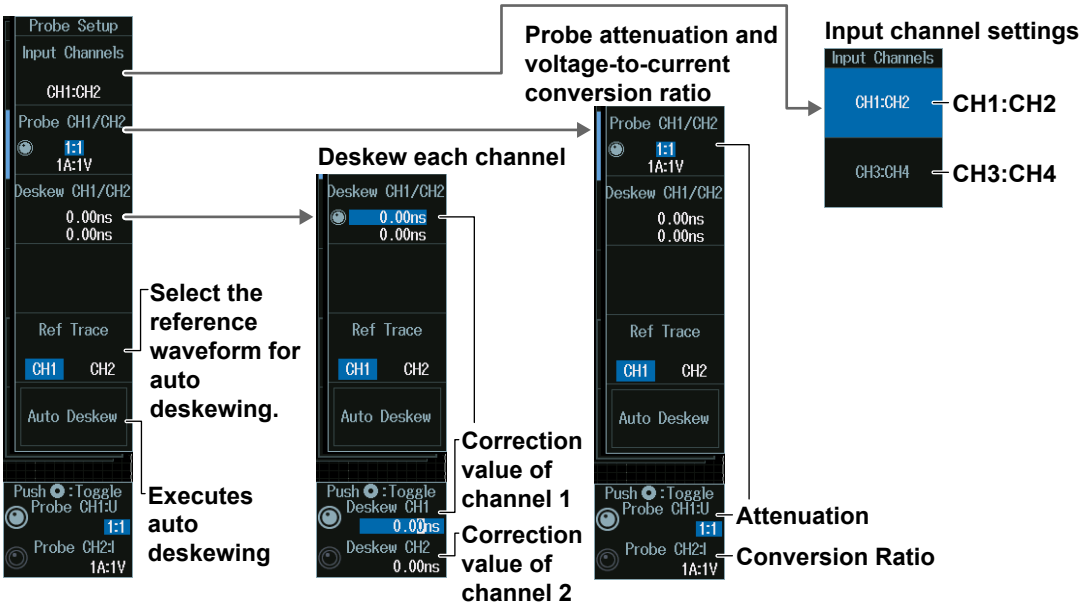
Set this when the scaling mode is Manual.

Note

- If you set the power supply analysis type to SW Loss, automated measurement of waveform parameters is enabled. The measured values from the measurement items set on the MEASURE menu and the switching loss measurement items are displayed on the screen. A maximum of 30 measurement items can be displayed. If measured switching loss values are not displayed, reduce the number of MEASURE menu measurement items.
  ► section 9.1
- If you set the power supply analysis type (Type) to SW Loss, the cycle mode (Cycle Mode) on the Item Setup screen (page 9-2) on the MEASURE menu is fixed to SW Loss.
- If the power waveform display is turned on, the operator (Operation) of the computation/reference waveform (MATH/REF menu) is fixed to Power, and other operators cannot be used.

Probe (Probe Setup)

Press the **Probe Setup** soft key to display the following menu.



Probe Attenuation Ratio and Voltage-to-Current Conversion Ratio (Probe CH1/CH2 or Probe CH3/CH4)

1. Press the **Probe CH1/CH2** or **Probe CH3/CH4** soft key.
2. Turn the **jog shuttle** to set the attenuation ratio (Probe CH1:U, Probe CH3:U) or conversion ratio (Probe CH2:I, Probe CH4:I).

- Press **SET** (upper right on the front panel) to switch between attenuation ratio and conversion ratio.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



The channel number display varies depending on the input channel selection.

Deskewing Each Channel (Deskew CH1/CH2)

1. Press the **Deskew CH1/CH2** or **Deskew CH3/CH4** soft key.
2. Turn the **jog shuttle** to set the correction value of channels 1 and 3 (Deskew CH1/CH3) or channels 2 and 4 (Deskew CH2/CH3).

- Press **SET** (upper right on the front panel) to switch between the correction value of channel 1 or channel 2.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

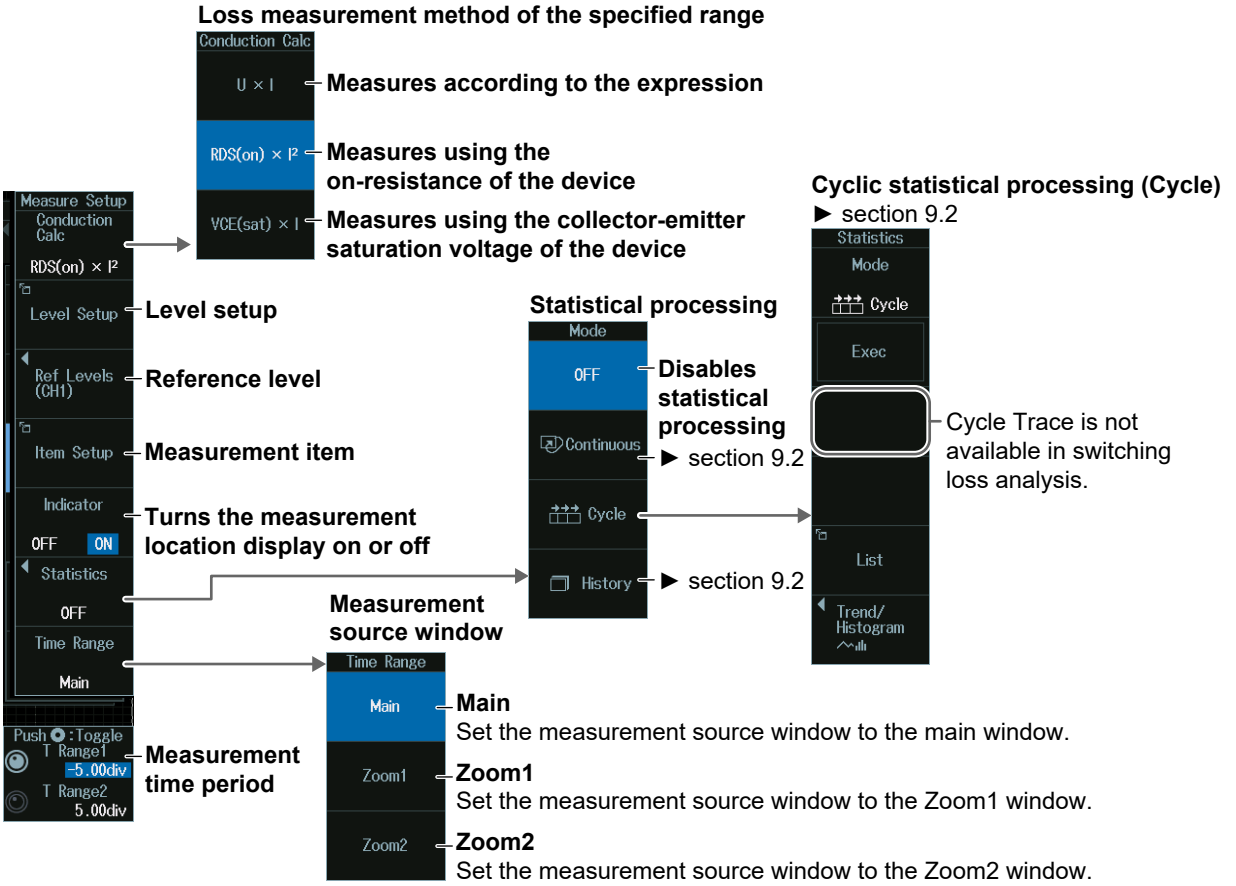
Jog shuttle setting menu



The channel number display varies depending on the input channel selection.

Measurement Setup (Measure Setup)

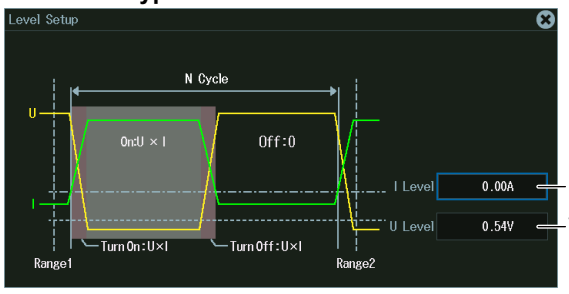
Press the **Measure Setup** soft key to display the following menu.



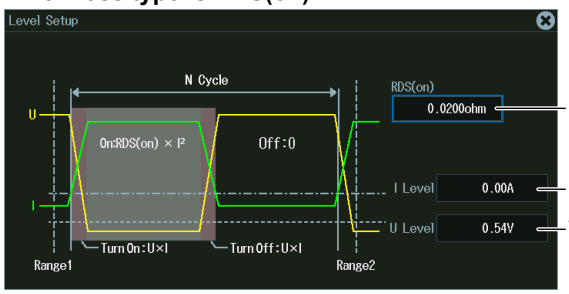
Level Setup (Level Setup)

Press the **Level Setup** soft key to display the following screen.

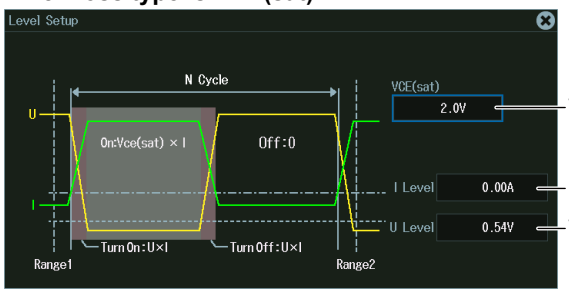
When loss type is U×I



When loss type is RDS(on)×I²



When loss type is VCE(sat)×I



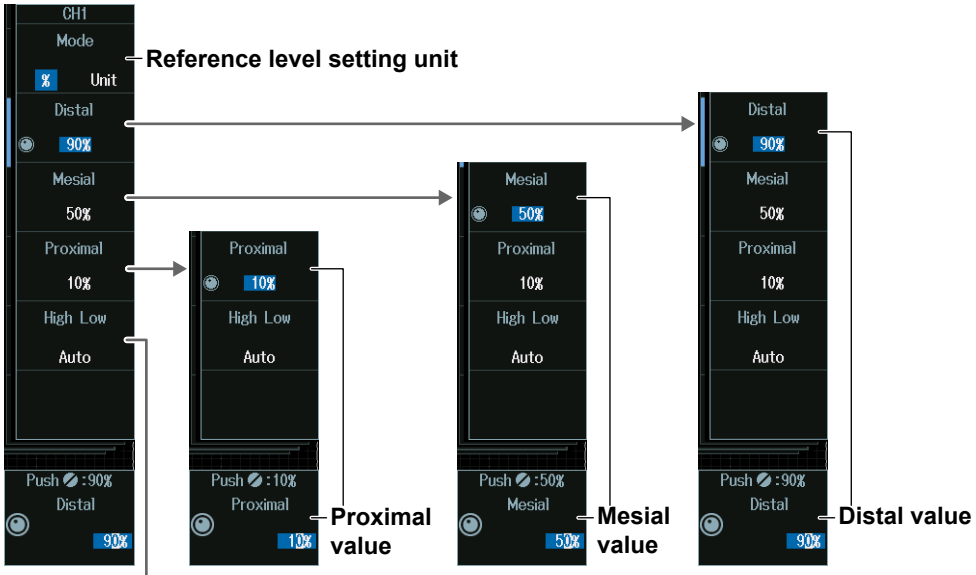
VCE (sat) value

Current level

Voltage level

Reference Levels (Ref Levels)

Press the **Ref Levels** soft key to display the following menu.



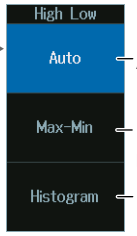
Reference level setting unit

Proximal value

Mesial value

Distal value

How to determine the high and low values



Automatically take into account the effects of ringing and spikes

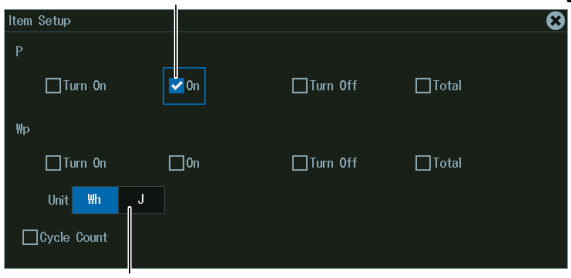
Use the maximum and minimum values in the measurement range

Make the maximum frequent values the maximum and minimum values

Measurement Items (Item Setup)

Press the **Item Setup** soft key to display the following menu.

Select the measurement items that you want to use.



Power unit

Measurement Time Period (T Range1/T Range2)

Turn the **jog shuttle** to set the measurement start point (T Range1) or measurement end point (T Range2).

- Press **SET** (upper right on the front panel) to switch between measurement start point or measurement end point.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Measurement start point

Measurement end point

14.3 Performing Safe Operating Area Analysis

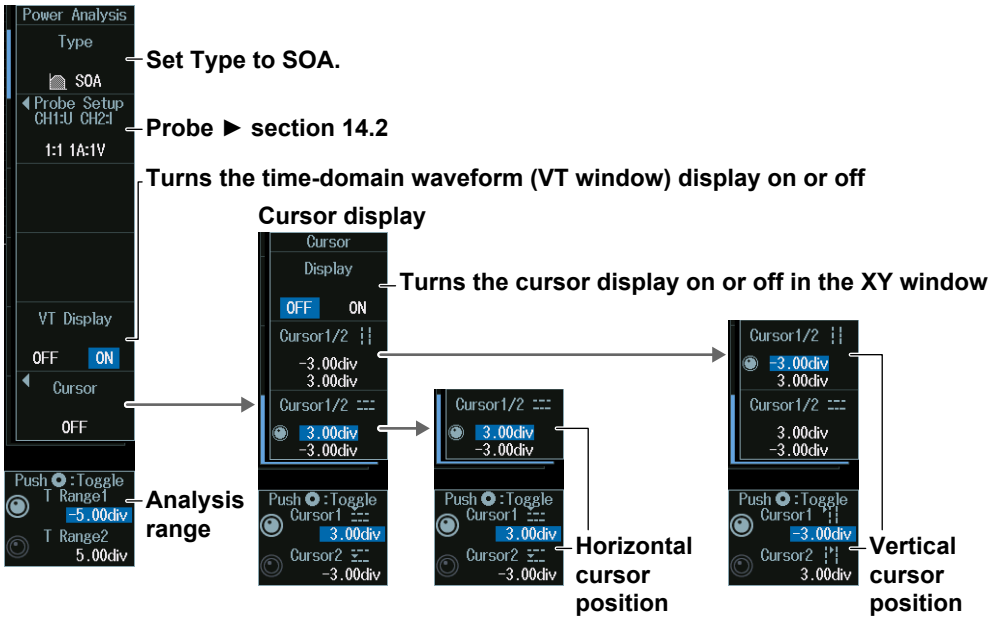
The instrument can display the safe operating area of power by plotting the voltage signal input channel and current input signal channel on the XY waveform display. This section explains the following settings for performing safe operating area analysis:

- Probe
- Turning the VT waveform display on or off
- Cursor display
- Measurement range

► "Safe Operating Area Analysis (SOA)" in the Features Guide

ANALYSIS Power Analysis Menu

1. Press **ANALYSIS** to display the ANALYSIS menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ANALYSIS menu from ANALYSIS on the top menu that is displayed.
2. Press the **Power Analysis** soft key, the **Type** soft key, and then the **SOA** soft key to display the following menu.



Note

If you set the power supply analysis type to SOA, XY waveforms are automatically displayed on the screen.

Displaying the VT Waveforms (VT Display)

Press the **VT Display** soft key to show or hide time-domain waveforms.

Analysis Range (T Range1/T Range2)

Turn the **jog shuttle** to set the analysis start point (T Range1) or analysis end point (T Range2).

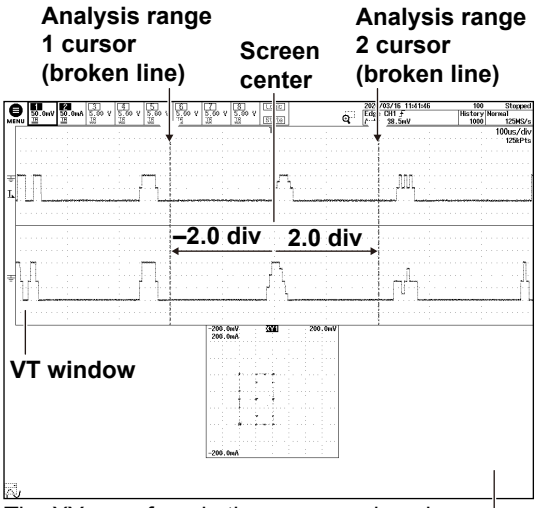
- Press **SET** (upper right on the front panel) to switch between analysis start point or analysis end point.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Time-Domain Waveform (VT Window) Display and Analysis Range

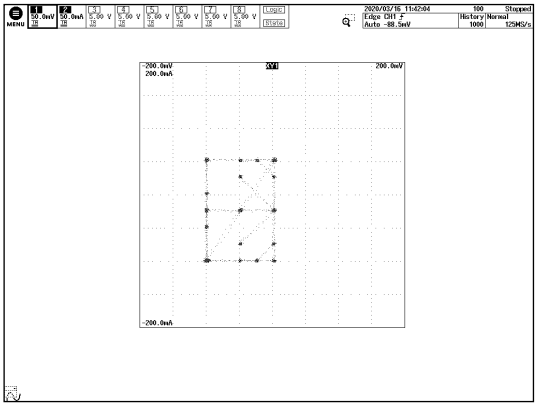
• When the VT window is shown



The XY waveform in the range enclosed by the analysis range cursor on the VT window is displayed.

XY window

• When the VT window is hidden



Vertical Cursor Positions (Cursor1/Cursor2)

1. Press the **Cursor** soft key.
2. Press the **Cursor1/2** soft key.
3. Turn the **jog shuttle** to set vertical cursor 1 (Cursor1) or vertical cursor 2 (Cursor2).
   - Press **SET** (upper right on the front panel) to switch between vertical cursor 1 and vertical cursor 2.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Vertical cursor 1 position

Vertical cursor 2 position

Note

Setting the Vertical Cursor Positions

If you press SET several times and make the jog shuttle control both vertical cursor 1 and vertical cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen.

Horizontal Cursor Position (Cursor1/Cursor2)

1. Press the **Cursor** soft key.
2. Press the **Cursor1/2** soft key.
3. Turn the **jog shuttle** to set horizontal cursor 1 (Cursor1) or horizontal cursor 2 (Cursor2).
   - Press **SET** (upper right on the front panel) to switch between horizontal cursor 1 and horizontal cursor 2.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Horizontal cursor 1 position

Horizontal cursor 2 position

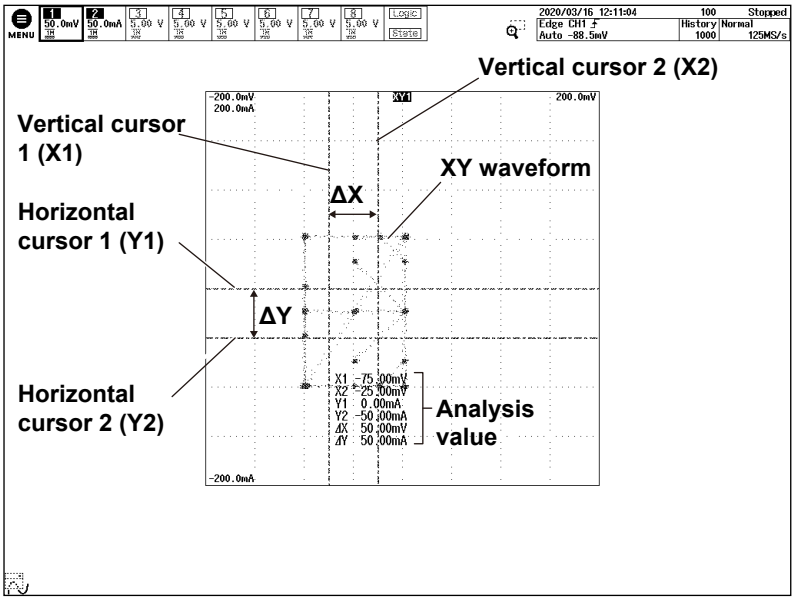
Note

Setting the Horizontal Cursor Positions

If you press SET several times and make the jog shuttle control both horizontal cursor 1 and horizontal cursor 2, you can move them together.

When you move the two cursors together, the cursors no longer move when one of the cursors reaches the edge of the screen.

Safe Operating Area Analysis (Cursor Display)



14.4 Performing Harmonic Analysis

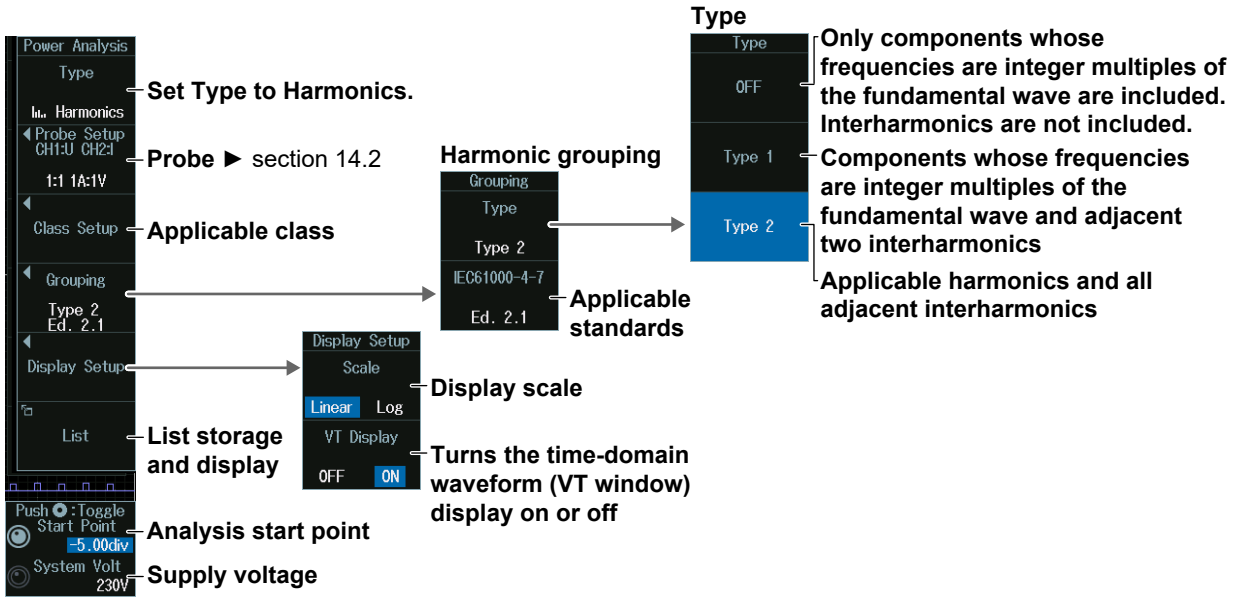
This section explains the following settings for performing harmonic analysis:

- Probe
- Applicable class
- Harmonic grouping
- Display setup
- List storage and display
  List storage, list size, and display position
- Analysis start point
- EUT's power supply voltage

► "Harmonic Analysis (Harmonics)" in the Features Guide

ANALYSIS Power Analysis Menu

1. Press **ANALYSIS** to display the ANALYSIS menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ANALYSIS menu from ANALYSIS on the top menu that is displayed.
2. Press the **Power Analysis** soft key, the **Type** soft key, and then the **Harmonics** soft key to display the following menu.

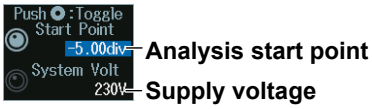


Analysis Start Point and Supply Voltage (Start Point/System Volt)

Turn the **jog shuttle** to set the analysis start point (Start Point) or supply voltage (System Volt).

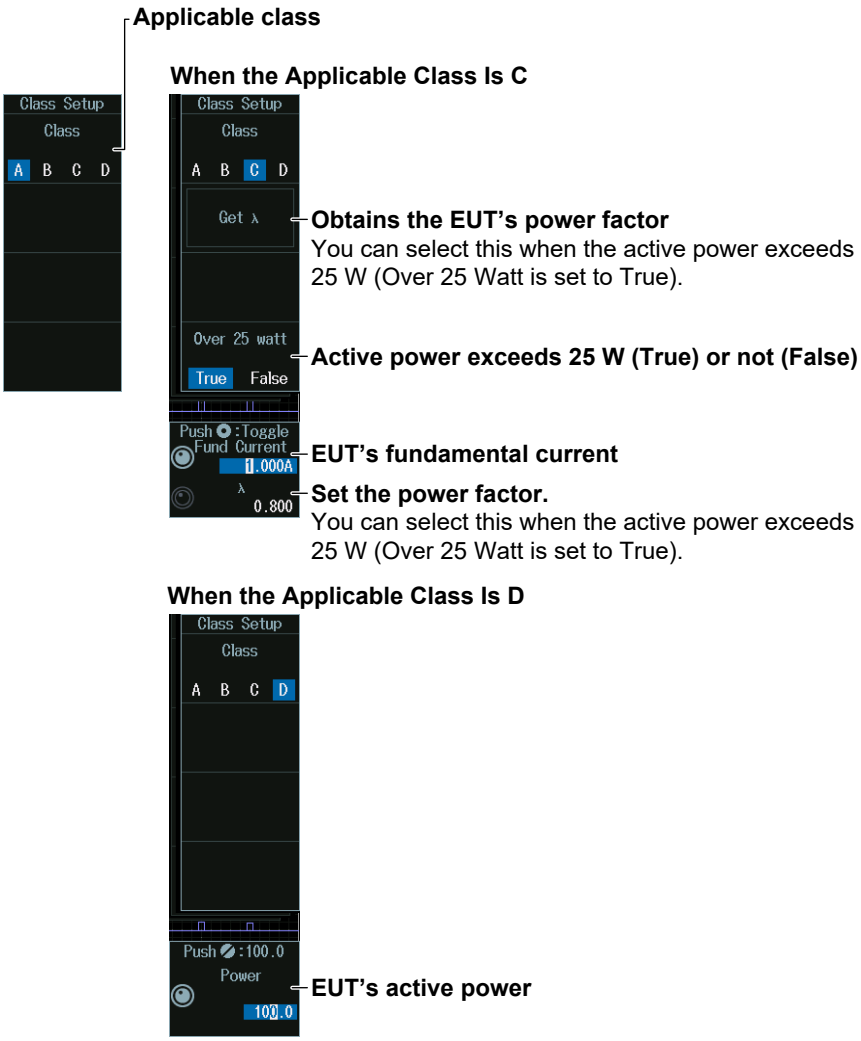
- Press **SET** (upper right on the front panel) to switch between analysis start point or supply voltage.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Applicable Class (Class Setup)

Press the **Class Setup** soft key to display the following menu.



Note

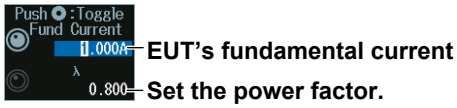
While λ (the power factor) is being obtained, Get λ changes to Abort. It may take time to obtain λ if the record length is long. To stop obtaining λ, press the Abort soft key.

Setting the EUT's Fundamental Current and Power Factor (Fund Current/λ)

Turn the **jog shuttle** to set the EUT's fundamental current (Fund Current) or power factor (λ).

- Press **SET** (upper right on the front panel) to switch between the EUT's fundamental current and power factor.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



EUT's Active Power (Power)

Turn the **jog shuttle** to set the EUT's active power (Power).

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



EUT's active power

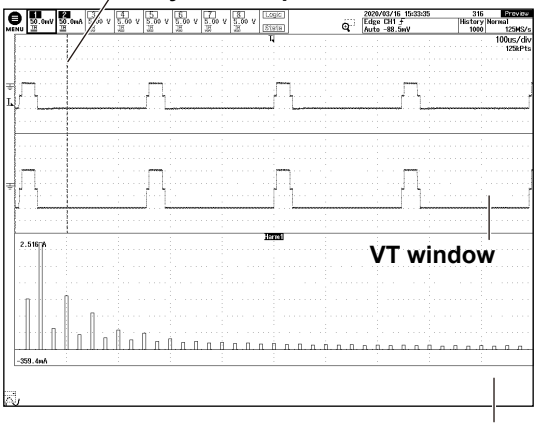
Displaying the VT Waveforms (VT Display)

Press the **Display Setup** soft key and then the **VT Display** soft key to show or hide time-domain waveforms.

