signal *X*plorer™

DL9040/DL9140/DL9240 Series
Digital Oscilloscope

USER'S MANUAL

YOKOGAWA ◆
Yokogawa Electric Corporation

Product Registration

Thank you for purchasing YOKOGAWA products.

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Foreword

Thank you for purchasing the DL9000 Digital Oscilloscope. This user's manual contains useful information about the functions, operating procedures, and handling precautions of the DL9000. To ensure correct use, please read this manual thoroughly before beginning operation. After reading the manual, keep it in a convenient location for quick reference whenever a question arises during operation. The following two manuals, including this one, are provided as manuals for the DL9000. Read them along with this manual.

Manual Title	Manual No.	Description
DL9040/DL9140/DL9240 Series Digital Oscilloscope USER'S MANUAL	IM 701310-01E	This manual. Explains all functions and procedures of the DL9000 excluding the communication functions.
DL9040/DL9140/DL9240 Series Digital Oscilloscope Communication Interface USER'S MANUAL (CD)	IM 701310-17E	Describes the communication functions of the communication interface.
DL9040/DL9140/DL9240 Series Digital Oscilloscope Serial Bus Signal Analysis Function User's Manual	IM 701310-51E	Explains the operating procedures of the optional I^{2}C bus signal/SPI bus signal analysis function.

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from the actual 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.
- Copying or reproducing all or any part of the contents of this manual without the permission of Yokogawa Electric Corporation is strictly prohibited.
- The TCP/IP software of this product and the document concerning the TCP/IP software have been developed/created by YOKOGAWA based on the BSD Networking Software, Release 1 that has been licensed from California University.

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- For purposes of this manual, the TM and ® symbols do not accompany their respective trademark names or registered trademark names.
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Revisions

- 1st Edition: June 2005
- 2nd Editon: August 2005
- 3rd Editon: January 2006

Checking the Contents of the Package

Unpack the box and check the contents before operating the instrument. If some of the contents are not correct or missing or if there is physical damage, contact the dealer from whom you purchased them.

DL9000

Check that the model name and suffix code given on the name plate on the rear panel match those on the order.
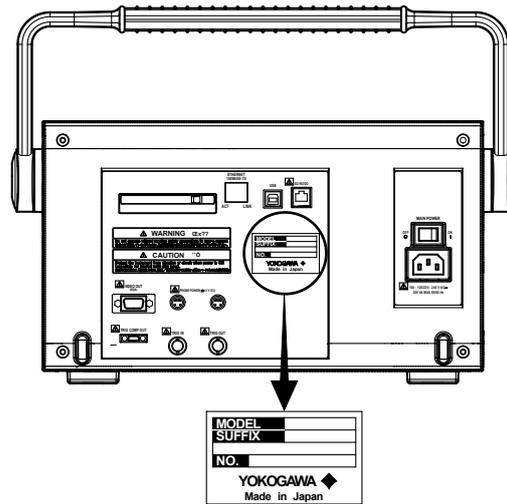
MODEL	SUFFIX	Specifications
701307		DL9040 Digital Oscilloscope 4 channels, 5 GS/s 500 MHz, max. 2.5 MW/channel
701308		DL9040L Digital Oscilloscope 4 channels, 5 GS/s 500 MHz, max. 6.25 MW/channel
701310		DL9140 Digital Oscilloscope 4 channels, 5 GS/s 1 GHz, max. 2.5 MW/channel
701311		DL9140L Digital Oscilloscope 4 channels, 5 GS/s 1 GHz, max. 6.25 MW/channel
701312		DL9240 Digital Oscilloscope 4 channels, 10 GS/s 1.5 GHz, max. 2.5 MW/channel
701313		DL9240L Digital Oscilloscope 4 channels, 10 GS/s 1.5 GHz, max. 6.25 MW/channel
Power cord	-D	UL/CSA Standard power cord (Part No.: A1006WD) [Maximum rated voltage: 125 V; Maximum rated current: 7 A]
	-F	VDE Standard Power Cord (Part No.: A1009WD) [Maximum rated voltage: 250 V; Maximum rated current: 10 A]
	-Q	BS Standard Power Cord (Part No.: A1054WD) [Maximum rated voltage: 250 V; Maximum rated current: 10 A]
	-R	AS Standard Power Cord (Part No.: A1024WD) [Maximum rated voltage: 250 V; Maximum rated current: 10 A]
	-H	GB Standard Power Cord (Part No.: A1064WD) [Maximum rated voltage: 250 V; Maximum rated current: 10 A]
Help language	-HJ	Japanese
	-HE	English
	-HC	Chinese
Options	/B5	Built-in printer
	/P2	Probe power supply
	/C8*	Built-in hard disk drive and Ethernet interface
	/C10*	Ethernet interface
	/F5	I^2C + SPI bus analysis function

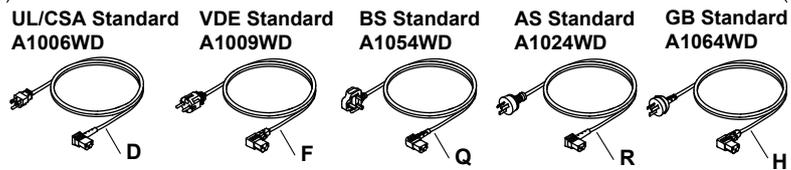*/C8 and /C10 options cannot be specified simultaneously.

- **No. (Instrument No.)**
  When contacting the dealer from which you purchased the instrument, please give them the instrument number.
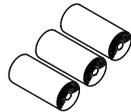
Standard Accessories

The standard accessories below are supplied with the instrument. Check that all contents are present and that they are undamaged.
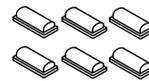
Power Cord (one of the following power cords is supplied according to the instrument's suffix codes)
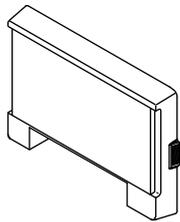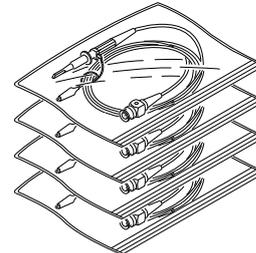
UL/CSA Standard A1006WD	VDE Standard A1009WD	BS Standard A1054WD	AS Standard A1024WD	GB Standard A1064WD
D	F	Q	R	H

Printer roll paper*1
B9988AE   3 rolls

Rubber Feet
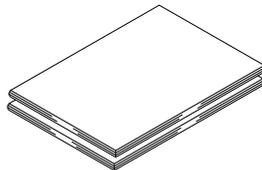**B8080FR**
6 pcs

Front panel protection cover
B8080EM

500 MHz Passive Probe PB500
701943   4 probes

User's manual (1pc, this manual)/
Serial Bus Signal Analysis Function
User's Manual*2(1pc)

Soft case
B8080FQ

Communication interface
User's manual*3
B8080RE(CD)

*1: When using the optional built-in printer (/B5)
*2: Provided on models with the /F5 option.
*3: Printed manuals can be purchased separately. Contact your nearest YOKOGAWA dealer.

Optional Accessories (Sold Separately)

The optional accessories below are available for purchase separately. For information and ordering, contact your nearest YOKOGAWA dealer.

Name	Model	Specifications
PB500 (10 : 1 passive probe)	701943	10 MΩ (10 : 1), 500 MHz, 1.5 m (one piece in one set)
PBA2500 (2.5 GHz active probe)	701913	2.5 GHz bandwidth, for the DL9000 Series
PBD2000 (2 GHz differential probe)	701923	2 GHz bandwidth, for the DL9000 Series
PBL5000 (5 GHz probe)	701974	5 GHz bandwidth, with an SMA-BNC adapter
DC block	701975	For 50 ohm input, SMA
FET probe	700939	900 MHz bandwidth
100 : 1 probe	700978	100 MHz bandwidth
Differential probe	701921	DC to 100 MHz bandwidth/max. ±700 V
Differential probe	701922	DC to 200 MHz bandwidth/max. ±20 V
Differential probe	700925	DC to 15 MHz bandwidth/max. ±500 V
Differential probe	700924	DC to 100 MHz bandwidth/max. ±1400 V
Differential probe	701920	DC to 500 MHz bandwidth/max. ±30 V
Current probe	701933	DC to 50 MHz bandwidth, 30 Apeak
Current probe	701932	DC to 100 MHz bandwidth, 30 Apeak
Dedicated GO/NO-GO cable	366973	
Trigger comparison output cable	701976	

Spare Parts (Sold Separately)

The spare parts below are available for purchase separately.

For information about the spare parts and ordering, contact your dealer.

Part Name	Part No.	Minimum Q'ty	Remarks
Printer roll paper	B9988AE	10	Thermo-sensible paper, 111 mm × 10 m

Safety Precautions

This instrument is an IEC protection class I instrument (provided with terminal for protective earth grounding).
The general safety precautions described herein must be observed during all phases of operation. If the instrument is used in a manner not specified in this manual, the protection provided by the instrument may be impaired. Yokogawa Electric Corporation assumes no liability for the customer's failure to comply with these requirements.

The Following Symbols Are Used on This Instrument.

Warning: handle with care. Refer to the user's manual or service manual. This symbol appears on dangerous locations on the instrument which require special instructions for proper handling or use. The same symbol appears in the corresponding place in the manual to identify those instructions.

Protective ground terminal

Functional ground terminal (do not use this terminal as a protective ground terminal.)

Alternating current

Direct current

ON (power)

OFF (power)

Stand-by

In-position of a bi-stable push control

Out-posotion of a bi-stable push control

Make sure to comply with the precautions below. Not complying might result in injury or death.

⚠️

WARNING

Power Supply
Before connecting the power cord, ensure that the source voltage matches the rated supply voltage of the DL9000 and that it is within the maximum rated voltage of the provided power cord.

Power Cord and Plug
To prevent the possibility of electric shock or fire, be sure to use the power cord supplied by YOKOGAWA. The main power plug must be plugged into an outlet with a protective earth terminal. Do not invalidate this protection by using an extension cord without protective earth grounding.

Protective Grounding
Make sure to connect the protective earth to prevent electric shock before turning ON the power. The power cord that comes with the instrument is a three-pin type power cord. Connect the power cord to a properly grounded three-pin outlet.

Necessity of Protective Grounding
Never cut off the internal or external protective earth wire or disconnect the wiring of the protective earth terminal. Doing so poses a potential shock hazard.

Defect of Protective Grounding
Do not operate the instrument if the protective earth or fuse might be defective. Make sure to check them before operation.

Do Not Operate in an Explosive Atmosphere
Do not operate the instrument in the presence of flammable liquids or vapors. Operation in such environments constitutes a safety hazard.

Do Not Remove Covers
The cover should be removed by YOKOGAWA's qualified personnel only. Opening the cover is dangerous, because some areas inside the instrument have high voltages.

External Connection
Securely connect the protective grounding before connecting to the item under measurement or an external control unit. If you are going to touch the circuit, make sure to turn OFF the circuit and check that no voltage is present. To prevent the possibility of electric shock or an accident, connect the ground of the probe and input connector to the ground of the item being measured.

How to Use This Manual

Structure of the Manual

This user's manual consists of the following sections:

Chapter	Title	Description
1	Names and Functions of Parts	Identifies the parts of the instrument and their functions, and describes the screen displays.
2	Functions	Introduces the unit's features, functions, and measurement principles. Operational details are not given in this chapter. However, reading this chapter will help you understand the operating procedures given in the chapters that follow.
3	Making Preparations for Measurements	Presents safety precautions, and explains how to install, connect up, and switch on the unit. Also explains how to connect the probes and how to set the date.
4	Basic Operations	Explains basic operations, including key and rotary knob operations, numeric value and character entry, waveform acquisition start/stop, automatic setup, setup initialization, snapshots, trace clearing, and help function.
5	Vertical and Horizontal Axes	Explains settings related to vertical and horizontal (time) axes. Verticalaxis settings include channel on/off, input coupling, probe type, and voltage sensitivity.
6	Triggers	Explains how to set up and use triggers to control the timing of waveform acquisition. Includes description of trigger modes, trigger types, trigger source, and trigger level.
7	Acquisition and Display	Explains acquisition parameters (acquisition mode, sampling mode, record length, history memory), etc.
8	Display	Explains display format, interpolation, zoom, graticule, and other display-related parameters.
9	Computation	Describes computations on waveforms, including linear scaling, arithmetic operations, integration, phase shift, filter settings, and waveform smoothing.
10	Waveform Analysis	Describes cursor measurement, automatic measurement of waveform parameters and statistical processing, the telecom tests, XY displays, FFT computation, graph and list displays of waveform parameters, frequency distribution displays and so on.
11	Displaying and Searching History Waveforms	Describes how to display and search history waveforms.
12	Printing Screen Images	Explains how to print screen images to built-in printer and external USB printer.
13	Saving and Loading Data	Explains how to store screen image data, waveform data, and setup data to an external storage medium such as PC card, internal hard disk (optional). Also explains how to load the stored waveform data and setup data and how to delete data, etc.
14	Displaying Reference Waveforms	Describes how to display reference waveforms and history waveforms, saving data, and displaying scale values and labels.
15	Ethernet Communications (Optional)	Explains how to use the Ethernet interface to store various data to a PC and how to access the DL9000 from a PC.

Chapter	Title	Description
16	**Rear Panel Input and Output**	
		Describes the external trigger input, trigger output, and video signal output.
17	**Other Operations**	
		Explains how to set the menu and message languages, etc.
18	**Troubleshooting, Maintenance, and Inspection**	
		Gives troubleshooting advice; explains screen messages and self-test operation.
19	**Specifications**	
		Summarizes the main specifications of the DL9000 in tables.
	Appendix	
		Explains the relationships between time axis, sampling rate, and record length.
	Index	
		Index of contents.

Symbols and Notation Used in This Manual

Unit
k: Denotes 1000.   Example: 100 kS/s (sampling rate)

K: Denotes 1024.   Example: 720 KB (storage capacity of a floppy disk)

Used Characters
- Bold characters used in the procedural explanations indicate characters that are marked on the panel keys or the characters of the soft keys displayed on the screen menu.
- The SHIFT + xxx key refers to first pressing the SHIFT key (the indicator above the SHIFT key lights), and then pressing the xxx key. The menu marked in purple below the pressed key appears on the screen.

Safety Markings
The following markings are used in this manual.

<table>
<tr><td>⚠</td><td>Danger. Refer to corresponding location on the instrument. This symbol appears on dangerous locations on the instrument which require special instructions for proper handling or use. The same symbol appears in the corresponding place in the manual to identify those instructions.</td></tr>
<tr><td>**WARNING**</td><td>Calls attention to actions or conditions that could cause serious injury or death to the user, and precautions that can be taken to prevent such occurrences.</td></tr>
<tr><td>**CAUTION**</td><td>Calls attentions 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.</td></tr>
<tr><td>*Note*</td><td>Calls attention to information that is important for proper operation of the instrument.</td></tr>
</table>

Notations Used in the Procedural Explanations
On pages that describe operating procedures in Chapter 2 through 18, the following notations are used to distinguish the procedures from their explanations.

<table>
<tr><td>**Procedure**</td><td>Follow the steps indicated with numbers. The procedures are given with the premise that the user is carrying out the steps for the first time. You may not need to carry out all the steps, if you are changing the settings.</td></tr>
<tr><td>**Explanation**</td><td>This section describes the setup parameters and the limitations regarding the procedures. A detailed description of the function is not provided in this section. For details on the function, see chapter 1.</td></tr>
</table>

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Appendix

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1.1   Front Panel and Rear Panel

Top Panel

Built-in printer
Prints the display contents.
For installing the paper roll, see section 12.1.
For printing operations, see section 12.2.

Front Panel
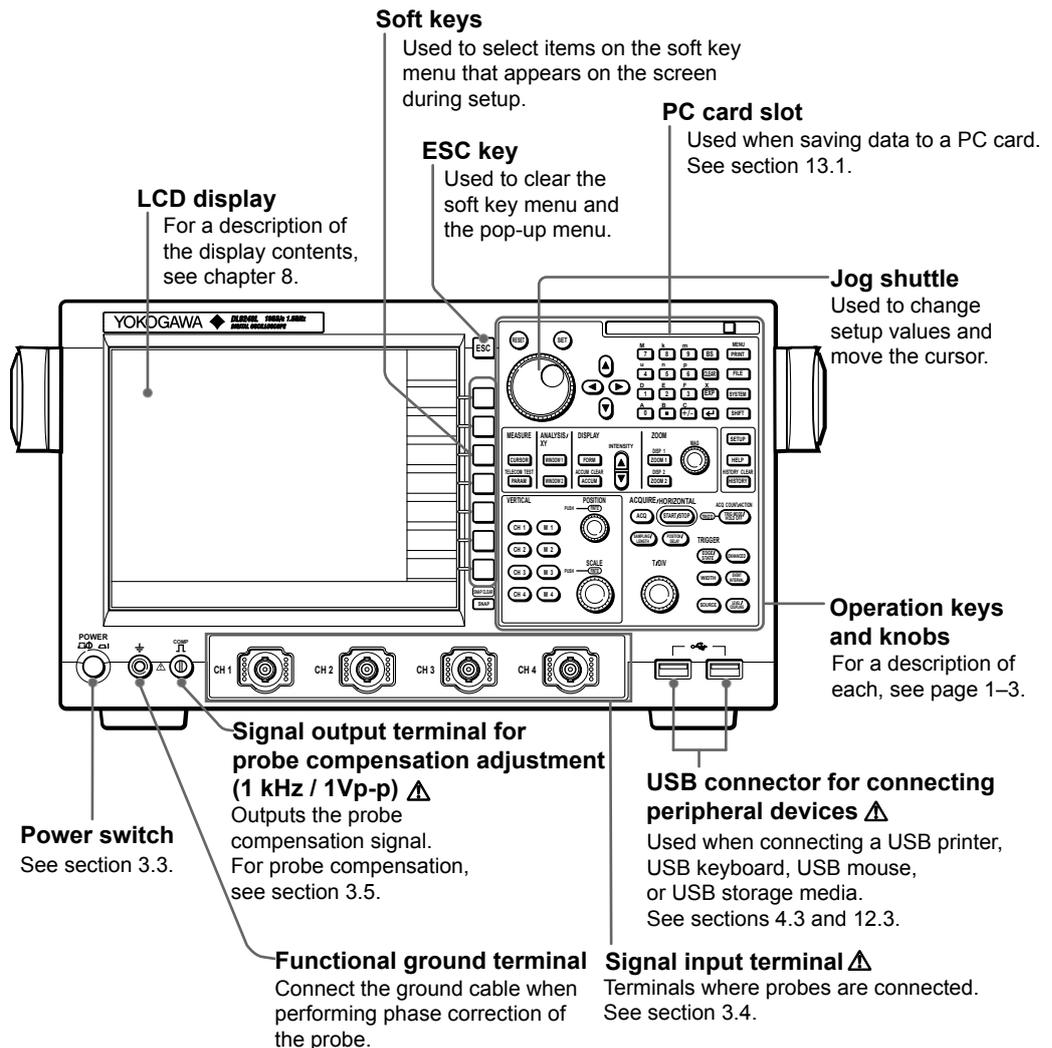
Soft keys
Used to select items on the soft key
menu that appears on the screen
during setup.

PC card slot
Used when saving data to a PC card.
See section 13.1.

ESC key
Used to clear the
soft key menu and
the pop-up menu.

LCD display
For a description of
the display contents,
see chapter 8.

Jog shuttle
Used to change
setup values and
move the cursor.

**Operation keys
and knobs**
For a description of
each, see page 1–3.

**Signal output terminal for
probe compensation adjustment
(1 kHz / 1Vp-p)** ⚠
Outputs the probe
compensation signal.
For probe compensation,
see section 3.5.

Power switch
See section 3.3.

**USB connector for connecting
peripheral devices** ⚠
Used when connecting a USB printer,
USB keyboard, USB mouse,
or USB storage media.
See sections 4.3 and 12.3.

Functional ground terminal
Connect the ground cable when
performing phase correction of
the probe.

Signal input terminal ⚠
Terminals where probes are connected.
See section 3.4.

Rear Panel

Ethernet port (optional)
Used when connecting to a network.
See section 15.1.

USB connector for connecting to a PC
Used when connecting a PC with a USB
interface. See the *Communication Interface
User's Manual (IM701310-17)*.

GO/NO-GO output connector ⚠
and external start/stop input connector
Outputs the GO/NO-GO determination output signal.
Also used to externally control start/stop for the DL9000.
See section 16.4.

PC card slot
Used when saving data
to a PC card.
See section 13.1.

Main power switch
See section 3.3.
Power connector ⚠
See section 3.3.

Comparator output ⚠
Outputs the trigger
comparator signal.
See section 16.5.

**Trigger output
terminal**
Used when outputting the
trigger signal externally.
See section 16.2.

External trigger ⚠
input terminal
Used when inputting an
external trigger signal.
See section 16.1.

Probe power supply terminal (optional) ⚠
Used to supply power to an FET probe or
a current probe made by YOKOGAWA.
See section 3.4.

Video signal output connector
Used when displaying the DL9000 display
image on an external display. See section 16.3.

1.2 Operating Keys and Knobs

Vertical Axis, Channel, and Calculation
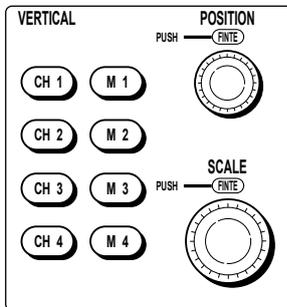
CH1 to CH4 keys (Chapter 5)

These display menus for switching the display of each channel ON/OFF, vertical position, coupling, probe type, offset voltage, bandwidth limit, expansion or reduction of the vertical axis, linear scaling, and waveform labels. Pressing one of these keys before using the V/DIV knob assigns the corresponding channel to the V/DIV knob operation. Each CH key lights when the corresponding channel is ON.

M1 to M4 keys (Chapter 9, Chapter 14)

These keys are used for waveform calculation settings, and settings relating to reference waveforms. Each key lights when the display is ON.

POSITION knob

When the voltage range is changed, you can change the center position. This knob includes a push switch, and can be pressed to change the resolution of the setting. Normal (Coarse) resolution is 1 div, and when pressed, lighting the Fine indicator, the resolution is 0.01 div.

SCALE knob

This sets the vertical axis sensitivity. Before turning this knob, press one of the CH1 to CH4, or M1 to M4 keys, to select the waveform adjusted. If you change this while waveform acquisition is stopped, the change takes effect when waveform acquisition is restarted. This knob includes a push switch, and can be pressed to change the resolution of the setting. When the knob is pressed, lighting the Fine indicator, the resolution is finer.

Waveform Acquisition and Horizontal Axis
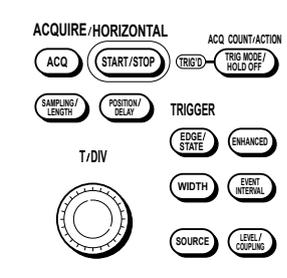
ACQ key (Sections 7.1, 7.2)

Displays a menu for setting the method of waveform acquisition.

START/STOP key (Section 4.7)

Depending on the trigger mode, this starts/stops waveform acquisition. During waveform acquisition, the key lights.

TRIG MODE/HOLD OFF (Sections 7.1, 7.8)

Displays a menu for selecting the trigger mode. Pressing the SHIFT key before pressing the MODE key displays the action on trigger menu.

SAMPLING/LENGTH key (Sections 7.3 to 7.6)

Displays a menu for setting record length, equivalent time sampling, interleave, and interpolation.

POSITION/DELAY key (Sections 6.5, 6.6)

Displays a menu for the trigger delay and trigger settings.

EDGE/STATE key (Sections 6.7 to 6.10)

Displays a menu for Edge/State trigger settings.

Press one of four keys, including the following ENHANCED key, WIDTH key, and EVENT INTERVAL key, to select the trigger type. The pressed key lights, indicating that it is selected.

WIDTH key (Sections 6.11 to 6.13)

Sets the Width trigger.

ENHANCED key (Section 6.17)

Displays a menu for TV trigger settings.

EVENT INTERVAL key (Sections 6.14 to 6.16)

Displays a menu for event trigger settings.

SOURCE key (Chapter 6)

Displays a menu for setting trigger sources.

LEVEL/COUPLING key (Section 6.3)

Displays a menu for trigger coupling, HF rejection, Window comparator, and other settings.

TIME/DIV knob (Section 5.8)

Sets the time axis scale. If you change this while waveform acquisition is stopped, the change takes effect when waveform acquisition is restarted.

Waveform Analysis/Screen Display/Screen Image Printing/Data Saving/History Waveform/etc.
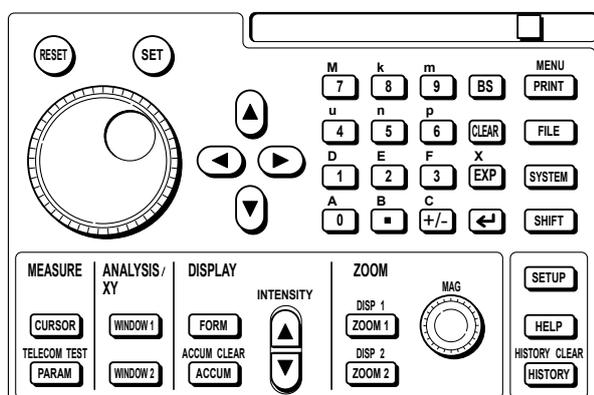
Waveform Analysis

CURSOR key (Section 10.1)

Displays a menu for cursor measurement.

PARAM key (Sections 10.2 to 10.4)

Displays a menu for automatic waveform parameter measurement and statistics processing. Pressing the SHIFT key, followed by the PARAM key displays a menu for the telecom test.

WINDOW1 key and WINDOW2 key (Sections 10.5 to 10.8)

Display a menu for XY display, FPT analysis, waveform parameter histogram and list, and other settings. When the display is ON, the key lights.

Screen Display

FORM key (Sections 8.1 to 8.4)

Displays a menu relating to screen display.

(SHIFT+) ACCUM key (Section 7.7)

Displays a menu for waveform overwriting display. Pressing the SHIFT key, followed by the ACCUM key clears the overwriting waveform.

(SHIFT+) ZOOM1 and ZOOM2 keys (Sections 8.6, 8.7)

Display a menu for waveform zoom display and data search functions. Pressing the SHIFT key, followed by the ZOOM key displays a menu relating to zoom waveform positioning.

MAG dial (Section 8.6)

In a zoom display, turn this dial to change the zoom ratio on the applicable vertical/ horizontal axis.

Screen Image Printing/Data Saving/History Waveform/etc.

RESET key

Returns a numeric input value to its default.

SET key

Confirms a menu item selected with the rotary knob.

Arrow keys (◄ ► ▲ ▼ keys)

The left and right arrow keys move the digit cursor sideways when entering a numeric value.

Use the up and down arrow keys to enter a numeric value.

Numeric keypad

Use this for entering numeric values, file names, and so on.

(SHIFT+) PRINT key (Sections 12.2, 12.3, 13.8)

Prints the screen image data. Pressing the SHIFT key, followed by the PRINT key displays a menu when printing the screen image data to the internal printer or USB printer.

FILE key (Sections 13.4 to 13.7, 13.9 to 13.12)

Displays a menu for data saving and recall operations using a PC card or USB memory, and for file operations.

SYSTEM key

Displays a menu relating to calibration, network, computer interface settings, date and time, message language, click sound, self-test, and storage media formatting.

Displays system information (which options are installed, and firmware version).

SHIFT key

Pressing this once lights the key, and enables the functions indicated on each key by a purple legend above the key. Pressing the key once more returns to the normal functions.

SETUP key (Section 4.5)

Displays a menu for the initialization function returning settings to their factory defaults, the auto setup function automatically setting values according to input signals, and for storing and recalling setting information.