Time-Domain Waveform (VT Window) Display

• When the VT window is shown

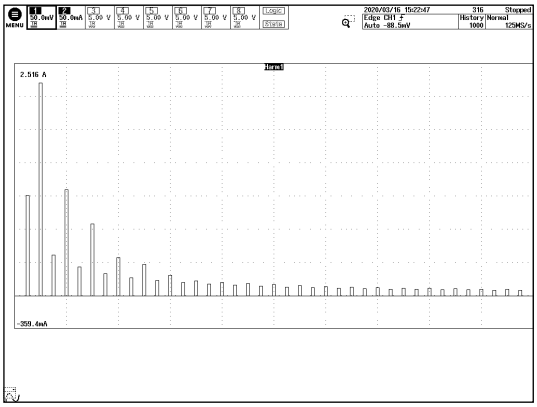
Analysis start point



VT window

Harmonics display window

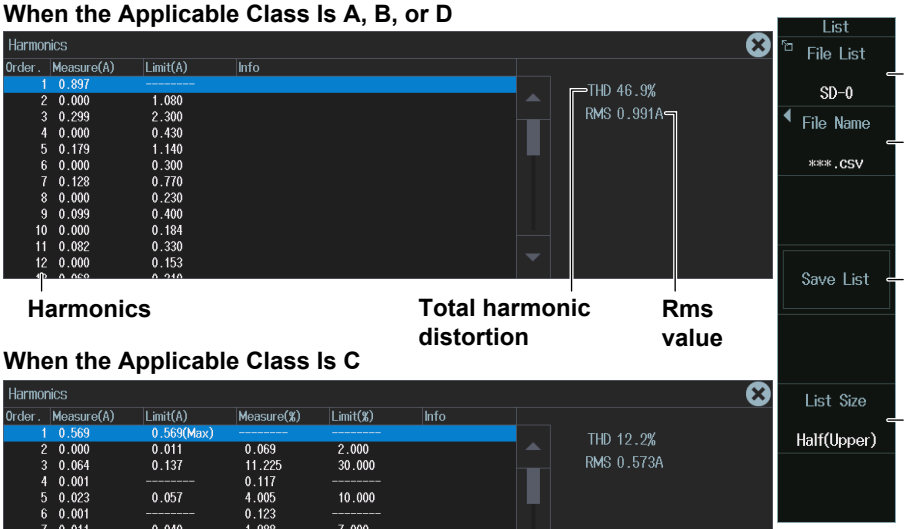
• When the VT window is hidden



List Storage and Display (List)

Press the **List** soft key to display the following menu.

When the Applicable Class Is A, B, or D



Harmonics

Total harmonic distortion

Rms value

► section 17.2

► section 17.2

Saves the list

List size and display position

When the Applicable Class Is C

14.5 Measuring the Joule Integral

This section explains the following settings for measuring the Joule integral:

- Probe
- Measurement content
  Turning Joule integral on or off, measurement source window, measurement range
- Turning Joule integral waveform display on or off
- Auto scaling
- Center point and sensitivity

► **"Measuring Inrush Current by Computing the Joule Integral (I2t)" in the Features Guide**

ANALYSIS Power Analysis Menu

1. Press **ANALYSIS** to display the ANALYSIS menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ANALYSIS menu from ANALYSIS on the top menu that is displayed.
2. Press the **Power Analysis** soft key, the **Type** soft key, and then the **I²T** soft key to display the following menu.



Set the type to I²T.

Probe ► section 14.2

Measurement content

Turns the Joule integral waveform display on or off

Executes auto ranging
Automatically set the vertical display range of the Joule integral waveform.

Center point

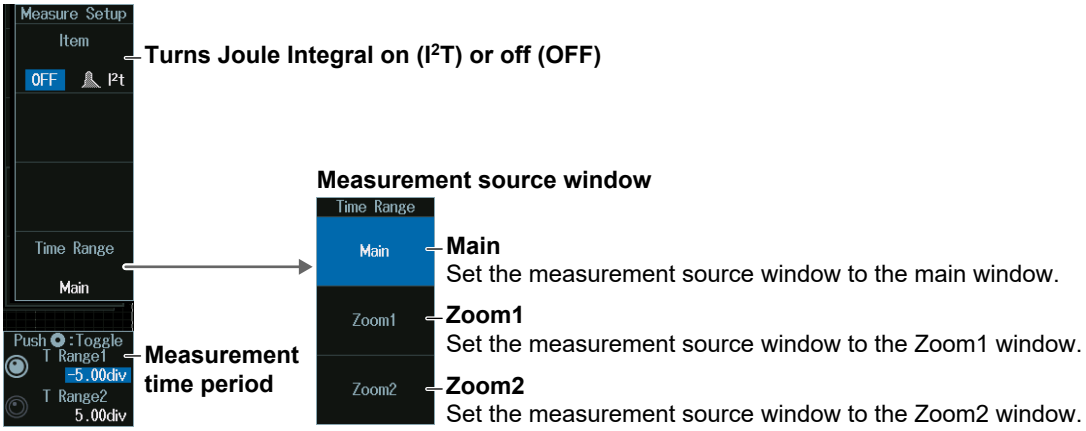
Sensitivity

Note

If the Joule integral waveform display is turned on, the operator (Operation) of the computation/reference waveform (MATH/REF menu) is fixed to I^2T, and other operators cannot be used.

Measurement Setup (Measure Setup)

Press the **Measure Setup** soft key to display the following menu.

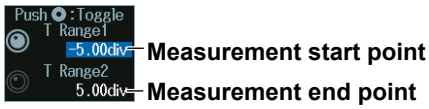


Measurement Time Period (T Range1/T Range2)

Turn the **jog shuttle** to set the measurement start point (T Range1) or measurement end point (T Range2).

- Press **SET** (upper right on the front panel) to switch between measurement start point or measurement end point.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

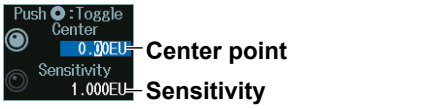


Center Position and Sensitivity (Center/Sensitivity)

Turn the **jog shuttle** to set the center position (Center) or sensitivity (Sensitivity).

- Press **SET** (upper right on the front panel) to switch between center position and sensitivity.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



14.6 Measuring Power

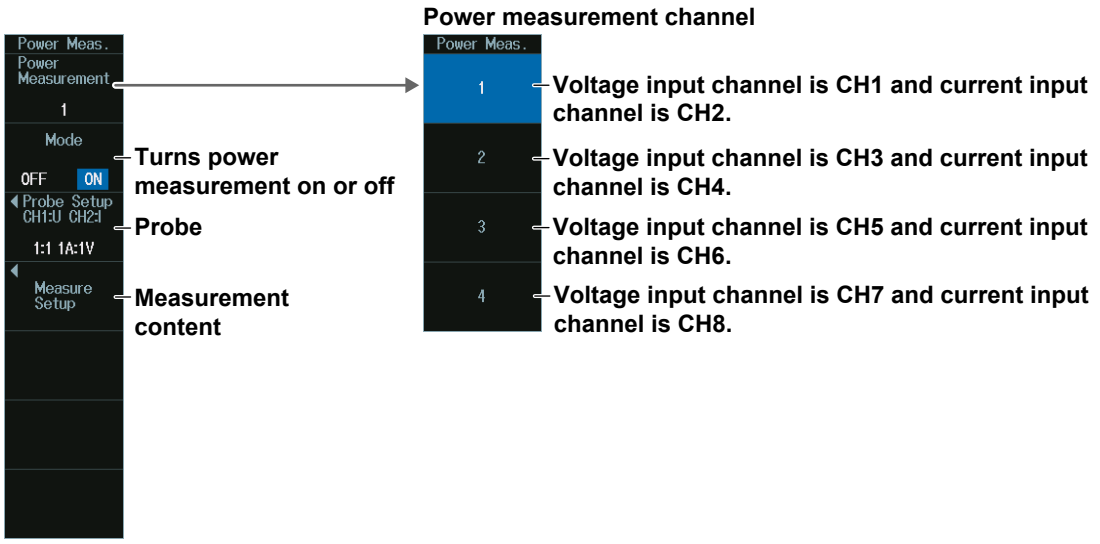
This section explains the following settings for measuring Joule power:

- Turning power measurement on and off
- Probe
- Measurement content
  Measurement items, reference levels for auto measurement, measurement location indicator, cycle mode, calculation that uses automated measurement values, statistical processing, measurement source window, measurement range

► “Power Measurement (Power Measurement)” in the Features Guide

ANALYSIS Power Measurement Menu

1. Press **ANALYSIS** to display the ANALYSIS menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the ANALYSIS menu from ANALYSIS on the top menu that is displayed.
2. Press the **Power Measurement** soft key to display the following menu.

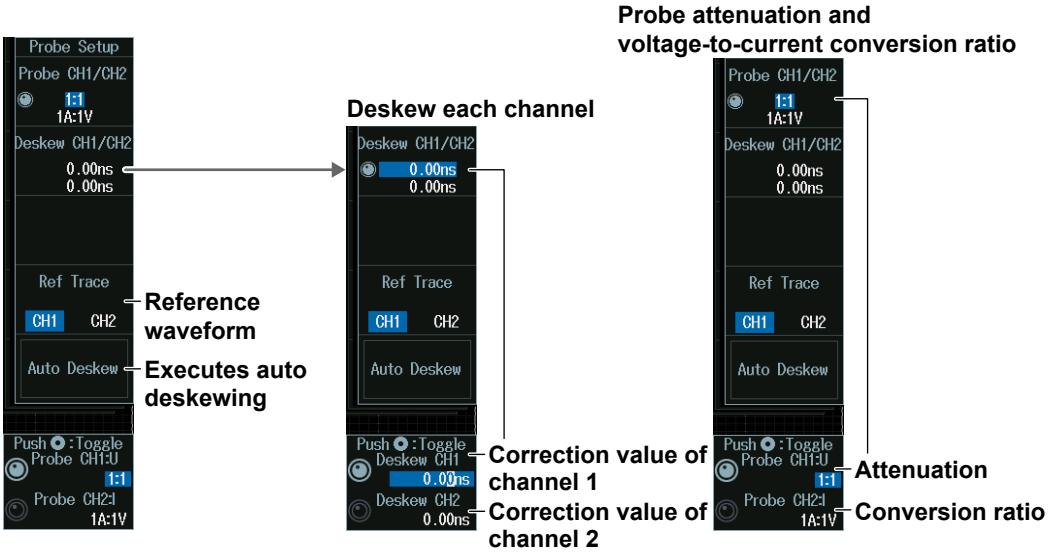


Note

- The available power measurement channel settings vary depending on the model.
  - The available settings on 8ch models are as follows:
    Power Measurement 1 to Power Measurement 4
  - The available settings on 4ch models are as follows:
    Power Measurement 1 and Power Measurement 2
- For input channels that are assigned to power measurement and whose mode is set to ON, the following standard waveform parameters cannot be set. Because the measurement items of power measurement are the same as the following standard waveform parameters, the power measurement values are used in place of waveform parameters.
  Max, Min, P-P, Rms, Mean, Sdev (AC RMS), Avg Freq
- The power measurement cycle mode (Cycle Mode) and the cycle mode (Cycle Mode) measurement item (Item Setup) on the MEASURE key menu are also changed in sync.

Probe (Probe Setup)

Press the **Probe Setup** soft key to display the following menu.



Probe Attenuation Ratio and Voltage-to-Current Conversion Ratio (Probe CH1/CH2, CH3/CH4, CH5/CH6, CH7/CH8)

1. Press the **Probe CH1/CH2**, **Probe CH3/CH4**, **Probe CH5/CH6**, or **Probe CH7/CH8** soft key.
2. Turn the **jog shuttle** to set the attenuation ratio (Probe CH1:U, CH3:U, CH5:U, CH7:U) or conversion ratio (Probe CH2:I, CH4:I, CH6:I, CH8:I).

- Press **SET** (upper right on the front panel) to switch between attenuation ratio and conversion ratio.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



The channel number display varies depending on the input channel selection.

Deskewing Channels (Deskew CH1/CH2, CH3/CH4, CH5/CH6, CH7/CH8)

1. Press the **Deskew CH1/CH2**, **Deskew CH3/CH4**, **Deskew CH5/CH6**, or **Deskew CH7/CH8** soft key.
2. Turn the **jog shuttle** to set the channel 1/channel 2, channel 3/channel 4, channel 5/channel 6, or channel 7/channel 8 correction value (Deskew CH1/CH2, CH3/CH4, CH5/CH6, CH7/CH8).

- Press **SET** (upper right on the front panel) to switch between the correction value of channel 1 or channel 2.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

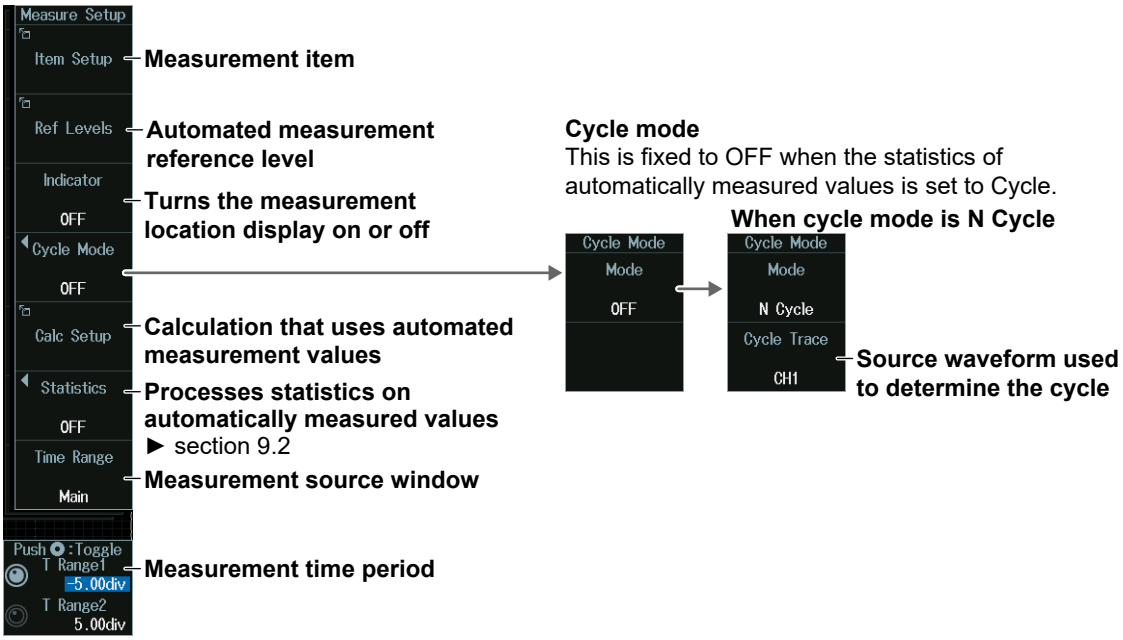
Jog shuttle setting menu



The channel number display varies depending on the input channel selection.

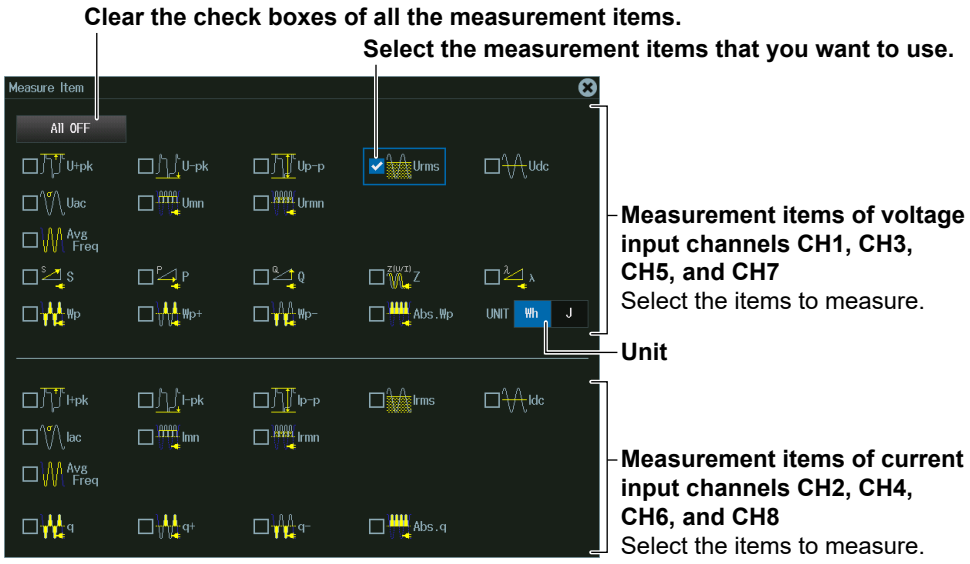
Measurement Setup (Measure Setup)

1. Press the **Mode** soft key to turn power measurement on.
2. Press the **Measure Setup** soft key to display the following menu.



Measurement Items (Item Setup)

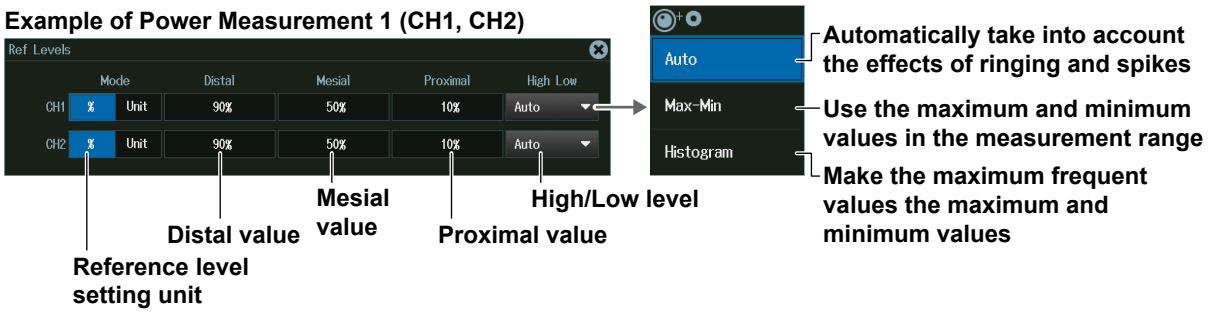
Press the **Item Setup** soft key to display the following menu.



Reference Level for Automated Measurement (Ref Levels)

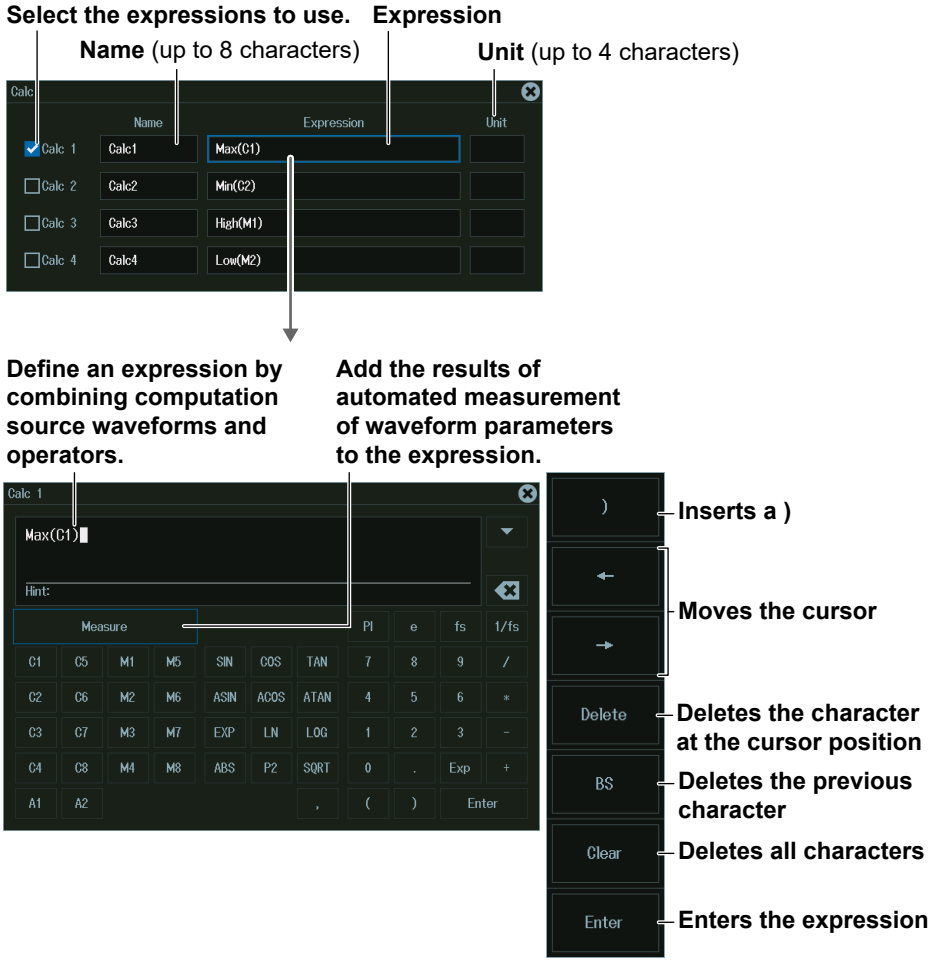
Press the **Ref Levels** soft key. Depending on the power measurement that is selected (Power Measurement1 to Power Measurement4), the following screen appears.

Example of Power Measurement 1 (CH1, CH2)



Calculations That Use Automated Measurement Values (Calc Setup)

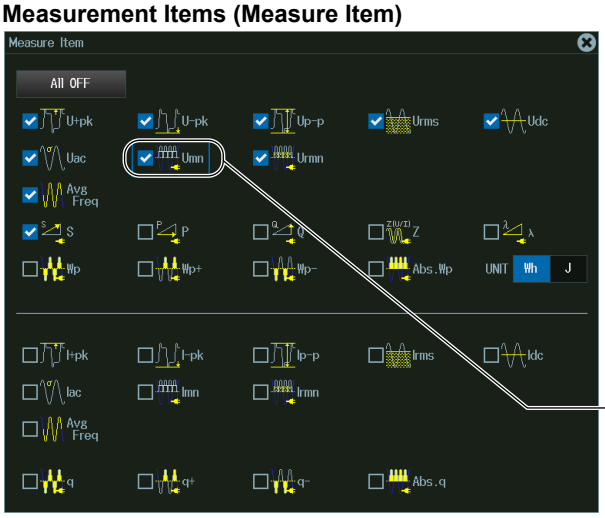
Press the **Calc Setup** soft key to display the following menu.



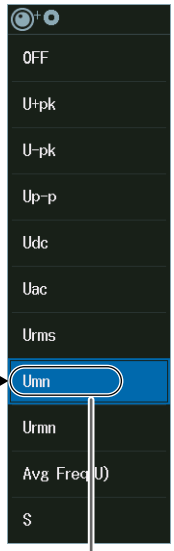
Measurement Location Indicator (Indicator)

1. Press the **Indicator** soft key.
   A portion of the items selected in “Measurement Source Waveform and Measurement Items (Item Setup)” is listed in the setup menu.
2. Use the **jog shuttle** or the **SET** key to select the item whose measurement location you want to indicate.
3. Press **SET** to confirm your selection.
   The measurement location of the item you specify is indicated by a cursor.

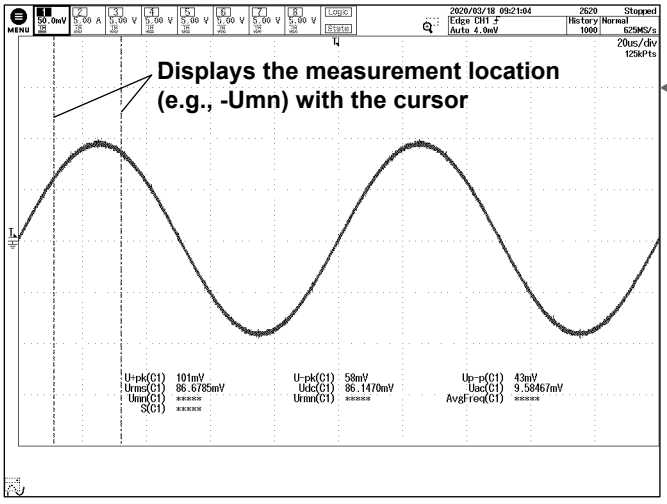
Measurement Items (Measure Item)



Setup menu



The selected measurement items appear in the setup menu.



Note

- If you turn the power measurement on, automated measurement of waveform parameters is enabled. The measured values from the measurement items set on the MEASURE menu and the power measurement items are displayed on the screen.
  A maximum of 30 measurement items can be displayed. If the measured power values are not displayed, reduce the number of MEASURE menu measurement items. ► section 9.1
- If you turn power measurement on, the cycle mode (Cycle Mode) on the MEASURE key menu’s Item Setup screen (page 9-2) is changed according to the power measurement cycle mode (Cycle Mode), and you will not be able to change it from the MEASURE key menu.
- If you change the statistical processing type (Statistics), the statistical processing type (Statistics) on the MEASURE key menu also changes in sync.

15.1 Displaying Waveform History Waveforms

This section explains the following settings for displaying history waveforms, which are waveforms that were previously saved to acquisition memory:

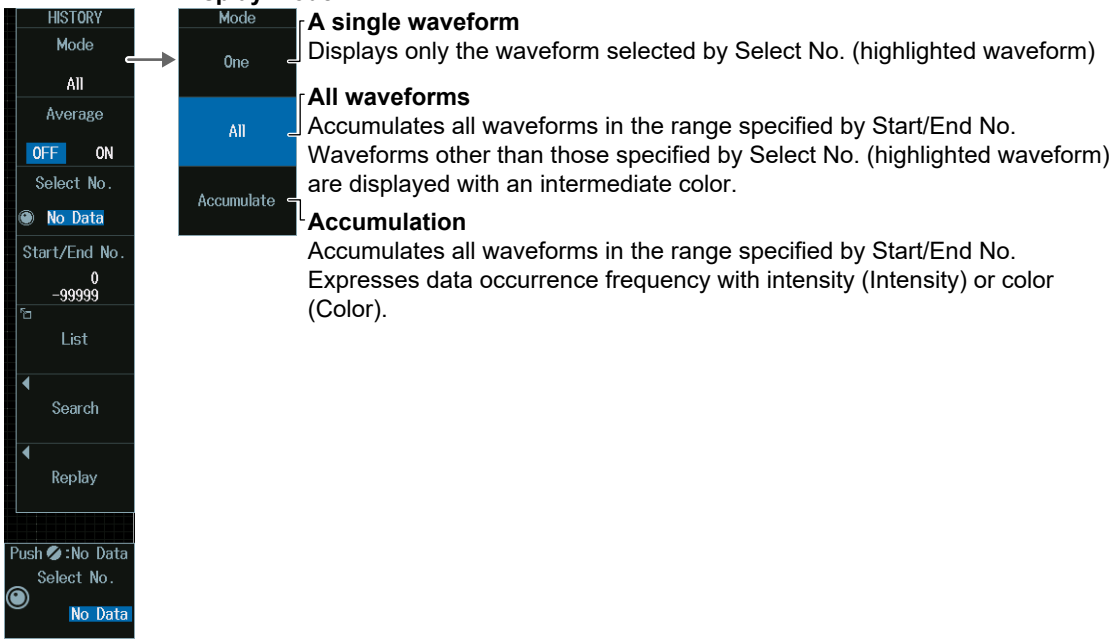
- Display mode
- Turning averaging on or off
- Highlighting of the selected record number
- Display range (start and end record numbers)
- Showing a list of timestamps
- Replay
- Gradation mode

► "Displaying and Searching History Waveforms" in the Features Guide

HISTORY Menu

Press **HISTORY** to display the following menu.