(SHIFT+) HISTORY key (Chapter 11)

Displays a menu for displaying waveforms using the history memory function, and when searching. Pressing the SHIFT key, followed by the HISTORY key clears the displayed history waveform.

1.3   Screen Display

Normal Display Screen

Waveform acquisition status

Stopped	HD out (writing to hard disk in progress)
Running (acquisition in progress)	Pre (acquiring pre data)
Waiting for trigger	Post (acquiring post data)

Sampling rate

Trigger position

Acquisition mode

T/div. See section 4.2

Waveform acquisition count

Specified record length

Input channel status
Coupling
Scale
Probe attenuation rate

Computing/Reference waveform status

Trigger mode

Trigger source, Polarity

Trigger level

Trigger coupling, HF rejection, Hysteresis

— **Vertical position mark**

⏚ **Ground level mark**

Trigger position mark

Acquisition Mode Display

Normal:	Normal mode
Envelope:	Envelope mode
Average:	Average mode

Note

The LCD screen of this instrument may have a number of defective pixels.

Screen Displaying Zoom Waveforms

T/div of the Z1 zoom waveform display. See section 7.12.

Z1 zoom range

X-axis of Z1 zoom range

Z2 zoom range

T/div of the normal waveform display. See section 4.2.

Normal waveform record

Y-axis of Z1 zoom range

CH1

<< Main : 125 K >>

1ms/div

Normal waveform display area

V/div of the Z1 zoom waveform

Z1: 500us/div
1.28 V/div

Z2: 100us/div
5.00 V/div

T/div of the Z2 zoom waveform display. See section 7.12.

V/div of the Z2 zoom waveform

Zoom waveform display area

CH1

Display area of the Z1 zoom waveform

Display area of the Z2 zoom waveform

Screen Displaying Analysis Windows

150.0mV

Main : 125 k

500us/div

CH1

Max(C1)	107mV	Min(C1)	-9mV
High(C1)	99mV	Low(C1)	-9mV
P-P(C1)	116mV	Hi-Low(C1)	108mV
+Over(C1)	9.2%	-Over(C1)	8.7%

250.0mV
2.500ms

2.500ms

Waveform parameter measurements

20.40 V

Y-axis scale of XY waveform

Analysis results

Mean	106.719mV
σ	275.000uV
Peak	107mV
Itg±σ	90.7%
Itg±3σ	97.4%

-20.40 V
-250.0mV

-150.0mV

X-axis scale of XY waveform

WINDOW1
(analysis window 1)

WINDOW2
(analysis window 2)

2.1   Block Diagram

System Configuration
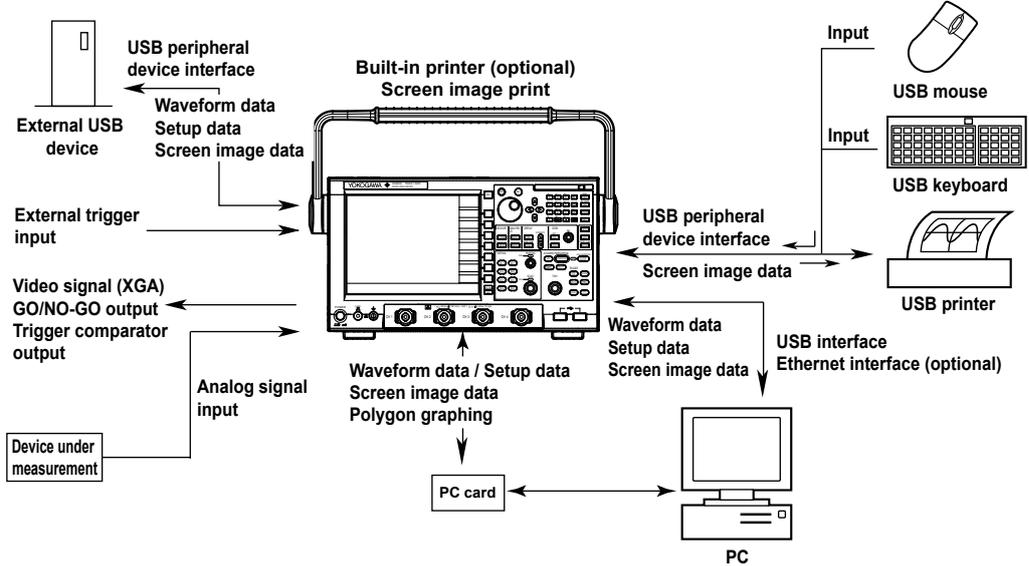
Block Diagram
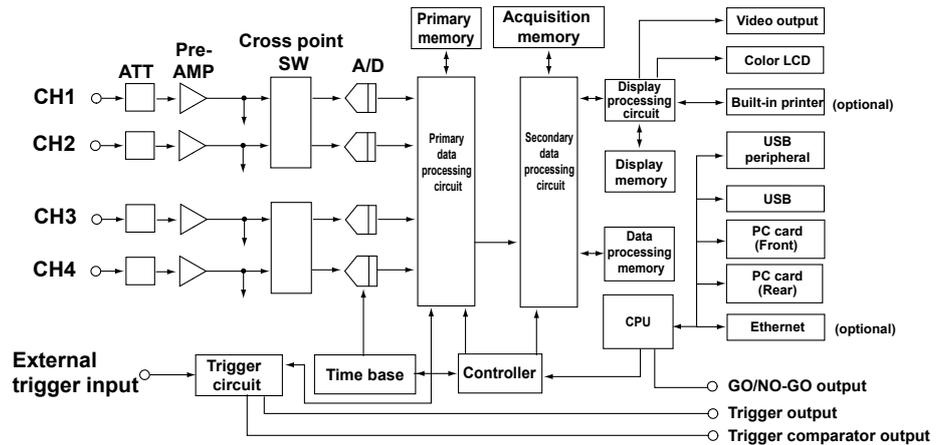
Signal Flow

The signal applied to each signal input terminal is first passed to the vertical control circuit consisting of an attenuator (ATT) and pre-amplifier. At the attenuator and pre-amplifier, the amplitude of each input signal is adjusted according to the settings such as the input coupling, voltage sensitivity (Scale), and offset voltage. The adjusted input signal is then passed to the cross-point switch. The signal input to the cross-point switch is passed to the A/D converter according to the interleave setting.

At the A/D converter, the received voltage level is converted into digital values. The digital data is written to the primary memory by the primary data processing circuit at the sample rate that matches the time axis setting.

When the trigger is applied, data written to the primary memory is transferred to the acquisition memory.

The data written to the acquisition memory is converted into waveform display data by the secondary data processing circuit, transferred to the waveform processing circuit, and stored in the display memory. The waveforms are displayed on the LCD using the data stored in the display memory.

2.2 Channels and Displayed Waveforms

There are three types of waveform that can be displayed on the DL9000.
• Input waveforms
• Computed waveforms
• Reference waveforms

The reference waveform can be selected from input waveforms, computed waveforms, and previously stored input or computed waveforms.

The DL9000 provides the following channels.
• Input channels (CH1 to CH4)
• Computation channels (M1 to M4)

By assigning a waveform to each channel, the assigned waveforms can be displayed.
Depending on the channel type, different waveforms can be assigned as follows.

Input channels: Measurement waveforms currently being captured, computed waveforms

Computation channels: Computed waveforms, reference waveforms

Note
If a computed waveform is assigned to an input channel, it is displayed as MATH5 to MATH8.

Input Waveforms

These are waveforms for measurement input to an input channel.

Computed Waveforms

These are waveforms computed from input waveforms or reference waveforms.
In the calculation equation that can be set in the menu for channels 1 to 4 is fixed, being the input waveform of the input channel being set. When a calculation is set in the menu for channels 1 to 4, the data of the channel for which the calculation is set is the calculation value.
For details of computations, see page 2-24.

Note
To use a calculated result as a source for a different calculation equation, set the calculation equation in the menu for channels 1 to 4, then use that result (one of channels 1 to 4) as the source in the separate calculation formula.

Reference Waveforms

Any of input waveforms, other computed waveforms, and previously stored input or computed waveforms can be selected for display. The history information for the selected waveform is also read in.
It is also possible to make a separate selection from the history waveforms to display only one, or to display all of the history waveforms superimposed.
A history waveform refers to any previous waveform stored in acquisition memory.
For details of history waveforms, see Chapter 11.

2.3 Vertical and Horizontal Axes

The vertical sensitivity setting is used to adjust the displayed amplitude of the waveform for easy viewing. The vertical sensitivity is set by assigning a voltage or a current value to one grid square (1 division) on the screen.

By switching attenuators with different attenuation and changing the amplification of the pre-amplifier, the sensitivity changes in steps (for example, voltage sensitivity changes in steps as in 1 V/div, 2 V/div, and 5 V/div).

If 1.00 V/div is changed to 0.500 V/div

Vertical position mark

GND level mark

1 div = 1.00 V

1 div = 0.500 V
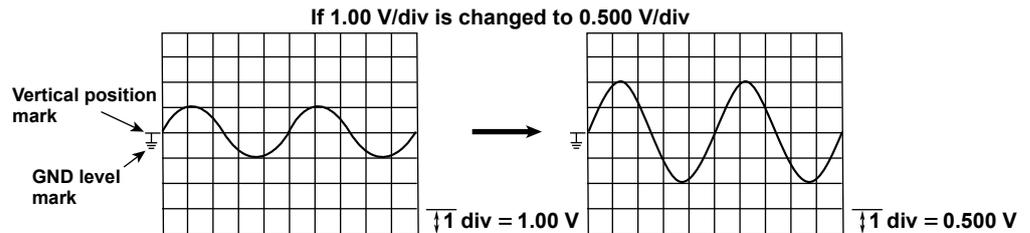
Note

Vertical Sensitivity Setting and Measurement Resolution

To measure a voltage with high precision, the vertical sensitivity should be adjusted so that the input signal is measured with as large an amplitude as possible.

The DL9000 uses 8-bit A/D converters to sample the input signal at a resolution of 250 levels (LSB). The waveforms are displayed using 25 levels per division.

Valid Data Range

The output with 250 levels as described above is displayed at 25 levels per division, and therefore the effective display range is ±5 divisions from the center of the screen. However, if the vertical axis position is moved after stopping data (waveform) acquisition, the valid data range also moves by the same amount.

Vertical Position of the Waveform <<For the operation procedure, see Section 5.3>>

Since the DL9000 can display eight waveform channels, including computation channels, the waveforms are displayed superimposed, and can be difficult to read.

In this case, you can change the display position of waveforms on the vertical axis (vertical position) in the range of ±4 divisions for easier viewing. The vertical sensitivity switches around the vertical position (mark).

Position 2.00 div

Position 0.00 div

Vertical position mark

Position −3.00 div
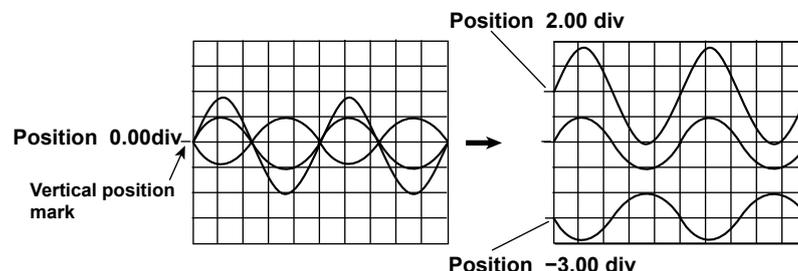
Input Coupling <<For the operation procedure, see Section 5.4>>

If you wish to observe just the amplitude of an AC signal, it is best to remove the DC component from the input signal. On the other hand, there are times when you wish to check the ground level or observe the entire input signal (both the DC and AC components). In these cases, you can change the input coupling setting. By changing the input coupling, the method used to input the signal to the vertical control circuit (voltage axis) is switched. The following types of input coupling are available.

AC1 MΩ

The input signal is coupled to the attenuator of the vertical control circuit through a capacitor. This setting is used when you wish to observe only the amplitude of the AC signal, eliminating the DC component from the input signal.

DC1 MΩ

The input signal is directly coupled to the attenuator of the vertical control circuit. Use this setting if you wish to observe the entire input signal (DC component and AC component).

DC50 Ω

The same as for DC1 MΩ above, except that the input impedance is 50 Ω. Care is required, as this reduces the maximum input voltage.

GND

The input signal is not coupled to the attenuator of the vertical control circuit, which is connected to ground. You can use this setting to check the ground level on the screen.

AC1 MΩ	DC1 MΩ	DC50 Ω	GND
Input terminal — Vertical control circuit — 1 MΩ	Input terminal — Vertical control circuit — 1 MΩ	Input terminal — Vertical control circuit — 50 Ω	Input terminal — Vertical control circuit
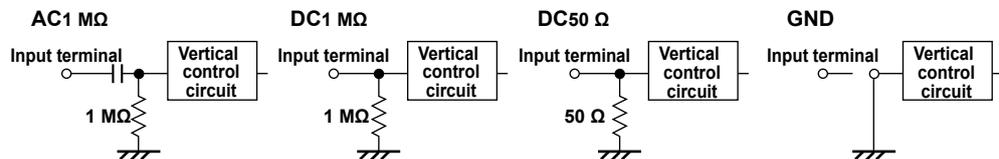
Probe Attenuation/Current-to-Voltage Conversion Ratio <<For the operation procedure, see Section 5.6>>

Normally a probe is used in connecting the circuit being measured to the measurement input terminal. Using a probe has the following advantages.
- Avoids disturbing the voltage and current of the circuit being measured.
- Inputs the signal with no distortion.
- Expands the voltage range that the DL9000 can measure.

The DL9000 is supplied with 500 MHz passive probes. The supplied probe attenuates the measured voltage signal by a factor of 1/10. When using the probe, in order to read the measurement voltage correctly, the attenuation setting on the DL9000 must be set to match the probe attenuation. The DL9000 automatically recognizes when the supplied 500 MHz passive probes (voltage probes) are connected, and sets the attenuation ratio to 10 : 1.

In addition to the 10 : 1 setting, the DL9000 has settings for a voltage probe of 1 : 1, 100 : 1, and 1000 : 1, and for a current probe settings of 10 A : 1 V and 100 A : 1 V. When using probes, set the attenuation ratio to match that of the probe.

Offset Voltage <<For the operation procedure, see Section 5.2>>

When observing a signal superimposed on a predetermined voltage, an offset voltage can be applied to eliminate the predetermined voltage so that only the changes in the signal can be observed with higher vertical axis sensitivity.

Usually, the offset voltage does not affect the cursor measurement values, the result of the automated measurement of waveform parameters, or the computed values. However, by setting Offset Cancel to ON (see section 5.10), you can calculate with the offset voltage subtracted from cursor measurement values, results of the automated measurement of waveform parameters, and computed values.
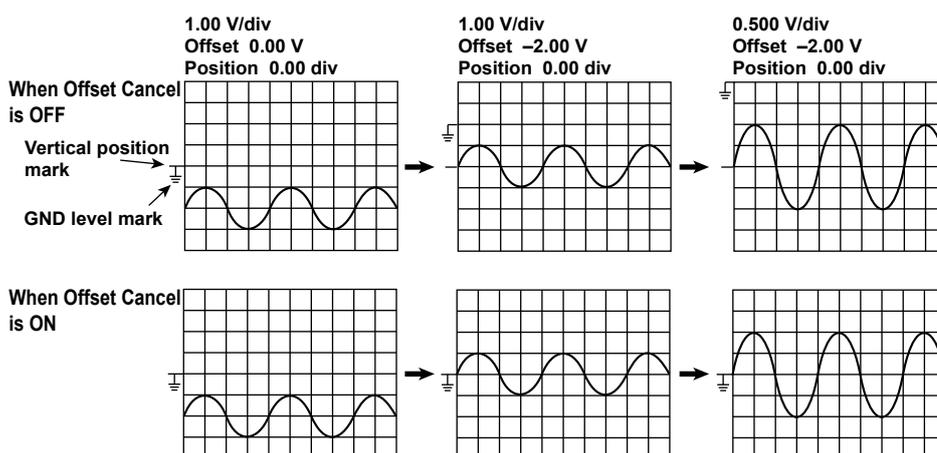
Inverted Waveform Display

This inverts the waveform display about the Position value as center. The inversion applies to the display only, and does not affect the measurement value. Setting the inverted display ON/OFF does not affect waveform parameter automatic measurement values or calculations.

Bandwidth Limit <<For the operation procedure, see Section 5.5>>

Input signals can have bandwidth limits above a certain frequency set independently for each channel. You can observe waveforms with the noise components above the specified frequency eliminated. The frequency can be selected from FULL, 200 MHz, 20 MHz, 8 MHz, 4 MHz, 2 MHz, 1 MHz, 500 kHz, 250 kHz, 125 kHz, 62.5 kHz, 32 kHz, 16 kHz, and 8 kHz.

Horizontal Axis (Time Axis)

Time Axis Setting <<For the operation procedure, see Section 5.8>>

The time axis scale (T/div) is set as time per grid square (1 div). The setting range is from 500ps/div to 50s/div. Since horizontal axis display range is 10 div, the waveform display time is T/div × 10.
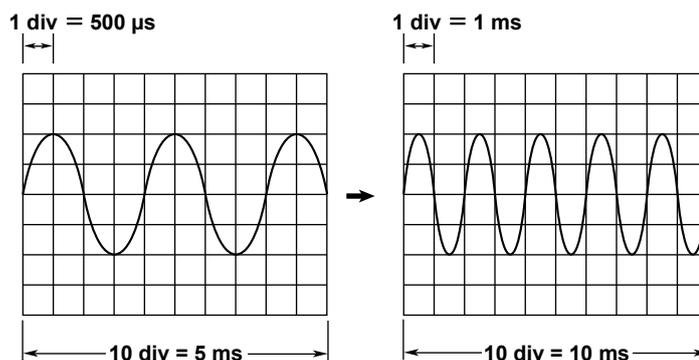
Relationship between the Specified Record Length, Time Axis Setting, Sample Rate, and Display Record Length

If you change the time axis setting with respect to the specified record length of the acquisition memory, the sample rate and display record length change. For more details about this relationship, see Appendix 1.

Time Axis Setting and Roll Mode Display

If T/div is set to a certain range (see Appendix 1), instead of the displayed waveform being updated by a trigger (update mode), the waveform is displayed in roll mode. In roll mode, as new data is captured, the oldest values are deleted from the screen, as the waveform scrolls from right to left. Thus roll mode display allows waveforms to be observed in the same way as on a pen recorder. It is useful in observing low frequency signals or signals that change slowly. It is also useful in detecting glitches (spikes in the waveform) that occur intermittently.

* Roll mode display is also used when the trigger mode is set to single. However, the displayed waveforms stop when a trigger is activated.
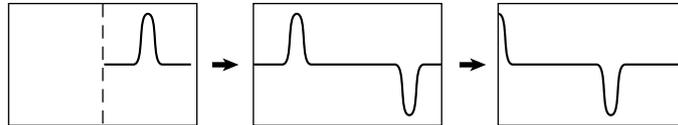
2.4 Triggers

A trigger is a cue used to display the waveform on the screen. The trigger is activated when the specified trigger condition is met. At this point, the waveform is ready to be displayed on the screen.

Trigger Source, Trigger Slope, and Trigger Level

Trigger source
Trigger source refers to the signal that is used in checking the trigger condition.

Trigger slope
Trigger 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.

Edge
The term "edge" is used to refer to the point at which the trigger source slope passes the trigger level (or if trigger hysteresis is set, the point at which it has passed the level by the hysteresis amount).

Trigger level
Trigger level refers to the level at which a trigger is activated when the trigger source passes the certain level.
With simple triggers such as the edge trigger described later, a trigger is activated when the level of the trigger source passes through the specified trigger level.

Trigger level

Trigger source

**When set to rising (⌐⌐),
the trigger is activated here (edge)**
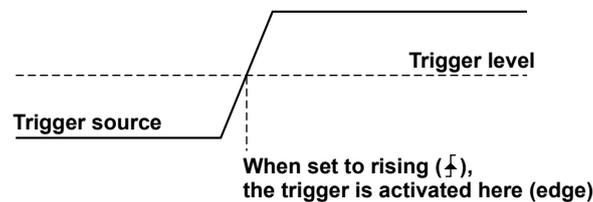
Trigger Type <<For the operation procedure, see Chapter 6>>

The DL9000 provides three basic trigger types: "Edge/State," "Width," and "Enhanced." Then by setting "Event Interval," a trigger can be applied that is dependent on the period of a recurring trigger condition, or the time interval between two triggers.

Edge/State trigger
There are four types of Edge/State trigger, as follows.
- **Edge trigger**
  When the trigger source passes through the specified trigger level on a rising or falling edge, a trigger is activated. You can select the trigger source from input signals, the external trigger signal, and the commercial power supplied to the DL9000. In the case of commercial power, a trigger is activated only on the rising edge.

- **Edge (Qualified) trigger**
  While the states of the input channels meet a certain condition only, an edge on a single trigger source activates the trigger.

  Qualify: CH1 = H, CH2 = L, AND, Trigger source: CH3, rising
  L: low level, H: high level
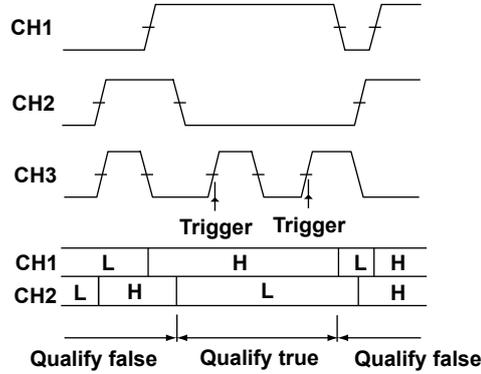
- **State trigger**
  The trigger is activated in any of the following cases.
  - The trigger is activated when the logical condition (State) of the specified input(s) is met or when it is not met.
  - At the timing of the rising or falling edge of the specified channel (clock channel), the input logical condition (State) is checked, and the logical condition is normalized (High level when the condition is met, or Low level when it is not). The trigger is activated when this normalized condition changes.

State: CH1 = H, CH2 = L, CH3/CH4 = X, AND
Clock: None, Polarity: Enter
L: low level, H: high level
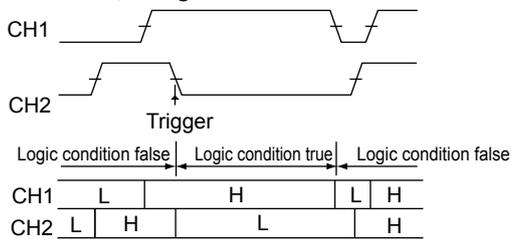
State: CH1 = H, CH2 = L, CH3/CH4 = X, AND
Clock: None, Polarity: Exit
L: low level, H: high level
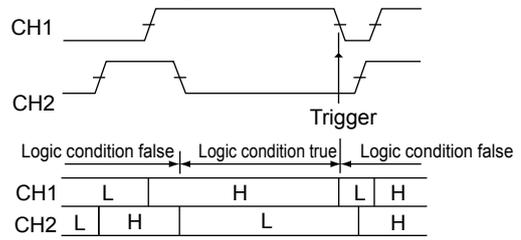
State: CH1 = H, CH2 = L, CH4 = X, AND
Clock: CH3, rising, Polarity: Enter
L: low level, H: high level
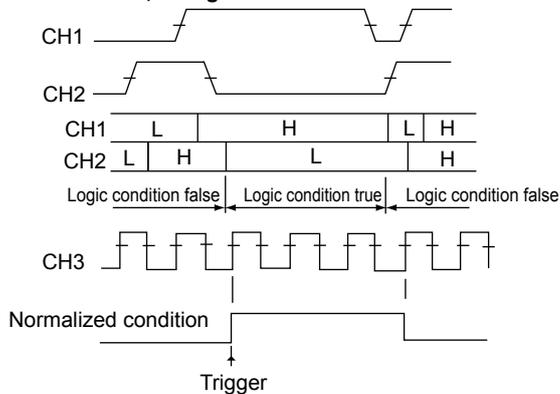
State: CH1 = H, CH2 = L, CH4 = X, AND
Clock: CH3, rising, Polarity: Exit
L: low level, H: high level
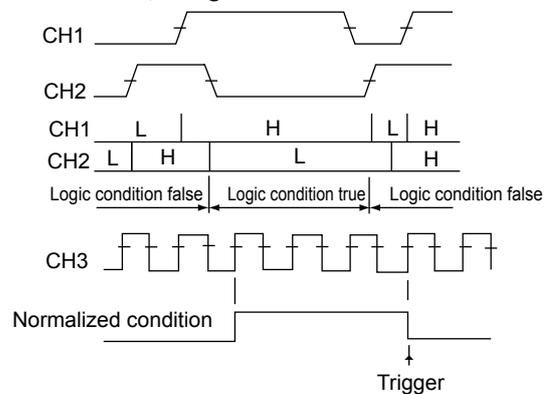
- **Edge OR trigger**
  The trigger is activated by an edge on multiple trigger sources. When an Edge OR trigger is used, the frequency of the trigger sources is limited to 200 MHz or less.

Width

The trigger is activated by the duration of a pulse (pulse width). There are three types of width trigger, as follows.

- **Pulse Width trigger**
  The trigger is activated according to the relationship of the pulse width of the single trigger source and the specified time.
  - At the end of a pulse longer than the specified time (More than)
  - At the end of a pulse shorter than the specified time (Less than)
  - At the end of a pulse longer than specified time T1 and shorter than specified time T2 (Between)
  - At the end of a pulse either shorter than specified time T1 or longer than specified time T2 (Out of range)
  - A trigger when the pulse width exceeds the specified time (Time out)
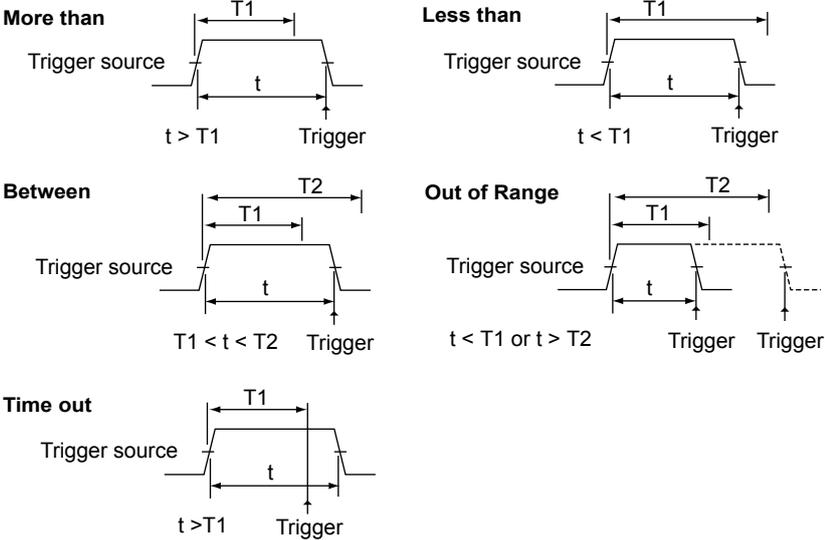
- **Pulse (Qualified) trigger**
  While the states of the input channels meet a certain condition only, the trigger is activated according to the relationship of the pulse width of the single trigger source and the specified time. The timing at which the trigger is activated is the same as for Pulse Width.
  State: CH1 = H, CH2 = L, AND, Trigger source: CH3, More than
  L: low level, H: high level
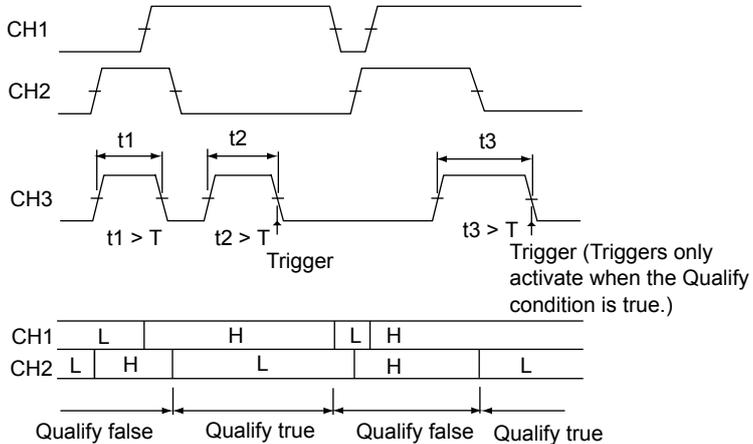
- **Pulse State trigger**

  The trigger is activated in any of the following cases.

  - The trigger is activated when the relationship holds between the specified time and the time for which the set input logical condition (State) holds or the time for which it does not hold.
  - At the timing of the rising or falling edge of the specified channel (clock channel), the input logical condition (State) is checked, and the logical condition is normalized (High level when the condition is met, or Low level when it is not). The trigger is activated on detecting for the first time that the relationship holds between the specified time and the time for which the normalized condition holds or the time for which it does not hold.

State: CH1 = H, CH2 = L, CH3/CH4 = X, AND
Clock: None, Polarity: True, More than
L: low level, H: high level
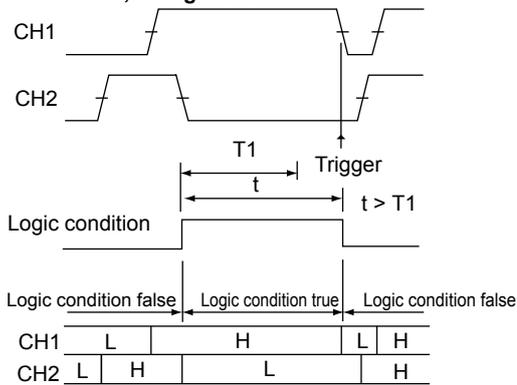
State: CH1 = H, CH2 = L, CH3/CH4 = X, AND
Clock: None, Polarity: False, More than
L: low level, H: high level
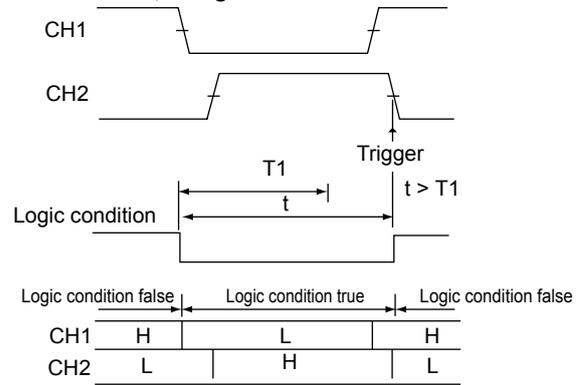
State: CH1 = H, CH2 = L, CH4 = X, AND
Clock: CH3, rising, Polarity: True
L: low level, H: high level
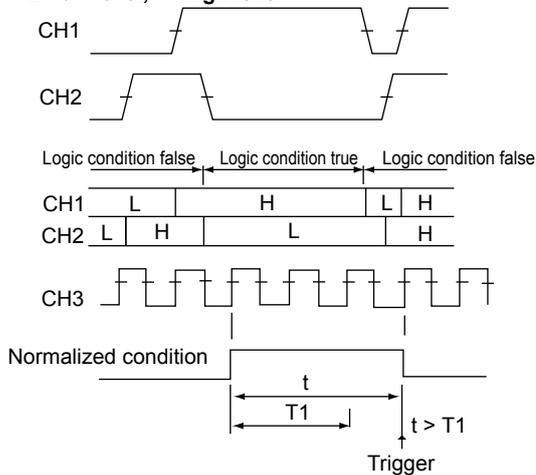
State: CH1 = H, CH2 = L, CH4 = X, AND
Clock: CH3, rising, Polarity: False
L: low level, H: high level
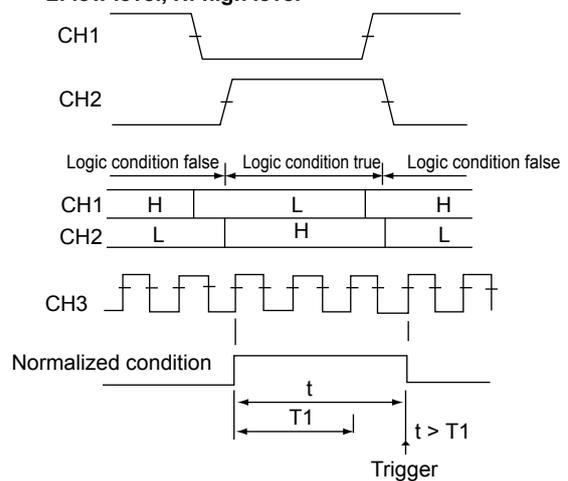
Enhanced

- **TV trigger**

  This trigger is used when observing a video signal. NTSC (525/60/2), PAL (625/50/2), and HDTV (1125/60/2) standards are supported. The horizontal sync signal can be set to any frequency, allowing a trigger to be taken from any TV signal, not necessarily one of the above standards.
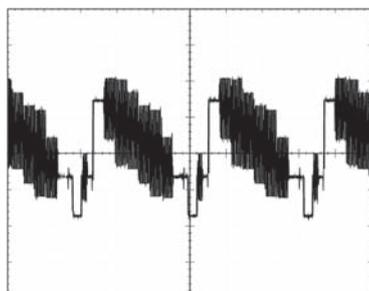
- **Serial**

  This is a trigger function for capturing serial pattern signals. This function can be used on products with firmware version 1.60 or higher.

  This function detects the serial data pattern in sync with the selected clock signal. You can specify a serial data pattern using up to 128 bits as a condition for activating a trigger. This allows you to set the CS signal that controls the interval for detecting the data source or the latch source that specifies the timing for comparing the pattern.

- **I²C**

  This is a trigger function for capturing I²C bus signals. This function can be used on products with firmware version 1.60 or higher. Triggers can be activated using five trigger modes.

  I²C Bus is an abbreviation for Inter Integrated Circuit Bus. It is a bidirectional bus for connecting ICs. Note that the /F5 option is required to analyze I²C bus signals.

- **SPI**

  This is a trigger function for capturing SPI bus signals. This function can be used on products with firmware version 1.60 or higher.

  The SPI (Serial Peripheral Interface) Bus is a synchronized serial bus that is widely used for inter-IC communications and data communications. Note that the /F5 option is required to analyze SPI bus signals.

Event Interval

Taking the trigger condition, excluding OR trigger and TV trigger, as an event, the trigger is activated when the event period, or the interval between two events meets preset time conditions. The time condition is the same as the time condition for the Width trigger.

- **Cycle**
  When the event period is within the specified time range

  More than
  Determination time: T1
  t1 < T1   t2 > T1   t3 < T1

  Event

  Trigger

  Less than
  Determination time: T1
  t1 < T1   t2 > T1   t3 < T1

  Event

  Trigger   Trigger

  Between
  Determination time: T1, T2
  T1 < t1 < T2 T2 < t2   t3 < T1

  Event

  Trigger

  Out of Range
  Determination time: T1, T2
  T1 < t1 < T2 T2 < t2   t3 < T1

  Event

  Trigger   Trigger

  Time out
  Determination time: T1
  t1 < T1   t2 > T1   t3 < T1

  Event

  Trigger
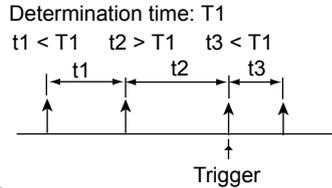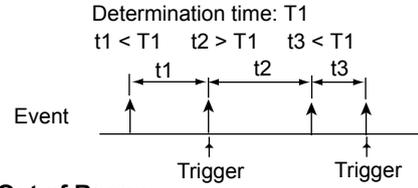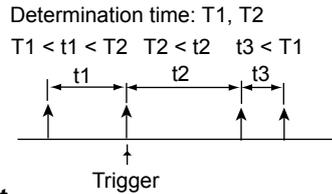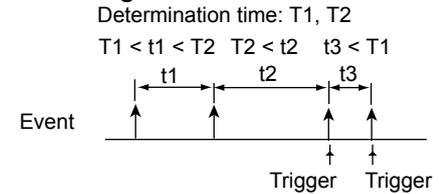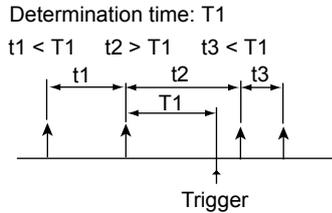
- **Delay**
  When the time interval between event 1 occurring and the first occurrence of event 2 meets the specified time condition.
  If the time interval between event 1 occurring and the first occurrence of event 2 does not meet the specified time condition, then the decision is restarted the next time that event 1 occurs.
  The following shows More Than as an example.

  More than
  Determination time   Determination time

  Event 1

  Starts again from here

  Event 2

  Trigger

  When event 2 occurs during the time interval, detection starts again from the next occurrence of event 1.
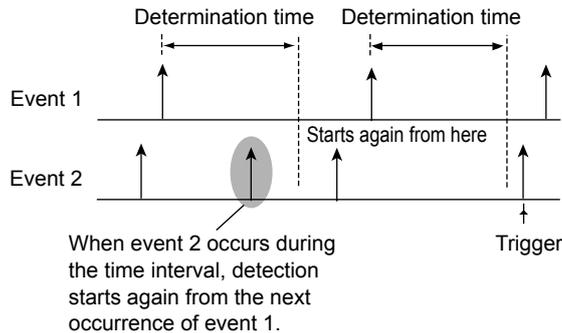
- **Sequence**
When the time interval between event 1 occurring and the first occurrence of event 2 meets the specified time condition.
If the time interval between event 1 occurring and the first occurrence of event 2 does not meet the specified time condition, the occurrence of event 2 is ignored, and the trigger is activated when event 2 occurs to meet the specified time condition.
The following shows More Than as an example.

More than
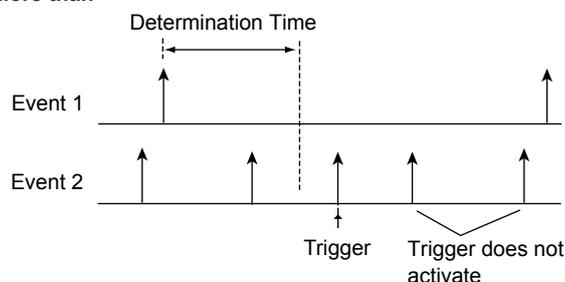
Window Comparator <<For the operation procedure, see Section 6.3>>

This determines whether a trigger condition based on a waveform rising edge or falling edge, or High/Low, or a Qualify or State logical condition falls within (IN) or outside (OUT) a specified range (Window).
The Window comparator can be enabled or disabled for each channel separately. The trigger condition changes according to the Window comparator setting for the channel set for a trigger source and so on.
For example, if the source channel of an Edge trigger has the Window comparator enabled, the trigger can be activated according as the source channel waveform is within or outside the specified area.

Trigger Mode <<For the operation procedure, see Section 6.1>>

Sets the conditions for updating the displayed waveforms. The following five trigger modes are available.

Auto Mode

If a trigger is not activated within a specified time (approximately 100 ms, referred to as the timeout time), the displayed waveforms are automatically updated.

Auto Level Mode

The displayed waveforms are updated in the same way as in auto mode.
In the case of an Edge trigger, if the trigger is not activated when the timeout time has elapsed, the amplitude of the trigger source is detected, and the trigger level is automatically updated to the center value of the amplitude.

Normal Mode

The displayed waveforms are updated only when the trigger condition holds. The displayed waveforms are not updated if a trigger does not occur.

Single Mode
When the trigger condition holds, the displayed waveforms are updated once only, and waveform acquisition is stopped. This mode is useful when you are observing a single-shot signal.

N single mode
For the specified number of times only, waveforms are acquired and stored in different memory areas each time the trigger condition holds, then acquisition stops and all acquired waveforms are displayed.

Trigger Position <<For the operation procedure, see Section 6.6>>

When waveform acquisition starts, the trigger is activated by the set trigger condition, and the waveform captured to acquisition memory is displayed. When the trigger delay described in the next item is set to 0 s, the trigger position coincides with the point at which the trigger condition becomes true. By moving the trigger position on the screen, the display ratio of the waveform data ("pre-" data) before the trigger point which has been captured to acquisition memory (the pre-trigger part), and data ("post-" data) after the trigger point (the post-trigger part) can be changed.

Trigger Delay <<For the operation procedure, see Section 6.5>>

Normally the waveform is displayed before and after the trigger point, but by when a trigger delay is set, the waveform can be captured and displayed after a certain delay from when the trigger is activated, either specified as a time or by a specified edge.
By time: Set a delay time after the trigger occurs. The delay is from 0 to 10 s.
First Edge after time: After the set time has elapse from the trigger occurring, delay until the specified edge is detected. The set time is from 0 to 10 s.
Edge Count: After the trigger occurs, delay until the specified edge has been detected a certain number of times.

Trigger Coupling <<For the operation procedure, see Section 6.3>>

As with the input signals, the input coupling can be switched on trigger sources. Select the input coupling that is suitable for the trigger source signal.
The following two types of input coupling are available for the trigger source signal.
DC
Select this setting when using the source as is with no processing of the signal.
AC
Select this setting when using the signal with the DC components removed for the trigger source.

HF Rejection <<For the operation procedure, see Section 6.3>>

Turn HF rejection ON to eliminate high frequency components above 15 kHz or 20 MHz from the trigger source. This prevents triggers from being activated at unexpected points due to the effect of high frequency noise.

Trigger Hysteresis <<For the operation procedure, see Section 6.3>>

If there is insufficient trigger level width and noise is present in the trigger source, the trigger point fluctuates each time a trigger is activated. This causes the displayed waveforms to be unstable. Again, even with a slope of the polarity opposite to that specified, noise near the threshold value can cause the trigger to be activated. To avoid such problems, a given margin (hysteresis) is added to the specified trigger level.

The DL9000 provides a selection between ⌁ (narrow hysteresis) and ⌁ (wide hysteresis). When ⌁ is selected, the hysteresis is increased, and fluctuation in the trigger point due to noise can be reduced, giving a more stable waveform display. However, this setting can make the trigger point less precise, reducing the trigger sensitivity, so that a trigger source of low amplitude may fail to activate. With a stable waveform free of noise, or a low amplitude trigger signal, set the hysteresis to ⌁.

Trigger Hold-off <<For the operation procedure, see Section 6.4>>

The trigger hold-off function temporarily stops detection of the next trigger once a trigger has been activated. This function is useful when observing a pulse train signal, such as a PCM code or when using the history memory function described later (see page 2-19) and you want to change the waveform acquisition period.

2

Explanation of Functions

2.5 Waveform Acquisition Conditions

Acquisition Mode <<For the operation procedure, see Section 7.1>>

When storing sampled data in the acquisition memory (see "Signal Flow" in section 2.1), it is possible to perform processing on data and display waveforms based on the processed data. The following three types of data processing are available.

Normal Mode

In this mode, sampled data is stored in the acquisition memory without special processing.

Envelope Mode

In normal mode or averaging mode, the sample rate (the number of times data is acquired per second in the acquisition memory) drops if T/div is increased (see Appendix 1). However, in envelope mode, the maximum and minimum values are determined from the data sampled at 2.5 GS/s or 5 GS/s at time intervals one half that of the sampling period (inverse of the sample rate) of normal mode regardless of the interleave mode setting (ON or OFF). The maximum and minimum values are stored as pairs in the acquisition memory.

Envelope mode is useful when you want to avoid aliasing (see next page), since the sample rate remains high irrespective of the time axis setting. It is also useful when you want to detect glitches (narrow pulse signals) or display an envelope of a modulating signal.

Envelope curve
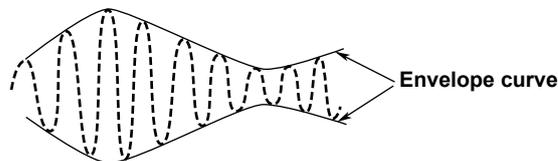
Averaging Mode

In the averaging mode, waveforms are acquired repeatedly to obtain the average of waveform data at the same time point (the same time in relation to the trigger point). The DL9000 takes the exponential or simple average of the waveform data and writes the results to the acquisition memory. The averaged data is then used to generate the display. When the trigger mode is auto mode, auto level mode, or normal mode then exponential averaging is used, and in the single mode, simple averaging. This mode is useful such as when eliminating random noise superimposed on the signal.

The attenuation constant of exponential averaging can be set in the range of 2 to 1024 ($2n$ steps, where n is a positive integer). The average count of simple averaging can be set in the range of 2 to 65536 ($2n$ steps, where n is a positive integer).

Exponential averaging
(when trigger mode is set to auto, auto level, or normal)

$$A_n = \frac{1}{N}\{(N-1)A_{n-1} + X_n\}$$

A_n: n^{th} averaged value
X_n: n^{th} measured value
N: Attenuation constant (2 to 1024, 2^n steps)

Simple average
(When trigger mode is set to single)

$$A_N = \frac{\sum\limits_{n=1}^{N} X_n}{N}$$

X_n: n^{th} measured value
N: Average count
     (acquisition count, 2^n steps)

High Resolution Mode <<For the operation procedure, see Section 7.2>>

Normally, this unit takes digital values from the 8-bit A/D converter, applies specified processing, and then stores 8-bit values in primary memory.
However, by applying bandwidth limits to the input signal, you can uniformly increase the resolution of the A/D converter.
In the high resolution mode, data is stored in primary memory as 16-bit values, maintaining the increased resolution obtained by limiting the bandwidth.

Record Length <<For the operation procedure, see Section 7.3>>

The term record length refers to the number of data points acquired per channel in the acquisition memory. The record lengths that can be set are: 2.5 k words (2500 points), 6.25 k words, 12.5 k words, 25 k words, 62.5 k words, 125 k words, 250 k words, 625 k words, 1.25 M words, 2.5 M words, and 6.25 M words (the maximum record length that can be set varies from model to model). Basically, if you change the time axis setting, the sample rate is changed to maintain the set record length at the same value. However, in some cases the record length is changed as a result, for example, of a changed time axis setting (see Appendix 1).

Sampling Mode <<For the operation procedure, see Sections 7.4 to 7.6>>

Depending on the time axis setting, you can switch the mode used to sample the input signal (sampling mode). The time axis ranges that allow the sampling mode to be changed vary depending on the acquisition mode and other settings. For details, see Appendix 1.

Realtime sampling mode

When the time axis setting is changed, the sample rate changes, and data can be sampled at a maximum sample rate of 5 GS/s for the 701307/701308/701310/701311 (2.5 GS/s with interleave mode off; for details of interleave mode see Section 2.5), and a maximum of 10 GS/s for the 701312/701313 (5 GS/s with interleave mode off). The input signal is sampled sequentially, and the data is stored in the acquisition memory. In this mode, according to the sampling theorem*, the waveform can only be correctly displayed up to a frequency which is one-half of the sample rate (samples per second, or S/s). Therefore, an appropriate sample rate for a waveform is such that the frequency of the waveform is comparatively lower.

* If the sample rate is relatively low compared with the input signal frequency, then higher harmonic content of the signal will be lost. In this case, according to the Nyquist sampling theorem, the high frequency components may be transformed into low frequencies, by the process known as aliasing. acquisition By setting the mode to envelope waveform capture, aliasing can be avoided.

Aliased signal Input signal Sampling point
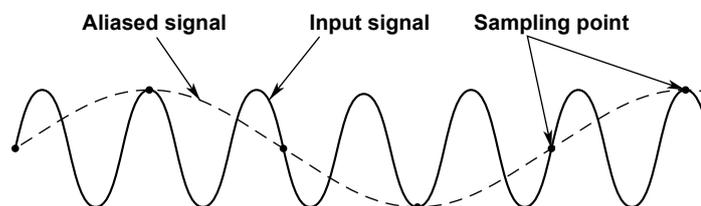
Repetitive Sampling Mode

In the repetitive sampling mode, the time axis can be set with a sample rate exceeding the maximum of 5 GS/s for the 701307/701308/701310/701311 (2.5 GS/s with interleave mode off), or 10 GS/s for the 701312/701313 (5 GS/s with interleave mode off). In this mode, one waveform is created from several cycles of a repetitive signal. This is equivalent to sampling the signal at a higher sample rate than the actual sample rate. The DL9000 enables an apparent maximum sample rate up to 2.5 TS/s.

When the repetitive sampling mode is off, because of the relation between the time axis and the display record length, if the sample rate exceeds the sampling rate, the display record length is shortened to correspond to the time axis setting and sample rate.

There are two types of repetitive sampling. One is sequential sampling in which the data is sampled by intentionally offsetting the sampling points by a certain time with respect to the trigger point. The other is random sampling in which the data that is offset randomly from the trigger point is sampled and resorted with respect to the trigger point. The DL9000 employs random sampling which enables the waveform before the trigger point (trigger position, see Section 2.4) to be observed.

Interleave Mode

A single input signal is sampled by two A/D converters, enabling the maximum sample rate to be increased, to a maximum 10 GS/s (5 GS/s for the 701307/701308/701310/701311) in realtime sampling mode.

For the relation between the interleave mode and time axis, record length, and sample rate, see Appendix 1.

Interpolation

The actual sampling data can be interpolated to a maximum 1000 times (2000 times in high resolution mode), increasing the effective maximum sampling rate to 2.5 TS/s.

Action On Trigger <<For the operation procedure, see Section 7.8>>

When determining that a condition holds from the automated measurement of waveform parameters or from waveform passing zone condition, it is possible to carry out another action at the same time as waveform acquisition. The action to be carried out can be selected from a number of possibilities, including sounding an alarm, saving waveform data or a screen image, or printing a screen image.

The action on trigger operation is carried out with Exec on the menu screen. It cannot be carried out with the START/STOP key. Additionally, when the action on trigger is carried out, the trigger mode becomes the normal mode.

GO/NO-GO Decision <<For the operation procedure, see Sections 7.9 to 7.14>>

The GO/NO-GO function is useful when you want to inspect signals and track down abnormal symptoms on a production line making electronic equipment. The function determines whether the waveform is within the preset range and performs a predetermined action when the decision is GO or NO-GO. There are eight methods of making the determination:
- Setting a waveform zone on the screen
- Setting a rectangular zone on the screen
- Setting a polygonal zone on the screen
  Creating a polygon on a computer with the supplied software.
- Setting the range of a waveform parameter
- Setting the range of a periodic statistics parameter
- Setting the range of an FFT parameter
- Setting the range of an XY waveform parameter
- Setting the range of a telecom test item

History Memory <<For the operation procedure, see Chapter 11>>

When waveforms are being measured, the waveform data stored in the acquisition memory as a result of a trigger being activated is displayed as waveforms on the DL9000 screen, and can be viewed. When triggers are successively activated and waveforms are acquired, it is impossible to stop the measurement in time when an abnormal waveform appears (newer waveforms appear on the screen). Normally, abnormal waveforms in the past cannot be displayed. However, by using the history memory function, the past waveform data (history waveforms including the current displayed waveform) stored in the acquisition memory can be displayed when waveform acquisition is stopped.
You can select the display method from the following:
- Display any single waveform
- Display all waveforms with a color or intensity gradation
- Display all waveforms with no gradation, highlighting a single specified waveform
- Displaying the simple arithmetic mean of all waveforms

You can also automatically replay from the oldest waveform to the newest waveform, and vice versa.

The number of waveforms N that can be acquired and held as history waveforms varies from 1 to 2000 depending on the record length setting, and model. If the number of waveforms N that can be acquired and held is exceeded, the oldest history waveform is cleared. The waveform currently displayed on the screen (newest waveform) is counted as the 1st waveform, and up to N-1 waveforms in the past can be displayed. The following figure indicates an example when N = 1000.

Holds waveform data of the last 1000 triggers

Current display waveform
(Select Record = 0)

Select Record 0

Displays past waveforms
(Set the Select Record between 0 and –999)

Select Record –25
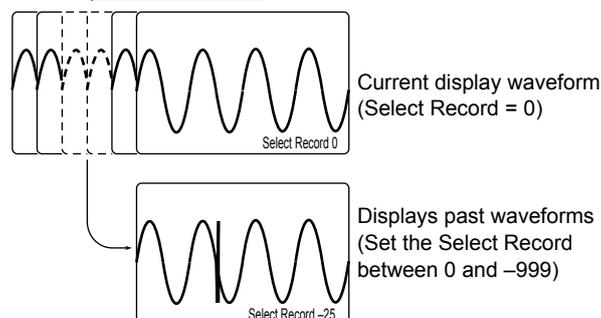
History search

When waveform acquisition is stopped, you can search for history waveforms that meet specified conditions.

Zone Search <<For the operation procedure, see Sections 11.2, 11.3, and 11.5>>

You can search for history waveforms that pass or do not pass a specified search zone. There are three types of search zone, as follows.

* **Waveform Zone**
  Set a zone on the screen using a waveform.
* **Rectangular zone**
  Set a rectangular zone on the screen.
* **Polygonal zone**
  Load a polygonal zone created on a computer.

Waveform Parameter Search <<For the operation procedure, see Sections 11.4, 11.6, and 11.7>>

From the history waveforms, you can search for waveform meeting or not meeting specified search parameter conditions. There are three types of search parameter, as follows.

* **Waveform Parameter**
  Search by values of the automated measurement of waveform parameters.
* **FFT Parameter**
  Search for FFT waveform marker measurement values, maximum values in a specified sector, or computation values using FFT measurement values.
* **XY Waveform Measurement Value**
  Search for a computation value using the area of an XY waveform or an area.

2.6   Display Conditions

Display Format <<For the operation procedure, see Section 8.1>>

Splitting the Screen
The screen can be split evenly so that input waveforms and computed waveforms can be easily viewed. The screen can be divided in the following ways:
Single (no split), Dual (two ways), Triad (three ways), Quad (four ways)

Waveform Assignment
You can select the assignment of the input channels to the divided windows.
- **Auto**
  Waveforms whose display is turned ON are assigned in order from the top.
- **Manual**
  Regardless of whether the display is ON or OFF, waveforms can be assigned freely to each window.

Display Interpolation <<For the operation procedure, see Section 8.2>>

If there are fewer than predetermined data points for the 10 divisions in the time axis direction, you can interpolate the data to display the waveform.

Sine Interpolation
Interpolated data is created with the function (sin x)/x, to interpolate between two points with a sine wave. Sine interpolation is suitable for observing sine waves or similar waves.

Linear Interpolation
Linearly interpolates between two points.

Pulse Interpolation
Interpolates between two points in a step pattern.

Interpolation OFF
Displays discrete dots without performing interpolation.

Accumulated Display <<For the operation procedure, see Section 7.7>>

The display time of old waveforms can be set longer than the waveform update period, so that newer waveforms are superimposed (accumulated) on older waveforms. There are two modes, as follows:
- **Count**
  The specified number of waveforms are superimposed. A gradation is applied according to the data frequency.
- **Time**
  Waveforms for the specified time are superimposed. A gradation is applied from older data to new.

For each of these modes, there are two types of display, as follows:
- **Persist**
  Display with a frequency gradation.
- **Color**
  Display with a color gradation.

The accumulated display is useful when observing noise, jitter, and transient phenomena in waveforms. The accumulated waveforms can also be saved.

Waveform Zooming <<For the operation procedure, see Section 8.6>>

Displayed waveforms can be enlarged in both the time axis and the voltage axis directions. This function is useful when the waveform acquisition time is set long and you wish to observe a particular section of the waveform closely. The zoom position can be set in grid div units.