You can also tap **MENU** (MENU) in the upper left of the screen and select the HISTORY menu from ACQ/DISP on the top menu that is displayed.



Display mode

A single waveform
Displays only the waveform selected by Select No. (highlighted waveform)

All waveforms
Accumulates all waveforms in the range specified by Start/End No.
Waveforms other than those specified by Select No. (highlighted waveform) are displayed with an intermediate color.

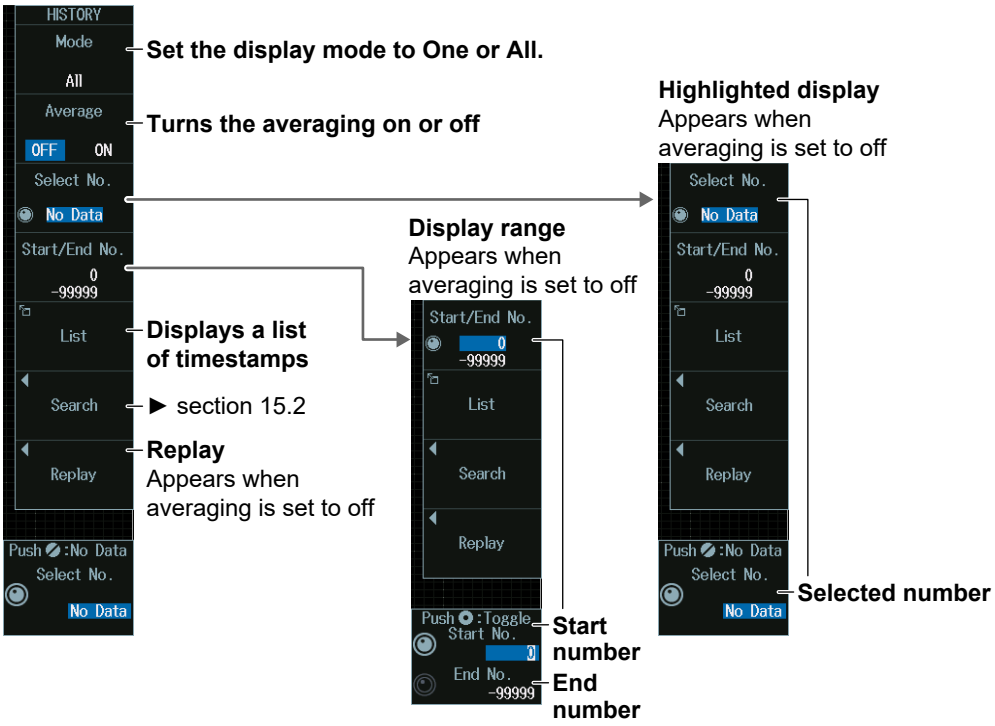
Accumulation
Accumulates all waveforms in the range specified by Start/End No.
Expresses data occurrence frequency with intensity (Intensity) or color (Color).

Note

- If you restart waveform acquisition by using the RUN/STOP key, all history waveforms that had been stored up to that point are cleared. However, if the trigger mode is set to Single (using the SINGLE key), the waveform that had been stored using the SINGLE key remains as a history waveform unless you change the waveform acquisition conditions.
- If you change the waveform acquisition conditions, all history waveforms that had been stored in the memory are cleared.
- If you change user-defined computation settings while using the history feature, recomputation is not performed on the history waveforms. To recompute, execute Math on History.

Single Waveform Mode (One), All Waveform Mode (All)

1. Press the **Mode** soft key.
2. Press the **One** or **All** soft key to display the following menu.



Highlighting (Select No.)

1. Press the **Select No.** soft key.
2. Turn the jog shuttle to set the record number (selection number) to highlight.
   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Display Range (Start/End No.)

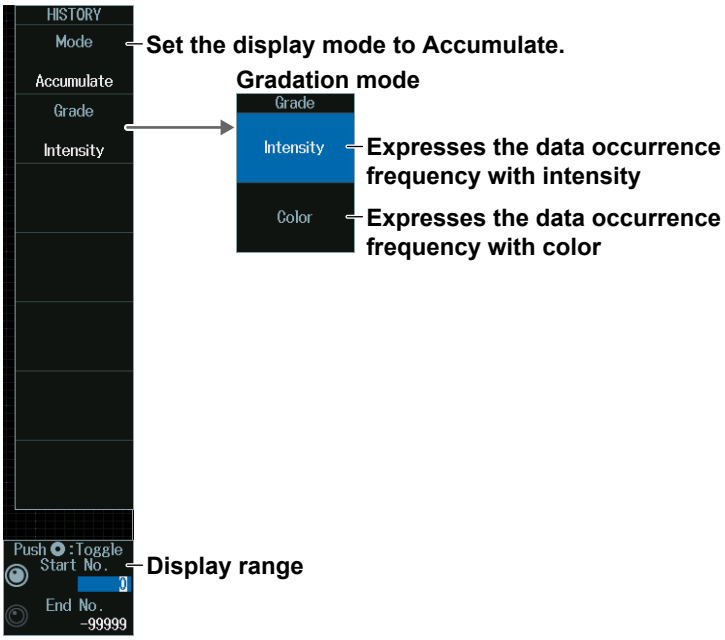
1. Press the **Start/End No.** soft key.
2. Turn the jog shuttle to set the start or end number.
   - Press **SET** (upper right on the front panel) to switch between the display range start point (Start No.) and the display range end point (End No.).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Accumulation Mode (Accumulate)

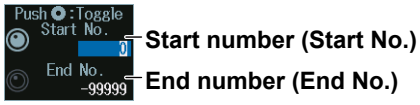
1. Press the **Mode** soft key.
2. Press the **Accumulate** soft key to display the following menu.



Display Range (Start/End No.)

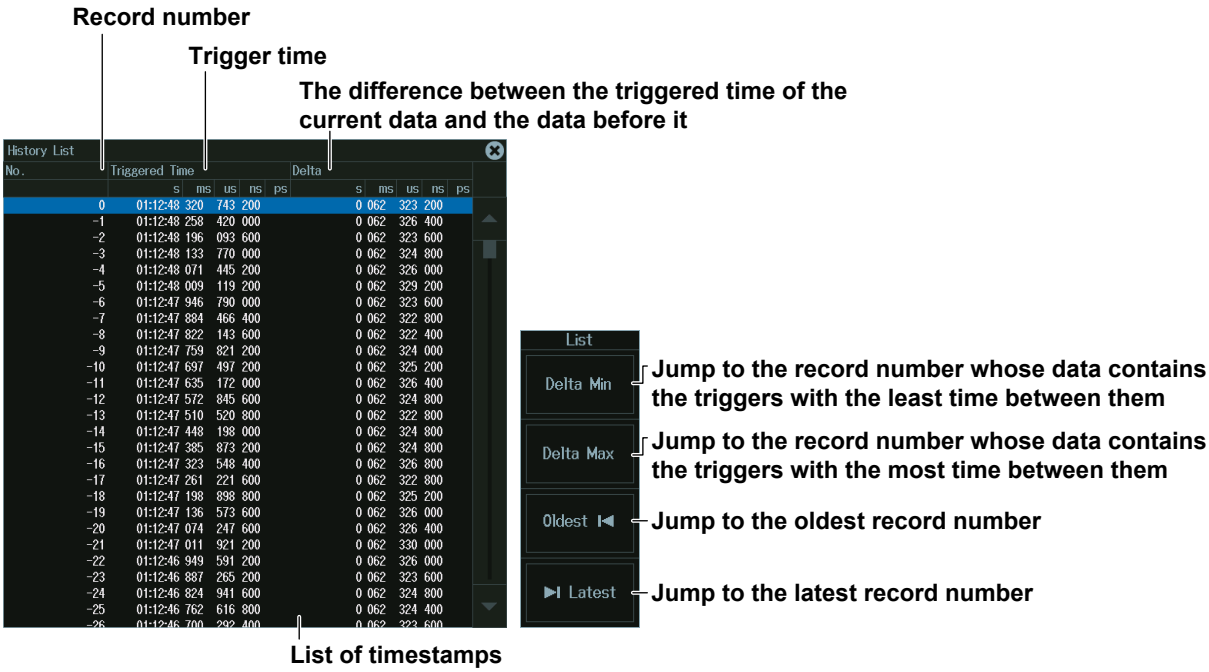
1. Press the **Start/End No.** soft key.
2. Turn the jog shuttle to set the start or end number.
   - Press **SET** (upper right on the front panel) to switch between the display range start point (Start No.) and the display range end point (End No.).
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



List of Timestamps (List)

Press the **List** soft key to display the following screen.



Note

Notes about Configuring the History Feature

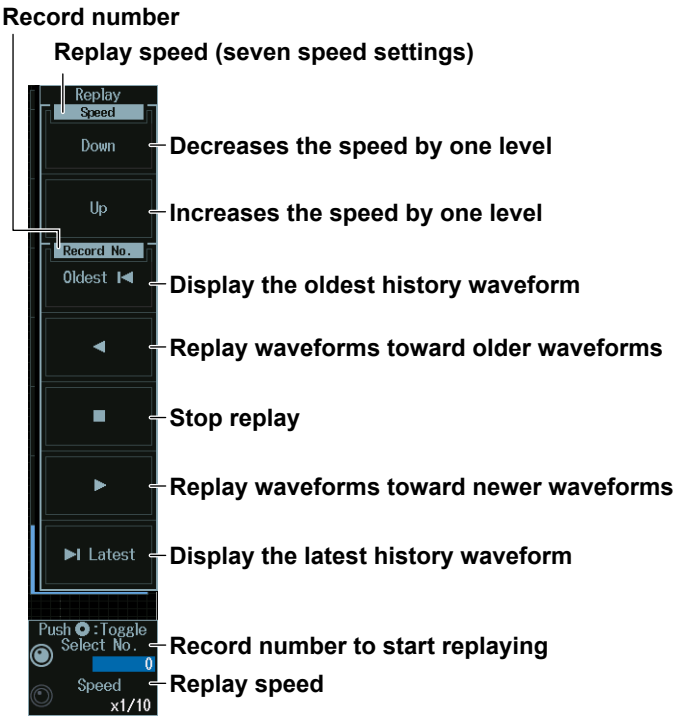
- When the acquisition mode is set to Average and the sampling mode is set to Repetitive, you cannot use the history feature.
- When the display is in roll-mode, you cannot use the history feature.
- If you stop waveform acquisition, the instrument only displays waveforms that have been acquired completely.

Notes about Recalling Data Using the History Feature

- Waveform acquisition stops when you display the History menu. You cannot display history waveforms while waveform acquisition is in progress.
- You can start waveform acquisition when the History menu is displayed. However, you cannot change the history feature settings while waveform acquisition is in progress.
- The settings are restricted so that the following relationship is retained: Last record (End) ≤ Select No. ≤ First record (Start).
- When you load waveform data from the specified storage device, history waveforms up to that point are cleared. The loaded waveform data is placed in record number zero. If you load a file containing multiple waveforms, the latest waveform is placed in zero, and earlier waveforms are placed in order to record numbers -1, -2, and so on.
- Computation and automated measurement of waveform parameters are performed on the waveform of the record number specified by Select No. You can analyze old data as long as you do not overwrite the acquisition memory contents by restarting waveform acquisition. If Average is set to ON, analysis is performed on the averaged waveform.
- History waveforms are cleared when you turn the power off.

Replay (Replay)

Press the **Replay** soft key to display the following menu.



Note

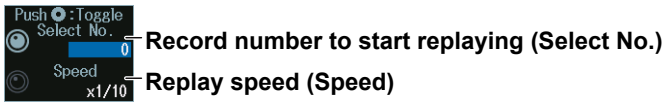
If you change the vertical scale, vertical position, time axis setting, trigger position, or other relevant settings and then display the preview, you cannot search for or replay history waveforms.

Record Number to Start Replaying (Select No./Speed), Replay Speed (Speed)

Turn the **jog shuttle** to set the record number to start replaying (Select No.) or the replay speed (Speed).

- Press **SET** (upper right on the front panel) to switch between the record number to start replaying (Select No.) and the replay speed (Speed).
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the pop-up menu that appears on the screen.

Jog shuttle setting menu



15.2 Searching History Waveforms

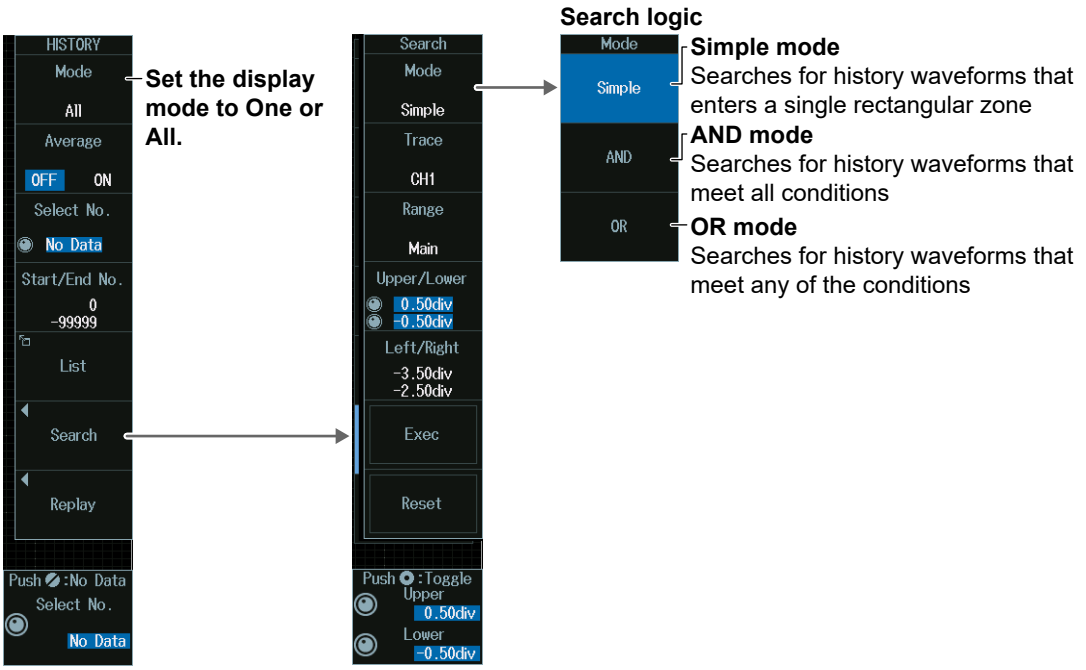
This section explains the following settings for searching history waveforms:

- Search condition
- Waveform to search
- Search source window
- Search range (rectangular zone)
- Search conditions (1 to 4)
  Search range mode
- Executing searches
- Finishing searches

► “Searching History Waveforms (Search)” in the Features Guide

HISTORY Menu

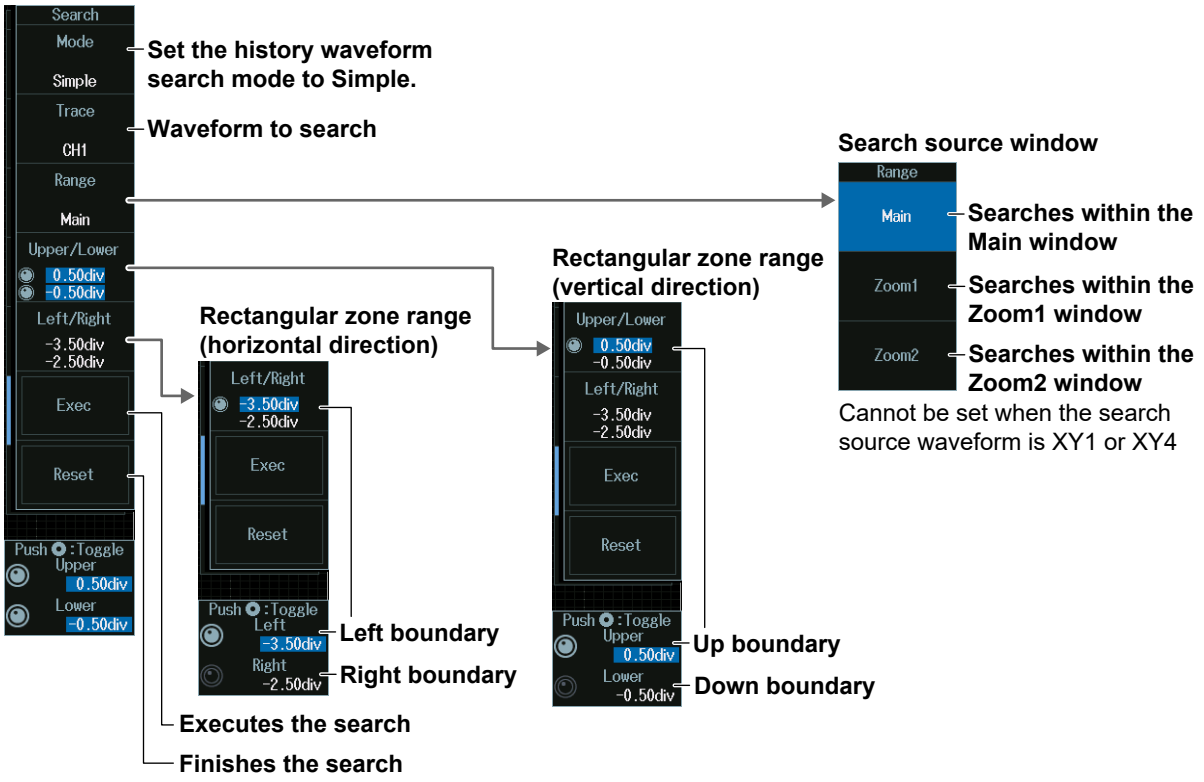
1. Press **HISTORY** to display the HISTORY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the HISTORY menu from ACQ/DISP on the top menu that is displayed.
2. Press the **Mode** soft key and then the **One** or **All** soft key to display the following menu.



Search Logic (Mode)

In Simple Mode

1. Press the **Mode** soft key and then the **Simple** soft key to display the following menu.



Note

The available search source waveform settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8, XY1 to XY4
- The available settings on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4, XY1, XY2

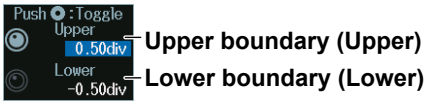
Rectangular Zone Range (Upper/Lower)

1. Press the **Upper/Lower** soft key.

2. Turn the **jog shuttle** to set the upper boundary (Upper) or lower boundary (Lower).

- Press **SET** (upper right on the front panel) to switch between upper and lower boundaries.
- You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Rectangular Zone Range (Left/Right)

1. Press the **Left/Right** soft key.
2. Turn the **jog shuttle** to set the left boundary (Left) or right boundary (Right).
   - Press **SET** (upper right on the front panel) to switch between left and right boundaries.
   - You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu

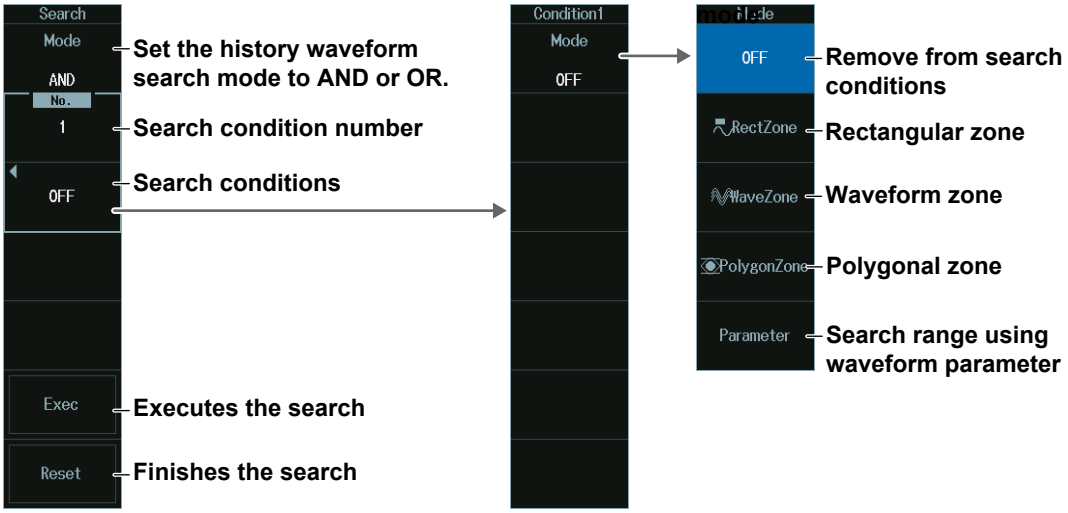


Left boundary (Left)

Right boundary (Right)

In AND or OR Mode

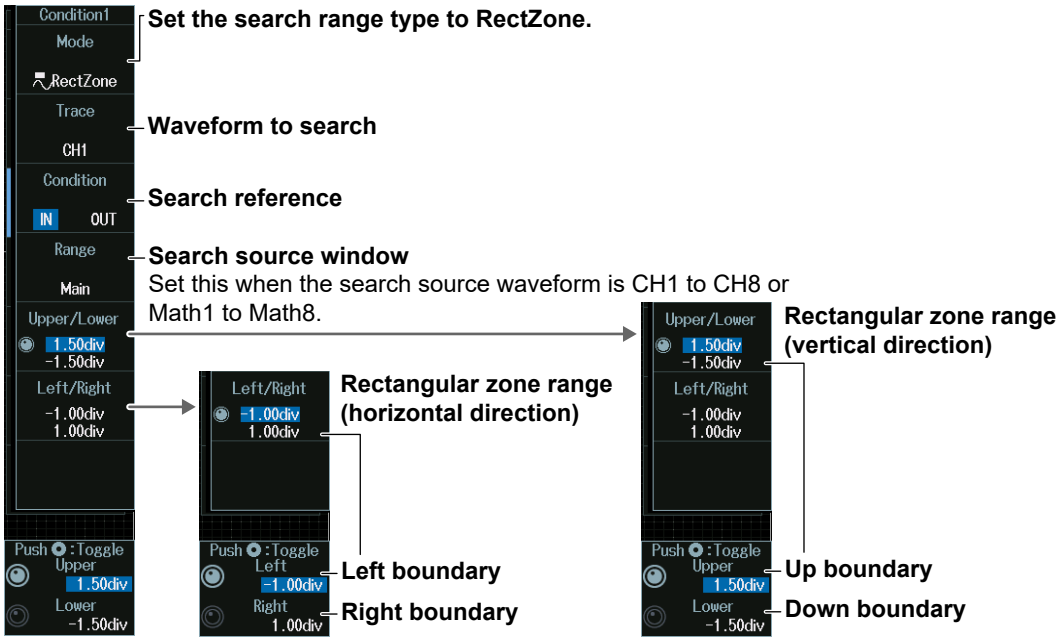
1. Press the **Mode** soft key, the AND soft key, and then the **OR** soft key to display the following menu.



Rectangular Zone (RectZone)

Set the search range (rectangular zone).

1. Press any of the search condition **1** to **8** (1 to 4 on 4ch models) soft keys and then the **Mode** soft key.
2. Press the **RectZone** soft key to display the following menu.



Note

The available source waveforms are as follows:

- No.1 to No.4
  CH1 to CH4, Math1 to Math4
- No.5 to 8 (8ch models only)
  CH5 to CH8, Math5 to Math8

Search source window

To make Zoom1 or Zoom2 a search source, turn on the Zoom1 or Zoom2 display from the ZOOM menu. For details, see section 10.1.

Rectangular Zone Range (Upper/Lower)

See the description of Rectangular Zone Range (Upper/Lower) of Simple mode.

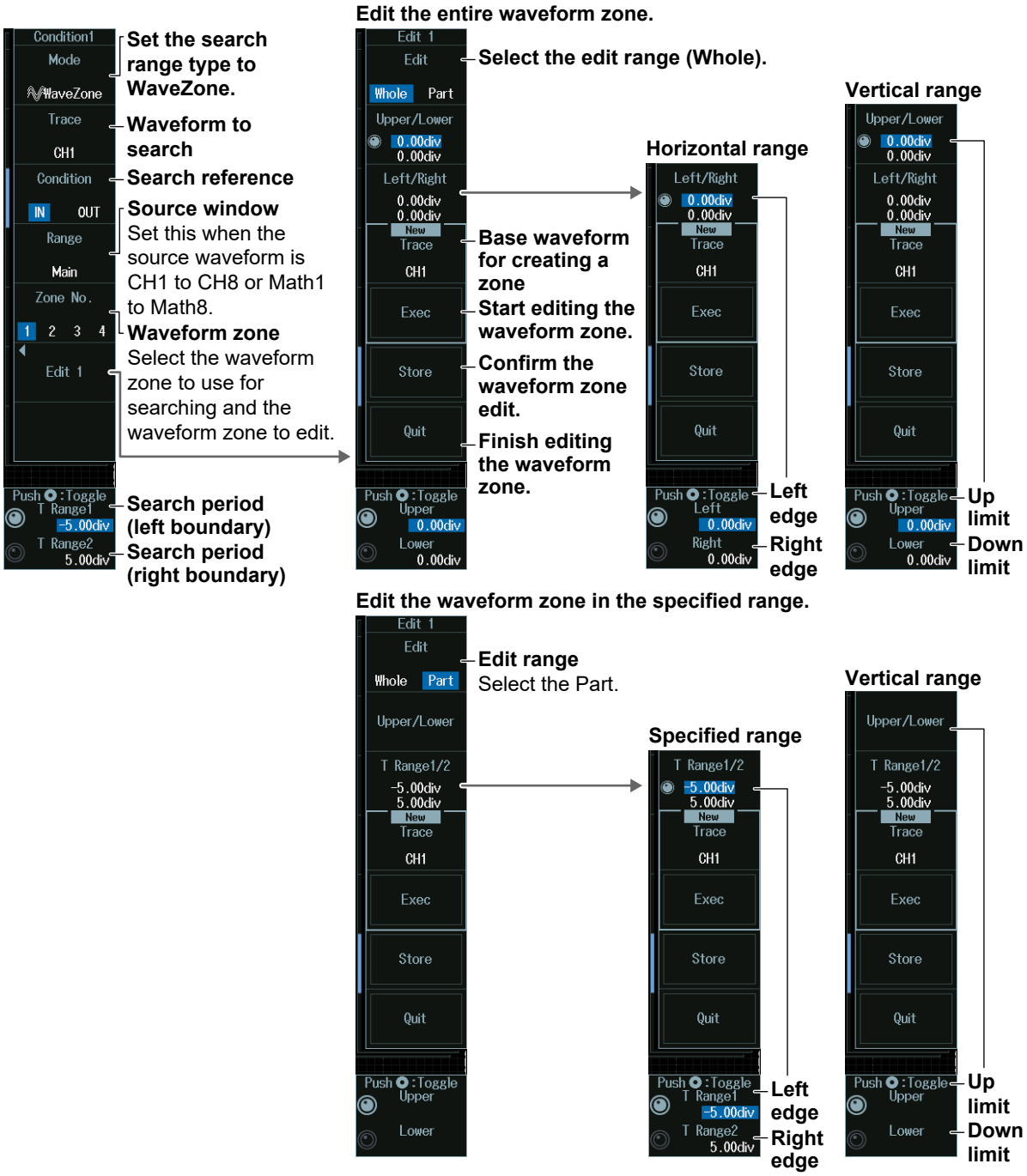
Rectangular Zone Range (Left/Right)

See the description of Rectangular Zone Range (Left/Right) of Simple mode.

Waveform Zone (WaveZone)

Set the search range (waveform zone).

1. Press any of the search condition **1** to **8** (1 to 4 on 4ch models) soft keys and then the **Mode** soft key.
2. Press the **WaveZone** soft key to display the following menu.



Note

The available source waveforms are as follows:

- No.1 to No.4
  CH1 to CH4, Math1 to Math4
- No.5 to 8 (8ch models only)
  CH5 to CH8, Math5 to Math8

Editing Waveform Zones (Edit 1 to Edit 8 (Edit1 to Edit4 on 4ch models))

1. Press the **Zone No** soft key, and select the number of the waveform zone that you want to edit.

   The appearance of the waveform zone edit soft keys (Edit 1 to Edit 8) changes depending on the selected waveform zone number.