The zoom waveform can be displayed at up to two positions simultaneously (dual zoom). The display combinations of the normal waveform, zoom waveform, and analysis screen windows are as follows, with the normal waveform display window identified as Main, the zoom waveform display windows as Z1 and Z2, and the analysis display windows as A1 and A2.
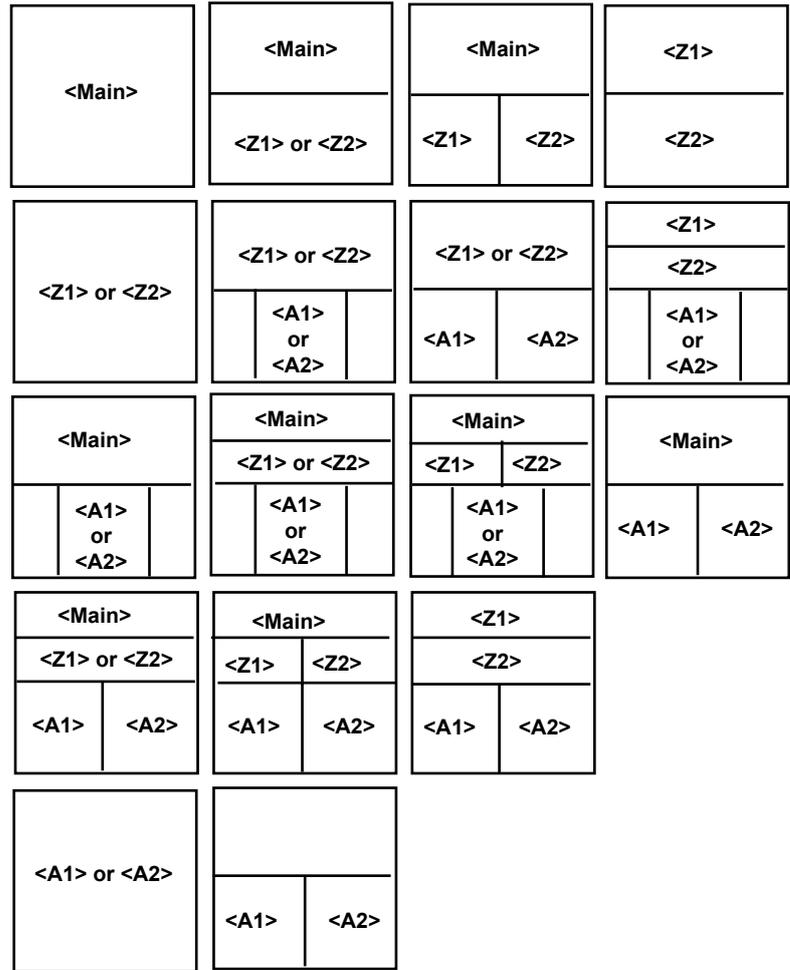
When the Main (normal waveform) and Zoom 1 or Zoom 2 waveforms are displayed simultaneously, a zoom box appears in the normal waveform display window to indicate the zoom position. The center of the zoom is the center of this box. For details of display examples, see Section 1.3, "Screen Displaying Zoom Waveforms."

You can select the display format of the zoom waveform window, and whether a trace is on or off, independently of the Main waveform window.

When zooming in the voltage axis direction, you can select a waveform to enlarge, and set it to 1.05 to 10 times normal size.

When zooming in the time axis direction, you can enlarge until there are ten data points in the zoom waveform display.

You can also set a point meeting a set trigger condition as the zoom center, or automatically move the zoom center.

Snapshot and Snap Clear <<For the operation procedure, see Section 8.8>>

By using the snapshot function, you can temporarily hold the waveform (snapshot waveform) that would be cleared when the screen is updated on the screen. The snapshot waveform is displayed in white, allowing for easy comparison against the updated waveform. The snapshot waveform can be printed as screen image data, but cannot be used for cursor measurement, automated measurement of waveform parameters, zoom, and computation functions.

Snap Clear
Press the SHIFT key, then press the SNAP SHOT key, to clear the snapshot waveform.

Scale Value Display <<For the operation procedure, see Section 5.12>>

The upper and lower limits (scale values) of the vertical and horizontal axes of each waveform can be displayed. For a display example, see "Normal Display Screen" in Section 1.3.

Displaying Waveform Labels <<For the operation procedure, see Section 8.5>>

A waveform label of up to eight characters can be assigned to each waveform and displayed. For a display example, see "Normal Display Screen" in Section 1.3.

2

Explanation of Functions

2.7 Waveform Computation

Prescaling and Rescaling <<For the operation procedure, see Chapter 9>>

Prescaling linearly scales the source waveform before carrying out computation. The computation uses the scaled values.
Rescaling linearly scales the results of the computation.

Computed Waveform Display

By setting a computation equation for each of CH1 to CH4, and M1 to M4, a maximum of eight computed waveforms can be displayed.

Through (Linear Scaling) <<For the operation procedure, see Section 9.1>>

By setting Through, linear scaling only can be carried out.

Addition, Subtraction, and Multiplication <<For the operation procedure, see Section 9.2>>

Addition, subtraction, and multiplication can be applied to any of CH1 to CH4, using the input waveform of the channel itself together with the waveform of any of CH1 to CH4 and REF1 to REF4 as operands, and can be applied to M1 to M4, using any two waveforms of CH1 to CH4 and REF1 to REF4 as operands. The computation result is used as the waveform (computed waveform) for CH1 to CH4 or M1 to M4.
The addition (+) and subtraction (–) functions are convenient for comparison with a reference signal, checking signal logic, or phase comparison, and multiplication ($\times$) can be used to check the power waveform when inputting a voltage signal and current signal.

Integration <<For the operation procedure, see Section 9.3>>

This integrates the selected waveform. Taking the specified integration start point as 0, the entire region is calculated, counting up toward the newest data, and counting down toward the oldest data. For CH1 to CH4 the computation applies to the input waveform of the channel itself, and for M1 to M4 applies to any of CH1 to CH4 and REF1 to REF4.

Phase Shift <<For the operation procedure, see Section 9.4>>

A waveform can be displayed phase-shifted. To advance the phase, set a positive value, and to delay the phase, set a negative value.

Filter <<For the operation procedure, see Section 9.5>>

High-frequency noise can be filtered out (with a low-pass filter), or low-frequency noise can be filtered out (with a high-pass filter).
You can select a first-order filter or a second-order filter. When a second-order filter is selected, there is no phase delay.

Smoothing <<For the operation procedure, see Section 9.6>>

A waveform can be displayed smoothed, by removing noise with a sliding average.

Edge Count <<For the operation procedure, see Section 9.7>>

This counts edges of a selected waveform. This function can be used on products with firmware version 1.60 or higher. Taking the specified integration start point as 0, the entire region is calculated, counting up toward the newest data, and counting down toward the oldest data. For CH1 to CH4 the computation applies to the input waveform of the channel itself, and for M1 to M4 applies to any of CH1 to CH4 and REF1 to REF4.

Rotary Count <<For the operation procedure, see Section 9.8>>

Phase changes between phase A (Source 1) and phase B (Source 2) are counted up or down, taking a rise above a specified level as 1, and a fall below the level as 0. This function can be used on products with firmware version 1.60 or higher. Taking the specified integration start point as 0, the entire region is calculated, counting up toward the newest data, and counting down toward the oldest data. For CH1 to CH4 the computation applies to the input waveform of the channel itself, and for M1 to M4 applies to any of CH1 to CH4 and REF1 to REF4.
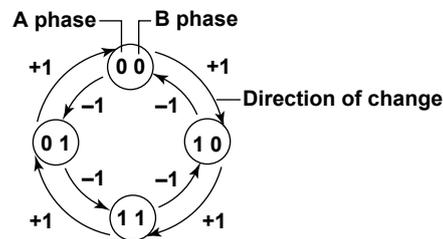
Scale Conversion of a Computed Waveform (Ranging) <<For the operation procedure, see Chapter 9>>

When displaying a computed waveform, normally auto scaling is carried out, but manual scaling can also be selected.
Auto scaling automatically determines from the computed waveform the center line level[1] (Center) in the vertical axis direction of the screen display window and the sensitivity[2] (Sensitivity), to display the computed waveform.
Manual scaling allows both Center and Sensitivity to be set as required.
*1 For a voltage waveform this is a voltage value.
*2 For a voltage waveform, this is a voltage value per 1 div.

2.8 Analyzing and Searching Waveforms

Cursor Measurements <<For the operation procedure, see Section 10.1>>

Cursors can be placed on the displayed waveform from waveform data held in acquisition memory (within the range of the display record length - see Appendix 1), and various measurement values at the intersection of the cursor and waveform can be displayed. There are six types of cursor.

Horizontal Cursors

Two broken lines (horizontal cursors) are displayed parallel to the horizontal axis, and the Y-axis values at the cursor positions can be measured. The level difference between cursors can also be measured.
A computation formula using the cursor measurement values can also be set, and the result displayed.

Vertical Cursors

Two broken lines (vertical cursors) are displayed parallel to the vertical axis, and the times from the trigger position to each vertical cursor, the time difference between the vertical cursors, and the reciprocal of the time difference can be measured.
A computation formula using the cursor measurement values can also be set, and the result displayed.

H&V cursors

The horizontal cursors and vertical cursors are displayed simultaneously.

VT cursor

A broken line (VT cursor) is displayed on the vertical axis, and the time from the trigger position to the VT cursor, and the VT cursor position measurement value are displayed.
A computation formula using the cursor measurement values can also be set, and the result displayed.

Marker Cursors

Four markers are displayed on the selected waveform. The level at each marker, the time from the trigger position, and the level difference and time difference between markers can be measured.
A computation formula using the marker measurement values can also be set, and the result displayed.

Serial cursor

A broken line (serial cursor) is displayed on the vertical axis, showing a two-valued function of the waveform from the cursor position, according to the bitrate, bit length, and threshold settings.

Automated Measurement of Waveform Parameters

Automated Measurement of Waveform Parameters <<For the operation procedure, see Section 10.2>>

Automated measurement can be performed on various measurement parameters of the displayed waveform stored in the acquisition memory.

Up to a maximum of 1,000,000 automatic measurement results can be saved in a file. There are 27 different measurement items. A maximum of 16 items can be displayed from the selected items for all channels together. A computation formula using the automatic measurement values can also be set, and the result displayed.

Statistical Processing <<For the operation procedure, see Section 10.3>>

Statistical processing can be performed on the automated measurement values described above. The following five statistics can be determined on the two measured values of automated measurement parameters.

*   Maximum value (Max)
*   Minimum value (Min)
*   Mean value (Mean)
*   Standard deviation (σ)
*   Count of measurement values subjected to statistics processing (Cnt)

The following three statistical processing methods are available.

*   **Normal Statistical Processing**
    Statistical processing is carried out while acquiring waveforms, on the specified number of waveforms from the most recently captured. If waveform acquisition is stopped, then restarted, the statistical processing from before stopping is continued. Carrying out a Restart in the menus resets the statistical processing up to that point. It is also possible to set the number of data values used in statistical processing.
*   **Statistical Processing Over One Cycle of Measurement or Within Measurement Range**
    In the displayed waveforms, the period is found sequentially from the oldest data, and data within that period is used for measurement of the selected automatic measurement item, then statistical processing is carried out. The method of finding the period is the same as for Period in the normal waveform parameters.
*   **Statistical Processing of History Waveforms**
    Automated measurement is performed on the history waveforms in the selected range and statistical processing is performed. The statistical processing is carried out from the oldest waveforms first.

Telecom Test <<For the operation procedure, see Section 10.4>>

There are two tests used in analysis of telecommunications signals: the mask test, and the test for automatic measurement of waveform parameters for the eye pattern test.
The automated measurement of waveform parameters of eye patterns can be used on products with firmware version 1.60 or higher.
The tests operate on accumulated waveforms with the mode count.
In the mask test, a mask pattern created with the software supplied free of charge by Yokogawa is read into the DL9000, and the waveforms passing through the mask are counted.
In the eye pattern test, the following items are measured in the eye pattern.
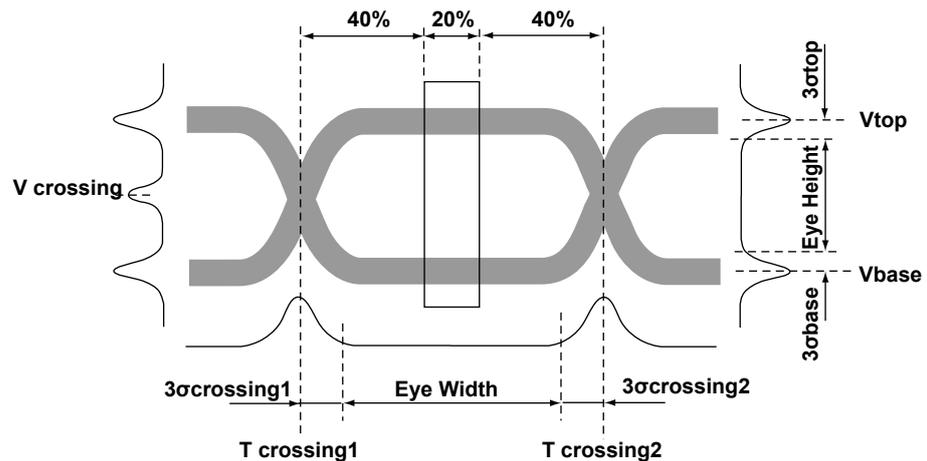
Vtop:	Vertical histogram top peak average voltage
Vbase:	Vertical histogram bottom peak average voltage
σ top:	Vertical histogram top peak standard deviation
σ base:	Vertical histogram bottom peak standard deviation
Tcrossing1:	First crossing point average time value
Tcrossing2:	Second crossing point average time value
Vcrossing:	Voltage at the point of intersection of the rising edge and falling edge
Crossing %:	Level of the point of intersection of the rising edge and falling edge of the eye pattern as a proportion of the difference between Vtop and Vbase
Eye Height:	Height of the opening in the eye diagram
Eye Width:	Width of the opening in the eye diagram
Q Factor:	Quality factor for the eye diagram showing the height of the eye pattern opening, with respect to the noise at both high and low voltage levels
Jitter:	Magnitude of the fluctuation in the time position of the crossing point
Duty Cycle Distortion %:	
	The percentage of full bit width of time difference between the intermediate point of the falling edge and the intermediate point of the rising edge at the intermediate threshold value.
Ext Rate dB:	Extinction rate dB
Rise:	Rise time from the specified lower to upper threshold level
Fall:	Fall time from the specified upper to lower threshold level

The following formulas are used to calculate each item.

$$\text{Crossing\%} = 100 \; \frac{V \text{ crossing} - V \text{ base}}{V \text{top} - V \text{base}}$$

$$\text{Duty Cycle Distortion\%} = 100 \; \frac{|T \text{rising50\%} - T \text{falling50\%}|}{T \text{ crossing2} - T \text{crossing1}}$$

$$\text{EyeHeight} = (V \text{top} - 3\sigma \text{top}) - (V \text{base} + 3\sigma \text{base})$$

$$\text{EyeWidth} = (T \text{ crossing2} - 3\sigma \text{crossing2}) - (T \text{crossing1} + 3\sigma \text{crossing1})$$

$$\text{Jitter} = \sigma \text{ crossing1}$$

$$\text{QFactor} = \frac{V \text{top} - V \text{base}}{\sigma \text{top} + \sigma \text{base}}$$

$$\text{ExtRatedB} = 10\log \left(\frac{V \text{top} - V \text{dark}}{V \text{base} - V \text{dark}} \right)$$

X-Y Analysis <<For the operation procedure, see Section 10.5>>

With one waveform level applied to the X-axis (horizontal axis), and a second waveform level applied to the Y-axis (vertical axis), the phase relationship between the two input signals can be observed. Simultaneous observation of X-Y waveforms and normal T-Y waveforms (waveform display using time axis and level) is possible.

It is also possible to specify the ranges for X-Y analysis, or carry out analysis depending on the specified waveform level.

The X-Y analysis results can be used for cursor measurement, and also the area can be computed. For details of the computation of area, see Appendix 2, "Waveform Area Computation."

You can use the X-Y waveform display function to measure the phase angle between two sine wave signals. For example, an X-Y display of two sine waves produces a so-called Lissajous figure, from which the phase angle can be read.

Lissajous waveform
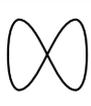
Phase angle 0°			
Phase angle 45°			
Phase angle 90°			
Frequency ratio (X : Y)	**1 : 1**	**1 : 2**	**1 : 3**
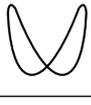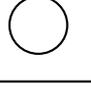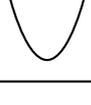
FFT Analysis <<For the operation procedure, see Section 10.6>>

This executes a Fast Fourier Transform (FFT), and displays the power spectrum.

You can select the trace for the real part or the trace for the imaginary part. If the trace for the imaginary part is not set, the real part only is used for calculation, and negative frequencies are not displayed.

You can select the time window from Rectangular, Hanning, and Flattop.

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 zero level. Hence, it is best suited to continuous signals. With the Hanning window, the frequency resolution is high compared to the flattop window. However, the flattop window has a higher spectral level accuracy. When the waveform being analyzed is a continuous signal, select the whichever of the Hanning window and flattop window is more suitable for the application.

The number of points in the FFT can be selected from 2.5 k, 6.25 k, 12.5 k, 25 k, 62.5 k, 125 k, and 250 k. The FFT range is specified in the display window (Main/Zoom 1/Zoom 2). If the display window record length is more than the number of FFT points, the data is downsampled for computation.

Marker measurement or peak value measurement can be used on the FFT waveform.

Waveform Parameter Histogram, Trend and List Displays <<For the operation procedure, see Section 10.7>>

You can display a selected waveform parameter as a histogram or trend. In the histogram display, the average value, standard deviation, peak value, and distributed integration value of a waveform parameter can be measured. In the trend display, time series changes in the waveform parameter can be observed, and a cursor displayed to measure the level.

Results of automated measurement of waveform parameters can be displayed in a list.

Accumulated Histogram Display <<For the operation procedure, see Section 10.8>>

For a repeatedly captured waveform, a frequency distribution histogram (Vertical, Horizontal) is shown for the specified region. On the histogram, the average value, standard deviation, maximum value, minimum value, peak value, intermediate value, and distributed integration value can be measured, and with the cursors, X-axis values or times can be measured. Using these measurement values, further calculation can be carried out.

This is useful for measuring jitter.

2.9 Communications

Command-Based Communications (USB/Ethernet) <<For the operation procedure, refer to the CD Communications Interface User's Manual>>

A USB interface is provided as standard equipment, and an Ethernet interface is available as an option. Using communication commands, you can output waveform data to a computer for data analysis or control the DL9000 using an external controller to carry out waveform measurements.
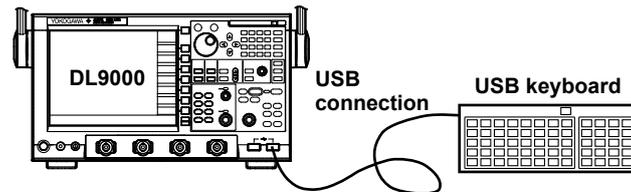
Saving and Recalling Data on a Network Drive <<For the operation procedure, see Section 15.3>>

In the same way as on the internal storage media, waveform and setting data can be saved to or recalled from a computer on the network, and screen image data can also be saved.
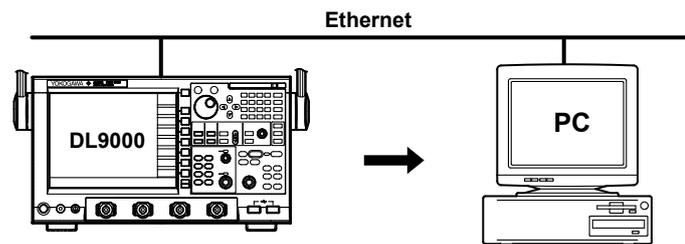
Accessing the DL9000 from a Computer <<For the operation procedure, see Section 15.5>>

By accessing the DL9000 from a computer on the network, you can extract files from the DL9000 internal storage media.
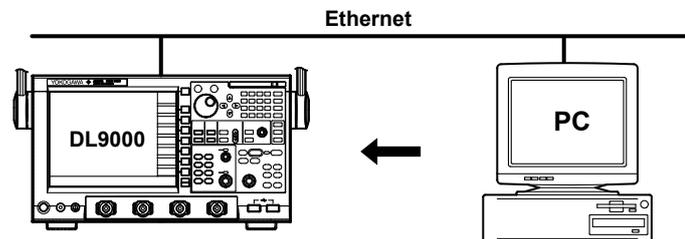
2.10 Other Useful Functions

Entering Numeric and Text Data from a USB Keyboard <<For the operation procedure, see Section 4.3>>

A USB keyboard can be connected, and used for entering file names and comments. Since the functions of the keys on the DL9000 front panel are also assigned to keys on the keyboard, the keyboard can be used in the same way as the keys on the DL9000 itself.
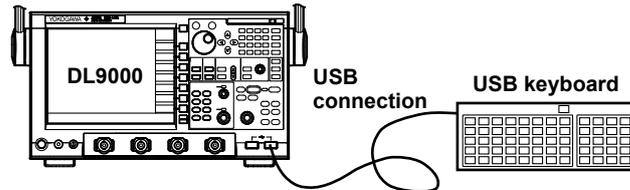
Operating the DL9000 Using a USB Mouse <<For the operation procedure, see Section 4.3>>

You can use a USB mouse to operate the DL9000 as you would using the front panel keys. In addition, you can point to a desired item on a menu and click the item. This is analogous to pressing a soft key corresponding to a menu and pressing the SET key.
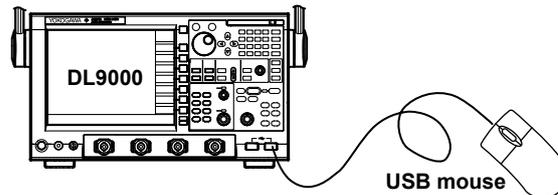
Initialization <<For the operation procedure, see Section 4.4>>

You can return all settings to their default values. However, some of the settings are not initialized (see Section 4.4). To initialize all settings excluding the date/time setting (display ON/OFF is initialized) to their factory defaults, turn ON the power while holding down the RESET key. Release the RESET key after a beep sounds.

Auto Setup <<For the operation procedure, see Section 4.5>>

This function automatically sets the voltage axis, time axis, trigger settings, and other settings to suit the input signal. This is useful when the characteristics of the input signal are unknown. However, the auto setup function may not work depending on the input signal.

Screen Image Printing <<For the operation procedure, see Chapter 12>>

Screen images can be printed on the built-in printer (option), USB printer, or network printer (when the Ethernet interface option is installed).

Saving and Loading Data from a Storage Medium <<For the operation procedure, see Chapter 13>>

The DL9000 allows various data to be stored to and loaded from the following storage media.
• PC card (standard equipment)
• External USB device (MO disk drive/hard disk drive etc.)
• Network drive (when the Ethernet interface option is installed)

MO/Hard disk drive, etc. **DL9000** **PC card** **PC**
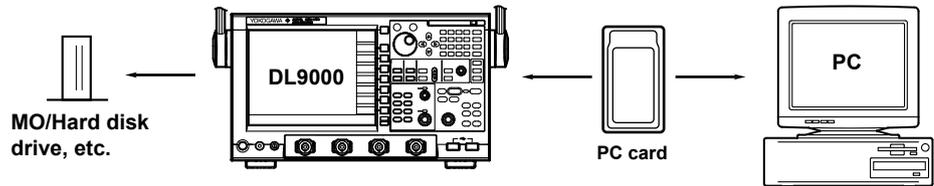
Saving and Loading Setting Data, Waveform Data, and Waveforms <<For the operation procedure, see Sections 13.4 and 13.5>>

Setup data, waveform data, and snapshot waveforms can be saved to or loaded from a selected storage medium.

Saving Screen Image Data <<For the operation procedure, see Section 13.8>>

Screen image data can be stored to a selected storage medium. The formats that can be saved are BMP, PNG, and JPEG and these can be used to incorporate the screen image data in a document using DTP software.

Saving Values from Automated Measurement of Waveform Parameters and SPI Signal Detail Analysis Lists <<For the operation procedure, see Section 13.9>>

The values from automated measurement of waveform parameters can be saved to a selected storage medium.

3.1   Handling Precautions

Safety Precautions

If you are using this instrument for the first time, make sure to thoroughly read the safety precautions given on pages v and vi.

Do Not Remove the Case

Do not remove the case from the instrument. Some sections inside the instrument have high voltages and are extremely dangerous. For internal inspections or adjustments, contact your dealer.

Unplug If Abnormal Behavior Occurs

If you notice smoke or unusual odors coming from the instrument, immediately turn OFF the power and unplug the power cord. If such an irregularity occurs, contact your dealer.

Do Not Damage the Power Cord

Nothing should be placed on the power cord. The cord should be kept away from any heat sources. When unplugging the power cord from the outlet, never pull by the cord itself. Always hold and pull by the plug. If the power cord is damaged, contact your dealer for replacement. Refer to page ii for the part number when placing an order.

General Handling Precautions

Do Not Place Objects on Top of the Instrument

Never place other instruments or objects containing water on top of the instrument, otherwise a breakdown may occur.

Do Not Apply Shock to the Input Section

Shocks to the input connectors or probes may turn into electrical noise and enter the instrument via the signal lines.

Do Not Damage the LCD

Since the LCD screen is very vulnerable and can be easily scratched, do not allow any sharp objects near it. Also it should not be exposed to vibrations and shocks.

Unplug during Extended Non-Use

Unplug the power cord from the outlet.

When Carrying the Instrument

Remove the power cord and connecting cables. Use the handles to lift and carry the instrument.
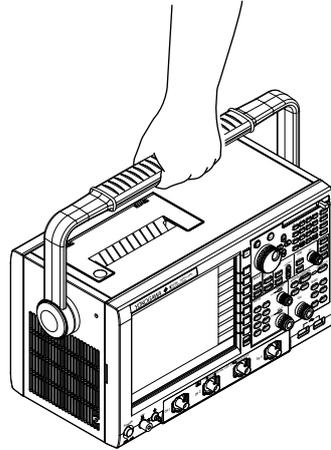
Using the handle

CAUTION

Do not apply unreasonable force to the handle. This could break the handle.

To change the handle position, first press the attachments at each end of the handle, to release the latches, as shown in the following figure. Move the handle so that it clicks into place when you release the attachments. The handle can be fixed in the two positions 1 and 2.
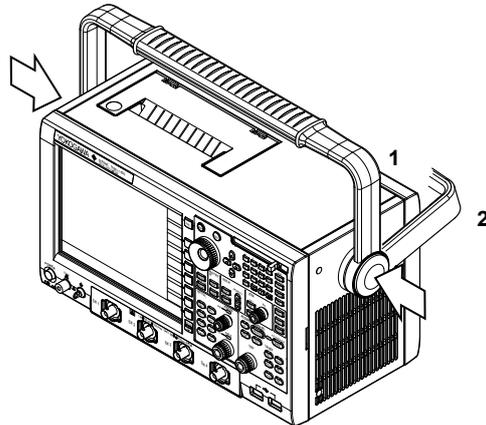
Cleaning

When cleaning the case or the operation panel, first remove the power cord from the AC outlet. Then, wipe with a dry, soft, clean cloth Do not use chemical such as benzene or thinner. These can cause discoloring and deformation.

3.2 Installing the Instrument

Installation Conditions

Install the instrument in a place that meets the following conditions.

Flat, Even Surface

Install the instrument with the correct orientation on a stable, horizontal surface. The recording quality of the printer may be hindered when the instrument is placed in an unstable or inclined place.

Well-Ventilated Location

Inlet holes are located on the top and bottom of the instrument. There are also exhaust holes on the right side. To prevent internal overheating, allow for enough space around the instrument (see the figure below) and do not block the inlet and exhaust holes.