2. Press one of the soft keys from **Edit 1** to **Edit 8** (Edit1 to Edit4 on 4ch models), whichever is shown on the menu. An edit menu for the waveform zone that you selected will be displayed.

- **Selecting the Base Waveform**

  To edit without changing the base waveform, proceed to step 5.

3. Press the **Trace (New)** soft key, and from the displayed menu, select the base waveform.

4. Press the **Exec (New)** soft key. A waveform zone is created from the base waveform.

- **Editing the Entire Waveform Zone**

5. Press the **Edit** soft key to select **Whole**.

6. Press the **Upper/Lower** soft key or the **Left/Right** soft key to select the zone boundaries to edit.

7. Turn the **jog shuttle** to edit the waveform zone.

   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

   Jog shuttle setting menu

   Left boundary

   Right boundary

   Press SET (upper right on the front panel) to switch between left and right boundaries.

- **Editing a Part of the Waveform Zone**

5. Press the **Edit** soft key to select **Part**.

6. Press the **T Range1/2** soft key.

7. Turn the **jog shuttle** to set the time scale range.

   You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

   Jog shuttle setting menu

   Left edge

   Right edge

   Press SET (upper right on the front panel) to switch between left and right edges.

8. Press the **Upper/Lower** soft key to select the upper and lower zone boundaries.

9. Turn the **jog shuttle** to edit the waveform zone.

   The procedure for using the jog shuttle setting menu is the same as that in step 7.

- **Confirming the Waveform Zone**

Press the **Store** soft key to confirm the waveform zone that you edited and store it in the internal memory.

- **Finishing Waveform Zone Editing**

Press the **Quit** soft key to confirm the waveform zone that you edited and store it in the internal memory.

The screen returns from the editing screen to the previous menu. If you do not confirm the edited waveform zone by pressing the Store soft key, the changes that you made are lost.

Note

- If you change the base waveform (Trace (New)) for creating a zone, the waveform zone that you edited up to that point will be lost.
- If you want to switch from the edit menu to a different menu, you need to finish editing first. Press the Quit soft key to finish editing.

Search Period (T Range)

Turn the **jog shuttle** to set the search period.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Search period (left boundary)

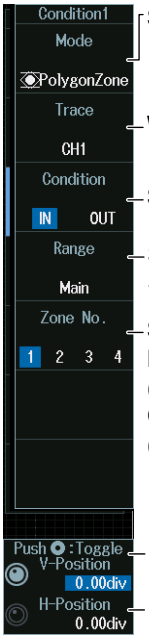
Search period (right boundary)

Press SET (upper right on the front panel) to switch between left and right search period boundaries.

Polygonal Zone (PolygonZone)

Set the search range (polygonal zone).

1. Press any of the search condition **1** to **8** (1 to 4 on 4ch models) soft keys and then the **Mode** soft key.
2. Press the **PolygonZone** soft key to display the following menu.



Set the search range type to PolygonZone.

Waveform to search

Search reference

Search source window
Set this when the search source waveform is CH1 to CH8 or Math1 to Math8.

Select the polygonal zone.
Load a polygonal shape in advance into the specified zone number (Zone No.1 to Zone No.8) using the file load feature (see section 17.7). Create polygonal shapes on your PC using the dedicated software (Mask Editor Software).

Moves the polygonal zone (vertical position)

Moves the polygonal zone (horizontal position)

* Load a polygonal zone in advance.

Note

The available source waveforms are as follows:

- No.1 to No.4
  CH1 to CH4, Math1 to Math4
- No.5 to 8 (8ch models only)
  CH5 to CH8, Math5 to Math8

Search source window

To make Zoom1 or Zoom2 a search source, turn on the Zoom1 or Zoom2 display from the ZOOM menu. For details, see section 10.1.

Moving the Polygonal Zone (V-Position, H-Position)

Turn the **jog shuttle** to move the polygonal zone.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Moves the polygonal zone (vertical position)

Moves the polygonal zone (horizontal position)

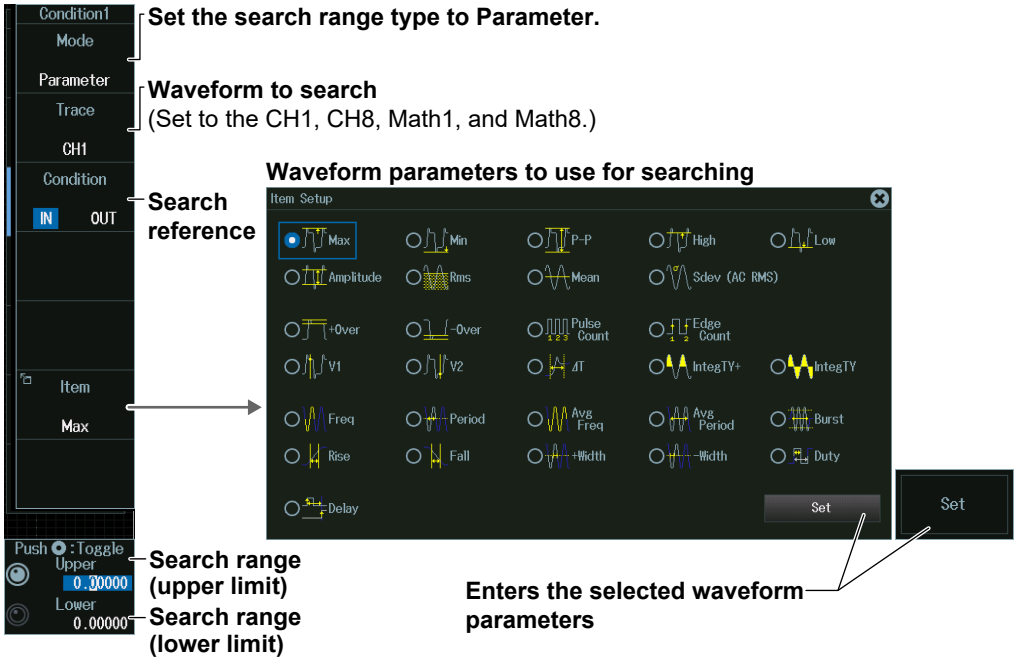
Press SET (upper right on the front panel) to switch between moving the polygonal zone horizontally or vertically.

Setting a Search Range Using Parameters (Parameter)

Set the search range (parameter).

1. Press any of the search condition **1** to **8** (1 to 4 on 4ch models) soft keys and then the **Mode** soft key.
2. Press the **Parameter** soft key to display the following menu.

When CH1 to CH8 or Math1 to Math8 Is the Search Source Waveform



Note

Waveform Parameters

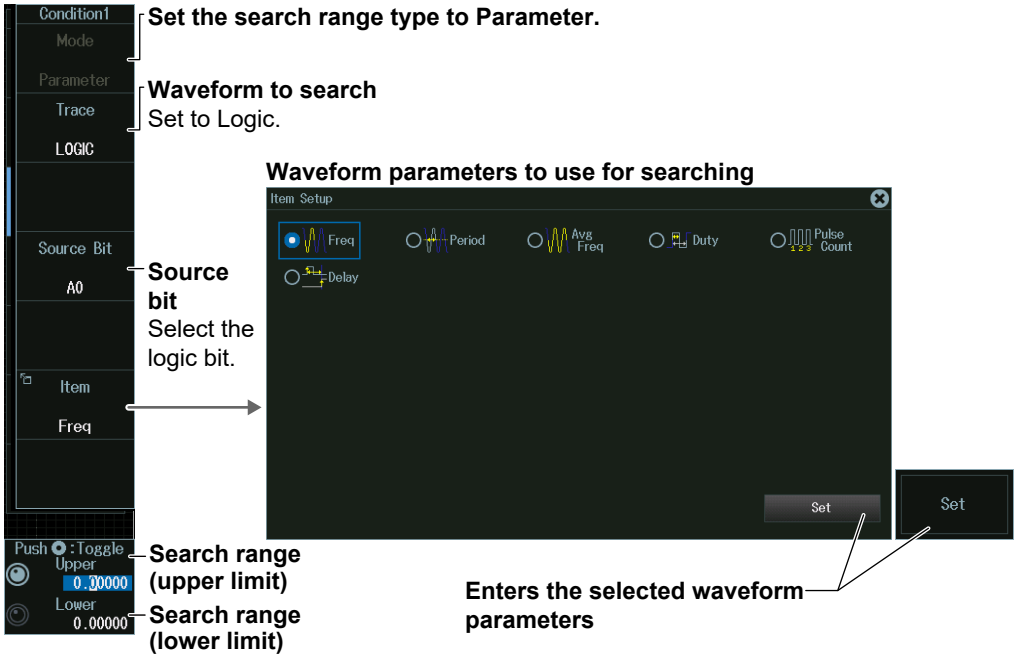
You can select the measurement items to use in searching from all of the items used for automated measurement of waveform parameters. For information on setting automated measurement of waveform parameters, see section 9.1.

Waveform to search

The available search source waveform settings vary depending on the model.

- The available settings on 8ch models are as follows:
  CH1 to CH8, Math1 to Math8, XY1 to XY4, Logic, FFT1 to FFT4
- The available settings on 4ch models are as follows:
  CH1 to CH4, Math1 to Math4, XY1, XY2, Logic, FFT1 to FFT2

When Logic Is the Search Source Waveform



Note

Waveform Parameters

You can select the measurement item to use in searching from the items used for time axis measurement of waveform parameters shown below.

Freq, Period, Avg Freq, Duty, Pulse Count, Delay

For information on setting automated measurement of waveform parameters, see section 9.1.

Source bit

The following source bit display applies to models with the /L32 option.

C0 to C7 (LOGIC port C), D0 to D7 (LOGIC port D)

When XY1 to XY4 Is the Search Source Waveform



Set the search range type to Parameter.

Waveform to search
Set to a value from XY1 to XY4 (XY1 or XY2 on 4CH models).

Search reference

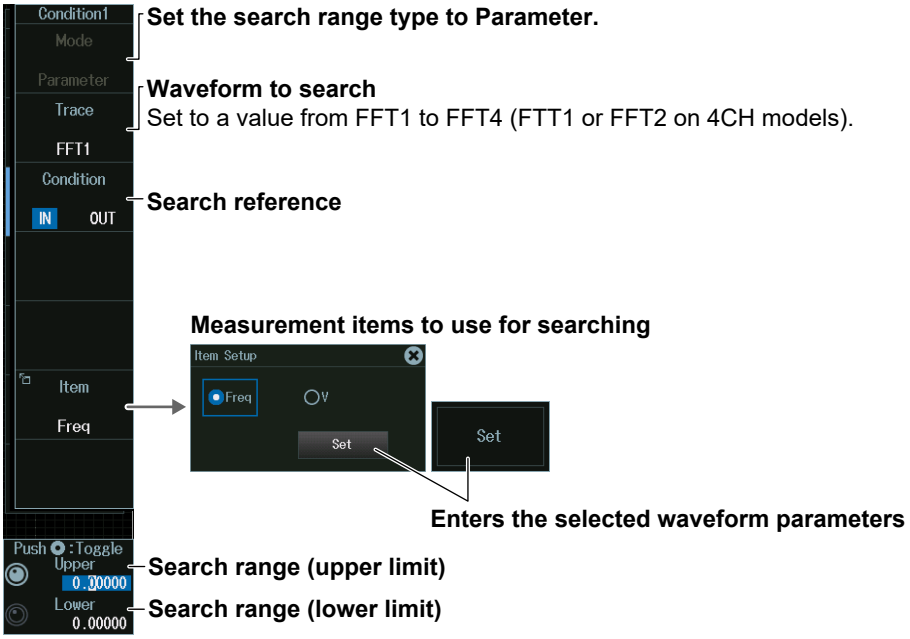
Search range (upper limit)

Search range (lower limit)

Note

The measurement item to use in searching is the waveform area of XY1 to XY4 (XY1 and XY2 on 4ch models). For information on setting how the XY waveform is displayed and how its area is determined, see chapter 5 of this manual and appendix 1 of the *Features Guide*, IM DLM5058-01EN.

When FFT1 to FFT4 Is the Search Source Waveform



Set the search range type to Parameter.

Waveform to search
Set to a value from FFT1 to FFT4 (FTT1 or FFT2 on 4CH models).

Search reference

Measurement items to use for searching

Enters the selected waveform parameters

Search range (upper limit)

Search range (lower limit)

Note

- You can select the measurement item to use in searching from the peak cursor measurement items (Freq, V) for FFT. For details on peak cursor measurements, see section 7.2.
- The search source waveforms on 4ch models are FFT1 and FFT2.

Search Range (Upper/Lower)

Turn the **jog shuttle** to set the search range.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Search range (upper limit)

Search range (lower limit)

Press SET (upper right on the front panel) to switch between upper and lower search range limits.

16.1 Loading Roll Paper Into the Built-In Printer (Option)

This section explains how to load roll paper into the optional built-in printer.

Printer Roll Paper

Use a YOKOGAWA roll paper. Do not use any other paper. When using the printer for the first time, use the roll paper supplied with the instrument. When you need extra roll paper, please contact your nearest YOKOGAWA dealer.

Part Number: B9988AE
Specification: Heat-sensitive paper, 10 m
Minimum Quantity: 10 rolls

Roll Paper Handling

The roll paper is made of heat-sensitive paper that changes color thermochemically. Please read the following information carefully.

Storage Precautions

The heat-sensitive paper starts changing color at about 70°C. The paper can be affected by heat, humidity, or chemicals, whether something has been recorded on it or not. As such, please follow the guidelines listed below.

- Store the paper in a cool, dry, and dark place.
- Use the paper as quickly as possible after you break its protective seal.
- If you attach a plastic film that contains plasticizing material such as vinyl chloride film or cellophane tape to the paper for a long time, the recorded sections will fade due to the effect of the plasticizing material. Use a holder made of polypropylene to store the roll paper.
- When starching the record paper, do not use starches containing organic solvents such as alcohol or ether. Doing so will change the paper's color.
- We recommend that you make copies of the recordings if you intend to store them for a long period of time. Because of the nature of heat-sensitive paper, the recorded sections may fade.

Handling Precautions

- Only use genuine YOKOGAWA roll paper.
- If you touch the roll paper with sweaty hands, there is a chance that you will leave fingerprints on the paper or smudge the recorded sections.
- If you rub the surface of the roll paper against something hard, there is a chance that the paper will change color due to frictional heat.
- If the roll paper comes into contact with chemicals, oil, and the like, there is a chance that the paper will change color or that the recorded sections will disappear.

Loading the Roll Paper



CAUTION

- Do not touch the print head. If you do, you may burn yourself.
- Do not touch the roll paper cutter section at the end of the printer cover. Doing so may cause injury.

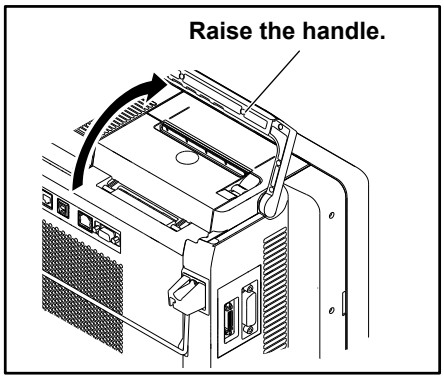
French



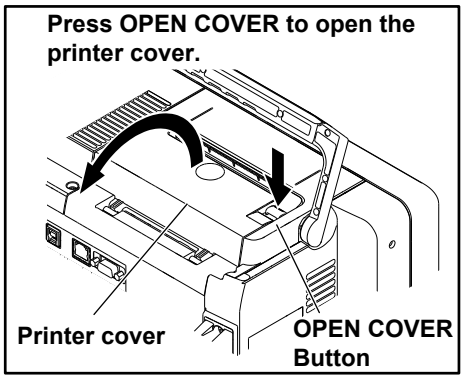
ATTENTION

- Ne pas toucher la tête d’impression. Vous pourriez vous brûler.
- Ne pas toucher la section du coupe-papier à l’extrémité du cache de l’imprimante. Vous pourriez vous blesser

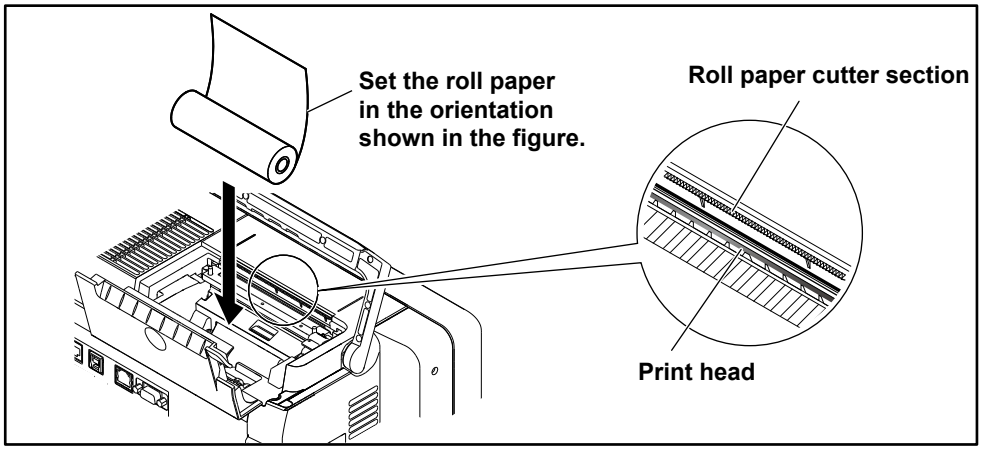
1.


Raise the handle.

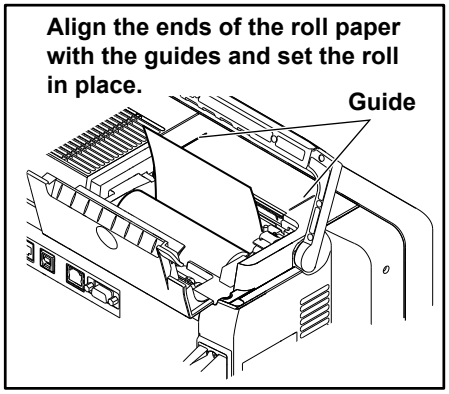
2.


Press OPEN COVER to open the printer cover.
Printer cover
OPEN COVER Button

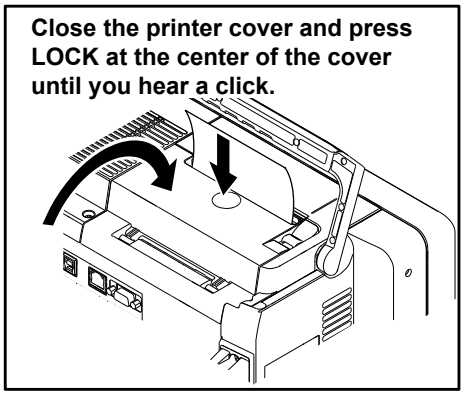
3.


Set the roll paper in the orientation shown in the figure.
Roll paper cutter section
Print head

4.


Align the ends of the roll paper with the guides and set the roll in place.
Guide

5.


Close the printer cover and press LOCK at the center of the cover until you hear a click.

16.2 Printing on the Built-in Printer (Option)

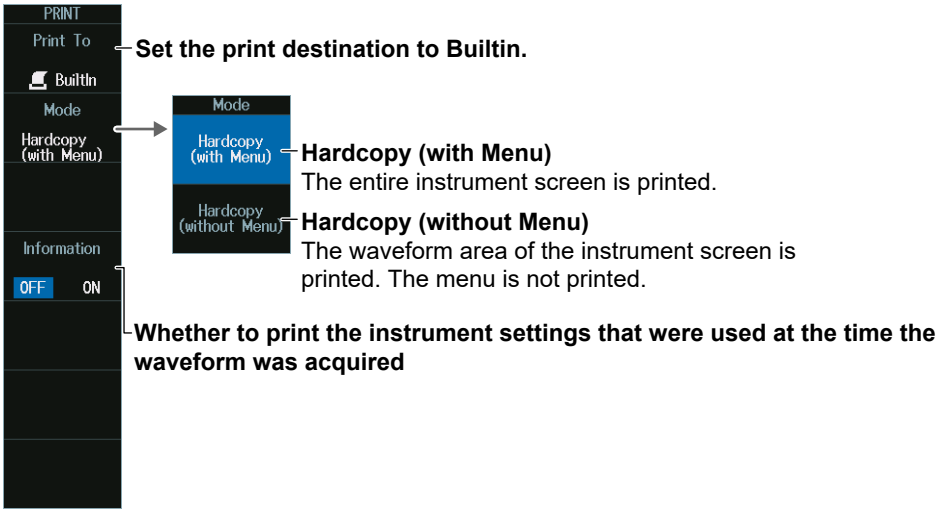
This section explains the following settings for printing on the built-in printer (option):

- Output destination
- Print mode
- Additional information

► “Printing on the Built-in Printer (BuiltIn) (Option)” in the Features Guide

PRINT BuiltIn Menu

1. Press **SHIFT+PRINT** (MENU) to display the PRINT menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the PRINT (PRINT MENU) menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Print To** and then the **Builtin** soft key to display the following menu.



Printing

Press **PRINT**. The image is output to the built-in printer according to the settings.

16.3 Printing on a USB Printer

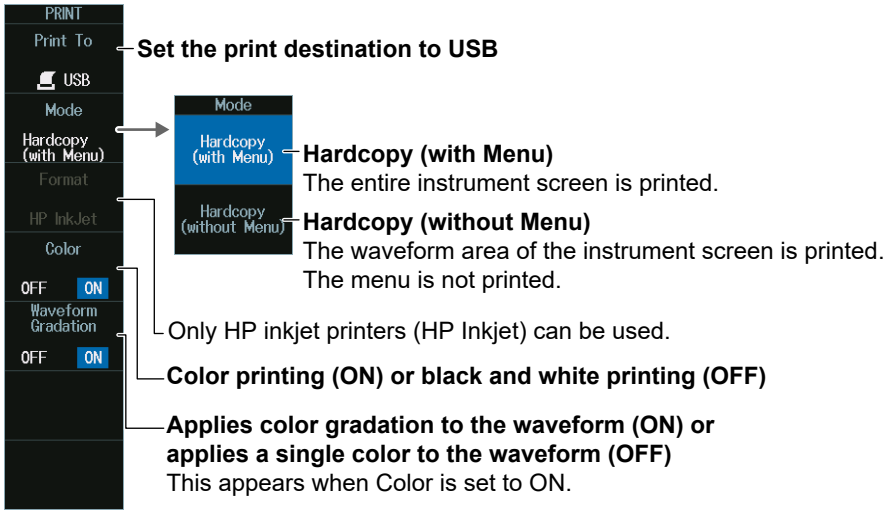
This section explains the following settings for printing on a USB printer:

- Output destination
- Print mode
- Printer type
- Color
- Waveform gradation

► "Printing on a USB Printer (USB)" in the Features Guide

PRINT USB Menu

1. Press **SHIFT+PRINT** (MENU) to display the PRINT menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the PRINT (PRINT MENU) menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Print To** and then the **USB** soft key to display the following menu.



Printing

Press **PRINT**. The image is output to the USB printer according to the settings.

Note

- Do not connect an incompatible USB printer.
- For USB printers that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

16.4 Printing on a Network Printer

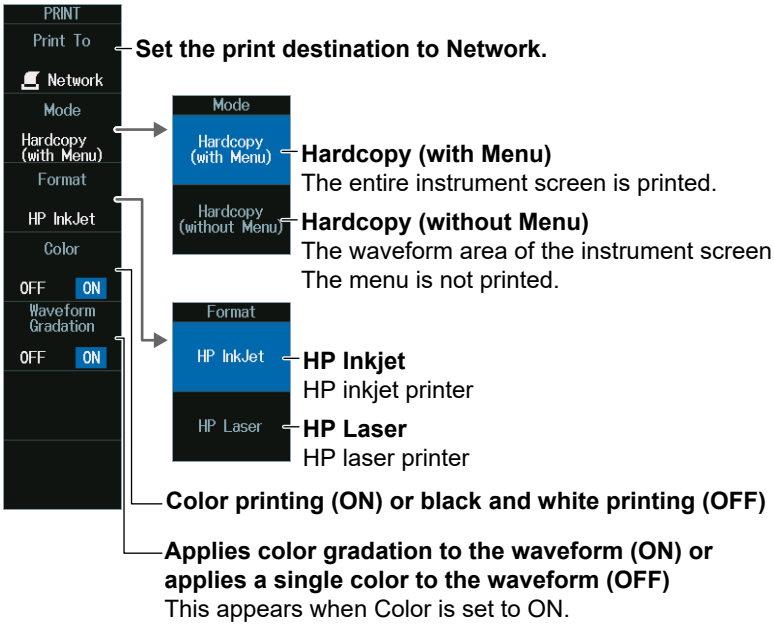
This section explains the following settings for printing on a network printer:

- Output destination
- Print mode
- Printer type
- Color
- Waveform gradation

► “Printing on a Network Printer (Network)” in the Features Guide

PRINT Network Menu

1. Press **SHIFT+PRINT** (MENU) to display the PRINT menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the PRINT (PRINT MENU) menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Print To** and then the **Network** soft key to display the following menu.



Printing

Press **PRINT**. The image is output to the network printer according to the settings.

Note

You must configure the network printer in advance by following the instructions in section 18.7.

16.5 Saving Screen Captures to Files

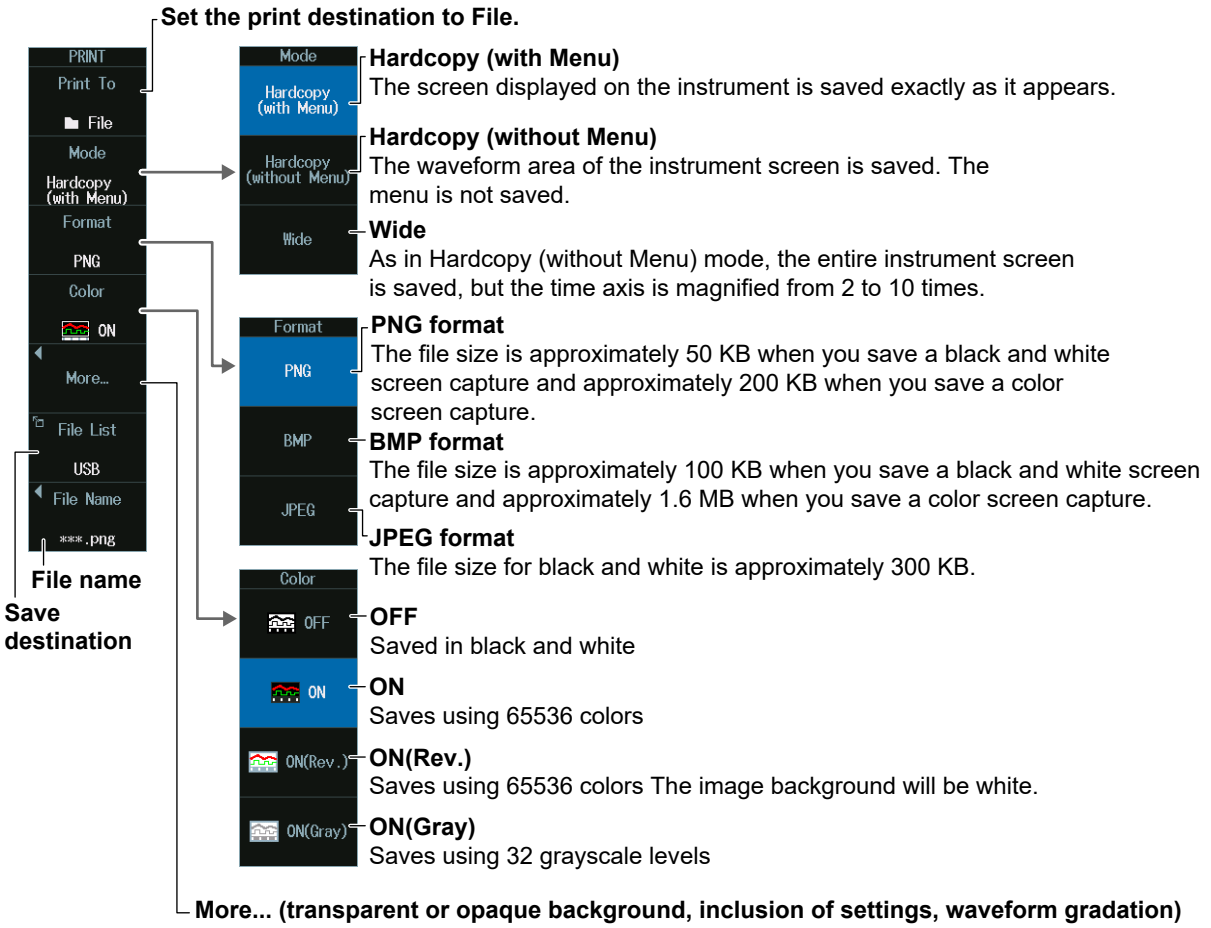
This section explains the following settings for saving screen captures to files:

- Output destination
- Save mode
- Data format
- Color data
- Background transparency (transparent or opaque)
- Including setting information
- Waveform gradation
- Save destination
- File name

► "Saving Screen Captures to Files (File)" in the Features Guide

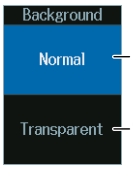
PRINT File Menu

1. Press **SHIFT+PRINT** (MENU) to display the PRINT menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the PRINT (PRINT MENU) menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Print To** and then the **File** soft key to display the following menu.