CAUTION

If the inlets on the left and bottom side of the instrument, and exhaust holes on the right side are blocked, the temperature of the instrument will rise, and can result in damage.
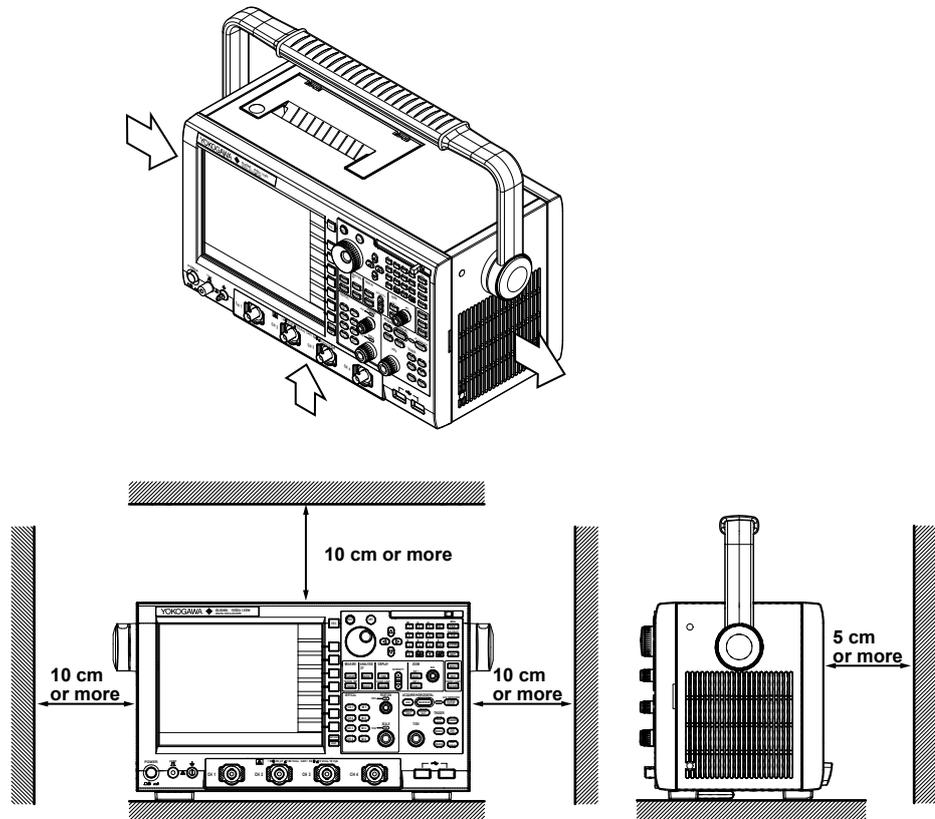
Including the spaces shown in the drawing above, allow for plenty of space to connect the cables and to open and close the cover of the built-in printer.

Ambient Temperature and Humidity

Ambient temperature: 5 - 40°C
Ambient humidity: 20 to 85% RH when the printer is not used.
                                    (No condensation)
                                    35 to 85% RH when using the printer.
                                    (No condensation)

Note

• To ensure high measurement accuracy, operate the instrument in the 23 ±5°C temperature range and 55 ±10% RH.
• Condensation may occur if the instrument is moved to another place where the ambient temperature is higher, or if the temperature changes rapidly. In such cases, allow the instrument adjust to the new environment for at least an hour before using the instrument.

Do not install the instrument in the following places.

• In direct sunlight or near heat sources.
• Where an excessive amount of soot, steam, dust, or corrosive gas is present.
• Near strong magnetic field sources.
• Near high voltage equipment or power lines.
• Where the level of mechanical vibration is high.
• On an unstable surface.

Installation position

Place the instrument in a horizontal position or inclined position using the stand or the handles (see the figure below). When using the stand, pull it forward until it locks. To retract it, set the stand back to its original position.
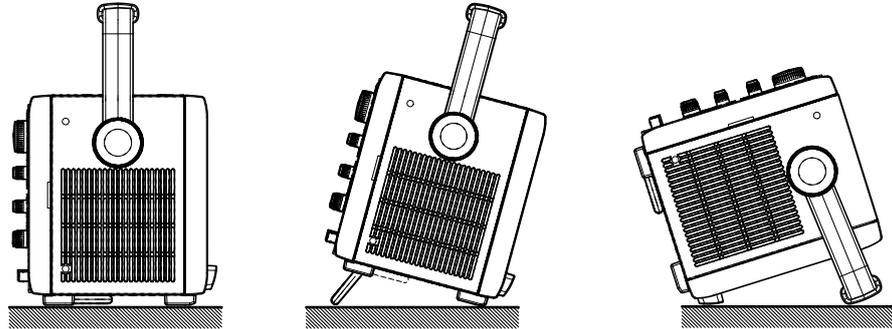
Rubber Feet

You can attach anti-slip rubber pads to the four feet on the bottom of the instrument, and the two projections on the rear. The DL9000 is supplied with six of these rubber pads.

2 rubber feet, left and right

4 rubber feet
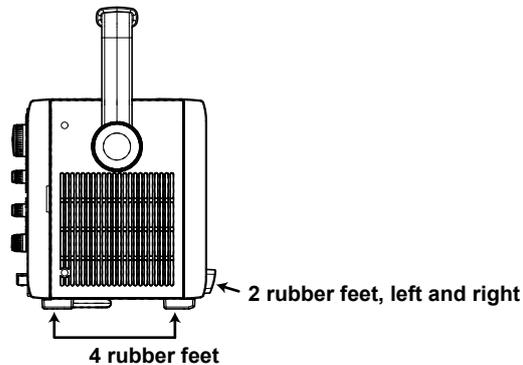
3.3 Connecting the Power

Before Connecting the Power

Make sure that you observe the following points before connecting the power. Failure to do so may cause electric shock or damage to the instrument.

WARNING

- Before connecting the power cord, ensure that the source voltage matches the rated supply voltage of the instrument and that it is within the maximum rated voltage of the provided power cord.
- Check that both the main power switch and power switch of the DL9000 are off before connection the power cord.
- To prevent the possibility of electric shock or fire, be sure to use the power cord for the instrument that was supplied by YOKOGAWA.
- Make sure to perform protective earth grounding to prevent electric shock. Connect the power cord to a three-prong power outlet with a protective earth terminal.
- Do not use an extension cord without a protective earth ground. Otherwise, the protection function will be compromised.
- If an AC outlet that conforms to the accessory power cord is unavailable and protective grounding cannot be furnished, do not use the instrument.

Connecting the Power Cord

1. Check that both the main power switch and power switch of the DL9000 are off.
2. Connect the power cord plug to the power connector on the rear panel.
3. Connect the other end of the cord to an outlet that meets the conditions below. Use the three-prong power outlet equipped with a protective earth terminal.

Item	
Rated supply voltage*	100 to 120 VAC/220 to 240 VAC (automatic switching)
Permitted supply voltage range	90 to 132 VAC/180 to 264 VAC
Rated supply voltage frequency	50/60 Hz
Permitted supply voltage frequency range	48 to 63 Hz
Maximum power consumption	Max. approx. 300 VA

* The DL9000 can use a 100-V or a 200-V system for the power supply. The maximum rated voltage differs according to the type of power cord. Check that the voltage supplied to the DL9000 is less than or equal to the maximum rated voltage of the provided power cord (see page ii) before using it.

3-prong outlet

Power cord (included)
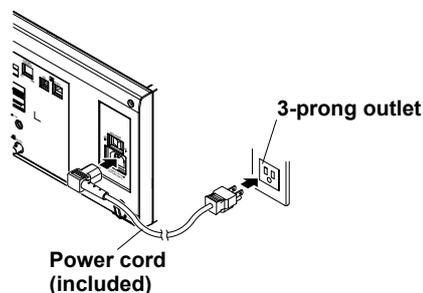
Turning ON the Power Switch

Items to Be Checked before Turning ON the Power
- The instrument is properly installed.:   "3.2 Installing the Instrument"
- The power cord is properly connected.:   Previous page

Turning ON the Main Power Switch
1.   Switch the rear panel power switch to the ON (|) position.
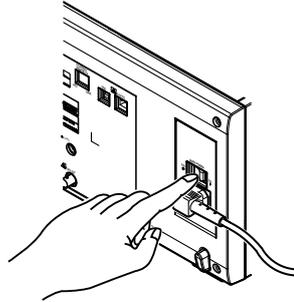
Turning ON the Power Switch
2.   Press the power switch on the front panel.
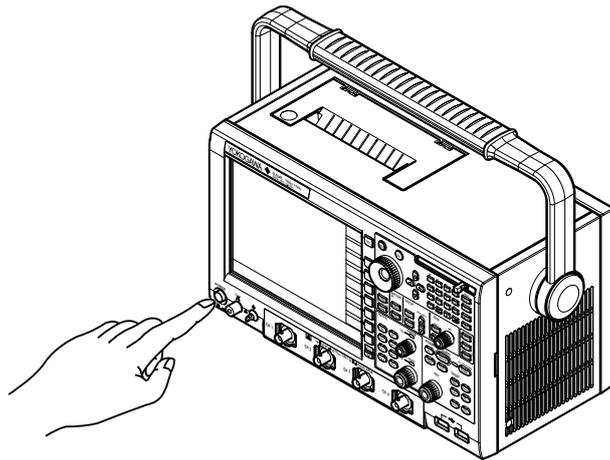
Powering off

CAUTION

Abruptly turning the main power switch off or unplugging the power cord while
saving data or printing with the built-in printer, may damage the built-in printer
or corrupt the media (PC card, internal hard disk, USB storage, and so on) on
which data is being saved. The data being saved is also not guaranteed. Always
complete data saving before turning off the main power switch.

Turning the Power Switch OFF
1.   Press the power switch on the front panel.

Turning the Main Power Switch OFF
2.   Check that the DL9000 internal fan has stopped, and that the screen is blank,
        then switch the power switch on the rear panel to the OFF (○) position.

Power Up Operation

A self-test and calibration start automatically when the power switch is turned ON. That lasts approximately 30 seconds. If the check results are satisfactory, the normal waveform display screen will appear.

Note
* Allow at least 10 seconds before turning ON the power switch after turning it OFF.
* If self-test and calibration do not start when the power is turned ON, or if the normal waveform display screen does not appear, turn OFF the power switch and check the following points.
  * That the power cord is plugged in properly.
  * That the correct voltage is coming to the power outlet (see previous page).
  * The settings are initialized (they are returned to factory default settings) by turning on the power switch while holding down the RESET key. For details on the initialization of the settings, see section 4.4, "Initializing Settings."
  If the instrument still fails to power up when the power switch is turned ON after checking these points, contact your dealer.
* It takes several seconds for the startup screen to appear.

For Taking Accurate Measurements

* To ensure accurate measurements, allow the instrument to warm up for at least 30 minutes after turning ON the power switch.
* After warm-up is complete, perform calibration (see section 4.8). If Auto Calibration is on, it will be executed automatically when T/div is changed and waveform acquisition is started.

Power Down Operation

The settings just prior to turning OFF the power (or when the power cord is unplugged) are stored. Therefore, the next time the power is turned ON, waveforms are measured using those settings.

Note
* A built-in lithium battery powers the memory that stores the settings. It has a life-span of approximately 5 years when kept at an ambient temperature of 23°C. When the lithium battery voltage falls below a certain level, a message is displayed on the screen (error 900) when the power switch is turned ON. Whenever you see this message, you must have the lithium battery replaced immediately. The user cannot replace the battery. Contact your dealer to have a new battery installed.
* If you turn OFF the main power switch of the rear panel when the power switch of the front panel is ON, the settings immediately before the power is turned OFF may not be stored correctly. An error message (error 900) may appear on the screen the next time you turn the power switch ON. This is not a malfunction. When turning the power OFF, turn OFF the power switch of the front panel, and then turn OFF the main power switch of the rear panel.

3

Making Preparations for Measurements

3.4 Connecting the Probe

Connecting a Probe

Connect a probe (or measurement input cable such as a BNC cable) to the input terminal on the bottom of the front panel. The input impedance is 1 MΩ ± 1% and approximately 20 pF or 50 Ω ± 1.5%.

![Warning symbol]
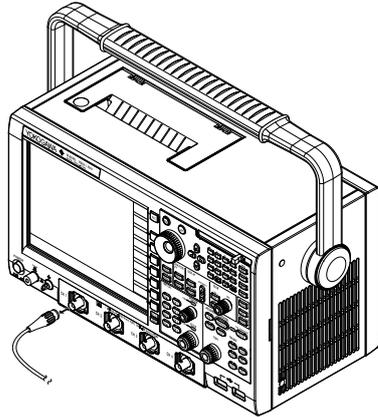
WARNING

- Always turn OFF the power of the object to be measured when connecting it to this instrument. Connecting or disconnecting a measuring lead while the power of the object to be measured is ON is extremely dangerous.
- Do not input excessive voltages that exceed maximum input voltage, withstand voltage, or tolerance surge voltage.
- Always use a protect ground (earth) for the instrument to prevent electric shocks.
- Avoid continuous connections in environments where there is the possibility that tolerance surge voltages can be generated.

![Caution symbol]

CAUTION

- The probe interface terminal is located near the input terminal on this instrument. When connecting the probe, make sure to prevent an excessive voltage due to static electricity, etc., from being applied to the probe interface terminal, as this may damage it.
- The probe interface terminal is located near the input terminal on this instrument. Do not short the probe interface terminal.
- The maximum input voltage for 1 MΩ- input is 150 Vrms when the frequency is 1 kHz or less. Applying a voltage exceeding the value can damage the input section. If the frequency is above 1 kHz, damage may occur even when the voltage is below the value.
- The maximum input voltage for 50 Ω-input is 5 Vrms and 10 Vpeak. Applying a voltage exceeding either of these values can damage the input section.

Precautions to Be Taken When Connecting Cables

*   When connecting a probe to the instrument for the first time, perform phase correction of the probe as described in section 3.5, "Compensating the Probe (Phase Correction)." If you do not, frequency characteristics will not be flat, and measurements will not be correct. Perform the phase correction on each channel to which a probe is to be connected.
*   Note that if the object being measured is directly connected to the instrument without using a probe, correct measurements may not be possible because of the effect of input impedance on the instrument. Use caution.

About Probes

Specification of standard supplied probe (model 701943), after probe phase compensation

Item	Specification	Conditions
Overall probe length	1.5 m	
Connector type	BNC	
Input impedance	10 MΩ ±2%	Together with an oscilloscope of input impedance 1 MΩ ±1%
Input capacitance	Approx. 14 pF	Together with an oscilloscope of input impedance 1 MΩ ±1%
Attenuation ratio	Not exceeding 10 : 1 ±2%	Together with an oscilloscope of input impedance 1 MΩ ±1%
Bandwidth	DC to 500 MHz (not exceeding –3 dB)	Together with an oscilloscope of input impedance 1 MΩ ±1%
Rise time	700 ps or less (*typical)	Together with an oscilloscope of input impedance 1 MΩ ±1%
Maximum input voltage	600 V (DC+AC peak) or 424 Vrms	When AC does not exceed 100 kHz

*   Typical values are typical or mean values. They are not strictly guaranteed.

Precautions to Be Taken When Using Voltage Probes Other Than Those Provided with the Instrument

*   When measuring a signal including a frequency close to 500 MHz, use a probe with a frequency range above 500 MHz.
*   Be aware that correct measured values will not be displayed when using a probe having an attenuation ratio other than 1 : 1, 10 : 1, 100 : 1, 1000 : 1, 10 A : 1 V, or 100 A : 1 V.

Setting the Probe Attenuation Ratio or Voltage-Current Conversion Factor

When using a probe not supported by the probe interface connector, follow the procedure described in Section 5.4 to set the DL9000 attenuation ratio or voltage-current conversion factor to match the probe attenuation ratio or voltage-current conversion factor. If this setting is not carried out, correct measurement values will not be displayed.

Connecting a Probe Supported by the Probe Interface Connector

If you connect a probe supported by the probe interface connector (701943 (500 MHz passive probe), 701913 (2.5 GHz active probe PBA2500), or 701923 (2 GHz differential probe PBD2000)) to the DL9000, the probe type is automatically recognized, and the attenuation ratio set. Power is supplied to the probe through the probe interface, and therefore it is not necessary to connect the probe power cable to the probe power supply terminals.

3

Making Preparations for Measurements

Connecting an FET Probe (700939), Current Probe (701932/701933), or Differential Probe (701920/701921)

When using a Yokogawa FET probe (700939), current probe (701932/701933), or differential probe (701920/701921), for probe power, use the probe power supply terminals (option) on the rear panel of the DL9000.
For details of the connection, refer to the operating instructions supplied with the probe.

⚠ CAUTION

Do not use the probe power supply terminals (option) on the rear panel of the DL9000 for purposes other than supplying power to the current probes (701932/701933), FET probe (700939), or differential probe (701920/701921). Also observe the number of probes that can be used. There is the possibility of damaging the instrument or the device connected to the probe power terminal.

Notes on Using the FET Prove (700939), Current Prove (701932/701933), and Differential Probe (701920/701921)

When connecting an FET probe (700939), current probe (701932/701933), or differential probe (701920/701921) to the probe power supply terminals (option) on the rear panel, ensure that the total current supplied to the two probe power supply terminals and the four probe interface connectors does not exceed 1.2 A. If the DL9000 power overcurrent protection circuit operates, this may make the operation of the DL9000 unstable.

Probe power supply terminals   **Probe interface connectors**

⚠ PROBE POWER(± 12 V DC ⎓)

CH 1   CH 2   CH 3   CH 4
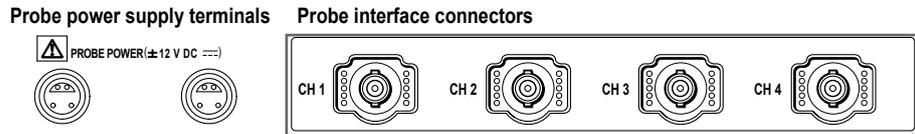
When using current probes (701932/701933), the number of probes is limited, depending on the measured current (the current measured by the current probes). The characteristics of measured current against current consumption for active probes that can be connected to the DL9000 are as follows.

Current probe (701932)


```
——— Positive power supply, DC input          ——— Negative power supply, DC input
- - - Positive power supply, AC (50 Hz) input  - - - Negative power supply, AC (50 Hz) input
```
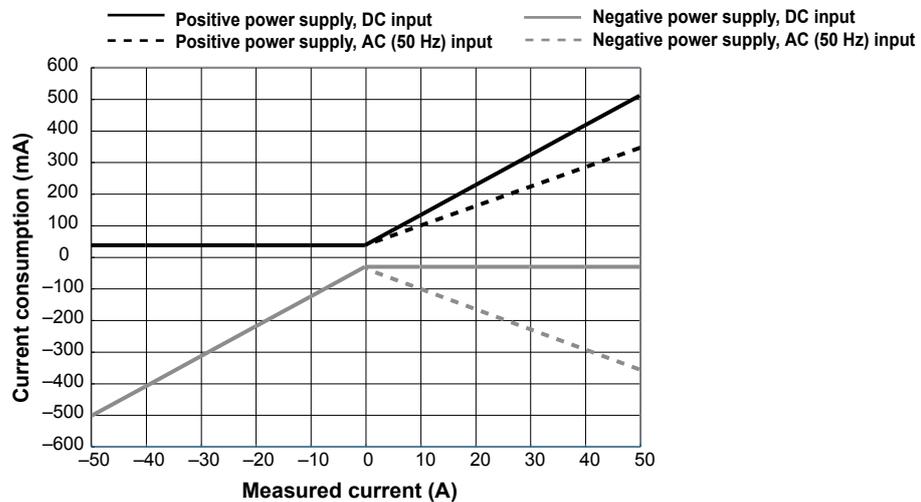
Current probe (701933)
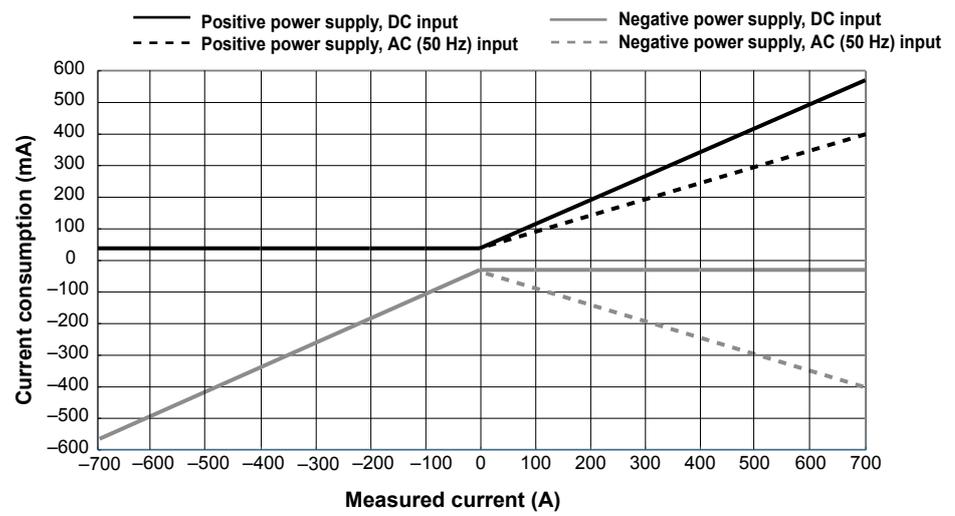
The current consumption of the FET probe (700939) and differential probe (701920, 701921) should be calculated as a maximum of 125 mA for both negative and positive.

3.5 Compensating the Probe (Phase Correction)

Be sure to perform phase correction of the probe first when using a probe to make measurements.

⚠️

CAUTION

Do not apply external voltage to the signal output terminal for probe compensation adjustment. This may cause damage to the internal circuitry.

Procedure

1. Turn ON the power switch.
2. Connect the probe to the input terminal to which the signal is to be applied.
3. Connect the tip of the probe to the signal output terminal for probe compensation adjustment on the front panel of the instrument and to the ground wire to the functional ground terminal.
4. Perform auto setup according to the procedures given in section 4.5, "Performing Auto Setup."
5. Insert a flat-head screwdriver to the phase adjustment hole and turn the variable capacitor to make the displayed waveform a correct rectangular wave.

Functional ground terminal

Phase adjustment hole

Signal output terminal for probe compensation adjustment
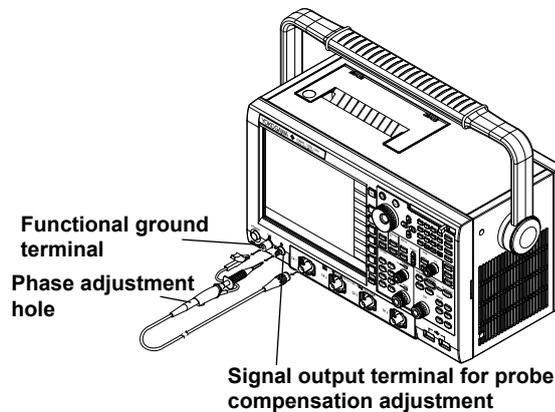
Explanation

Necessity of Phase Correction of the Probe

The probe comes with its phase corrected approximately to match the input capacitance of the relevant oscilloscope. However, there is variance in the input resistance and input capacitance of each input channel of individual oscilloscopes. This results in a mismatch in the voltage divider ratio between low and high frequency signals and causes uneven frequency characterstics.

There is a variable capacitor for adjusting the division ratio (trimmer) for high frequency signals on the probe. The phase is corrected by adjusting this trimmer so that even frequency characteristics are obtained.

When using the probe for the first time, make sure to perform phase correction.

Because the input capacitance varies on each channel, probe compensation is required when the probe is switched from one channel to another.

Phase Compensation Signal

The following square wave signal is output from the signal output terminal for probe compensation adjustment.

Frequency: Approx. 1 kHz

Amplitude: Approx. 1 V

Differences in the Waveform due to the Phase Correction of the Probe
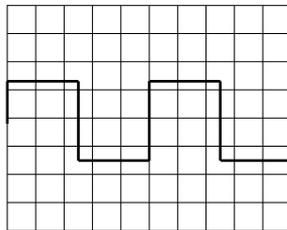
Correct waveform	Over compensated (The gain in the high-frequency region is too high.)	Under compensated (The gain in the high-frequency region is too low.)
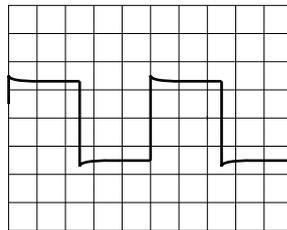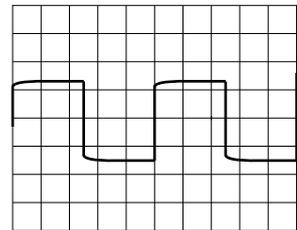
3.6 Setting the Date and Time
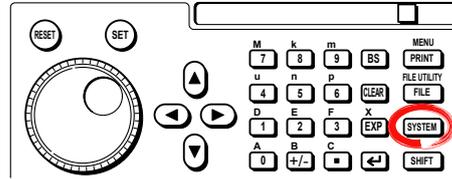
1. Press **SYSTEM**.
2. Press the **MISC** soft key.
3. Press the **Date/Time** soft key. The date and time setting dialog box opens.
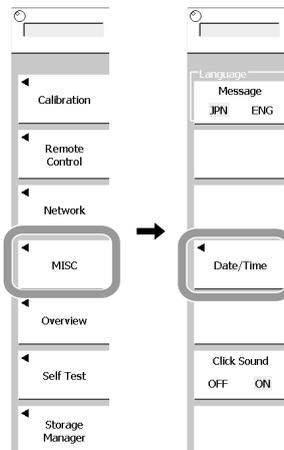
4. Press the **Display** soft key to select ON or OFF.
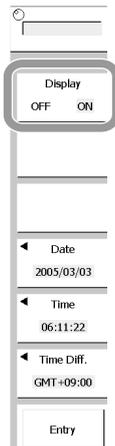
Manually Setting the Date and Time

• **Setting the Date**

5. Press the **Date** soft key.

6. Press the **Year** soft key. This switches the target of the rotary knob.

7. Turn the rotary knob to set the **Year**.

8. Likewise, set the **Month** and **Day**.

9. Press **ESC**.
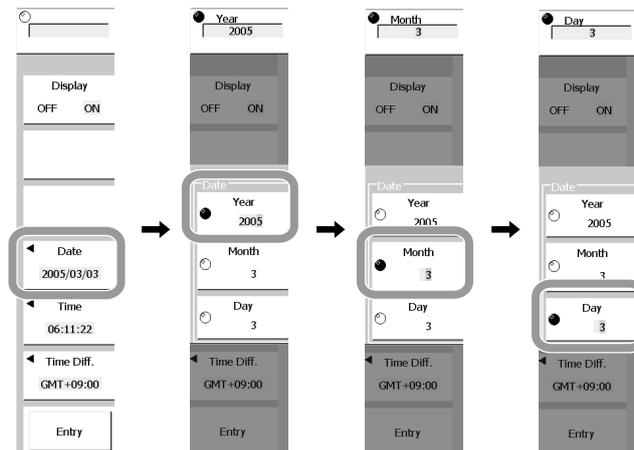
• **Setting the Time**

10. Press the **Time** soft key.

11. Press the **Hour** soft key. This switches the target of the rotary knob.

12. Turn the rotary knob to set the **Hour**.

13. Likewise, set the **Minute** and **Second**.

14. Press **ESC**.

3

Making Preparations for Measurements
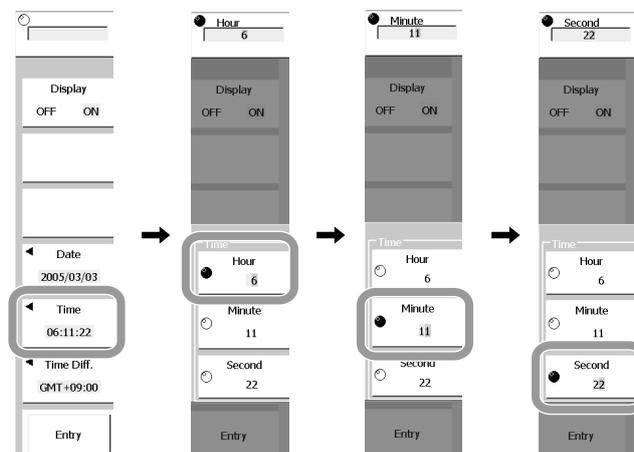
Setting the Time Difference from GMT (Greenwich Mean Time)

5. After step 4, press the **Time Diff** soft key. A menu appears, allowing you to set the time difference from GMT.

6. Press the **Hour** soft key and then set the Hour of Time Difference From GMT (Greenwich Mean Time) in the range of –12 to 13 with the **rotary knob**.

7. Likewise, set the **Minute** of Time Difference From GMT in the range of 0 to 59.

8. Press the **Entry** soft key. The date and time are now registered you set.
    If you do not press Entry, the information you set will be disabled.
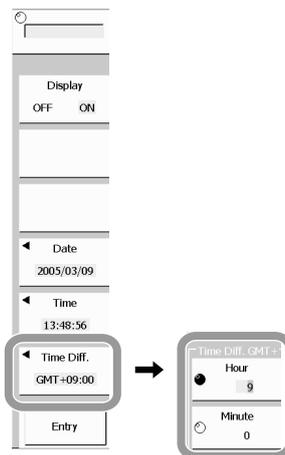
Explanation

The date and time settings are backed up by a built-in lithium battery even if the power is turned OFF.
Leap years are also supported.

Manual Setting
- **Date (Year/Month/Date)**
  Set the year, month and day.
- **Time (Hour/Minute/Second)**
  Set the time using a 24-hour clock.

Setting the Time Difference from GMT (Greenwich Mean Time)

Set the time difference from GMT (Greenwich Mean Time). Make sure to set this value if you are using the network function.

- **Setting the Time Difference from GMT (Greenwich Mean Time)**
  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 Hour to 9 and Minute to 00.
- **Checking the Standard Time**
  Check the standard time for the region where the DL9000 is to be used using one of the following methods.
  - Check the date and time settings on your PC (Windows).
  - Check the URL at right. http://www.worldtimeserver.com/

  Note
  The DL9000 does not support daylight savings time. To set the daylight savings time, adjust the time difference from GMT.

4.1   Operations and Functions of Keys and the Rotary Knob

Basic Key Operations

Displaying the Setup Menu of the Panel Keys

1.   Press the desired panel operation key. The setup menu for that key appears.

2.   Press the soft key corresponding to the desired setup menu item.
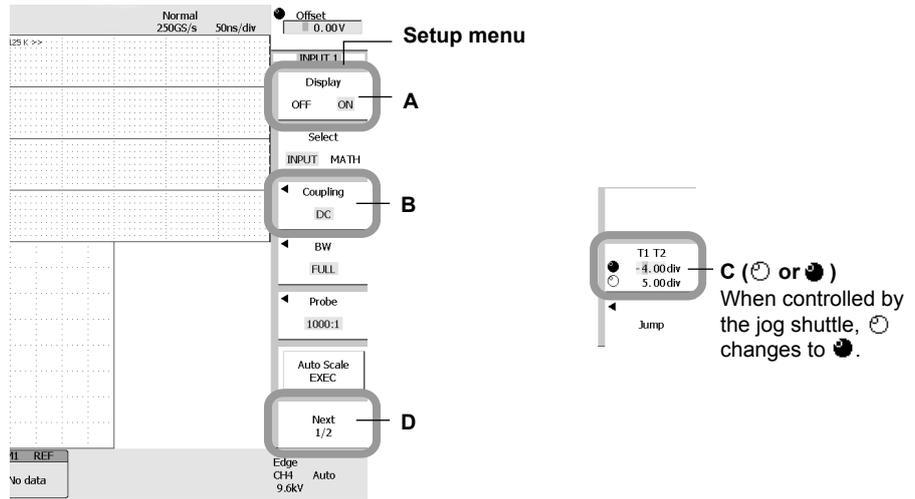
A: Press the corresponding soft key to switch the selected item.

B: Press the corresponding soft key to display the selection menu.
To make a selection, press the soft key corresponding to the selection.

C: Press the corresponding soft key to set the item under jog shuttle control.
Turn the jog shuttle to set the value. Press the arrow keys to move between digits.
You can directly enter the value using the keys on the front panel or a USB keyboard.

D: Appears when there are 2 pages of the setup menu.
Press the corresponding soft key to display page 2/2 (2 of 2) of the setup menu.
The name changes to "Back (2/2)." To return to page 1/2 (1 of 2), press the corresponding soft key again.
If there are 3 pages, the pages advance in the following order: page 1 → page 2 → page 3 → page 1 → page 2, and so on.

Note

For setup menus with multiple pages, the unit keeps the last setup menu that was open before the power was turned off. As a result, if you open the setup menu again after switching screens by pressing another panel key, the page you had been setting previously is displayed.
Explanations in this manual proceed on the assumption that the first page of the setup menu appears when the panel key is pressed.
The actual screen that appears when you press the panel key may differ from the explanations in this manual.

Displaying the Setup Menu Marked in Purple above the Panel Keys

In the explanations in this manual, "**SHIFT + panel key name (purple text)**" refers to the following operation.

1.   Press the **SHIFT** key. The SHIFT key illuminates to indicate the shifted state.
The setup menu marked in purple above the panel keys can be selected.

2.   Press the panel key corresponding to the setup menu you wish to display.

Operations on the Setup Dialog Box

1. Open the setup dialog box using basic key operations or other means.
2. Turn the **rotary knob** to move the cursor to the desired item.
3. Press **SET**.

    The behavior that results when you press SET varies depending on the item as described below.
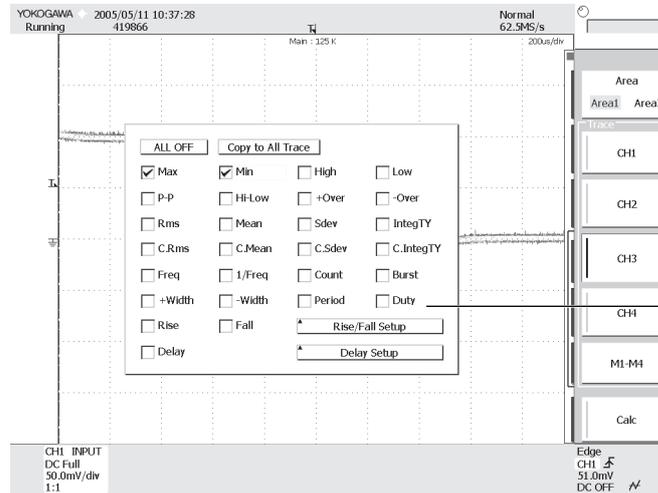
E Setup dialog box
Turn the jog shuttle to move the cursor to the item you wish to set.

When CH1 to CH4 or M1 to M4 is selected (F)   **When Calc is selected (G)**
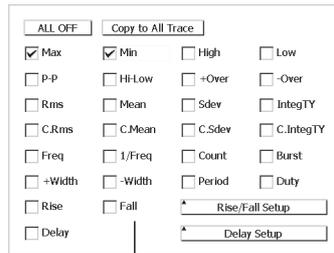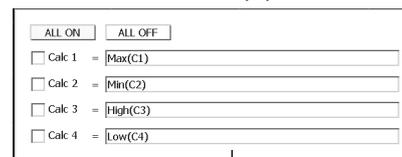
Selection menu   **Value entry box**

E: Turn the jog shuttle to move the cursor to the item you wish to set.
 Press SET to confirm the selection.

F: Press SET to switch the soft key menu to the settings for the item.

G: Press SET to display the value entry box.
 Turn the jog shuttle or use the numeric keypad to set the value.
 Press the arrow keys to move between digits.
 You can directly enter the value from a USB keyboard.

Clearing the Setup Menu and Setup Dialog Box Displays

Press **ESC**. The setup menu or the dialog box shown on top is cleared from the screen.

Note

In the procedural explanations in this manual, the operation of clearing the setup menu or setup dialog box may not be given.

4.2 Entering Values and Strings

Entering Values

Entering Values Directly Using the Dedicated Knobs

The dedicated knobs indicated below can be turned to directly enter values.

- POSITION knob
- SCALE knob
- TIME/DIV knob
- MAG dial
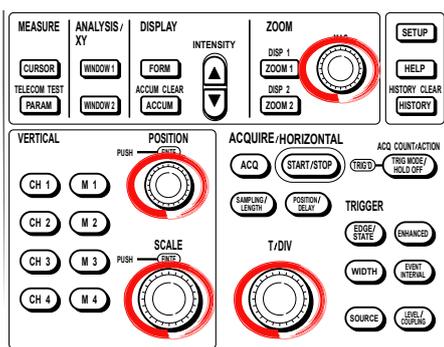
Entering Values Using the Rotary Knob

After selecting the setup item using the soft key, use the rotary knob to change the value (in the explanations in this manual, this operation may be indicated as "**rotary knob & SET**").
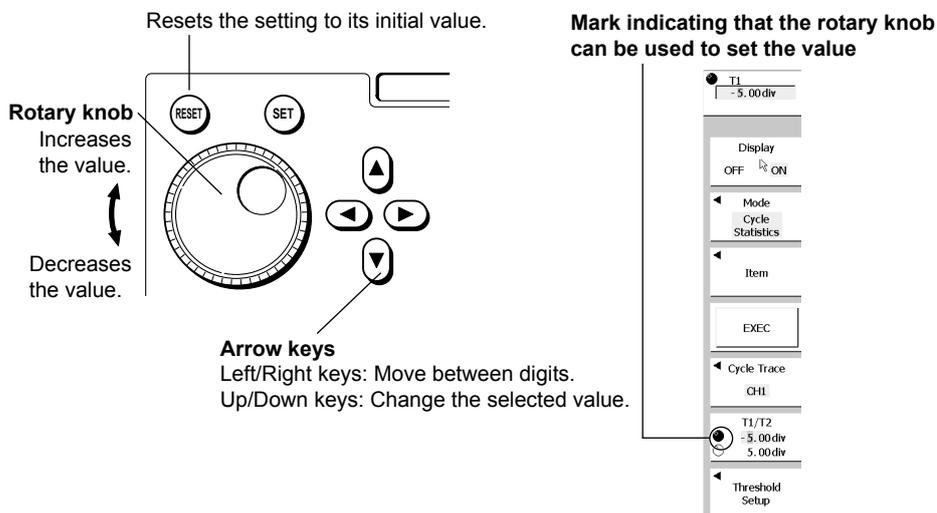
Note

The items that can be changed using the rotary knob are reset to their default values when the RESET key is pressed.

Entering Strings

The keyboard displayed on the screen is used to enter character strings such as file names and comments. The rotary knob, SET, and arrow keys are used to operate the keyboard to enter the character strings.

Operating the Keyboard

1. Turn the **rotary knob** to move the cursor to the character to be entered. Press the arrow keys on the front panel to move the cursor left/right and up/down.
2. Press **SET** key to enter the character.
   To enter a numeric value, you can use the numeric keypad on the front panel.
   To enter letters, press the INS soft key, then enter the characters. In insertion mode, the cursor appears between characters.
3. Repeat steps 1 and 2 to enter all the characters in the string.
4. You can press the **Enter** soft key or ↵ key on the front panel to confirm the string and clear the keyboard.
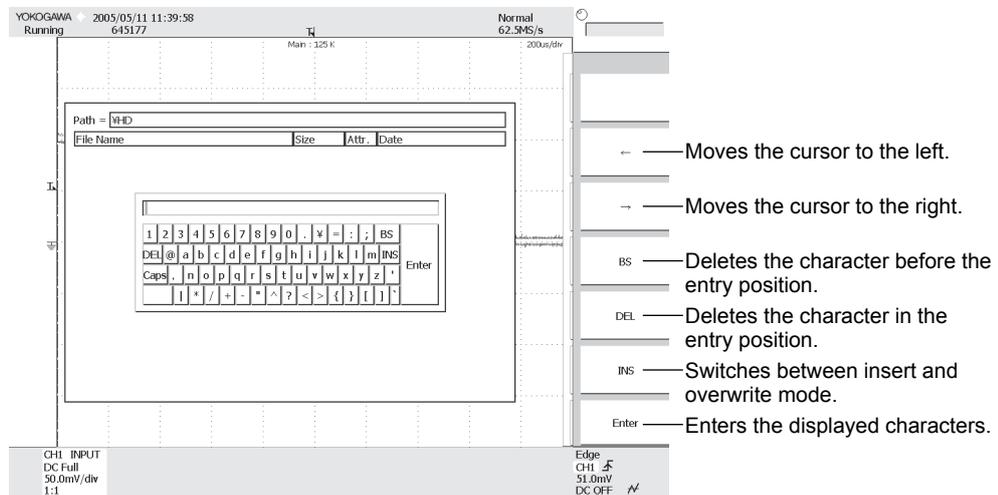
Note
- Multiple @ characters cannot be entered consecutively.
- File names are not case-sensitive. Comments are case-sensitive. In addition, the following file names cannot be used due to limitations of MS-DOS.
  AUX, CON, PRN, NUL, CLOCK, COM1 to COM9, and LPT1 to LPT9

4.3   Operating the DL9000 Using a USB Keyboard or a USB Mouse

Connecting a USB Keyboard

You can connect a USB keyboard for entering file names, comments, and other information.

Keyboards That Can Be Used

The following keyboards that conform to USB Human Interface Devices (HID) Class Version 1.1 can be used.
• When the USB keyboard language is English: 104 keyboard and 89 keyboard
• When the USB keyboard language is Japanese: 109 keyboard and 89 keyboard
USB keyboards that can be used depend on the setting of message language in section 17.1.
When the message language is set to Japanese, a Japanese keyboard can be used.

Note
• Connect only the keyboards that are allowed.
• The operation of USB keyboards connected to a USB hub or those that have mouse connectors is not guaranteed.
• For USB keyboards that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

USB Peripheral Connectors

A USB keyboard is connected to a USB peripheral connector on the front panel. There are two USB peripheral connectors (ports).

Port 1   **Port 2**

1 2 3 4

Pin No.	Signal Name
1	VBUS: +5 V
2	D–: –Data
3	D+: +Data
4	GND: Ground

Connection Procedure

When connecting a USB keyboard, directly connect the keyboard to the DL9000 using a USB cable as shown below. You can connect the USB cable regardless of whether the power to the DL9000 is ON or OFF (supports hot-plugging). Connect the type A connector of the USB cable to the DL9000; connect the type B connector to the keyboard. When the power switch is ON, the keyboard is detected and enabled approximately six seconds after it is connected.
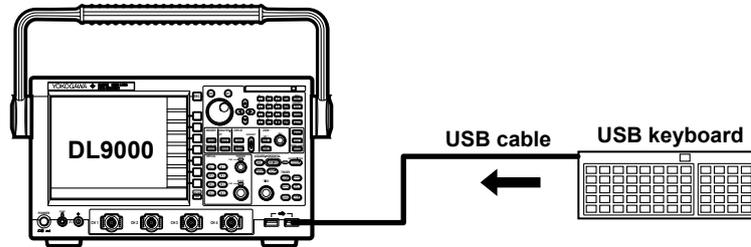
Note

- Do not connect USB peripheral devices other than the compatible USB keyboard, USB mouse, USB printer, or USB storage devices to the USB peripheral device interface connector.
- Do not connect multiple keyboards. Only 1 keyboard, 1 mouse, and 1 printer can be connected.
- Do not connect and disconnect multiple USB devices successively. Allow at least ten seconds between the connection and disconnection of a USB device and the connection and disconnection of the next USB device.
- Do not disconnect the USB cable after the power is turned ON until key operation becomes possible (approximately 20 to 30 s).

Entering File Names, Comments, and Other Items

When a keyboard is displayed on the screen, you can enter the file name, comment, and other items using a USB keyboard.

Entering Values from a USB Keyboard

You can enter values from a USB keyboard for items with the ● or ◔ icon.

Value entered using the keyboard

Press the corresponding soft key, and then enter the value using the USB keyboard. Press the Enter key to enter the value.

Operations Using a USB Mouse

You can use a USB mouse to operate the DL9000 as you would use the front panel keys. In addition, you can point to a desired item on a menu and click the item. This is analogous to pressing a soft key corresponding to a menu and pressing the SET key.

USB Peripheral Connectors

A USB mouse is connected to a USB peripheral connector on the front panel of the DL9000. For details on the USB peripheral connectors, see page 4-6.

Compatible USB Mouse

A USB wheel mouse conforming to USB HID Class Version 1.1 can be used.

Note
* For USB mouse devices that have been tested for compatibility, contact your nearest YOKOGAWA dealer.
* Some items cannot be specified when using a mouse without a wheel.

Connection Procedure

When connecting a USB mouse, directly connect the mouse to the USB peripheral connector using a USB cable. You can connect/disconnect the USB mouse connector regardless of the power ON/OFF state of the DL9000 (supports hot-plugging). When the power switch is turned ON, the mouse is detected approximately six seconds after it is connected, and a pointer ( ) is displayed.
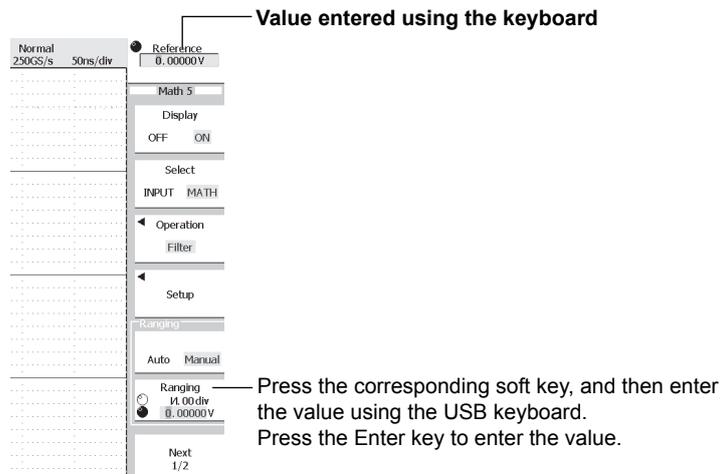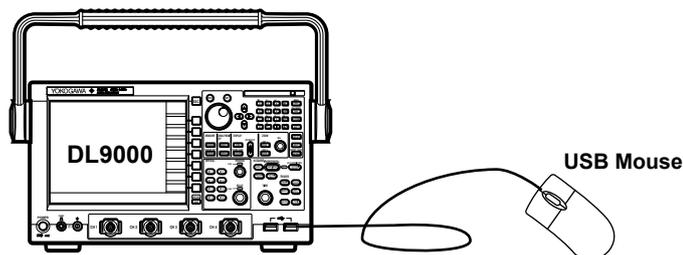

Note
* Do not connect USB peripheral devices other than the compatible USB keyboard, USB mouse, USB printer, or USB storage devices to the USB peripheral device interface connector.
* There are two USB peripheral connectors on the DL9000. However, do not connect mouse devices to both connectors at the same time.

4

Basic Operations

USB Mouse Operation

- **Setup Menu Operation (Similar to the Soft Key Operation)**
  Selecting an Item on the Setup Menu
  Left-click the item you wish to select on the setup menu.
  If another menu appears when you select an item, move the pointer to the new menu displaying the item you wish to select and left-click the item.
  If an item such as ON or OFF appears when you select an item, move the pointer to the new frame and left-click within the frame to switch the selected item.
  For menus in which items are selected using rotary knob & SET (see page 4-3), left-click the desired item. Left-click again to confirm the new setting and close the selection dialog box. You can turn the mouse wheel to select scrollable items.

Reference 0.00000 V	
Math 5	
Display OFF ☐ ON	
Select INPUT MATH	— Left-click within this frame to switch the selected item with each click.
◄ **Operation** Filter	— Left-click within this frame to show the selection menu. Point to the item you wish to select and left-click the item to confirm the selection.
◄ **Setup**	
Ranging	
Auto Manual	
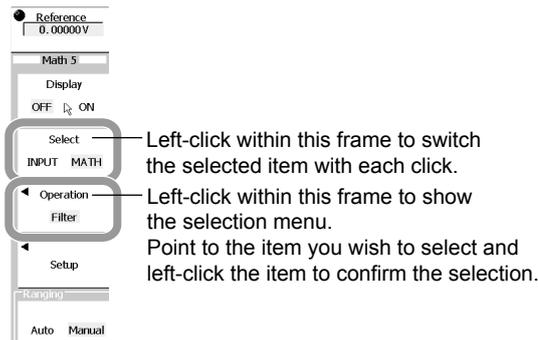
- **Selecting Toggle Box Items on the Dialog Box**
  Move the pointer to the item you wish to select and then left-click the item.
  The item is selected. Click the selected item again to deselect it.
  To close the dialog box, press the **ESC** key.

ALL OFF	Copy to All Trace		
☑ Max	☐ Min	☐ High	☐ Low
☑ P-P	☐ Hi-Low	☐ +Over	☐ -Over
☐ Rms	☐ Mean	☐ Sdev	☐ IntegTY
☐ C.Rms	☐ C.Mean	☐ C.Sdev	☐ C.IntegTY
☐ Freq	☐ 1/Freq	☐ Count	☐ Burst
☐ +Width	☐ -Width	☐ Period	☐ Duty
☐ Rise	☐ Fall	Rise/Fall Setup	
☐ Delay		Delay Setup	

Move the pointer over the item you wish to select and left-click.
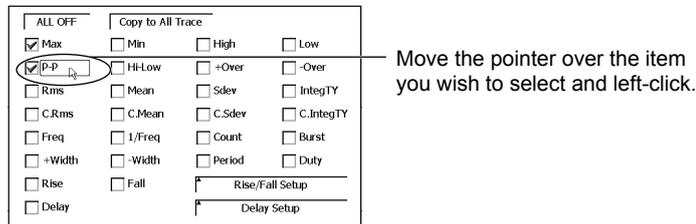
Note

To close an error dialog box, press the **ESC** key on the front panel.

4.4   Initializing Settings

Procedure
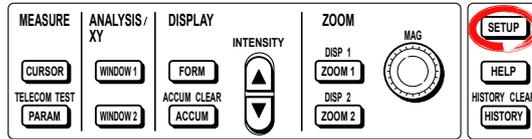
Executing Initialization

1.   Press **SETUP**. The SETUP menu appears.
2.   Press the **Initialize** soft key. Initialization is executed.

Initialize —— **Execute initialization**

Auto Setup

Undo —— **Cancel initialization**

Store

Recall
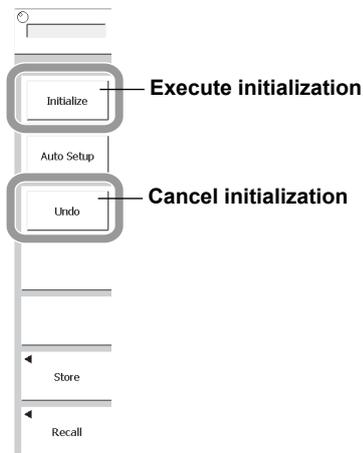
Canceling Initialization

3.   Press the **Undo** soft key. The settings return to the conditions that existed immediately before initialization.

Note

When you turn OFF the power switch, the settings that existed immediately before initialization are cleared. Therefore, the Undo operation is not possible in this case.

Explanation

You can restore the factory default settings. This is useful when you wish to clear previous settings or start measurement from scratch.

Initialization

Initialization refers to the act of restoring the factory default settings.

Items That Cannot Be Initialized

• Date/Time setting
• Settings related to communications
• English/Japanese language setting

Canceling Initialization

If you initialize the settings by mistake, you can press the Undo Initialize soft key to return to the settings that existed before the initialization.

Initializing All the Settings

When the power is turned ON while holding down the RESET key, all settings excluding the date/time setting (display ON/OFF is initialized) are initialized to factory default settings.

4.5 Performing Auto Setup

Procedure
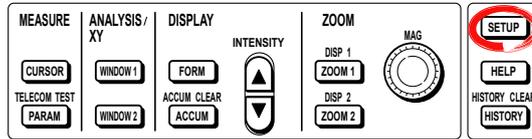
Executing Auto Setup

1. Press **SETUP**. The SETUP menu appears.
2. Press the **Auto Setup** soft key. Auto setup is executed.
    When auto setup is executed, waveform acquisition starts automatically.
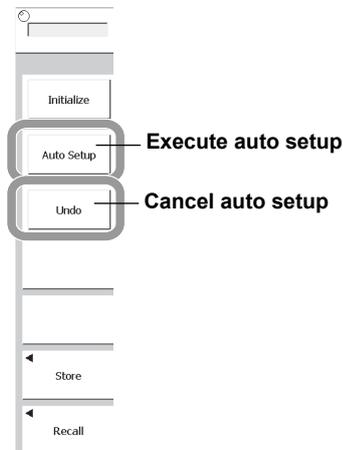
Canceling Auto Setup

3. Press the **Undo** soft key. The settings are set back to their original condition.

Explanation

The auto setup function automatically sets the key settings such as V/div, T/div, and trigger level that are appropriate for the input signal.

| **Before auto setup** | **After auto setup** |
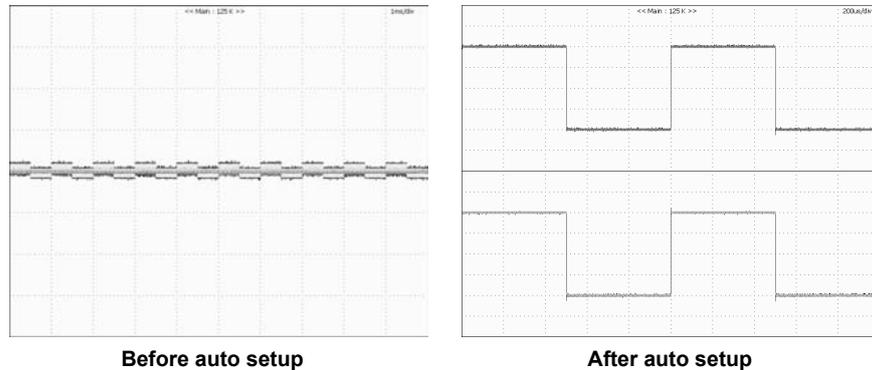
Center Position after Auto Setup
The center position after auto setup is 0 V.

Applicable Channels
Auto setup is performed on all channels.

Loaded Waveforms
When auto setup is executed, loaded waveforms are unloaded (cannot be recovered using the Undo soft key).

Canceling Auto Setup
Pressing the Undo soft key to sets the DL9000 back to the settings that existed before auto setup. However, when you turn OFF the power switch, the settings that existed immediately before auto setup are clear. Therefore, the Undo operation is not possible in this case.

Applicable Waveforms for Auto Setup

Frequency	Approx. 50 Hz or higher
Absolute value of the input voltage	Maximum value is greater than or equal to approximately 20 mV (1:1)
Type	Repetitive waveform (that is not complex)

Note

The auto setup function may not work properly if the waveform includes DC components or high-frequency components.