Background Transparent or Opaque (Background)

1. Press the **More** soft key.
2. Press the **Background** soft key to display the following menu.

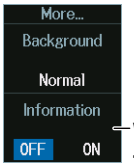


Normal
Saves data without changing the background (opaque)

Transparent
Saves data with a transparent background

Including Setting Information (Information)

1. Press the **More** soft key to display the following menu.
   When save mode is set to Hardcopy or Normal, channels, triggers, waveform acquisition, and other setting information can be included in waveform screen captures.



Whether to save the instrument settings that were used at the time the waveform was acquired

Waveform Gradation (Waveform Gradation)

1. Press the **More** soft key to display the following menu.
   Gradation can be applied to the waveform color when Color is set to ON (Rev.).

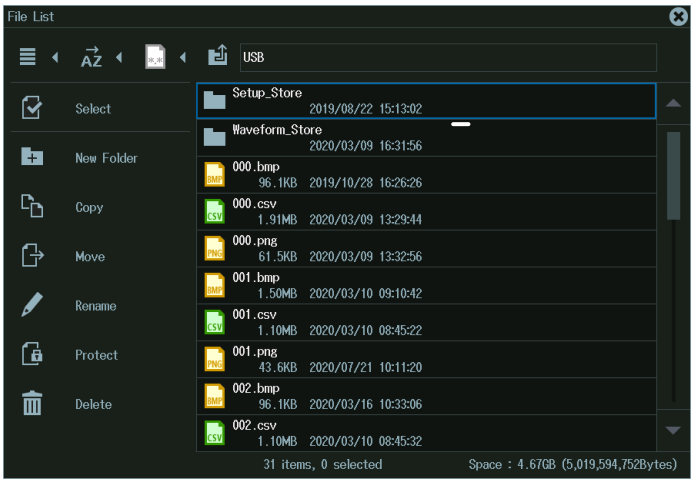


Applies color gradation to the waveform (ON) or applies a single color to the waveform (OFF)

Save Destination (File List)

1. Press the **File List** soft key to display the following menu.

File List screen



Note

This is the same as the file feature. Set the drive and folder to save the file to. For details, see section 17.2.

File name (File Name)

1. Press the **File Name** soft key to display the following menu.



Auto naming
Sets file names automatically. You can select numbers or times.

File name
Enter the file name.
For details, see section 3.3 in IM DLM5058-03EN.

Note

This is the same as the file feature (except the comment feature). You can save files with automatically generated names using sequence numbers or dates, or save the files with specific file names. For details, see section 17.2.

Saving

Press **PRINT** to save the screen capture file to the specified folder.

16.6 Printing and Saving Screen Capture Data to Multiple Output Destinations at the Same Time

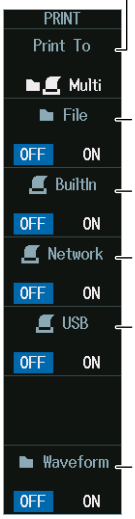
This section explains the following settings for printing and saving screen capture data and waveform data to multiple output destinations at the same time:

- Output destination
- Saving screen captures to files
- Printing screen captures on the built-in printer (option)
- Printing screen captures on the USB printer
- Printing screen captures on the network printer
- Saving Waveform Data

► **"Printing and Saving Screen Captures to Multiple Destinations (Multi)" in the Features Guide**

PRINT Multi Menu

1. Press **SHIFT+PRINT** (MENU) to display the PRINT menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the PRINT (PRINT MENU) menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Print To** and then the **Multi** soft key to display the following menu.



Set the output destination to Multi.
The instrument outputs screen capture data and waveform data according to the PRINT menu or FILE menu settings. For details on those settings, see the following sections.

Saving screen captures to files
► section 16.5

Printing screen captures on the built-in printer (option)
► section 16.2

Printing screen captures on the network printer
► section 16.4

Printing screen captures on the USB printer
► section 16.3

Saving waveform data
► section 17.2

Note

You cannot execute action-on-trigger or GO/NO-GO determination if Print To is set to Multi when Print is set to ON on the ACTION menu.
► sections 2.27 to 2.28

Printing and Saving

Press **PRINT**. The screen capture or waveform data is output to the specified output destinations.

17.1 Connecting USB Storage Devices to the USB Ports

CAUTION

Do not remove the USB storage device or turn off the power when the media (internal storage or USB storage device) access icon is blinking in the center of the screen or when the USB storage device access indicator is blinking. Doing so may damage the storage device or corrupt its data.

Access Icon



French

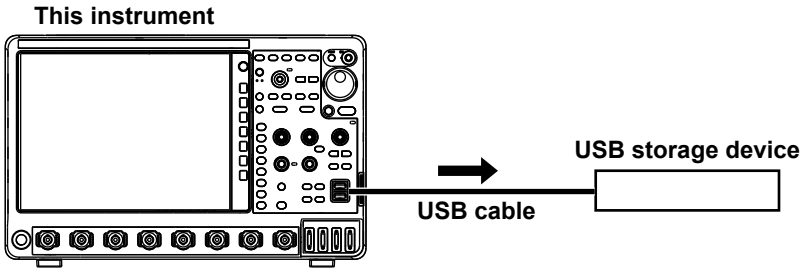
ATTENTION

Ne retirez pas le support de stockage USB et ne mettez pas l'alimentation hors tension lorsque l'icône d'accès au support (mémoire interne ou stockage USB) clignote au centre de l'écran ou que le voyant d'accès au support de stockage USB clignote. Vous risqueriez d'endommager le support de stockage ou les données qu'il contient.

Icône d'accès



You can connect/disconnect a USB cable at any time regardless of whether the instrument is on or off (hot-plugging is supported). Connect the type A connector of the USB cable to the instrument, and connect the other connector to the USB storage device. If you connect a USB storage device when the power switch is on, the device becomes available for use after the instrument identifies it.



Note

- Only connect a compatible USB keyboard, mouse, printer, or storage device to the USB port for peripherals.
- Do not connect and disconnect multiple USB devices repetitively. Provide at least a 10-second interval between removal and connection.
- Do not connect or remove USB cables from the time when the instrument is turned on until key operation becomes available (approximately 20 to 30 seconds).
- You can use USB storage devices that are compatible with USB Mass Storage Class version 1.1.
- The supported formats of USB storage are exFAT, FAT32, and FAT16.
- The instrument can handle up to two storage devices. If the connected medium is partitioned, the instrument treats each partition as a separate storage device. As such, the instrument can handle up to two partitions.

Confirming What Connected USB Storage Device Can Be Used

1. Press **FILE**, and then press the **Utility** soft key to display the file list.
   For details on the file list, see section 17.8.
2. Select (display one level up), and then press **SET**.
   - The next higher level is displayed. Repeat this step until the file list displays the media.
   - For more information on file operations, see section 17.8.

17.2 Saving Waveform Data

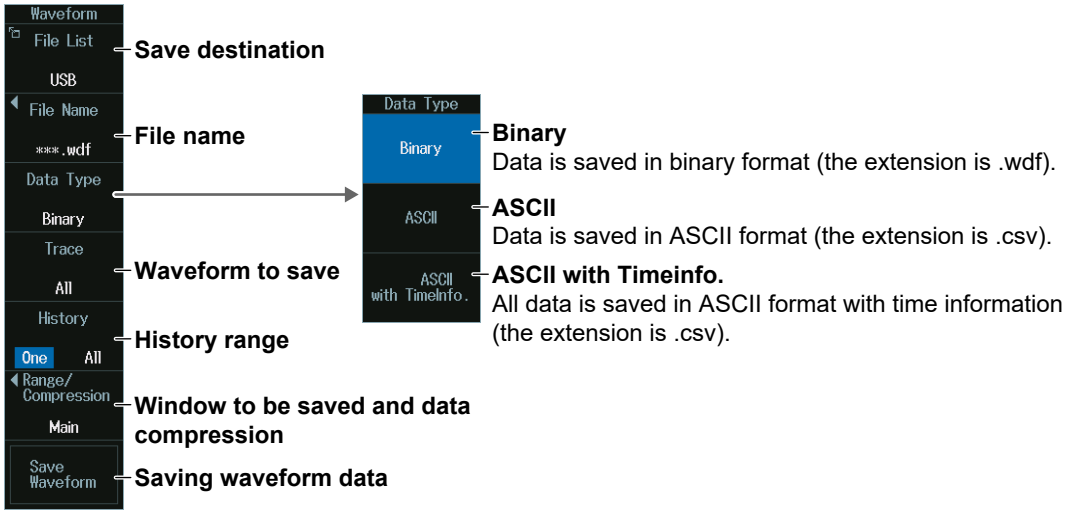
This section explains the following settings for saving waveform data):

- Save destination
- File name
- Data format
- Waveform to save
- History range
- Window to be saved
- Data compression
- Saving Waveform Data

► "Saving Waveform Data (Waveform)" in the Features Guide

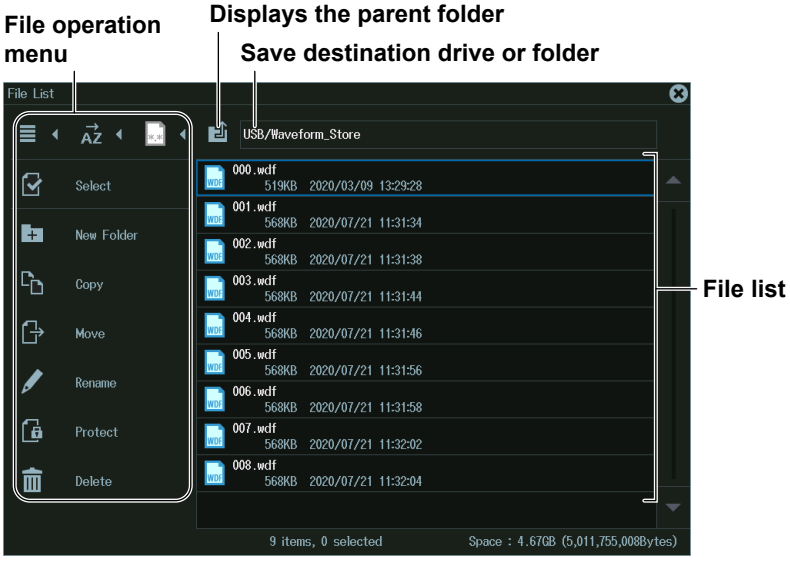
File Waveform (Save) Menu

1. Press **FILE** to display the FILE menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the FILE menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Waveform (Save)** soft key to display the following menu.



Save Destination (File List)

Press the **File List** soft key to display the following screen.

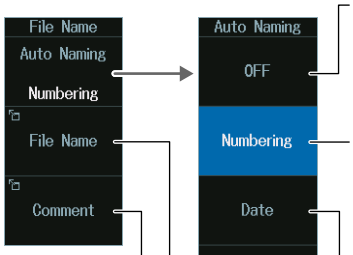


Note

- For more information on file operations, see section 17.8.
- The available settings for saving waveforms vary depending on the model.
  - The available settings on 8ch models are as follows:
    All, CH1 to CH8, Math1 to Math8, Logic
  - The available settings on 4ch models are as follows:
    All, CH1 to CH4, Math1 to Math4, Logic

File name (File Name)

Press the **File Name** soft key to display the following menu.

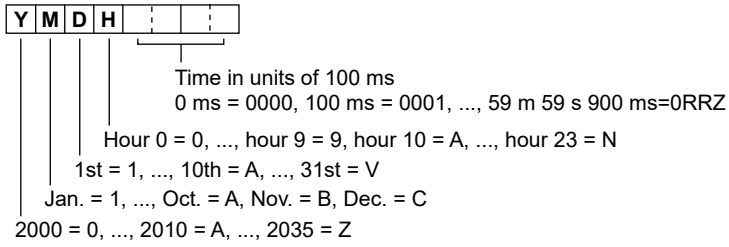


Auto naming

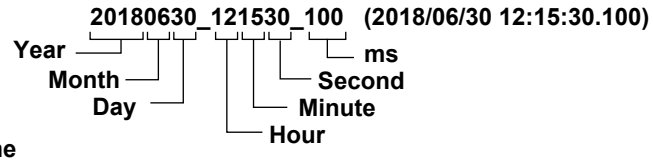
OFF
The auto naming feature is disabled. The name that you specify using the File Name setting is used. If a file with the same name exists in the save destination folder, an overwrite confirmation dialog box is displayed.

Numbering
The instrument automatically adds a three-digit number from 000 to 999 or a four-digit number from 1000 to 4999 after the common name specified using the File Name setting and saves the file.

Date
As shown in the following figure, the instrument uses an 8-character file name that is produced based on the date and time using base-36 numbers (0 to 9 and A to Z). The file name specified using the File Name setting is not used.



Date2
The file name is the date and time (down to ms) when the file is saved. The file name specified using the File Name setting is not used.



File name
You can set the common file name that is used when the auto naming feature is turned off or when the auto naming feature is set to Numbering.

Comment
You can add a comment that consists of up to 128 characters when you save a file. You do not have to enter a comment. All characters, including spaces, can be used in comments.

History Range (History)

Press the **History** soft key to select **One** or **All**.

History Range

Of the waveforms that are selected to be saved on the Trace menu, set which range of history waveforms to save.

One: The single waveform that is specified with Select No. on the HISTORY menu will be saved.[1]

All: All history waveforms within the range bounded by Start No. and End No. on the HISTORY menu will be saved.[1]

1 The waveform that you specify with Select No. is not necessarily highlighted.

The history range is fixed to One or All depending on the history waveform display mode (see section 15.1) and the type of data to be saved (Data Type) on the HISTORY menu.

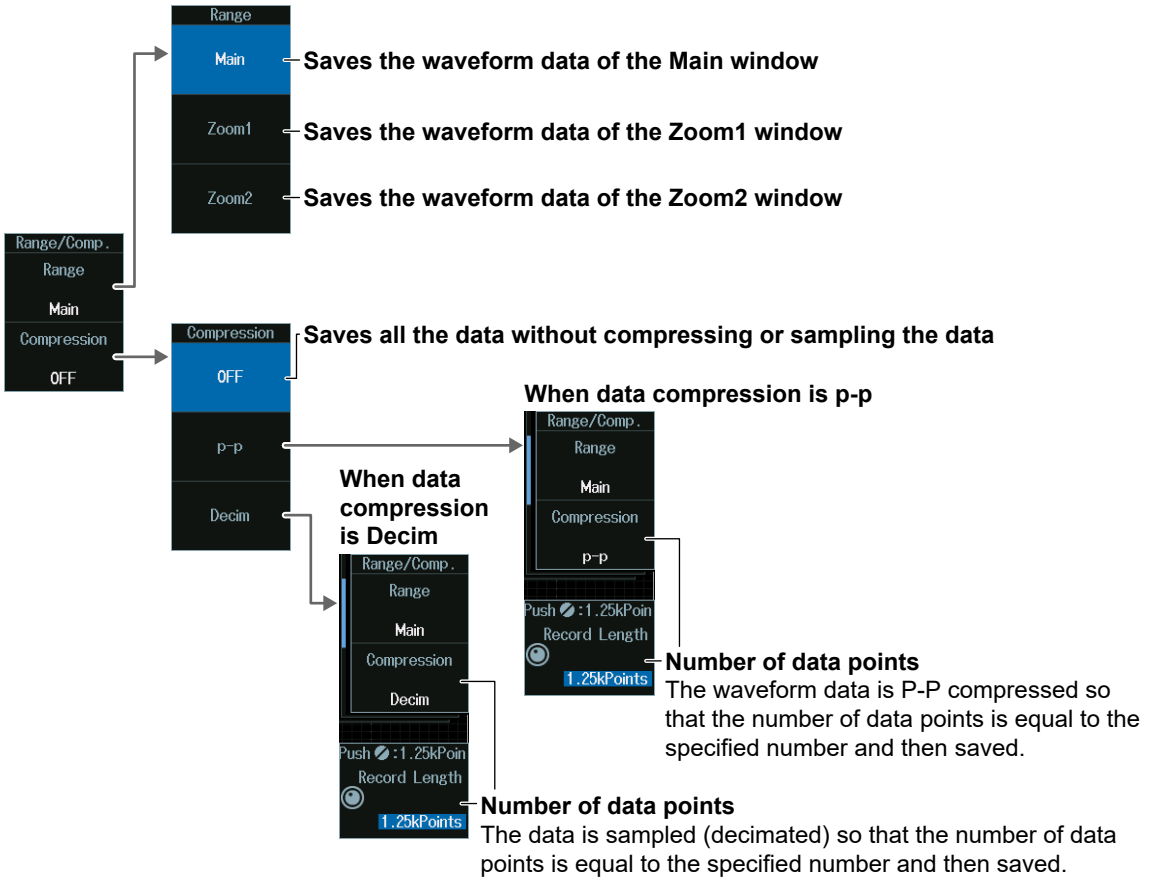
Display Mode (Mode) on the HISTORY Menu		One	All	Accumulate
Type of data to be saved (Data Type)	Binary	One or All selectable	One or All selectable	Fixed to All
	ASCII	Fixed to One	Fixed to One	Fixed to One
	ASCII with TimeInfo.	Fixed to One	Fixed to One	Fixed to One

Note

If Average on the HISTORY menu is set to ON, only a single set of averaged waveform data will be saved regardless of the display mode specified on the HISTORY menu, the type of data to be saved, and the history range.

Window to Be Saved and Data Compression (Range/Compression)

Press the **Range/Compression** soft key to display the following menu.



Saving Waveform Data in ASCII Format

If the window to be saved is set to Main, you can save the waveform data by compressing or sampling it. If you want to save waveform data whose record length exceeds is 1.25 Mpoints to a file in ASCII format, the data must be compressed. If the window to be saved is set to Zoom1 or Zoom2, data compression is not possible. Therefore, waveform data whose number of data points on the window to be saved exceeds1.25 Mpoints cannot be saved to a file in ASCII format.

Whether Data Compression and Waveform Loading Are Possible

Waveform data saved in binary format can be loaded into the instrument, but the possible load destinations vary depending on the data compression setting.
Waveform data saved in ASCII or ASCII with TimeInfo. format cannot be loaded into the instrument regardless of the data compression setting.

Waveform Load Destination		Loading into Channels (Load to Channels)	Loading into Reference Waveforms (Ref1 to Ref8)
Data compression (Compression)	OFF	Allowed	Allowed
	P-P	Not allowed	Allowed
	Decim	Not allowed	Allowed

Note

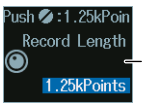
- For details on loading waveform data, see section 17.5.
- The available load destination settings vary depending on the model.
  The available settings on 8ch models are as follows:
  Ref1 to Ref8
  The available settings on 4ch models are as follows:
  Ref1 to Ref4

Number of Data Points (Record Length)

Turn the **jog shuttle** to set the number of actions.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Number of data points

17.3 Saving Setup Data

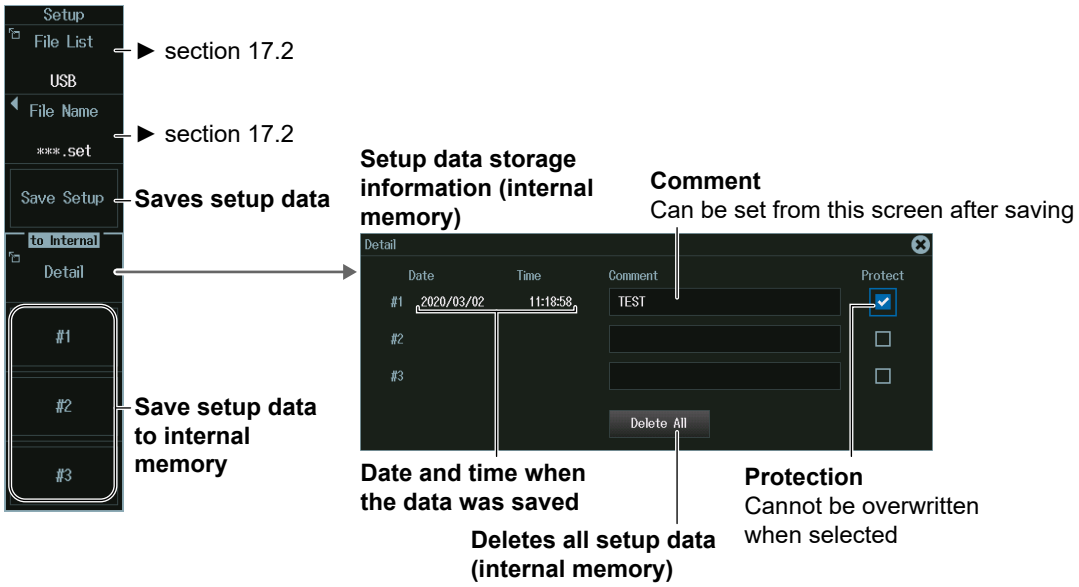
This section explains the following settings for saving setup data:
You can save setup data to a file or to three different internal memory locations.

- Save destination
- File name
- Detailed internal memory settings
- Saving setup data

► “Saving Setup Data (Setup)” in Features Guide

File Setup (Save) Menu

1. Press **FILE** to display the FILE menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the FILE menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Setup (Save)** soft key to display the following menu.



Saving Setup Data (Save Setup)

Press the Save Setup soft key to save the setup data with the specified file name at the selected save destination.

Saving Setup Data to Internal Memory (#1 to #3 (to Internal Memory))

Press a soft key from **#1** to **#3** to save the setup data at the selected internal memory number (.set extension).

Note

“Flash_Mem,” which is a save destination for Save Setup, is a memory area inside the instrument, but is different from the save destination of “to Internal #1 to #3.” The save destinations of “to Internal” are fixed to three locations. You cannot specify their file names. If you want to save more than three sets of setup data or if you want to assign file names to each file, save the setup data to “Flash_Mem,” which is a save destination for Save Setup.

17.4 Saving Other Types of Data

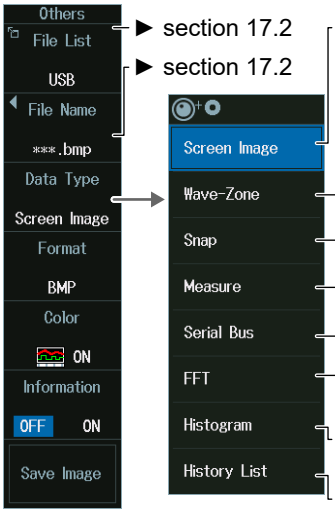
This section explains the following settings for saving screen captures, waveform zone data, snapshot waveform data, automated measurement values of waveform parameters, serial bus analysis results, FFT results, histogram data, and the list of timestamps:

- Save destination
- File name
- Saved data
- Data format
- Color data
- Waveform zone number
- Serial bus
- FFT
- Histogram
- Saved data

► "Saving Other Types of Data (Others)" in Features Guide

File Others (Save) Menu

1. Press **FILE** to display the FILE menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the FILE menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Others (Save)** soft key to display the following menu.



► section 17.2

► section 17.2

Screen Image:[1] Saves the displayed screen image in PNG, BMP, or JPEG format.

Wave-Zone: Saves the waveform zone to a file with a .zwf extension.

Snap: Saves the waveform data captured in a snapshot to a file with a .snp extension.

Measure: Saves the results of the specified item of automatic waveform parameter measurement to a file in CSV format.

Serial Bus: Saves the results of the serial bus analysis specified by Serial Bus 1 to Serial Bus 4 to a file in CSV format.

FFT:[2] Saves the computed results specified by FFT1 to FFT4 (FFT1, FFT2 on 4ch models) to a file in CSV format. Up to 1.25 Mpoints of data can be saved.

Histogram: Saves the waveform or waveform parameter histogram specified by Histogram1 or Histogram2 to a file in CSV format.

History List: Saves the list of timestamps to a file in CSV format.

1 Screen Image

- You can select whether to include setting information such as channels, triggers, and waveform acquisition, in waveform screen captures. For details on screen captures that include setting information, see section 16.5.
- Screen captures that can be saved on the FILE menu are those that correspond to Hardcopy (without Menu) save mode on the SHIFT+PRINT menu.

2 FFT Group

- When Freq Info. is set to ON, all data is saved with frequency information.
- When Freq Info. is set to OFF, all data is saved without frequency information.

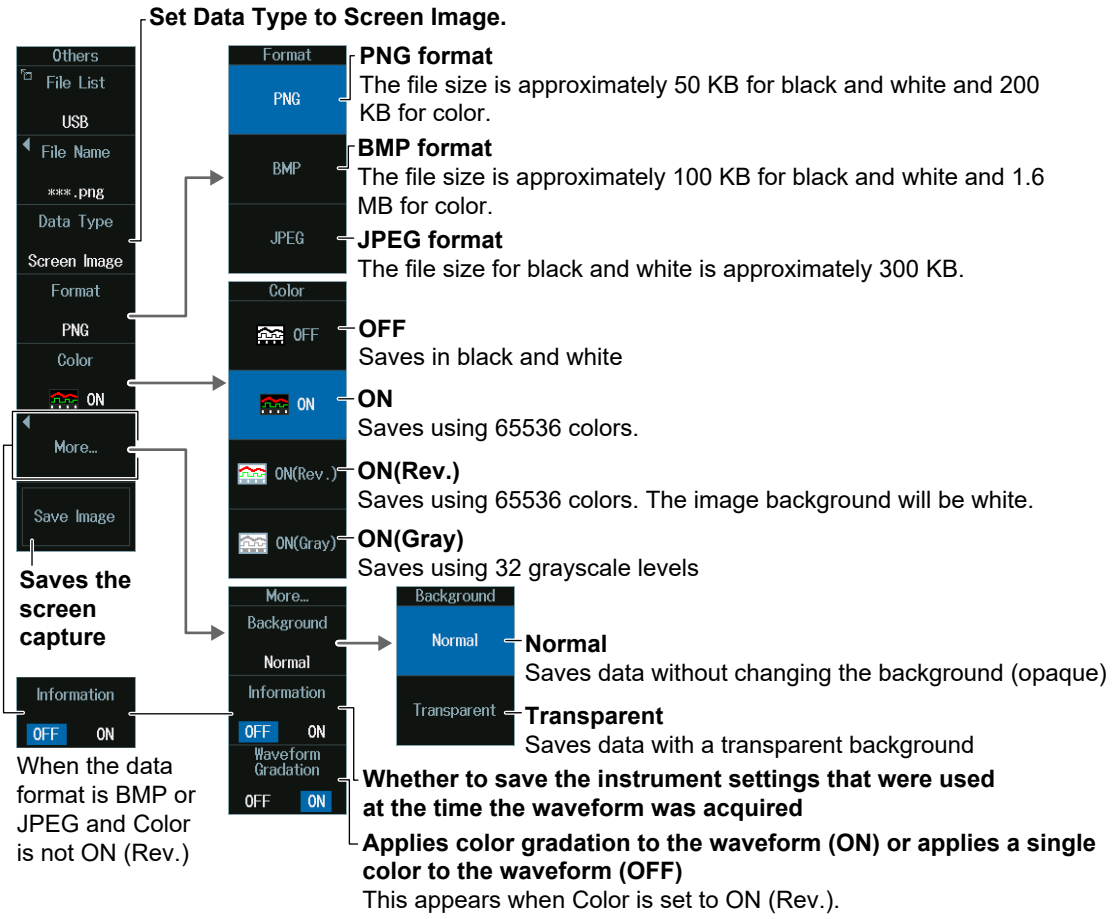
Note

The serial bus analysis results are saved according to the history range (History) of section 17.2.

Data Type to Save (Data Type)

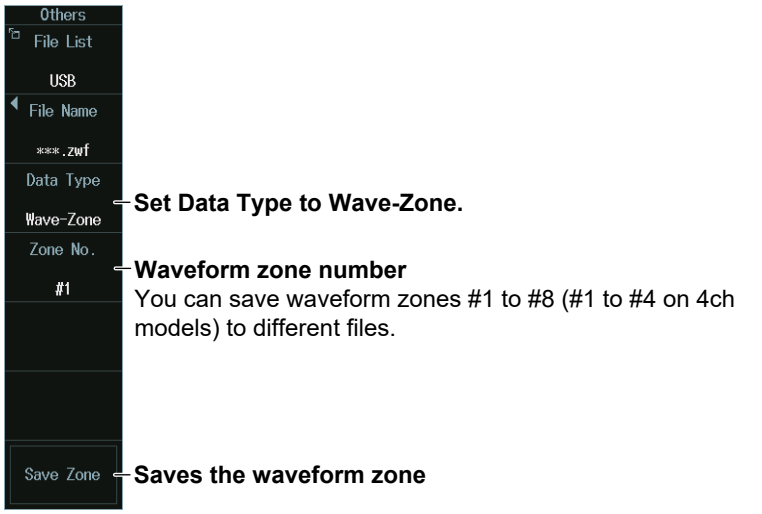
Screen Captures (Screen Image)

1. Press the **Data Type** soft key.
2. Press the **Screen Image** soft key to display the following menu.



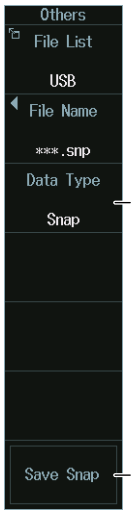
Waveform Zone (Wave Zone)

1. Press the **Data Type** soft key.
2. Press the **Wave-Zone** soft key to display the following menu.



Snapshot Waveforms (Snap)

1. Press the **Data Type** soft key.
2. Press the **Snap** soft key to display the following menu.



Set Data Type to Snap

Saves a snapshot waveform

Automated Measurement Values of Waveform Parameters (Measure)

1. Press the **Data Type** soft key.
2. Press the **Measure** soft key to display the following menu.

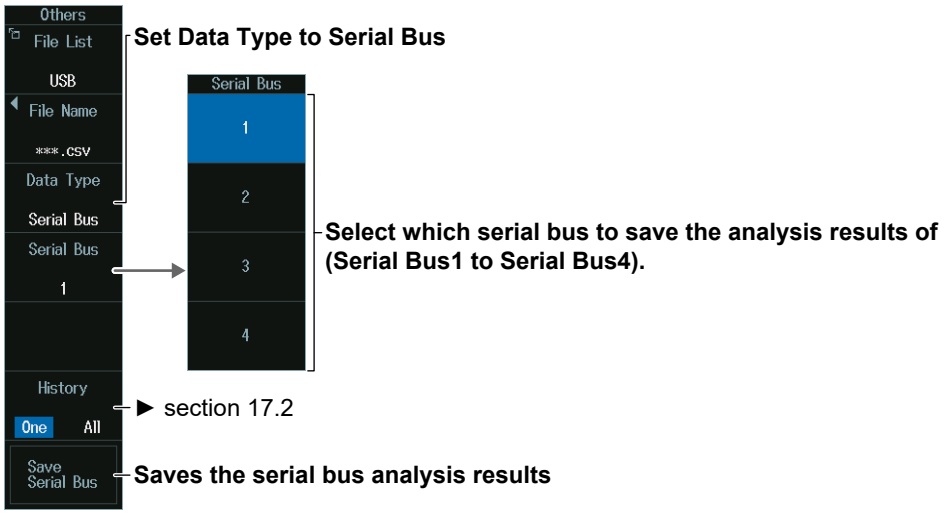


Set Data Type to Measure

Saves the automated measurement values of waveform parameters

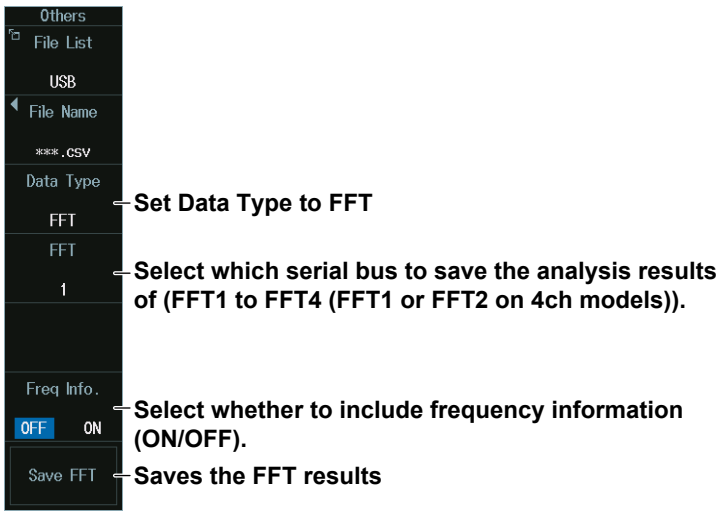
Serial Bus Analysis Results (Serial Bus)

1. Press the **Data Type** soft key.
2. Press the **Serial Bus** soft key to display the following menu.



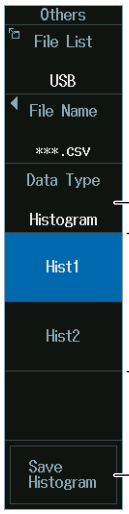
FFT Computation Results (FFT)

1. Press the **Data Type** soft key.
2. Press the **FFT** soft key to display the following menu.



Histogram (Histogram)

1. Press the **Data Type** soft key.
2. Press the **Histogram** soft key to display the following menu.



Set Data Type to Histogram.

Selects which histogram, Histogram1 or Histogram2, to save the history display of.

Saves the histogram display

List of Timestamps (History List)

1. Press the **Data Type** soft key.
2. Press the **History List** soft key to display the following menu.



Set Data Type to History List

Saves the list of timestamps

17.5 Loading Waveform Data

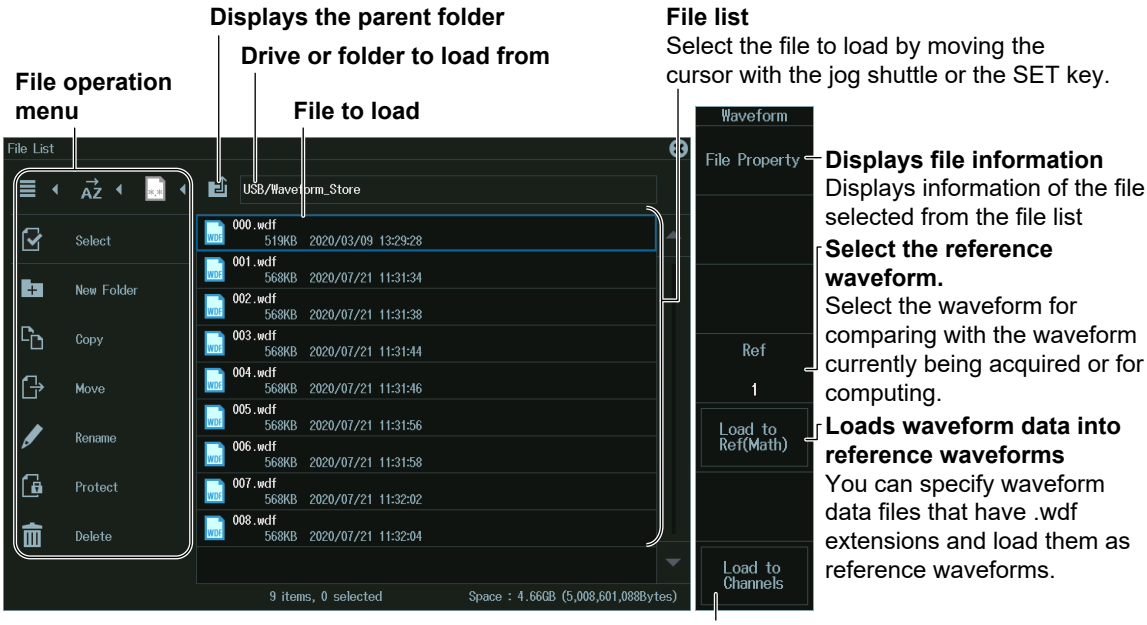
This section explains the following settings for loading waveform data):

- Displaying file information
- Loading waveform data into reference waveforms
- Loading waveform data into channels

► "Loading Waveform Data (Waveform)" in Features Guide

File Waveform (Load) Menu

1. Press **FILE** to display the FILE menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the FILE menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Waveform (Load)** soft key to display the following menu.



Note

- For instructions on how to use the file list, see section 17.8.
- To load a file saved from the waveform data of multiple channels as a reference waveform, use Load to Channels to load the waveform into channels, and then load the waveform as a computation reference waveform (see section 6.7).

17.6 Loading Setup Data

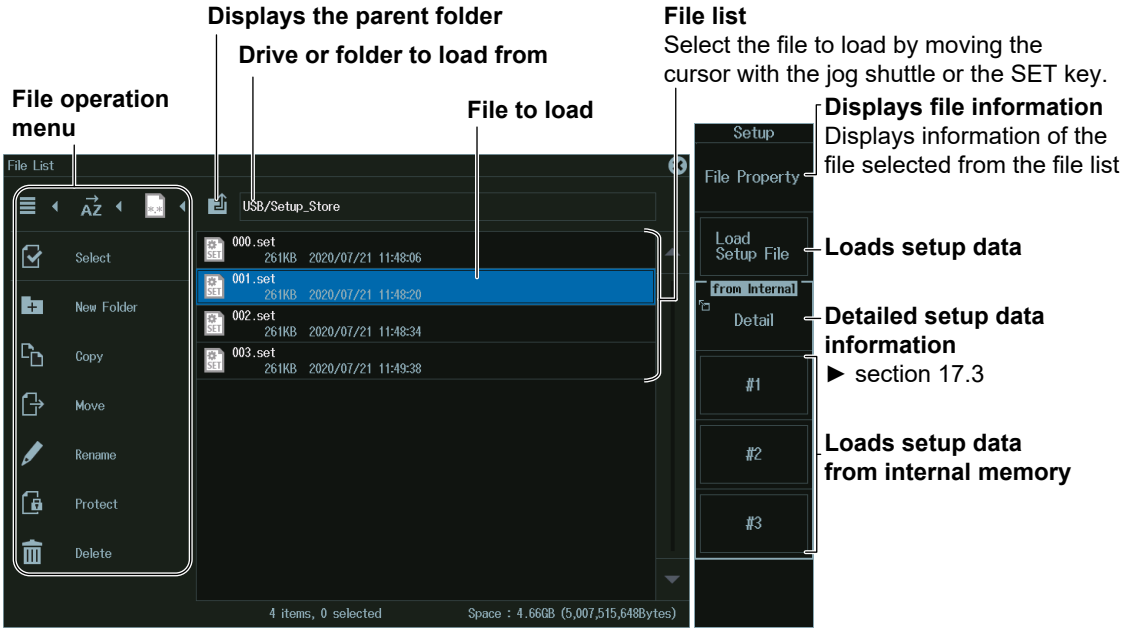
This section explains the following settings for loading setup data:
There are two methods you can use to load setup data. One method is to load setup data that has been saved to a file. The other method is to load setup data that is saved in the internal memory.

- Displaying file information
- Internal memory details
- Loading setup data

► "Loading Setup Data (Setup)" in the Features Guide

File Setup (Load) Menu

1. Press **FILE** to display the FILE menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the FILE menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Setup (Load)** soft key to display the following menu.



Note

For instructions on how to use the file list, see section 17.8.

17.7 Loading Other Types of Data

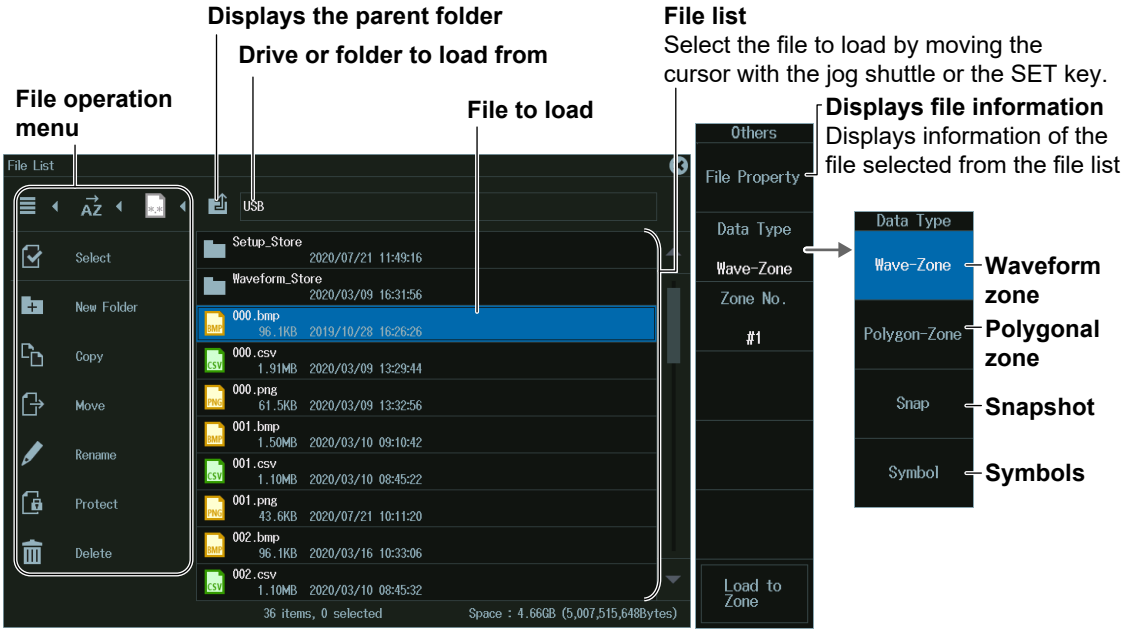
This section explains the following settings for loading waveform zones, polygonal zones, snapshot waveforms, or serial bus waveform symbol data:

- Displaying file information
- Data to load
- Loading data

► "Loading Other Types of Data (Others)" in Features Guide

File Others (Load) Menu

1. Press **FILE** to display the FILE menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the FILE menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Others (Load)** soft key to display the following menu.



Note

For instructions on how to use the file list, see section 17.8.

Data to Load (Data Type)

Waveform Zone (Wave Zone)	Load waveform zone files that have .zwf extensions that you created on the instrument into internal memory areas Zone1 to Zone8 (Zone1 to Zone4 on 4ch models).
Polygonal Zone (Polygon-Zone)	Load polygonal zone files that have .msk extensions that you created with the Mask Editor software into internal memory areas Zone1 to Zone8 (Zone1 to Zone4 on 4ch models).
Snapshot (Snap)	Load snapshot waveform files that have .snp extensions that you have saved.
Symbol (Symbol)	Load physical value/symbol definition files that have .sbl extensions that you have edited using the Symbol Editor tool.

Data to Load (Data Type)

Waveform Zone (Wave Zone)

1. Press the **Data Type** soft key.
2. Press the **Wave-Zone** soft key to display the following menu.



Set Data Type to Wave-Zone.

Select the waveform zone from the internal memory (#1 to #8).

Loads a waveform zone

Polygonal Zone (Polygon-Zone)

1. Press the **Data Type** soft key.
2. Press the **Polygon-Zone**Zone soft key to display the following menu.



Set Data Type to Polygon-Zone.

Select the polygonal zone from the internal memory (#1 to #8).

Loads a polygonal zone

Snapshot Waveforms (Snap)

1. Press the **Data Type** soft key.
2. Press the **Snap** soft key to display the following menu.



Set Data Type to Snap

Loads snapshot waveforms

Serial Bus Waveform Symbols (Symbol)

1. Press the **Data Type** soft key.
2. Press the **Symbol** soft key to display the following menu.



Set Data Type to Symbol.

Loads serial bus waveform symbol data (.sbl)

Note

Symbols (.sbl)

Character string bit pattern based on definitions in a CANdb file.
This is a file (.sbl) created by converting the data in a CANdb file (.dbc) using Symbol Editor.

Symbol Editor

This is a free software that you can download from the YOKOGAWA website (http://www.yokogawa.com/jp-ymi/).

CANdb File (.dbc)

A definition database file created using the CANdb or CANdb++ software produced by Vector Informatik.

17.8 Performing File Operations

This section explains the following settings for performing various file operations from the file list or the file UTILITY menu:

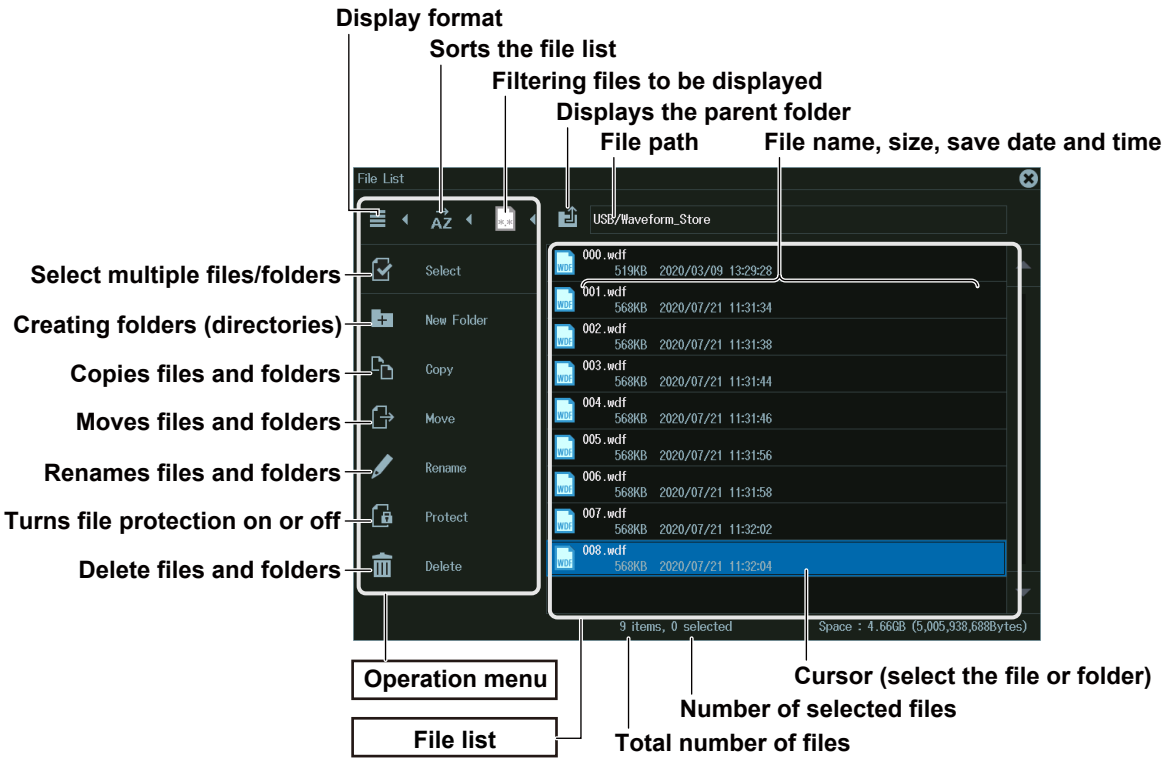
File list
- Display format
- Sorting the file list
- Filtering files to be displayed

- Displaying the parent folder
- Selecting multiple files and folders (All Set, All Reset, and Set/Reset)
- Creating folders (directories)
- Coping files and folders
- Moving files and folders
- Renaming files and folders
- Turning file protection on or off
- Deleting files and folders

FILE UTILITY menu
- Displaying file information
- Turning file protection on or off
- Selecting multiple files and folders (All Set, All Reset, and Set/Reset)

► “File Operations (Utility)” in Features Guide

File List (File List)



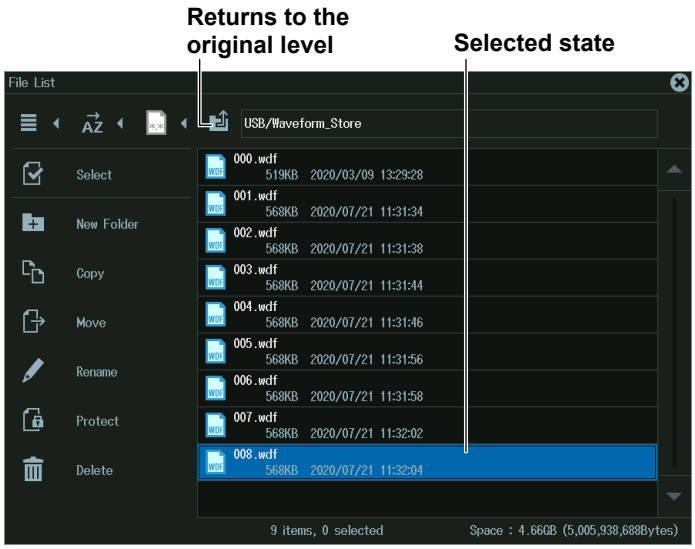
Switching Between the Operation Menu and the File List

- Tilt **SET** (●) to the left to move the cursor to the operation menu. Tilt it to the right to move the cursor to the file list.
- • To move the cursor between ☰, AZ,* and ,* tilt the **SET** key to the left or right.
  The icon varies depending on the selected menu item.
- To move the cursor to (display the parent folder), move the cursor to the top of the file list, then tilt **SET** up.

Selecting the Item to Operate (File List)

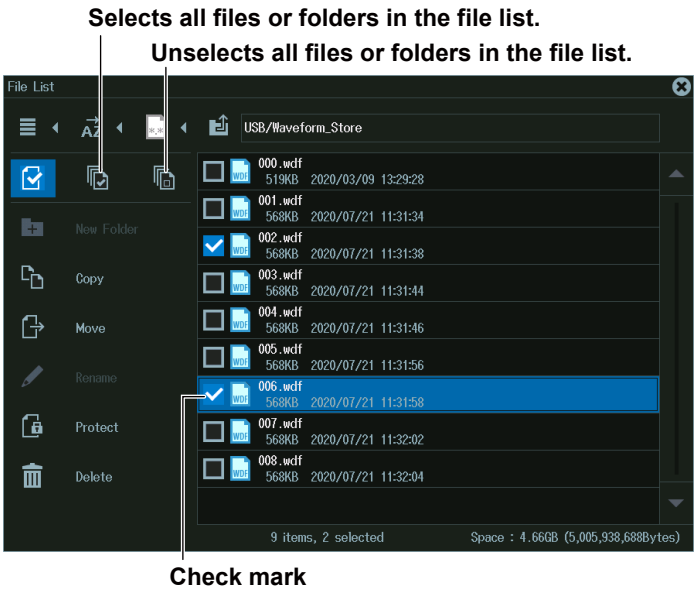
When Operating a File or Folder

1. Turn the **jog shuttle** or tilt the **SET** (●) key up and down to move the cursor to the file or folder you want to select.
   A blue frame appears around the selected file or folder.
2. To display inside of a folder, move the cursor to the folder, and press **SET** (●).
   To return to the original folder, move the cursor to (display the parent folder) and press SET.



When Operating Multiple Files and Folders (Select)

1. Display the content of a drive or folder that contains multiple files or folders that you want to select.
2. Select **Select** (☑) on the operation menu and press **SET**. to display the following screen.
   The cursor moves to the file list.



3. Move the cursor to a file or folder that you want to select on the file list.
4. Press **SET** (●).
   - A check mark is displayed next to the selected file or folder.
   - Press **SET** again to remove the check mark.
5. Repeat steps 3 and 4 to select all the files and folders you want.
   - To select all or unselect all, move the cursor to the operation menu, select Select All (⧉) or Unselect All (⧉), and then press **SET**.
   - To close the multiple selection screen, move the cursor to the operation menu, select Select (☑) and press **SET**. Multiple selection will be canceled.

Selecting the Operation Content (Operation Menu)

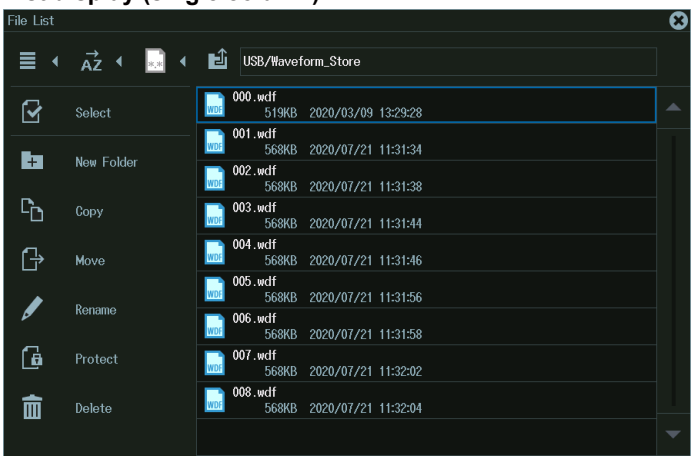
1. Turn the **jog shuttle** or move the **SET** (●) key up and down to move the cursor to the menu item you want to use.
2. Press **SET** (●).
   - The screen for the selected item appears.
   - To return to the previous screen, press **ESC**.

Display Format (☰)

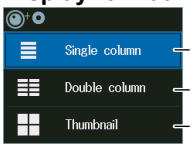
Select the icon (☰) from the operation menu, and press **SET**. The following screen appears.

The icon will change according to the currently selected display format.

List display (single column)



Display format

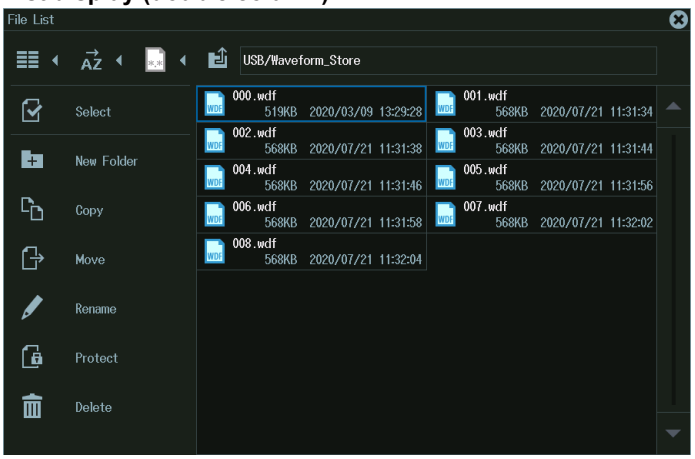


List display (single column)

List display (double column)

Thumbnail display

List display (double column)



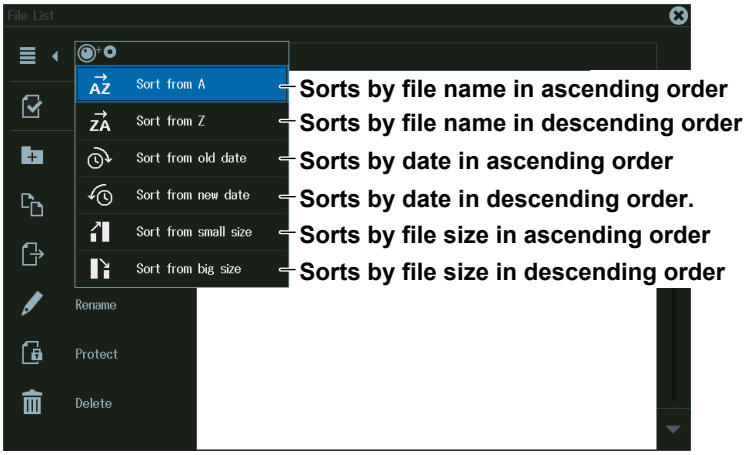
Thumbnail display



Sorting the File List (AZ)

Select the icon (AZ) from the operation menu, and press **SET**. The following screen appears.