Setup Data after Executing Auto Setup

Related CH1 to CH4

Select	INPUT
Position	0 div
Coupling	DC1 MΩ except DC50 Ω
	No change for DC50 Ω
BW	FULL
Offset	0 V
Invert	OFF

M1 to M4

Display	OFF

Acquisition

Mode	Normal
Hireso	OFF

SAMPLING/LENGTH

Interp	ON
Repetitive	ON
Interleave	OFF
Length	125 kW

Trigger

Mode	Auto
HoldOff	Min (20 ns)
Delay	OFF
Position	50%
Type	Edge
Polarity	Rise
Coupling	DC
Hysteresis	Small
HF Rej	OFF
Window	OFF

Accumulation

Mode	OFF

Screen display

Mapping	Auto
Dot Connect	Sine
Intensity	10 (Default)
Brightness	8 (Default)

Zoom

Zoom	OFF
Main	ON

Cursor

Display	OFF

Waveform parameter	
Display	OFF

Telecom Test

Display	OFF

Analysis

Display	OFF

Items depending on input signals

CH On/Off	ON when detecting voltage of ±7 mV or higher, OFF when detecting less than ±7 mV
V/div	Select the highest range of sensitivity that does not exceed ±3.5 div
Trigger Level	Center
Trigger Source	Channel whose input amplitude (Max-Min) is 1 division or greater with the lowest frequency
T/Div	The fastest sweep range that exceeds 5 ms/div whose input amplitude is 1 division or greater and which the fastest frequency can be observed with 2 cycles or greater
FORM VT Form	1 to 4 windows based on the active channels

4

Basic Operations

4.6   Storing and Recalling Setting Information
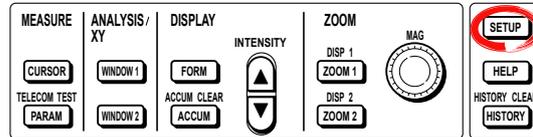
1.   Press **SETUP**. The SETUP menu appears.

Storing Setting Information
2.   Press the **Store** soft key. A menu to select the destination appears.
3.   Select where to store the information, from internal memory locations 1 to 4.

Recalling Setting Information
2.   Press the **Recall** soft key. A menu to select the setting data to be recalled appears.
3.   Select the setting data to be recalled, from internal memory locations 1 to 4.
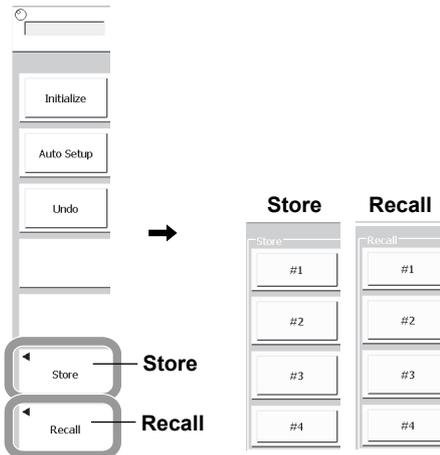
Explanation

You can save a maximum of four sets of setting data in the internal memory. By recalling previously stored setting data you can restore the original settings.

Data Stored
All of the soft key menu and rotary knob settings, and the on/off settings for channels are stored.

Selecting Where the Setting Information is Stored
You can store in any of the four internal memory locations, #1 to #4.
If there is already data stored in the selected internal memory location, this previous data is overwritten, and cannot be recovered.

Selecting Setting Information to be Recalled
Select one of the four internal memory locations #1 to #4 in which the setting information is stored.
You can only select a memory location that has setting information stored in it.

Note
- Even when the settings are initialized, the stored setting information is not lost.
- Recalling setting information during waveform acquisition stops the waveform acquisition.

4.7 Starting/Stopping Waveform Acquisition

Procedure
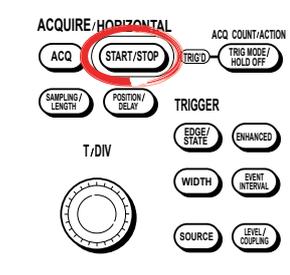
Starting/Stopping Waveform Acquisition

Press **START/STOP**. Waveform acquisition starts/stops.

Waveform is being acquired when the key illuminates.

Explanation

Waveform Acquisition and Indicator Display
• Waveform is being acquired when START/STOP illuminates. "Running" is displayed on the upper left corner of the screen.
• Waveform stops being acquired when START/STOP does not illuminate. "Stopped" is displayed on the upper left corner of the screen.

Operation When the Acquisition Mode Is Set to Averaging Mode
• Averaging is stopped when waveform acquisition is stopped.
• Averaging starts again when waveform acquisition is restarted.

START/STOP Operation during Accumulation
Accumulation is temporarily aborted when acquisition is stopped.
When restarting the acquisition, the DL9000 clears waveform that was already acquired and restarts accumulation.

> **Note**
> • When the trigger mode is other than Single, starting waveform acquisition clears data already stored in acquisition memory.
> • A snapshot function that keeps the current displayed waveform on the screen is also available. You can update the display without stopping waveform acquisition (see section 8.8).

4.8   Performing Calibration
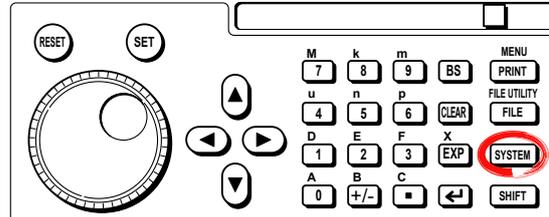
1.   Press **SYSTEM**.
2.   Press the **Calibration** soft key. The Calibration menu appears.
3.   Press the **Cal Exec** soft key. Calibration is executed.
4.   To set auto calbration press the **Auto Cal** soft key to select ON or OFF.
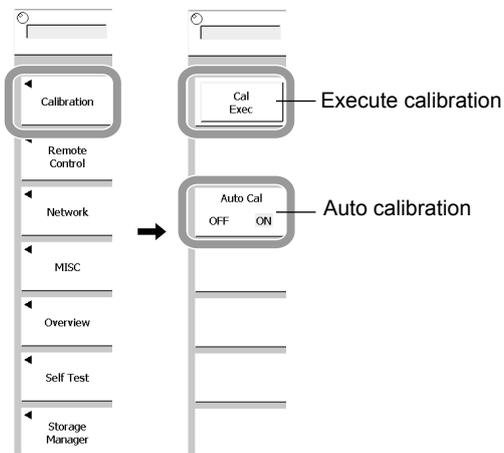
Explanation

Calibration

The following items are calibrated. Perform calibration when you wish to measure waveforms with high accuracy.

*   Ground level and gain of the vertical axis
*   Trigger threshold level
*   Time measurement value during repetitive sampling

Note

The calibration described above is performed automatically when the power switch is turned ON.

Precautions to Be Taken When Performing Calibration

*   Always allow the instrument to warm up for at least 30 minutes after the power is turned ON before starting calibration. If calibration is performed immediately after the power is turned ON, the calibration may be inaccurate due to drift caused by fluctuation in the temperature of the instrument.
*   Calibration must be performed when the temperature of the instrument is stable and is between 5°C and 40°C (preferably at 23°C ±5°C).
*   Do not apply a signal when performing calibration. Calibration may be executed incorrectly when an input signal is being applied.

Auto Calibration

Calibration is automatically performed when T/div is changed and waveform acquisition is started for the first time after the following time elapses after turning ON the power.

*   3 minutes
*   10 minutes
*   30 minutes
*   1 hour and every hour thereafter

If calibration is executed while a signal is applied to the DL9000, it is recommended that the DL9000 be recalibrated without applying a signal.

4

Basic Operations

5.1   Switching the Display of Input Waveforms ON and OFF

Procedure

VERTICAL   POSITION
                   PUSH ——— FINTE

CH 1   M 1
CH 2   M 2
                           SCALE
CH 3   M 3   PUSH ——— FINTE
CH 4   M 4
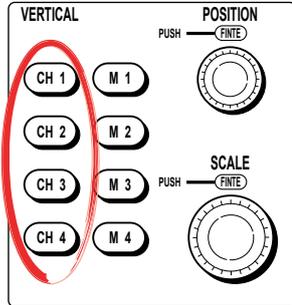
Switching the Display ON
1.   Press the key for the channel to be displayed, from **CH1** to **CH4**. The key lights, and the waveform appears.
     The menu for the channel settings appears.
2   Press the **Select** soft key, and select Input.

Switching the Display OFF
1.   Press the key for the channel to be turned off, from **CH1** to **CH4**.
     The menu for the channel settings appears.
2   Press the **Display** soft key, and select OFF.

Offset
1.700V

INPUT 1

Display
OFF   ON

Select
INPUT   MATH

◄ Coupling
DC

◄ BW
FULL(200MHz)

◄ Probe
Auto

Auto Scale
EXEC

Next
1/2
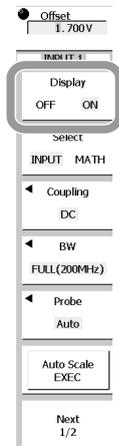
Explanation

The channel keys (CH1 to CH4) set to ON light.
When a channel key is off, press the key once to change the indication to ON, lighting the key.
When a channel key is lit, press the key twice in succession, changing the indication to OFF, and turning off the key.

Note
- The screen can be split into up to four display areas using the DISPLAY menu (see section 8.5). Scale values and waveform labels (see section 5.12) can also be displayed.
- If interleave mode is ON then CH2 and CH4 cannot be displayed.

5.2 Setting the Offset Voltage
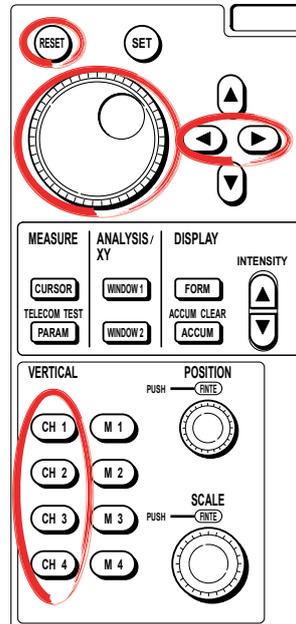
1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Display menu 1/2.
3. Set the offset value with the **rotary knob**.

   The column can be moved with the arrow keys.

Offset value

This option should be set to INPUT.

Switches the menu
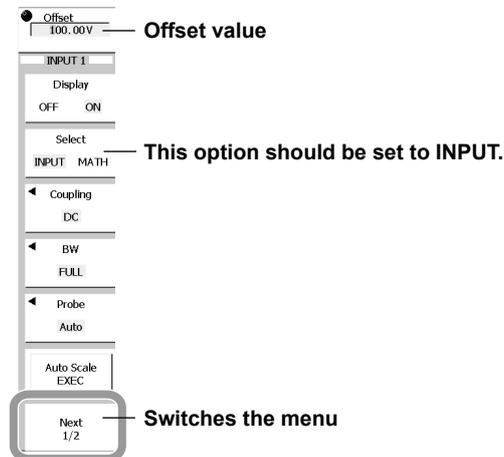
Explanation

The setting of the offset voltage is effective for all the input couplings: **AC1 MΩ**, **DC1 MΩ**, **DC50 Ω**, and **GND**.

You can also make the setting for the input waveform (when Select is set to Input).

Selectable Range of Offset Voltage

Voltage Sensitivity (Probe = 1 : 1)	Offset Voltage Selectable Range
2 mV/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 (−5.0 V to 5.0 V for DC 50 Ω)
1 V/div to 5 V/div	−100.0 V to 100.0 V

The resolution is 0.01 divisions. For 2 mV/div, the resolution is 0.02 mV.

Resetting the Offset Value
Pressing the **RESET** key resets the offset value to 0 V.

Note
*   If you change the probe attenuation, the offset changes proportionally to reflect the new attenuation rate.
*   The offset voltage does not change, even if you change the voltage sensitivity. However, an offset voltage outside the above selectable range is set to the maximum or minimum value that could be selected for the voltage sensitivity. If the voltage sensitivity is returned to its previous value without ch the offset voltage then the offset voltage also returns to its previous value.

5

Vertical and Horizontal Axes

5.3 Setting the Vertical Position of the Waveform
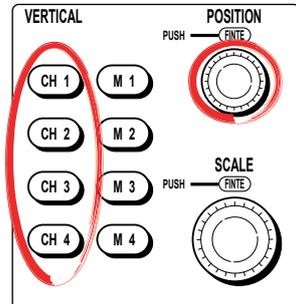
1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Use the **POSITION knob** to set the vertical position.
   By pressing the POSITION knob, lighting the FINE indicator, you can make settings with a higher resolution.

Explanation

Range of Movement
The vertical position can be moved within a range of ±4 divisions from the center of the waveform display frame.

Resolution
1 division (0.01 divisions with fine tuning)

Confirming the Vertical Position
For input waveforms and computed waveforms, the ground level and vertical position are marked to the left of the waveform display frame.

500 mV/div, Offset: –1 V, Position: 0 div

GND level mark →

Vertical position mark →
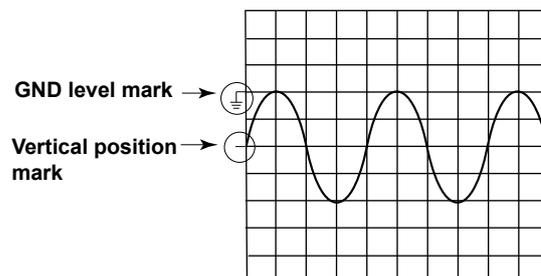
Note

If the position is changed after the waveform is acquired then data that is beyond the measurement range (see section 2.3) is handled as overflow data. Overflow data may result in a chopped waveform, as in the following figure.
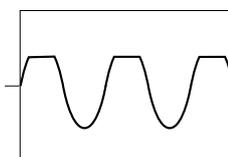
5.4 Setting the Input Coupling

Procedure
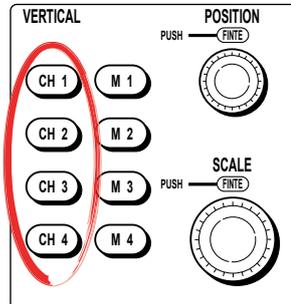
1. Press one of the **CH1** to **CH4** keys to select the channel.
2. The 1/2 menu appears.
3. Press the **Coupling** soft key. The coupling selection menu appears.
4. Press the soft key corresponding to the desired coupling.

This option should be set to INPUT.

Switches the menu
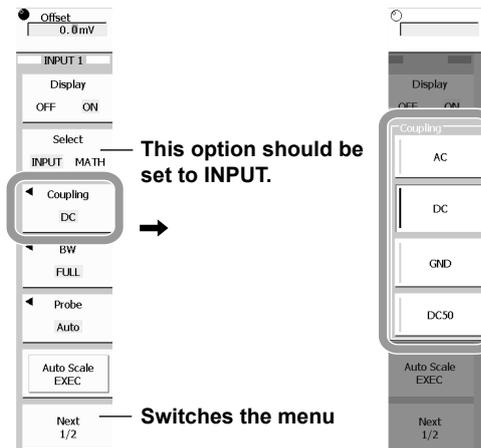
Note

When a probe supported by the DL9000 probe interface is used, the input coupling is set automatically.

Explanation

Selecting the Input Coupling

You can select the method of coupling the input signal to the vertical control circuit in the following ways.

AC: Acquires and displays only the AC component of the input signal.

DC: Acquires and displays all the components (DC and AC) of the input signal (1 MΩ input).
This can only be selected when measuring voltage.

GND: Checks the ground level.

DC50: Acquires and displays all the components (DC and AC) of the input signal (50 Ω input).

Input Coupling and Frequency Characteristics

The following shows the frequency characteristics when AC or DC are selected.

Note that when AC is selected, low frequency signals or signal components are not acquired (as shown in the figure below).

When AC is selected   When DC is selected

Attenuation   Attenuation

0 dB
− 3 dB   0 dB
                                                  − 3 dB

Input frequency   −3 dB attenuation point   Input frequency   −3 dB attenuation point

Lower −3 dB attenuation point when connected by AC

⚠
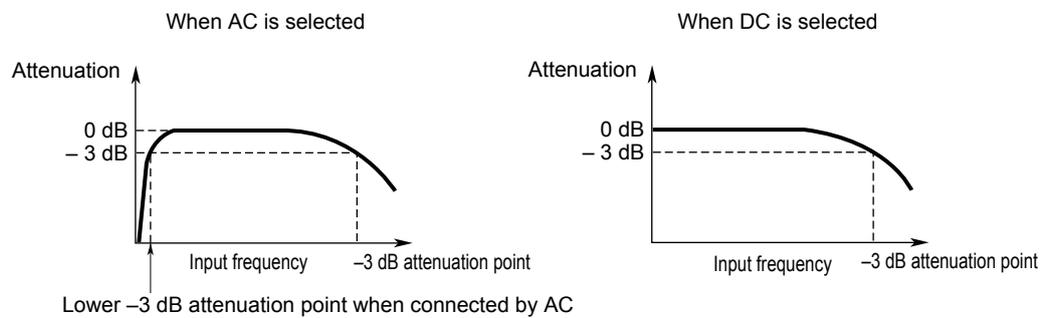
CAUTION

• The maximum input voltage for the 1-MΩ input is 150 Vrms when the frequency is 1 kHz or less. Applying a voltage exceeding this maximum can damage the input section. If the frequency is above 1 kHz, the input section may be damaged even when the voltage is below the values specified above.

• The maximum input voltage for the 50-Ω input is 5 Vrms and 10 Vpeak. Applying a voltage exceeding either of these voltages can damage the input section.

5.5   Setting Bandwidth Limits

Procedure

VERTICAL
POSITION
PUSH ——— FINTE
CH 1   M 1
CH 2   M 2
SCALE
PUSH ——— FINTE
CH 3   M 3
CH 4   M 4
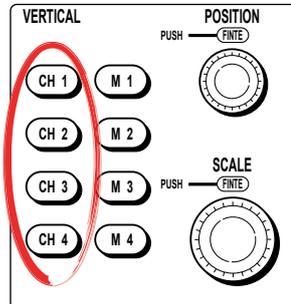
1. Press one of the **CH1** to **CH4** keys to select the channel.
2. The 1/2 menu appears.
3. Press the **BW** soft key. The Bandwidth menu appears.
4. Press the soft key corresponding to the desired bandwidth. If "8 M - 1 MHz" or "500 - 8 kHz" is selected, another Bandwidth menu appears. Press a soft key to select the bandwidth.

Offset
0.0mV

INPUT 1

Display
OFF   ON

Select   **This option should be**
INPUT MATH   **set to INPUT.**

◄ Coupling
DC   ➡

◄ BW
FULL

◄ Probe
Auto

Auto Scale
EXEC   **Switches the menu**

Next
1/2

Display
OFF   ON

Band Width

FULL

200MHz

20MHz

◄ 8M-1MHz

◄ 500k-8kHz

Next
1/2
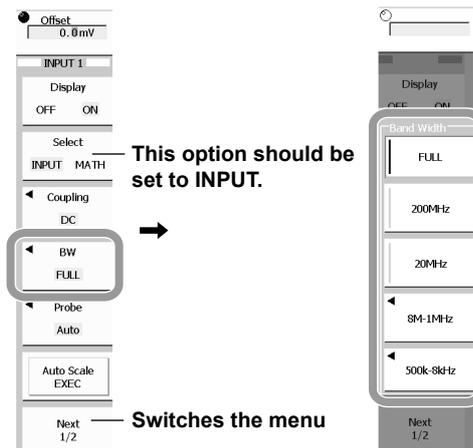
Note
The bandwidth limit is set for each channel. Set the bandwidth limit for all desired channels.

Explanation

Bandwidth

It is possible to remove the high frequency components from the input signal.
The frequency characteristics when the bandwidth has been given limits are shown below. If you select FULL, the largest bandwidth is selected.

– 3dB

Approx. 8 kHz   Approx. 32 kHz   Approx. 125 kHz   Approx. 500 kHz   Approx. 2 MHz   Approx. 8 MHz   Approx. 200 MHz
Approx. 16 kHz   Approx. 62.5 kHz   Approx. 250 kHz   Approx. 1 MHz   Approx. 4 MHz   Approx. 20 MHz   **FULL**
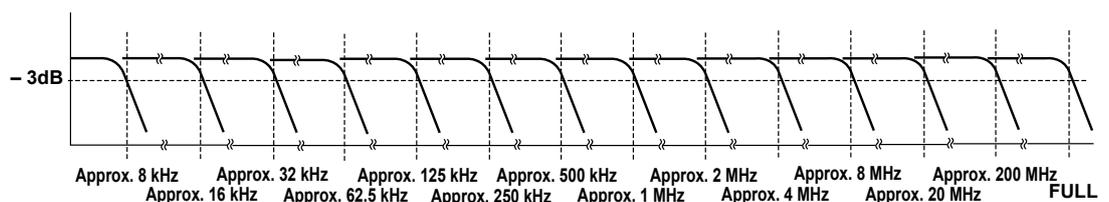
In high resolution mode, a 200 MHz filter is used internally even for FULL.

5.6   Setting the Probe Attenuation
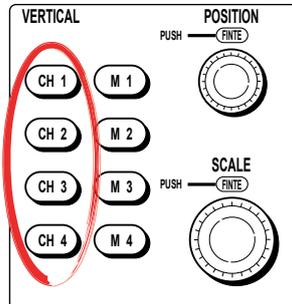
1. Press one of the **CH1** to **CH4** keys to select the channel.
2. The 1/2 menu appears.
3. Press the **Probe** soft key. The Probe menu appears.
4. Press the soft key corresponding to the desired type (attenuation ratio).

Menu on products with firmware version 1.80 or higher

Set the attenuation using the rotary knob.
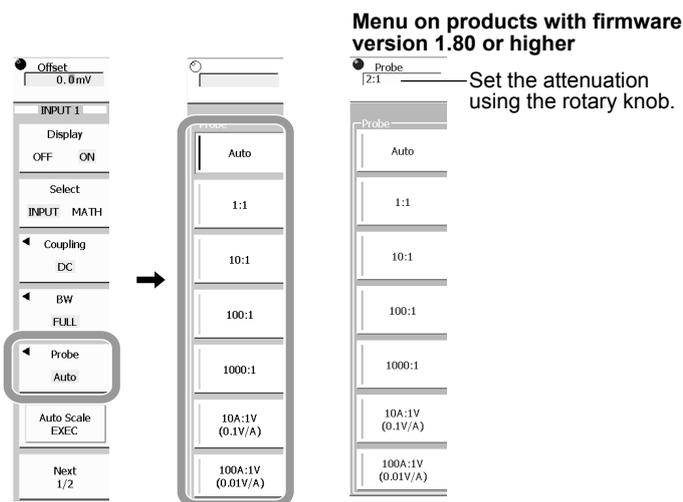
Explanation

The following probe types can be selected for each channel:
AUTO, 1 : 1, 10 : 1, 100 : 1, 1000 : 1, 10 A : 1 V, 100 A : 1 V.
1 : 1 to 1000 : 1 are probe attenuation settings.
10 A : 1 V and 100 A : 1 V are probe output current rates.
If AUTO is selected then the attenuation is automatically selected when the probe is connected to the corresponding probe interface.

In addition to using the soft keys to products with firmware version 1.80 or higher, you can now select the probe attenuation using the rotary knob. When using the rotary knob, you can select from the choices below. The menu corresponding to the attenuation that you select with the rotary knob is highlighted.
Auto, 1:1, 2:1, 5:1, 10:1, 20:1, 50:1, 100:1, 200:1, 500:1, 1000:1, 10A:1V, or 100A:1V

Note

If the probe type is not set correctly, the voltage and scale values of the input signals will not be displayed correctly. For example, if you set the attenuation to 1 : 1 when you are using a 10 : 1 voltage probe, the automatically determined waveform amplitude will be displayed as 1/10th the actual value.

5.7 Setting the Scale

Procedure
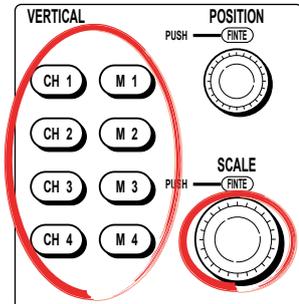
1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Turn the **SCALE knob** to set the V/div value.
   By pressing the SCALE knob, lighting the FINE indicator, you can make settings with a higher resolution.

Explanation

Setting V/div

The V/div (voltage sensitivity) setting is used to adjust the displayed amplitude of the waveform for easy measurement. You can set the value in terms of the voltage per division of the screen grid. V/div is set in steps of 1-2-5 (i.e., 1 V/div, 2 V/div, and 5 V/div).

Note

* The displayed waveforms do not change if you turn the SCALE knob while waveform acquisition is stopped. The new V/div value takes effect the next time waveform acquisition is restarted.
* Turning the SCALE knob while acquisition is stopped has no effect on cursor measurement values and automated measurement values of waveform parameters. The displayed values are for the determined V/div setting.

5.8 Setting T/div
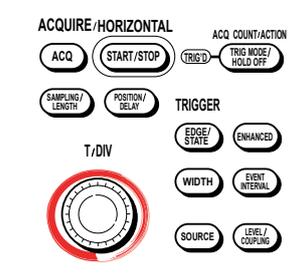
Turn the **T/DIV knob** to set the T/div value.

Note

- If the T/DIV knob is turned while acquisition is stopped, the new T/div value appears in the upper center of the screen and takes effect when acquisition is restarted.
- See Appendix 1, "Relationships Among the Time Setting, Sample Rate, and Record Length" for the relationship between T/div and the sample rate.

Explanation

You can set the value in terms of the time per division of the screen grid.

Selectable T/div Range

500 ps/div to 50 s/div

T/div and Roll Mode

Roll mode is used if T/div is set to a value between 100 ms/div and 50 s/div under the following conditions:

- Acquisition mode is set to a mode other than averaging.
- Trigger mode is set to auto, auto level, or single.

5.9 Using the Auto Scale Function
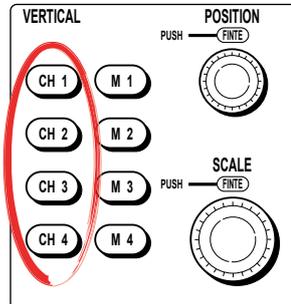
1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Press the **Select** soft key to select INPUT or MATH.

For INPUT:

3. Press the **Auto Scale EXEC** soft key for INPUT.
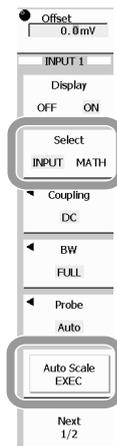
For MATH:

3. Press the **Ranging** soft key to select Auto.

Explanation

Auto Scale can be set for each channel.

The following are set in the following ways when Auto Scale EXEC is used:

V/div:	The maximum sensitivity that allows the input waveform p-p to be (6-position) div for the position setting.

Offset:	0 V when the input coupling is AC.

Center = (Max – Min)/2 when the input coupling is DC.

Trig Level:	DC offset position.

5.10 Canceling the Offset Value

Procedure
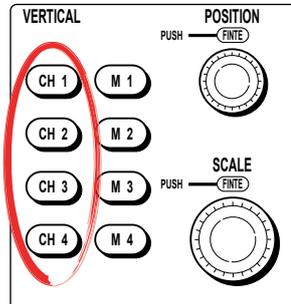
1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Press the **Next 1/2** soft key.
3. Press the **Offset Cancel** soft key to select ON or OFF.
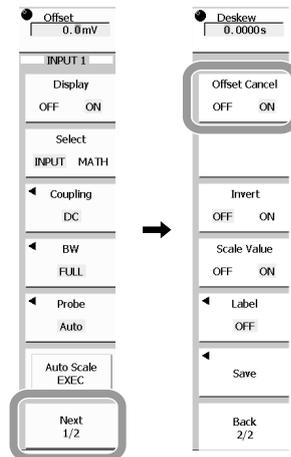
Explanation

Offset cancel can be set to ON or OFF for each channel.

ON: The value after the offset is cancelled is used as the channel trace value.

The offset value that is specified for each channel can be subtracted from the input signal and used for computation and automated measurement. The default setting is OFF.

OFF
    The offset value is not applied to computations and the results of automated measurements. The waveform is observed without subtracting the offset voltage (DC voltage) from the input signal. The vertical position of the screen corresponds to the offset voltage.

ON
    The offset value is applied to computations and the results of automated measurements. The offset value specified for each channel can be used to subtract an unneeded offset voltage (DC voltage) from the input signal for waveform observation. The vertical position is set to 0 V.