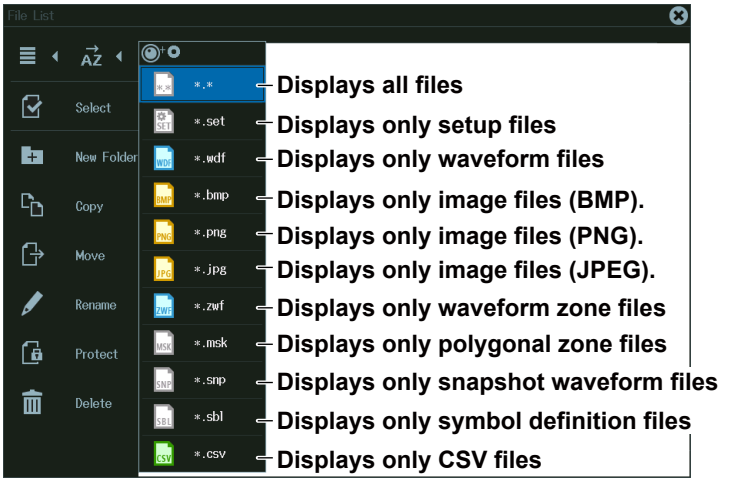
The icon will change according to the currently sort order.



Filtering the Files to Display (*.*)

Select the icon (*.*) from the operation menu, and press **SET**. The following screen appears.

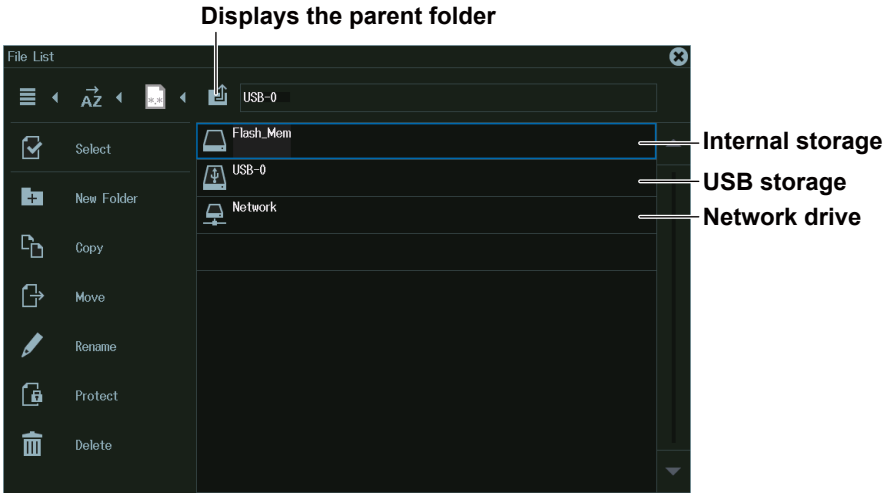
The icon varies depending on the selected file type.



Displaying the Parent Folder ( )

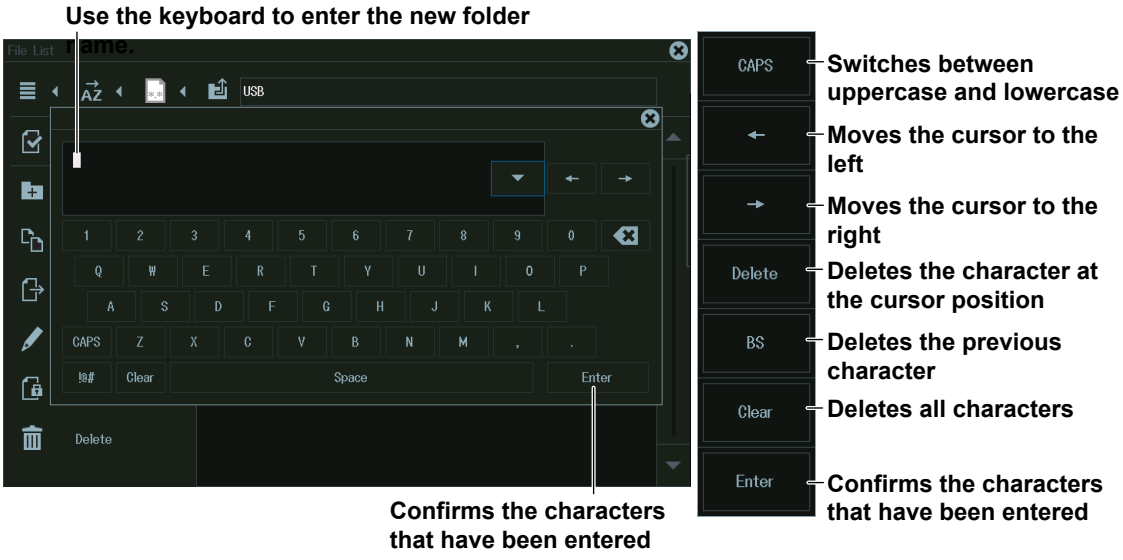
Select the icon ( ) from the operation menu, and press **SET**. The parent folder is shown in the file list.

When the top folder is displayed, you can change the storage device.



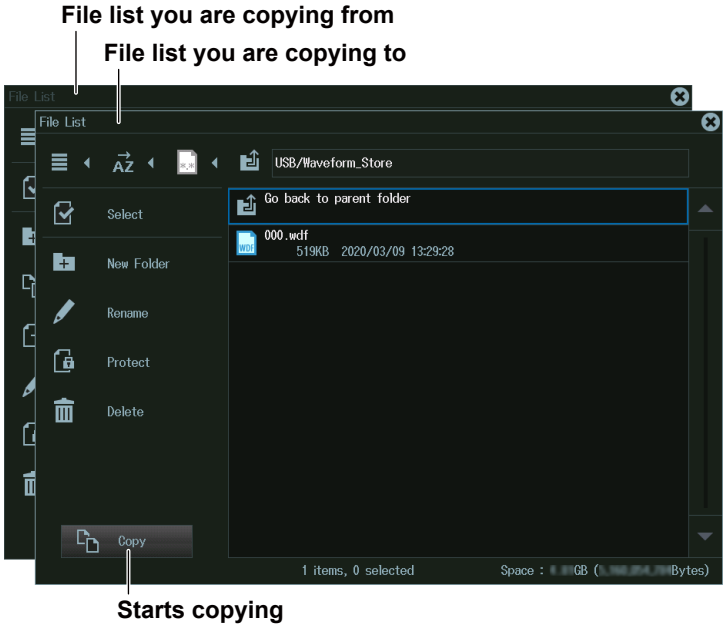
Making Folders (Directories) (New folder)

1. Create a folder and display the content of the drive or folder in the file list.
2. Select **New Folder** from the operation menu, and press **SET**. The following screen appears.



Copying Files and Folders (Copy)

1. Select the files and folders in the file list that you want to copy.
2. Select **Copy** from the operation menu, and press **SET**. The following screen appears.



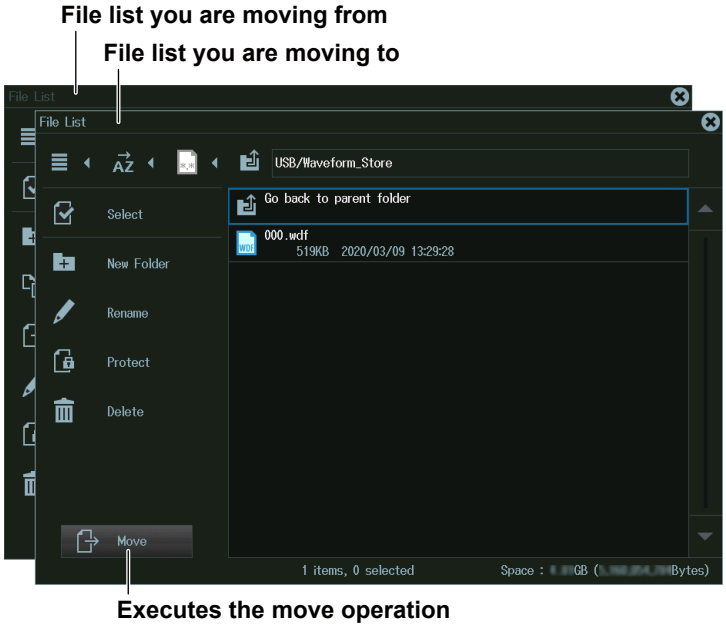
3. Select the drive or folder in the file list that you want to copy to.
4. Tilt **SET** to the left and move to the copy destination operation menu.
5. Select **Copy**, and press **SET**. The files and folders are copied to the destination.

Note

- By selecting multiple files, you can copy them all at the same time. For instructions on how to select multiple files, see page 17-19.
- You can perform file operations on the file list that you are copying to as well.

Moving Files and Folders (Move)

1. Select the files and folders in the file list that you want to move.
2. Select **Move** from the operation menu, and press **SET**. The following screen appears.



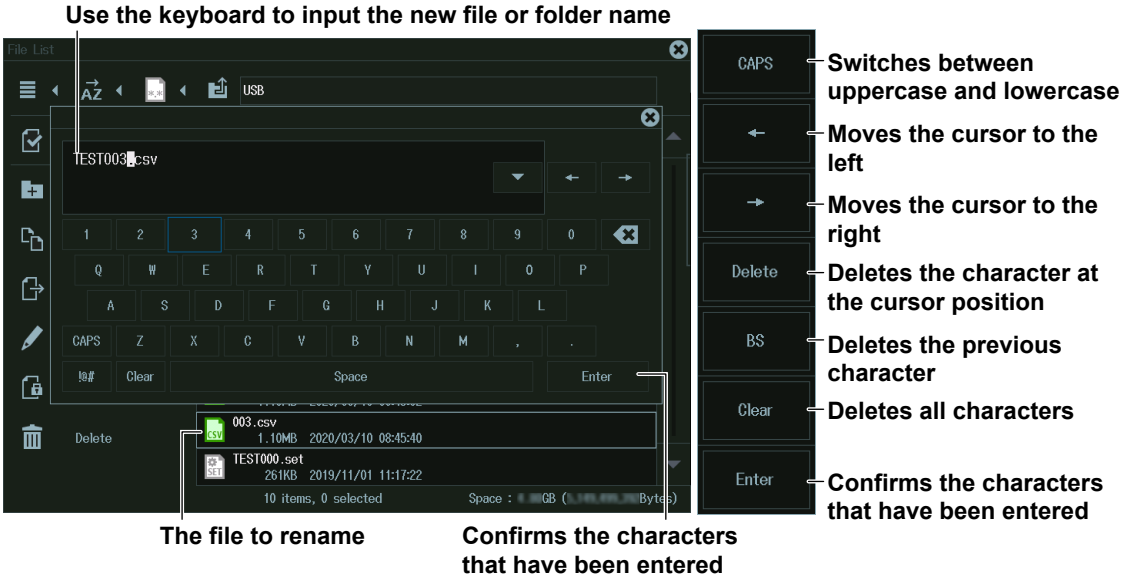
3. Select the drive or folder in the file list that you want to move to.
4. Tilt **SET** to the left and move to the move destination operation menu.
5. Select **Move**, and press **SET**. The files or folders are moved to the destination.

Note

- By selecting multiple files, you can move them all at the same time. For instructions on how to select multiple files, see page 17-19.
- You can perform file operations on the file list that you are moving files to as well.

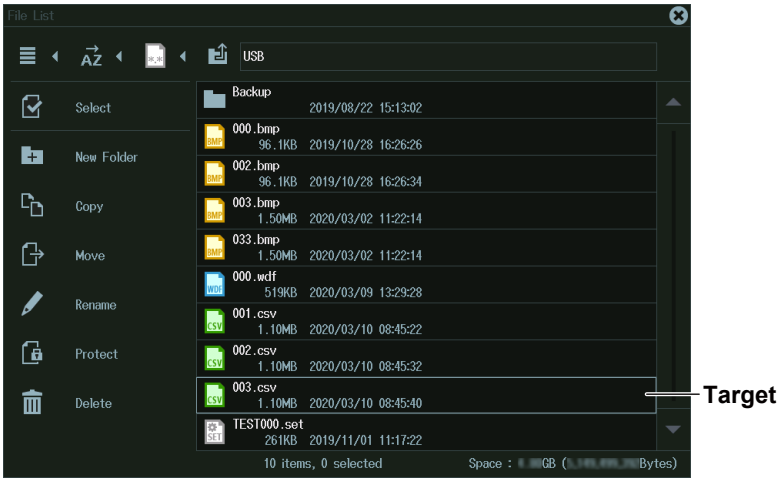
Renaming Files and Folders (Rename)

1. Select the file or folder that you want to rename from the file list.
2. Select **Rename** from the operation menu, and press **SET**. The following screen appears.



Deleting Files and Folders (Delete)

1. Select the file or folder that you want to delete from the file list.
2. Select **Delete** from the operation menu, and press **SET**. The selected file is deleted.

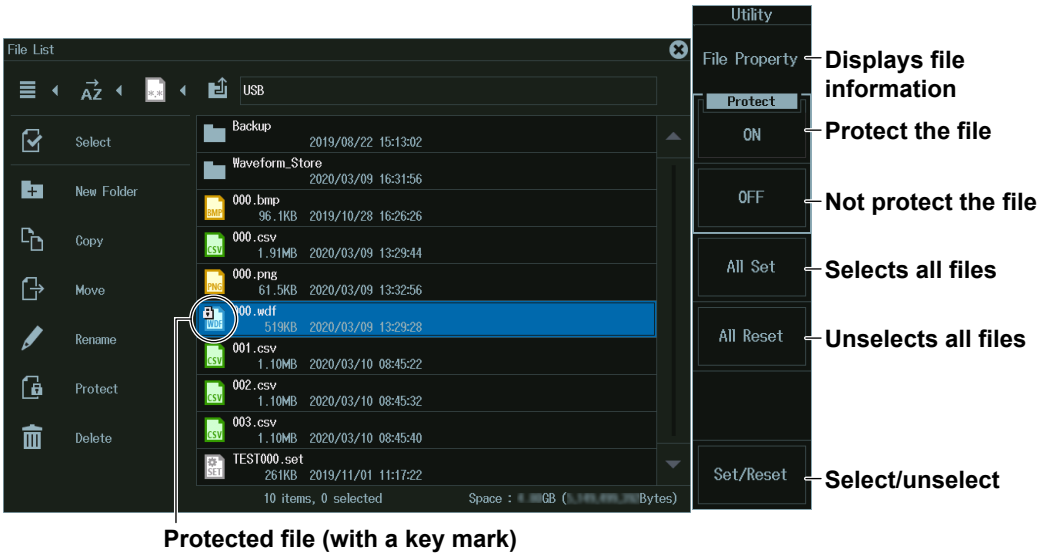


Note

By selecting multiple files, you can delete them all at the same time. For instructions on how to select multiple files, see page 17-19.

File Utility Menu

1. Press **FILE** to display the FILE menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the FILE menu from FILE/PRINT on the top menu that is displayed.
2. Press the **Utility** soft key to display the following screen.



Turning File Protection On or Off (Protect ON/OFF)

1. Select the file you want to protect.
2. Press the **ON (Protect)** soft key. A key mark is displayed on the selected file icon.
   You can also tap Protect on the operation menu to do the same.
   Pressing the **OFF (Protect)** soft key clears the key mark displayed on the selected file icon.

File Protection (Protect)

File Protection (Protect)	Description
ON	The selected file is protected. The file can be read from but cannot be written to. Nor can the file be deleted.
OFF	The selected files not protected. The file can be read from, written to, and deleted.

Selecting and Unselecting (Set/Reset)

1. Move the cursor to the file you want to access.
2. Press the **Set/Reset** soft key. Each time you press the soft key, the file toggles between selected and unselected.

18.1 Connecting the Instrument to a Network

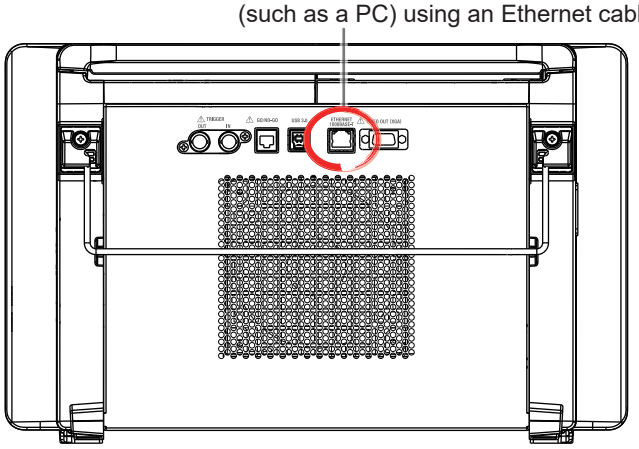
This section explains how to connect the instrument to a network.

Ethernet Interface Specifications

There is a 1000BASE-T port located on the rear panel of the instrument.

Item	Specifications
Ports	1
Electrical and mechanical specifications	IEEE802.3 compliant
Transmission system	Ethernet(1000BASE-T/100BASE-TX/10BASE-T)
Communication protocol	TCP/IP
Supported services	Server: FTP, VXI-11, Socket, HTTP (Web) Client: FTP (Net Drive), SMTP (Mail), SNTP, LPR (Net Print), DHCP, DNS, and PTP
Connector type	RJ-45 connector

Ethernet port
This port is for connecting the instrument to a controller (such as a PC) using an Ethernet cable.

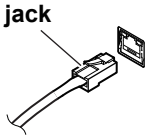


Items Required to Connect the Instrument to a Network

Cable

Use a network cable appropriate for the data rate of your network.

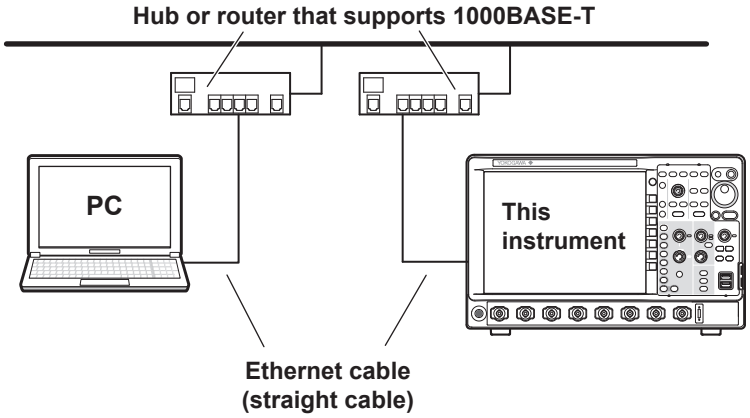
RJ-45 modular jack



Connection Procedure

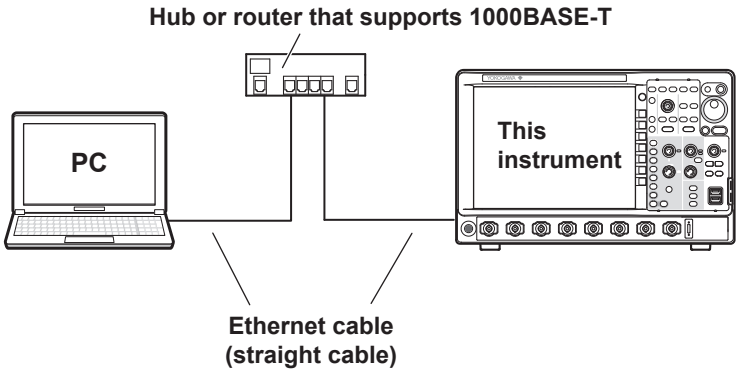
To Connect to a PC over a Network

1. Turn off the instrument.
2. Connect one end of an Ethernet cable to the ETHERNET 1000BASE-T port on the rear panel.
3. Connect the other end of the Ethernet cable to a hub or router.
4. Turn on the instrument.



To Connect to a PC through a Hub or Router

1. Turn off the instrument and the PC.
2. Connect one end of an Ethernet cable to the ETHERNET 1000BASE-T port on the rear panel.
3. Connect the other end of the Ethernet cable to a hub or router.
4. Connect the PC to the hub or router in the same way.
5. Turn on the instrument.



Note

- Use a hub or router that conforms to the transfer speed of your network.
- When you connect a PC to the instrument through a hub or router, the PC must be equipped with an auto switching 1000BASE-T/100BASE-TX/10BASE-T network card.
- Do not connect the instrument to a PC directly. Direct communication without a hub or router is not guaranteed to work.

18.2 Configuring TCP/IP Settings

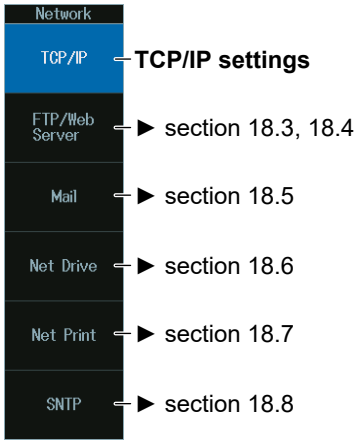
This section explains the following TCP/IP settings for connecting to a network:

- DHCP (IP address, subnet mask, and default gateway)
- DNS (domain name, DNS server IP address, and domain suffix)

► "TCP/IP (TCP/IP)" in the features guide

UTILITY Network Menu

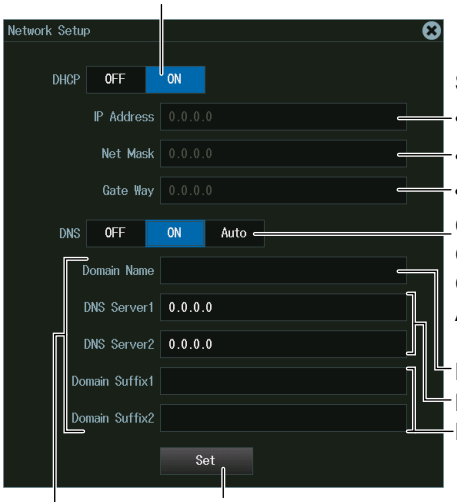
1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **Network** soft key to display the following menu.



TCP/IP settings
► section 18.3, 18.4
► section 18.5
► section 18.6
► section 18.7
► section 18.8

TCP/IP(TCP/IP)

Press the **TCP/IP** soft key to display the following screen.



Turns DHCP on or off

Set these when DHCP is disabled.
• IP address
• Subnet mask
• Default gateway

Configure the DNS settings.
OFF: DNS is disabled.
ON: DNS is enabled. The server addresses set manually.
Auto: DNS is enabled. The server address is set automatically.

Appears when DHCP is set to off

Domain name
IP address of DNS (primary, secondary)
Domain suffixes (primary and secondary)

Applies the settings

These are displayed when DNS is set to ON or Auto.

18.3 Accessing the Instrument from a PC (FTP Server)

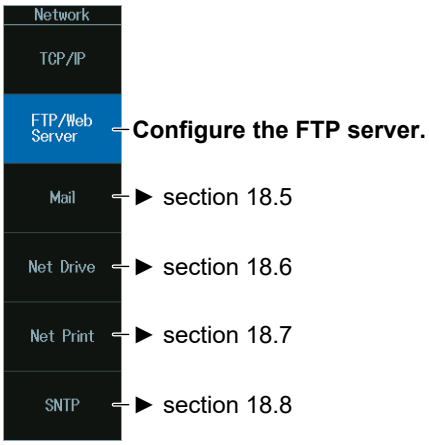
This section explains the following settings for accessing the instrument from a PC on a network:

- User name
- Password
- Timeout
- Starting an FTP client

► “FTP Server (FTP/Web Server)” in Features Guide

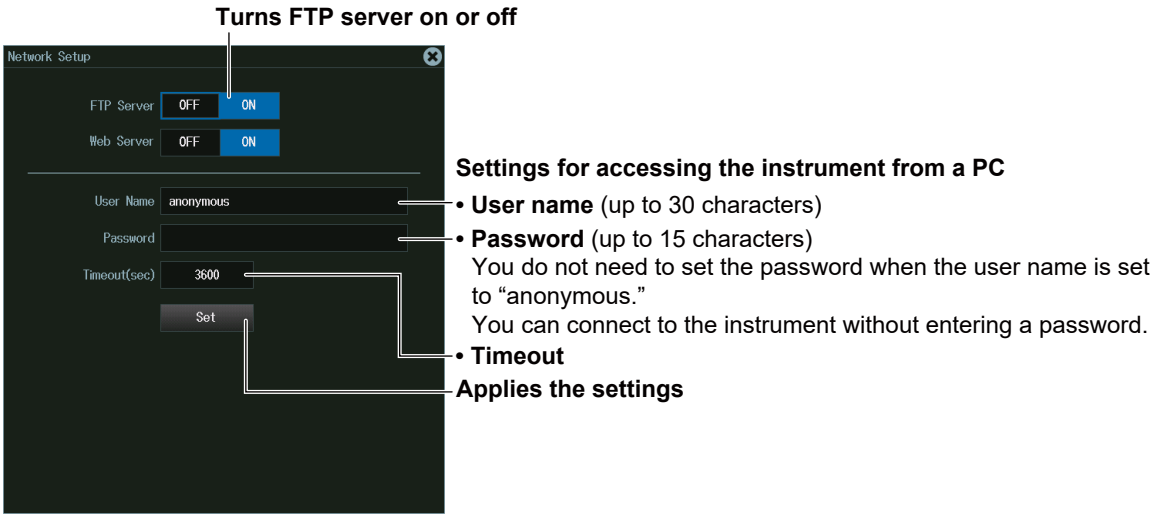
UTILITY Network Menu

1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **Network** soft key to display the following menu.



FTP Server (FTP/Web Server)

Press the **FTP/Web Server** soft key to display the following screen.



How to Access from a PC

Start an FTP client on a PC. Enter the user name and password that you set on the instrument’s network setup screen, which is shown above, and connect to the instrument.

18.4 Monitoring the Instrument's Display from a PC (Web Server)

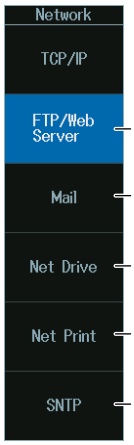
This section explains the following settings for accessing this instrument from a PC over a network to show the instrument's display on the PC and controlling the instrument from the PC:

- User name
- Password
- Operations on the PC

► "Web Server (FTP/Web Server)" in Features Guide

UTILITY Network Menu

1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **Network** soft key to display the following menu.



Configure the Web server.

► section 18.5

► section 18.6

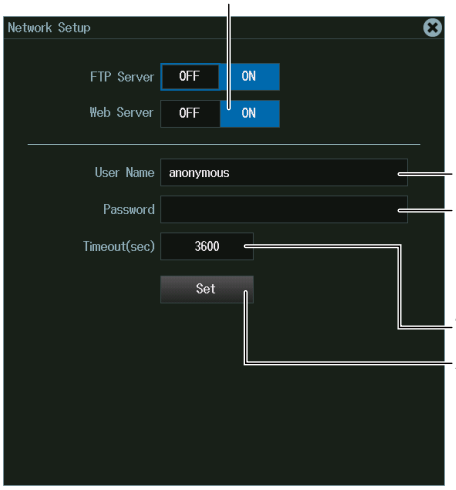
► section 18.7

► section 18.8

Web Server (FTP/Web Server)

Press the **FTP/Web Server** soft key to display the following screen.

Turns Web server on or off



Settings for accessing the instrument from a PC

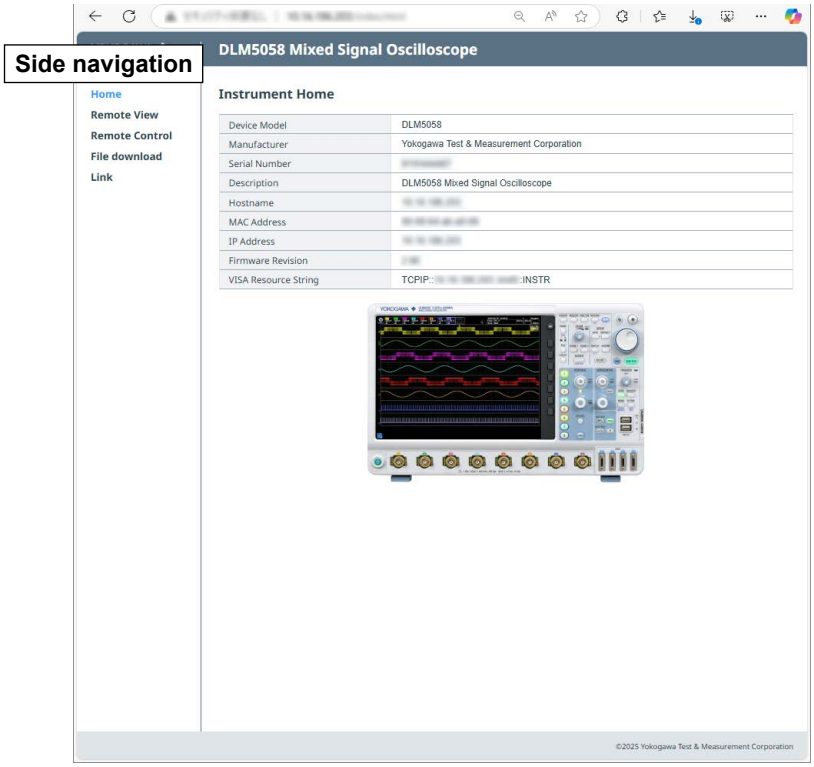
- **User name** (up to 30 characters)
- **Password** (up to 15 characters)
  You do not need to set the password when the user name is set to "anonymous."
  You can connect to the instrument without entering a password.

The timeout setting is valid only for the FTP server function.

Applies the settings

Operations on the PC

1. Connect the instrument to the network via Ethernet.
2. Start a web browser on a PC connected to the network.
3. Enter "http://IP address/" in the address bar to connect to the instrument.
   The IP address is the IP address of the instrument.
4. Enter the user name and password set on the previous page, and click OK. The instrument's home screen appears.
   User name and password are case-sensitive.
5. Click a side navigation item. The corresponding screen appears.

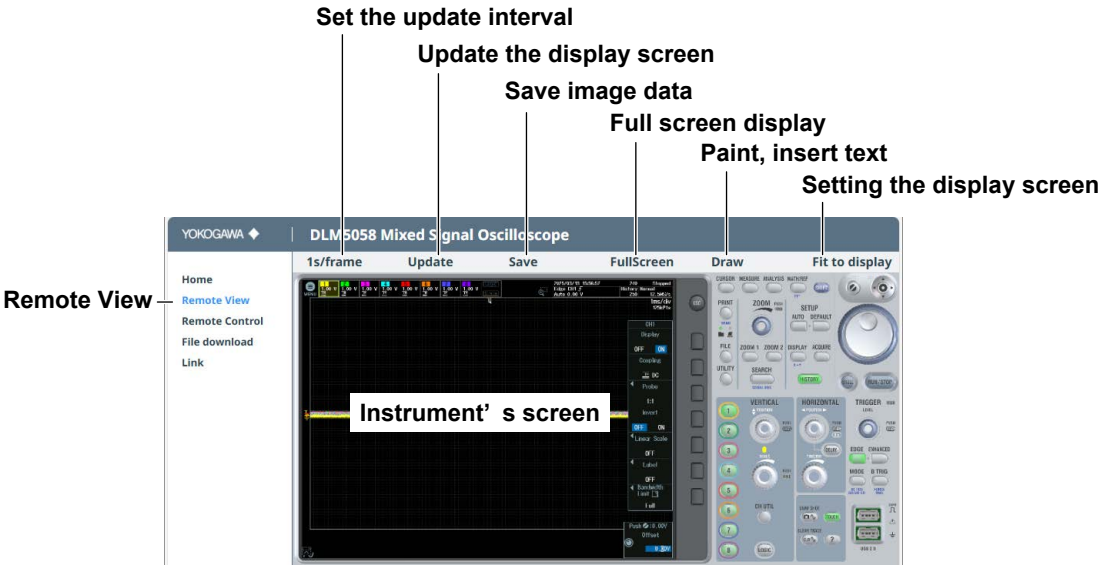


Home (Home)

Click **Home**. Information about the instrument is displayed.

Remote View (Remote View)

Click **Remote View** to display the following screen.



Set the update interval

Click **1s/frame**, and select the update interval for the display screen.

When you change the update interval, the display on the menu also changes from 1s/frame to the selected update interval.

Update the display screen

Click **Update**. The display screen is updated.

Save image data

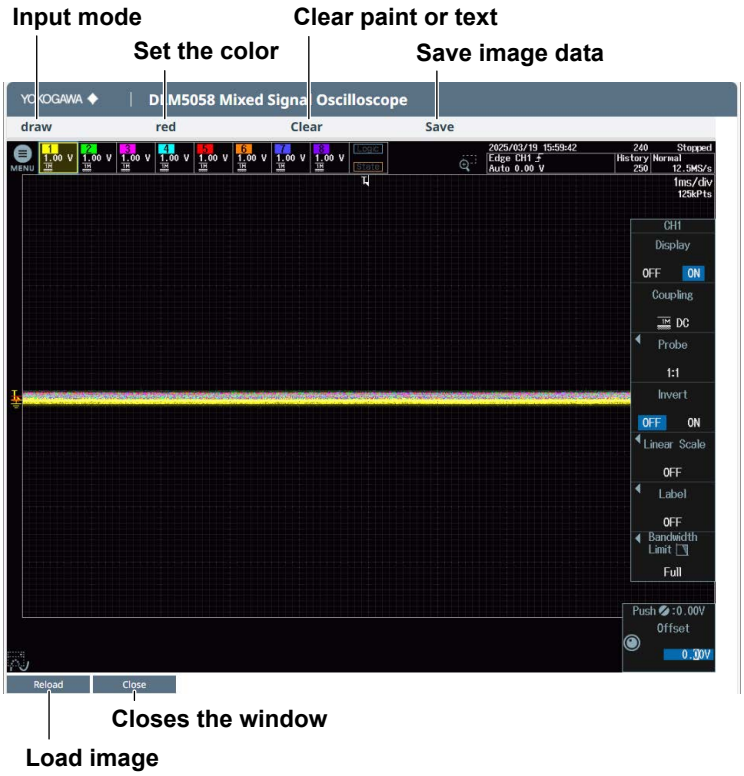
Click **Save**. The instrument's screen is saved in the PC.

Full screen display

Click **Full Screen**. Open the screen of this instrument in a new tab.

Paint, insert text

Click **Draw** to display the following screen.



- **Add lines**

1. Set the input mode to **draw**.
2. Drag the mouse. A line is added.

- **Add text**

1. Set the input mode to **text**.
2. Click where you want to add text. An input screen appears.
3. Enter the text, and click OK. The text is added.

Setting the display screen

Click **Fit to display** the following menu.

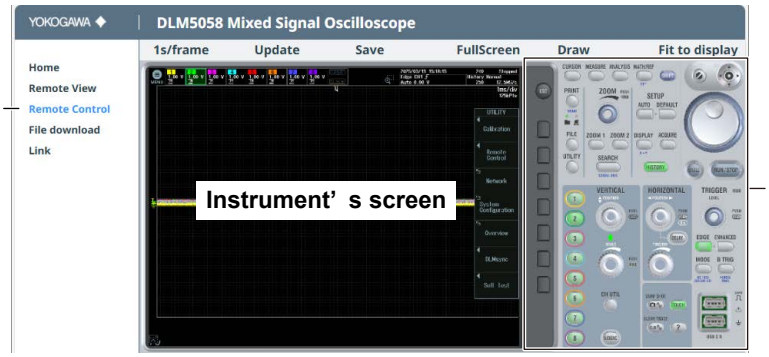
Fit to display: The sizes of the instrument's screen and control panel automatically adjust to the size of the browser window.

Full size: The sizes of the instrument's screen and control panel remain constant even if the browser window size changes.

When the display screen setting is changed, the display on the menu also changes from Fit to display to Full size.

Remote Control (Remote Control)

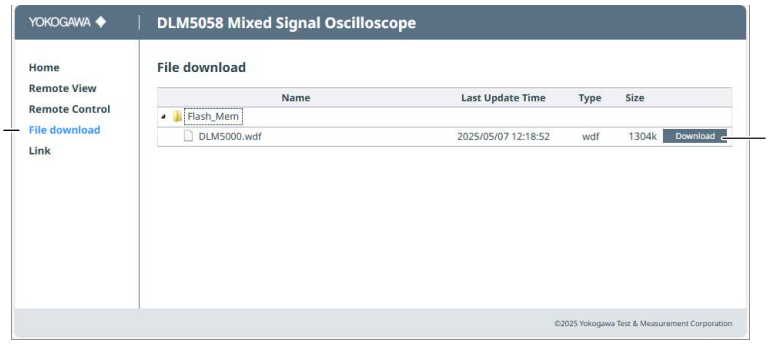
Click **Remote Control** to display the following screen. You can control the instrument's screen and panel keys. As with remote display explained earlier, s/frame, Update, Save, Full Screen, Draw, and Fit to display operations are available.



File download (File download)

Click **File download**. The directory structure of the instrument's internal storage (/C8 option) or a USB memory device connected to the instrument is displayed.

Click **Download** to download the file to your PC.



Link (Link)

Click **Link**. Displays a link to our website.

18.5 Configuring Mail Transmission (SMTP Client)

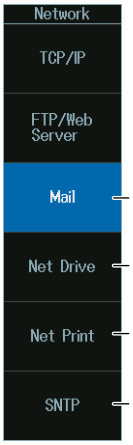
This section explains the following settings for transmitting mail to a specified mail address on a network:

- Mail server
- Mail address
- Comments
- Attaching image files
- Timeout
- User authentication
- Sending a test mail

► "Mail (Mail)" in Features Guide

UTILITY Network Menu

1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **Network** soft key to display the following menu.



Configure mail settings.

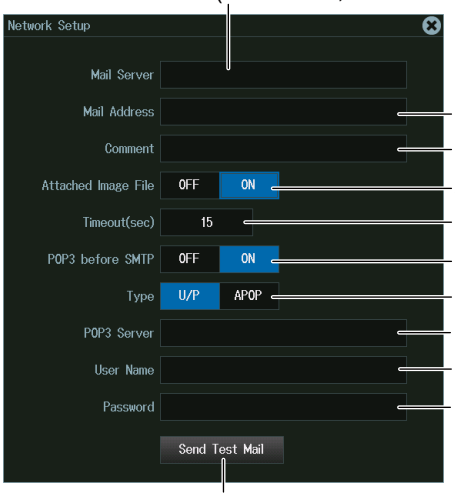
► section 18.6

► section 18.7

► section 18.8

Mail (Mail)

Press the **Mail** soft key to display the following screen.



Mail server
(IP address, or when DNS is enabled, the host name and domain name)

Mail address

Comment

Attaches image files

Timeout

Turns user authentication on or off

Encryption type (when user authentication is enabled)

Name of POP3 server

User name (up to 30 characters)

Password (up to 30 characters)

Sends a test mail

18.6 Connecting to a Network Drive (FTP Client)

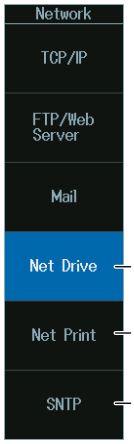
This section explains the following settings for accessing a network drive through an Ethernet connection to load or save various instrument's data:

- FTP server (file server)
- User name
- Password
- Turning FTP passive mode on or off
- Timeout
- Connecting to and disconnecting from network drives

► "Network Drive (Net Drive)" in the Features Guide

UTILITY Network Menu

1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **Network** soft key to display the following menu.



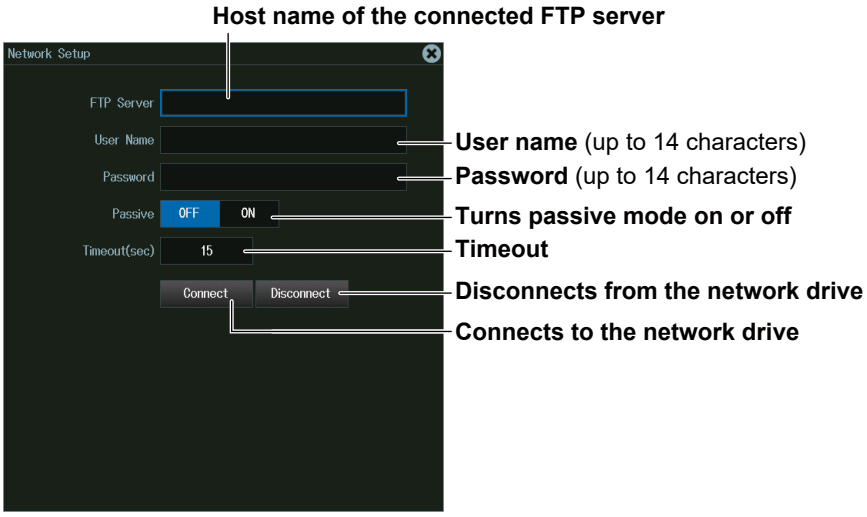
Configure the network drive settings.

► section 18.7

► section 18.8

Configuring Network Drive (Net Drive) Settings and Connecting to It

Press the **Net Drive** soft key to display the following screen.



18.7 Configuring a Network Printer

This section explains the following settings for printing screen images to a network printer:

- LPR server
- LPR name
- Timeout

► "Network Printer (Net Print)" in the Features Guide

UTILITY Network Menu

1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **Network** soft key to display the following menu.



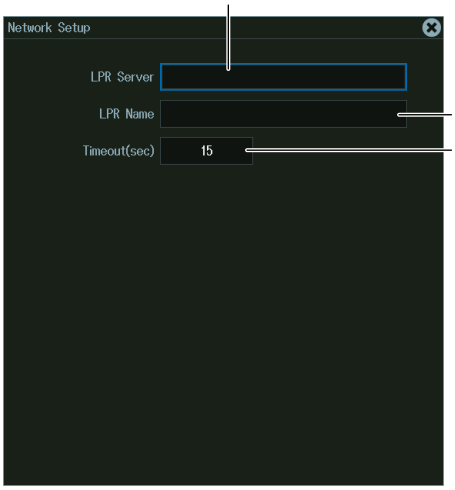
Configure network printer settings.

► section 18.8

Network Printer (Net Print)

Press the **Net Print** soft key to display the following screen.

LPR server
(IP address, or when DNS is enabled, the host name and domain name)



LPR name (name of shared printer)

Timeout

18.8 Using SNTP to Set the Date and Time

This section explains how to use SNTP to set the Instrument's date and time.

- SNTP server
- Timeout
- Executing time adjustment
- Automatic adjustment

► "SNTP (SNTP)" in the Features Guide

UTILITY Network Menu

1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **Network** soft key to display the following menu.

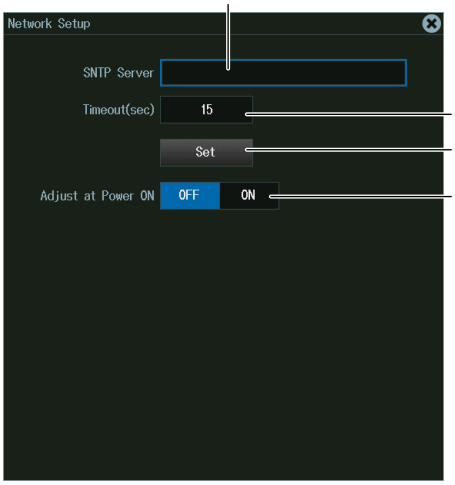


Configure the SNTP settings.

SNTP(SNTP)

Press the **SNTP** soft key to display the following screen.

SNTP server
(IP address, or when DNS is enabled, the host name and domain name)



Timeout

Executes clock adjustment

Automatic adjustment

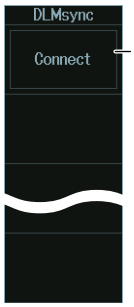
19.1 Starting and Stopping Synchronous Operation (DLMsync)

This section explains the settings for connecting this instrument to another DLM5034, DLM5038, DLM5054, or DLM5058.

► "Synchronous Operation (DLMsync)" in the Features Guide

UTILITY DLMsync Menu

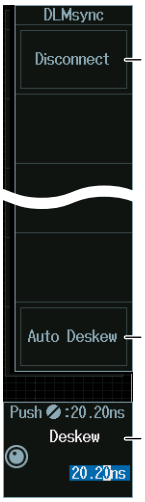
1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **DLMsync** soft key to display the following menu.



Starts synchronous operation
This instrument becomes the main unit and connects to the sub unit.
When a connection is established, the soft key menu changes to Disconnect.

Ending Synchronous Operation

Press the **Disconnect** soft key.



Ends synchronous operation
Disconnects from the sub unit.

► section 19.2

► section 19.2

Note

- During synchronous operation, a main unit or sub unit icon is displayed at the top of the screen.
- "Trigger: Controlled by Main Unit" is displayed at the top of the sub unit screen during synchronous operation.

19.2 Correcting the Sampling Skew between Units

This section explains the settings for correcting the sampling timing error (skew) between the main unit and sub unit.

UTILITY DLMsync Menu

1. Press **UTILITY** to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **DLMsync** and then the **Connect** soft key to display the following menu.



Executes auto deskewing
Auto deskewing is performed according to the connected signal source.

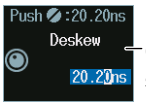
Correcting the sampling skew between units

Correcting the Sampling Skew between Units (Deskew)

Turn the jog shuttle to set the correction value for the sampling timing between units.

You can also tap the jog shuttle setting menu in the lower right of the screen and use the numeric keypad that appears on the screen.

Jog shuttle setting menu



Correcting the sampling skew between units

Note

To execute on auto deskew, you need to apply a same signal to CH1 of the main unit and CH1 of the sub unit through probes with the same specifications.
For details, see chapter 22, “Synchronous Operation,” in the Features Guide, IM DLM5058-01EN.

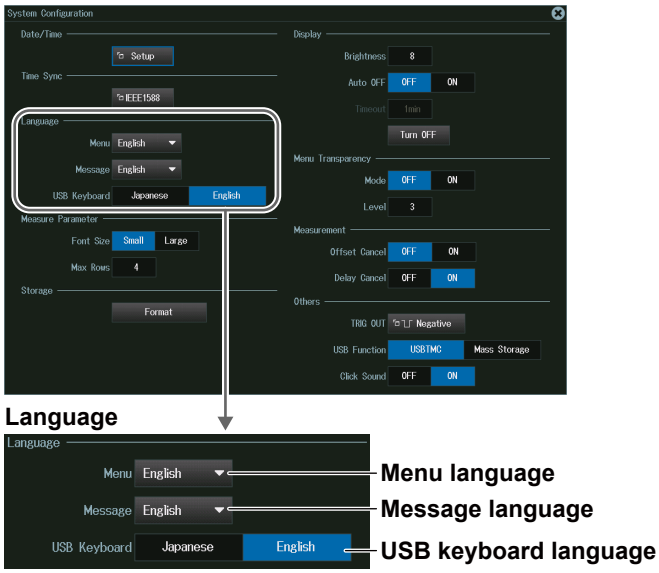
20.1 Changing the Menu, Message, and USB Keyboard Languages

This section explains the settings that you can use to change the instrument's menu, message, and USB keyboard languages.

► "Language (Language)" in Features Guide

UTILITY System Configuration Menu

1. Press **UTILITY**to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **System Configuration** soft key to display the following menu.



Language

Menu language

Message language

USB keyboard language

Note

Even if you set the menu or message language to a language other than English, some terms will be displayed in English.

USB Keyboard (USB Keyboard)

You can use the following keyboards that conform to USB Human Interface Devices (HID) Class Ver. 1.1.

English:	104-key keyboards
Japanese:	109-key keyboards

Note

For details on how the keys of this instrument are mapped to the keys on a USB keyboard, see appendix 2 in the *Getting Started Guide* (IM DLM5058-03EN).

20.2 Setting the Click Sound, Measured Value Font Size, and Number of Rows for Displaying Measurement Values

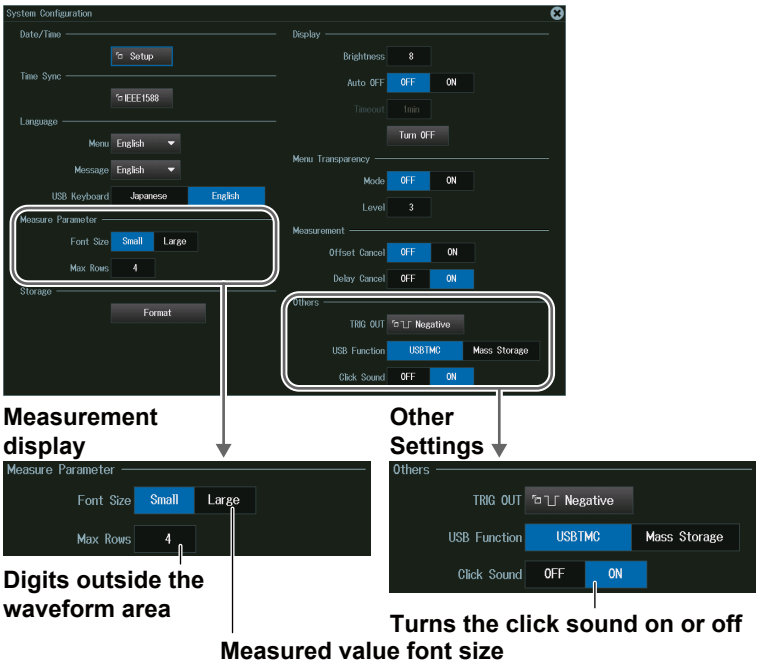
This section explains the following settings:

- Click sound on/off
- Measured value font size
- Number of rows for displaying measured values

► "Measurement Display (Measure Parameter)"
"Turning On or Off the Click Sound (Click Sound)"
in the Features Guide

UTILITY System Configuration Menu

1. Press **UTILITY**to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **System Configuration** soft key to display the following menu.



20.3 Viewing Setup Information (Overview)

This section explains how to view the current setup information.

► “Overview (Overview)” in the Features Guide

UTILITY Overview Menu

1. Press **UTILITY**to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **Overview** soft key to display the following menu.



Displays system overview
Displays mainly model and suffix code information

Displays setup information 1
Displays mainly the vertical and horizontal scale settings

Displays setup information 2
Displays mainly the trigger settings

Adds options
►IM 709821-01EN DLM5000 Additional Option License User’s Manual

Adding Options

A portion of the functions provided as options (with the instrument’s model name) can be installed by purchasing additional licenses after the purchase of the instrument. For more details, contact your nearest YOKOGAWA dealer.

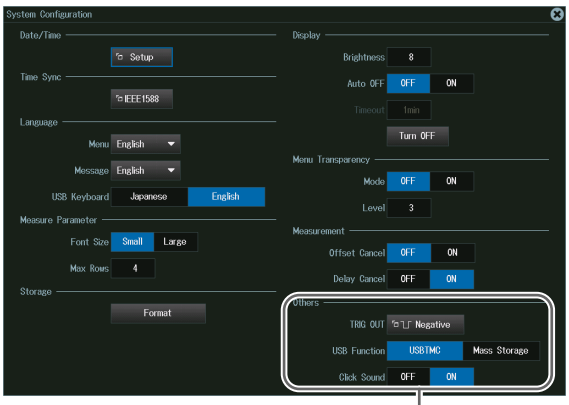
20.4 Using the DLM5000 as a USB Storage Device

This section explains the setting that enables you to use the instrument as a USB storage device through a USB connection made between the USB port on the instrument's rear panel and a PC.

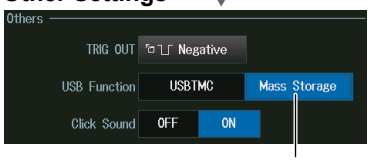
► "USB Communication (USB Function)" in the Features Guide

UTILITY System Configuration Menu

1. Press **UTILITY**to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **System Configuration** soft key to display the following menu.



Other Settings



Set USB Function to Mass Storage

Note

- From a PC, you can access the instrument's internal storage as a storage device. You cannot access the instrument's network drives or the storage device connected to the instrument's USB ports.
- Mass Storage functions as a read-only storage device.
- When you perform file operations in the internal storage from this instrument, the content of the internal storage of the instrument displayed on the PC is updated. During updating, the display on the PC may momentarily disappear.
- The USB communication function (USB Function) can also be set in Remote Control from the UTILITY menu. The setting values are linked with the settings on the System Configuration menu. For the operating procedure, see section 1.4 in IM DLM5058-17EN.

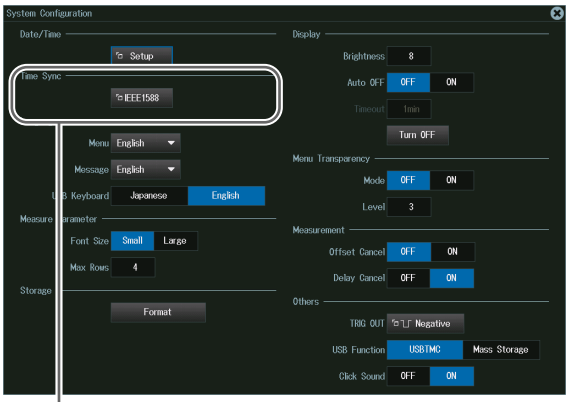
20.5 Synchronizing the Clock Using IEEE 1588

This section explains the settings used when running the instrument as a IEEE1588 slave device and synchronizing the clock and sampling clock by receiving Precision Time Protocol (PTP) packets from a master device.

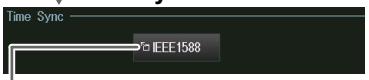
► “IEEE 1588 Clock Synchronization Feature (IEEE 1588)” in the Features Guide

UTILITY System Configuration Menu

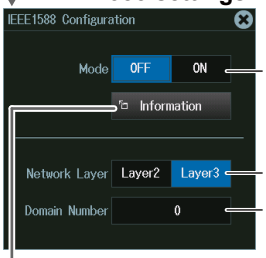
1. Press **UTILITY**to display the UTILITY menu.
   You can also tap **MENU** (MENU) in the upper left of the screen and select the UTILITY menu from UTILITY on the top menu.
2. Press the **System Configuration** soft key to display the following menu.



Time synchronization



IEEE 1588 settings

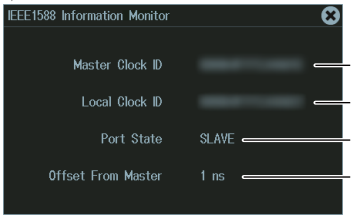


Select whether to synchronize the clock.

Network layer

Domain number

IEEE 1588 information monitor



Master clock ID (64-bit identifier)

Local clock ID (64-bit identifier)

Port status

Offset from master

Note

When time synchronization is enabled, start measuring after is displayed at the top of the screen. is displayed when the sampling clock stabilizes.

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ACTION Go/Nogo menu ... 2-120
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ANALYSIS Histogram menu ... 13-1
ANALYSIS Power Analysis menu (harmonic analysis) ... 14-11
ANALYSIS Power Analysis menu (Joule integral) ... 14-15
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