5.11 Displaying the Waveform Inverted
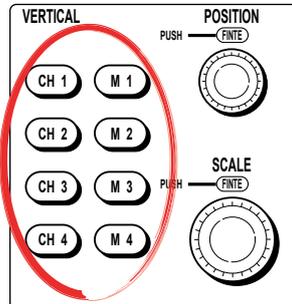
1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Press the **Next 1/2** soft key.
3. Press the **Invert** soft key to select ON.
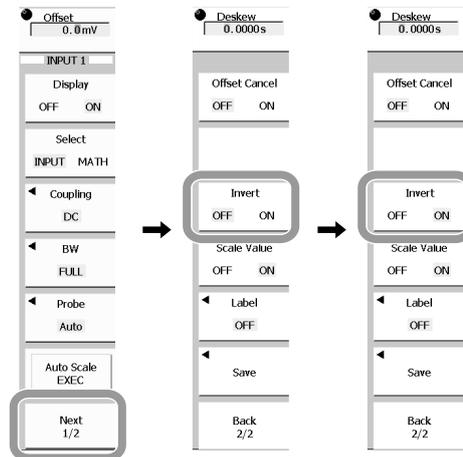
Explanation

Inverted Objects
The input signals of CH1 to CH4 and M1 to M4 can be individually inverted.
The display is inverted with respect to the center of the vertical position.

Inverted Display
- Cursor measurements, automated measurement of waveform parameters, and computations are performed on the original waveform.
- Trigger functions are performed on the original waveform even when the display is inverted.

5.12 Turning the Display of the Scale Value ON/OFF

Procedure
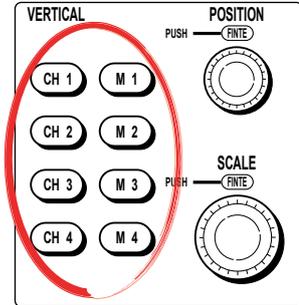
1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Press the **Next 1/2** soft key.
3. Press the **Scale Value** soft key to select ON or OFF.
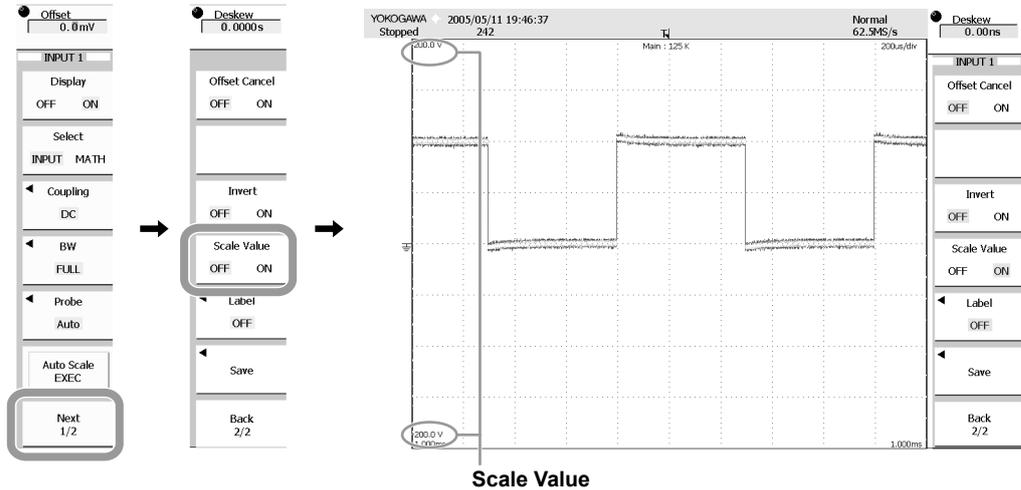
Scale Value

Explanation

The display of the maximum and minimum values for the vertical and horizontal axes, and the scale values for the maximum and minimum values, can be turned ON/OFF for each channel.

Note

The scale value is displayed to the left of the waveform. Or, if there is no space to the left of the waveform, it is displayed to the right.

6.1   Setting the Trigger Mode
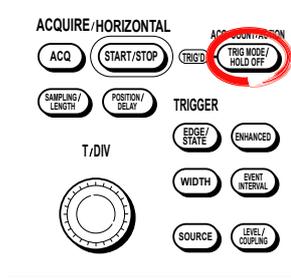
1.   Press **TRIG MODE/HOLD OFF**. The Trigger Mode menu appears.
2.   Press the soft key corresponding to the desired mode.
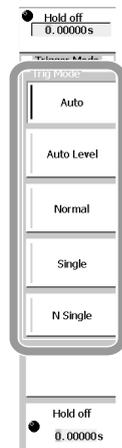
Explanation

Auto Mode

If the trigger condition is met within the 100 ms timeout period, the waveform is updated on each trigger occurrence. If the trigger condition is not met after the timeout period elapses, the waveform is automatically updated. If the time axis setting is in the range in which the display mode is set to roll mode, the display is set to roll mode (see page 2-6).

Auto Level Mode

If a trigger occurs within the timeout period, the waveform is displayed in the same fashion as in auto mode. If a trigger is not activated within the timeout period, then the center value of the amplitude of the trigger source is detected, and the trigger level is changed to that value. A trigger is activated using the new value, and the displayed waveforms are updated. Auto-level mode is valid only if the trigger source is between CH1 and CH4. For all other cases, the operation is the same as for auto mode.
If the time axis setting is in the range in which the display mode is set to roll mode, the display is set to roll mode.

Normal Mode

The display is updated only when the trigger conditions are met. The display is not updated if the trigger does not occur. Therefore, to check the waveform or ground level when no trigger is detected, use auto mode.

Single Mode

The display is updated once when the trigger conditions are met and the waveform acquisition stops. In the time axis setting range in which the display is set to roll mode, the display is set to roll mode. When a trigger occurs, the specified record length of data is acquired and the displayed waveform stops.

N Single Mode

When the trigger conditions are met, the display waveform is updated for the specified number of times, and then waveform acquisition is stopped.

Note

- The trigger mode setting is common to all triggers.
- The trigger conditions when the displayed waveform was acquired appear at the lower right of the screen.
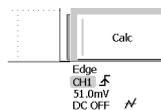
6.2 Setting the Trigger Type
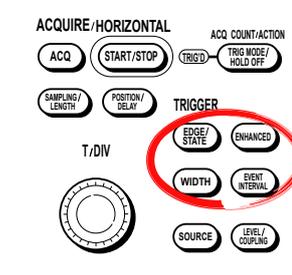
1. Press any of **EDGE/STATE**, **WIDTH**, **ENHANCED**, or **EVENT INTERVAL**. The key pressed lights, becoming active.

For an Edge/State Trigger (See sections 6.7 to 6.10)

2. Press the soft key corresponding to the desired trigger type.
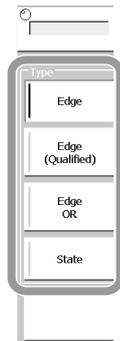
For a Width Trigger (See sections 6.11 to 6.13)

2. Press the soft key corresponding to the desired trigger type.

6
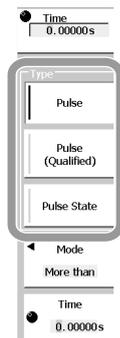
Triggers

For an Enhanced Trigger (For details, see section 6.17 and subsequent sections).

2. Press the **Type** soft key. The Type menu appears.
3. From the menu that appears, select the desired signal type.
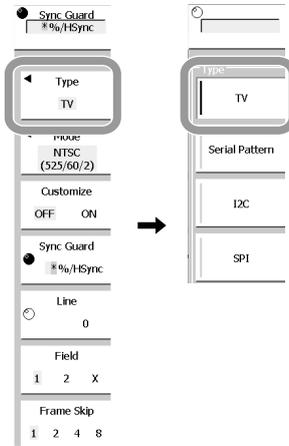
For an EVENT Interval (See sections 6.14 to 6.16)

2. Press the **Type** soft key. The Type menu appears.
3. Press the soft key corresponding to the desired trigger type.
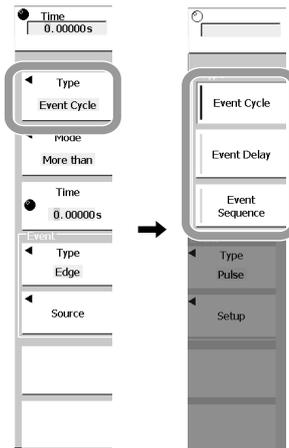
Explanation

Edge/State Trigger

There are four types of Edge/State triggers.

- **Edge trigger**

  When the slope of the trigger source passes through the specified trigger level on a rising or falling edge, a trigger is activated. You can select the trigger source from input signals, the external trigger signal, and the commercial power supplied to the DL9000. In the case of commercial power, a trigger is activated only on the rising edge.

- **Edge (Qualified) Trigger**

  While the state of each input channel satisfies the set condition, this function activates a trigger on the edge of a single trigger source.

- **State trigger**

  This function activates a trigger in either of the following circumstances.

  - When the specified logical condition (State) of the input is satisfied, or is no longer satisfied

  - When the logical condition (State) of the input has been checked at either the rising edge or the falling edge of the specified channel (clock channel), and it was confirmed that the logical condition has been met or not met for the first time

- **Edge OR Trigger**

  This function activates a trigger on the edge of multiple trigger sources.

Width

This function activates a trigger according to the time width. The following three triggers are available for Width.

- **Pulse trigger**

  This function activates a trigger according to the relationship between the pulse width of a single trigger source and the specified time.

  - End point of a pulse longer than the specified time (More than)
  - End point of a pulse shorter than the specified time (Less than)
  - End point of a pulse longer than the specified time T1 and shorter than the specified time T2 (Between)
  - End point of a pulse shorter than the specified time T1 and longer than the specified time T2 (Out of range)
  - Trigger when the pulse width exceeds the specified time (Time out)

- **Pulse (Qualified) Trigger**

  While the state of each input channel satisfies the set condition, this function activates a trigger according to the relationship between the pulse width of a single trigger source and the specified time. The timing at which a trigger is activated is the same as for a Pulse trigger.

6

Triggers

- **Pulse State trigger**
  This function activates a trigger in either of the following circumstances.
  - Relationship of the time width during which the logical condition (State) of the set input is met or is not met, and the specified time
  - When the logical condition (State) of the input has been checked at either the rising edge or the falling edge of the specified channel (clock channel), and it was confirmed that the logical state has been met or not met for the first time

Enhanced

This groups allows you to set triggers on special signals such TV triggers and serial pattern triggers. For details, see section 6.17 and subsequent sections.

Event Interval

Taking a trigger condition, excluding an OR trigger or TV trigger, as an event, the trigger is activated when the event period, or the interval between two events meets preset time conditions. The time condition is the same as the time condition for the Width trigger.

- **Cycle**
  Apply the trigger based on the relation between the event period and the specified time.
- **Delay**
  Apply the trigger based on the relation between the time interval between event 1 occurring and the first occurrence of event 2 and the specified time.
  If the time interval between event 1 occurring and the first occurrence of event 2 does not meet the specified time condition, then the decision is restarted the next time that event 1 occurs.
- **Sequence**
  Apply the trigger based on the relation between the time interval between event 1 occurring and the first occurrence of event 2 and the specified time.
  If the time interval between event 1 occurring and the first occurrence of event 2 does not meet the specified time condition, the occurrence of event 2 is ignored, and the trigger is activated when event 2 occurs to meet the specified time condition.

6.3   Setting Trigger Coupling/HF Rejection/Trigger Hysteresis/Window Comparator

Procedure
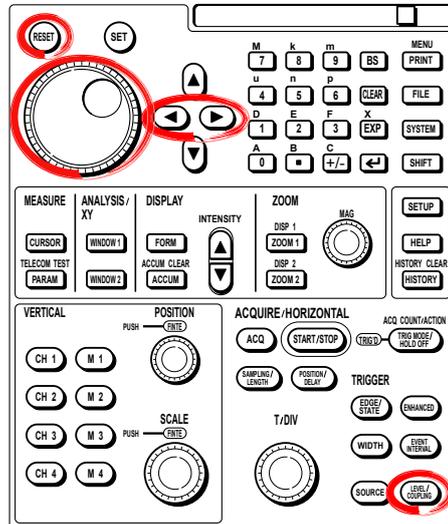
Setting the Trigger Coupling

1. Press **LEVEL/COUPLING**.
2. Press the **CH** soft key. A menu used to select the target channel appears.
3. Select the channel from among **CH1** to **CH4** and **EXT**, and press the corresponding soft key.
    If you select EXT, proceed to step 10.
4. Press the **Coupling** soft key to select DC or AC.

When EXT is selected
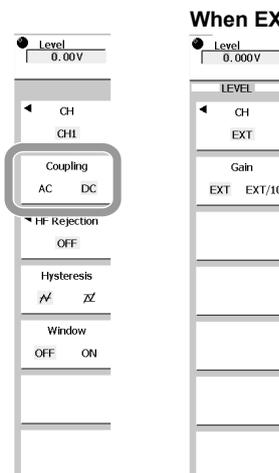
Note
The trigger coupling setting is common to all triggers. The trigger coupling setting is common to all triggers. However, in the case of TV trigger, this is fixed at TV.

Setting the HF Rejection

5. Press the **HF Rejection** soft key. The HF Rejection menu is displayed.

6. Press the soft key corresponding to the desired frequency.
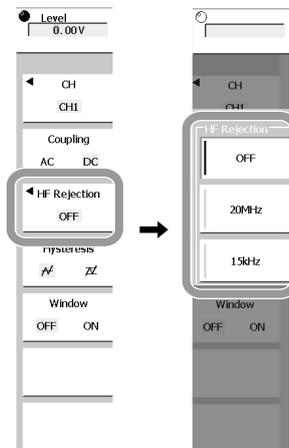
Note

The HF rejection setting is common to all triggers. However, for TV trigger this is fixed at 300 kHz.

Setting the Hysteresis

7. Press the **Hysteresis** soft key to select ∿ or ⊼.
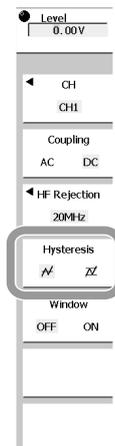
Note

The hysteresis setting is common to all triggers.

Setting the Window Comparator

8. Press the **Window** soft key to turn on the Window function. The soft key that is used to set the window appears.

9. Using the **rotary knob**, set the center voltage and the voltage.
    Press the Center/Width soft key to toggle between the Center (window center level) and Width (window width) settings.
    You can use the arrow keys to move the digit that is currently being set.
    Pressing RESET when the trigger coupling is DC changes the window comparator to the current offset value.
    When the trigger coupling is AC, the window comparator is set to 0 V.
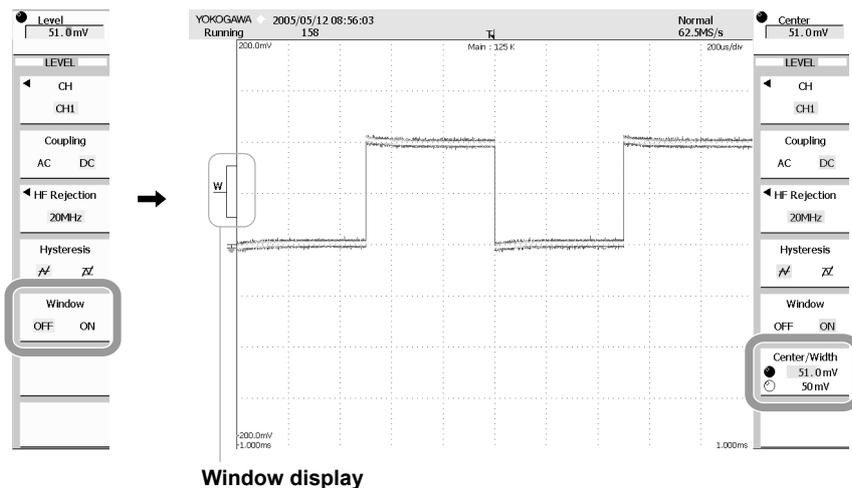
Window display

Note

The window comparator setting is common to all triggers.

Setting the Attenuation (for EXT)

10. Press the **Gain** soft key and then select either EXT or EXT/10.

Explanation

Trigger Coupling

You can select the trigger coupling.

AC	Uses a signal that is obtained by removing the DC component from the trigger source signal.
DC	Uses the trigger source signal as-is.

Note

- When using the TV trigger, this setting is fixed to TV.
- When the trigger source is EXT, this setting is fixed to DC.

HF Rejection

Specify 15 kHz or 20 MHz if you wish to use a signal that is obtained by removing the high frequency components (frequency components greater than 15 kHz or 20 MHz) from the trigger source signal as the trigger source.

Note

- This setting is not available when the trigger source is EXT.
- When using the TV trigger, this setting is fixed to 300 kHz.

Hysteresis

Sets a width to the trigger level so that triggers are not activated by small changes in the trigger signal.

⌇	Approximately 0.3 division* of hysteresis around the trigger level.
⌇	Approximately 1 division* of hysteresis around the trigger level.

* The value above is an approximate value. It is not strictly warranted.

Window Comparator

Determines the trigger condition determined by High/Low and the logical condition of State on the basis of whether the rising edge/falling edge of the waveform is inside (IN) or outside (OUT) the set range (Window).
The Window comparator can be enabled or disabled separately for each channel. The trigger conditions, etc., change according to the Window comparator settings of the channel set for the trigger source, etc.
For example, if Window comparator is enabled for an edge-triggered source channel, the trigger can be activated according to whether the waveform on the source channel is inside or outside the set area.

The setting range and resolution are as follows:

	Range	Resolution
Center	±4 div from the center of the screen	0.01 divisions
Width	±4 div around the center	0.02 divisions

6.4   Setting the Hold Off Time

Procedure
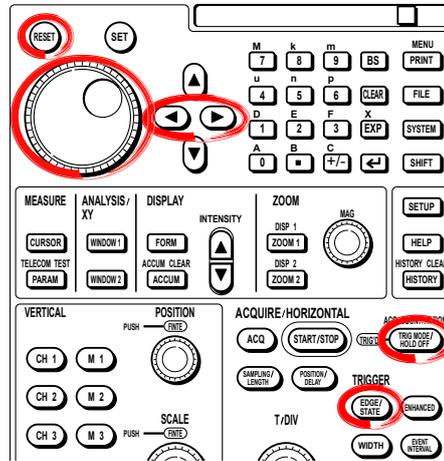
Edge Trigger

1.   Press **TRIG MODE/HOLD OFF**. The Trigger Mode menu appears.
2.   Press the **Hold Off** soft key, and set the rotary knob target to Hold off.
3.   Turn the **rotary knob** to set the hold off time.

    You can use the arrow keys to move the digit that is currently being set.

    Press RESET to reset the hold off time to 0.02 µs. (Use the arrow keys to change the selected digit until ns appears.)
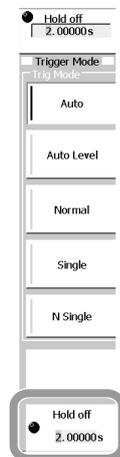
Explanation

As shown in the figure below, this setting prevents a trigger from being activated for a specified time, even when the trigger conditions are met during this time. This is useful when you wish to activate the trigger in sync with a periodic signal.
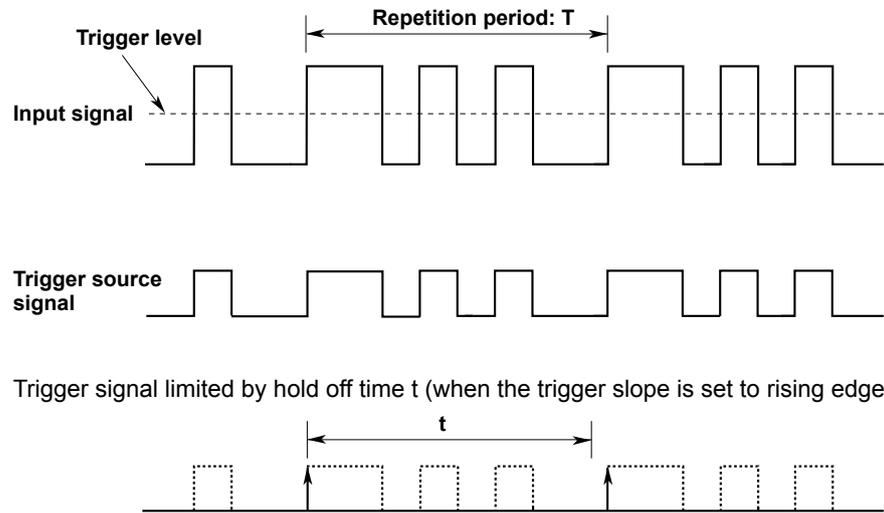
Selectable Range of the Hold Off Time
The selectable range is 0.02 μs to 10 s (the default value is 0.02 μs), and the resolution is 5 ns.

Note

•   The updating of the waveform may slow down when using repetitive sampling. In such case, set the hold off time to a smaller value.
•   If you are setting the hold off time to 100 ms or greater, set the trigger mode to normal.

6.5   Setting the Trigger Delay

Procedure
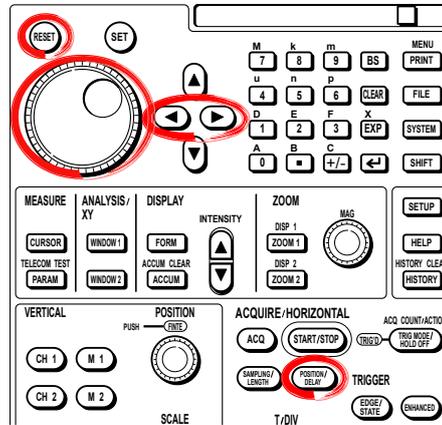
1. Press **POSITION/DELAY**. The Position/Delay menu appears.
2. Press the **Trigger Delay** soft key to turn the trigger delay on.
3. Press the **Delay Type** soft key.
4. Press the soft key for the delay type to be set.
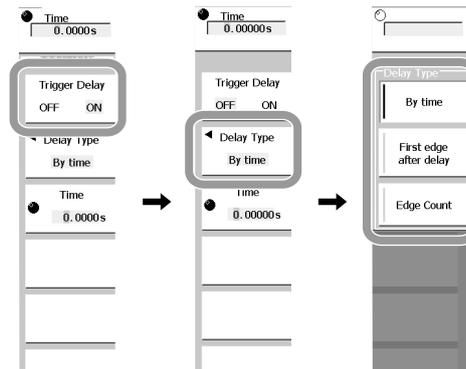
Setting the Delay Time (By time, First edge after delay)
When By time or First edge after delay is set, set the delay time.

5. Press the **TIME** soft key.
6. Turn the **rotary knob** to set the delay.

> You can use the arrow keys to move the digit that is currently being set.
> Pressing RESET resets the value to 0 s.
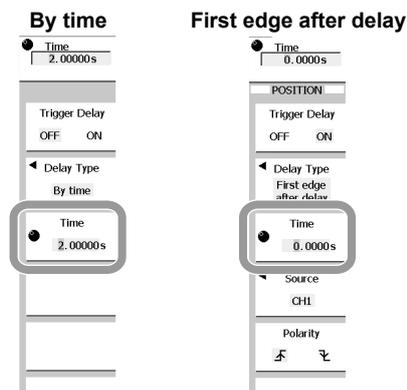
By time   **First edge after delay**

Setting Count (Edge Count)

When Edge Count has been set, set Count.

7.   Press the **Count** soft key.

8.   Turn the **rotary knob** to set Count.
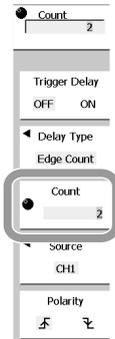
Setting the Source (First edge after delay, Edge Count)

When First edge after delay or Edge count is set, set the source.

9.   Press the **Source** soft key.

10. Press the soft key corresponding to the channel to be set.
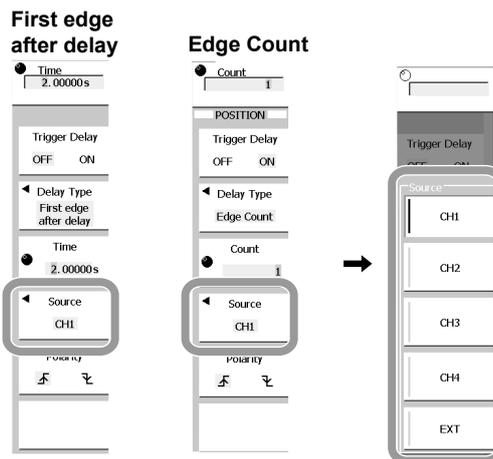
Selecting Rising Edge/Falling Edge (First edge after delay, Edge Count)

When First edge after delay or Edge Count has been set, select rising edge/falling edge.

11. Press the **Polarity** soft key to select ⌐ or ¬.
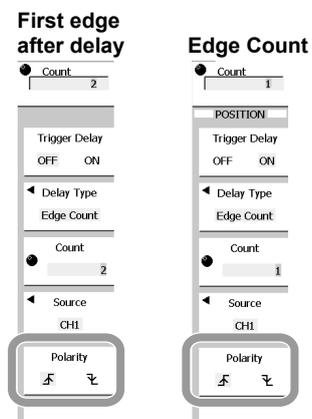
Explanation

Although the display usually shows the waveform before and after the trigger point, it is possible to display the acquired waveform after a fixed time period elapses using the trigger delay.

Delay Type

The following three delays are available for the delay type:

By time: Delay until the set time after the trigger condition is met.

First edge after delay: Delay until the first specified edge after the set time after the trigger condition is met.

Edge Count: Delay for the specified number of occurrences of the specified edge after the trigger condition is met.
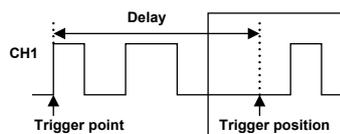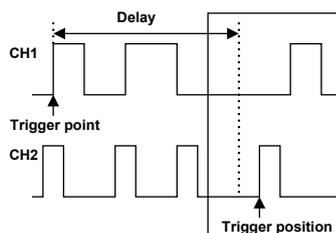
(1) By time   (2) First edge after delay   (3) Edge Count (when the trigger edge count is 3)
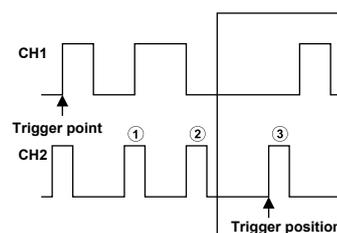
Selectable Range of Delay

Delay Type	Item	Resolution
By time	0 to 10 s	5 ps
First edge after delay	0 to 10 s	2 ns
Edge Count	1 to 10⁹	1 step

Note

When T/div is changed, the delay remains unchanged.

Level, Coupling, HF Rejection, Hysteresis, Window Comparator

The level, coupling, HF rejection, hysteresis and window comparator settings for a First edge after delay or Edge Count source channel are as described in section 6.3.

6.6 Setting the Trigger Position
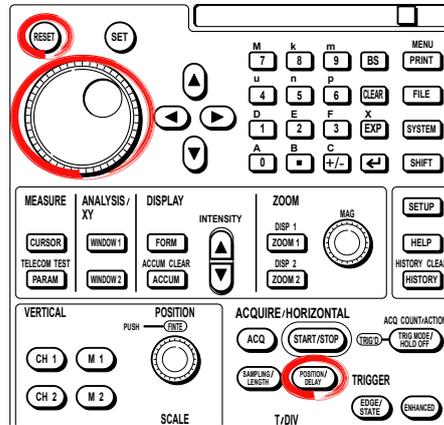
1. Press **POSITION/DELAY**. The Position/Delay menu appears.
2. Press the **Position** soft key.
3. Turn the **rotary knob** to set the trigger position.
   Pressing RESET resets the number to 50%.
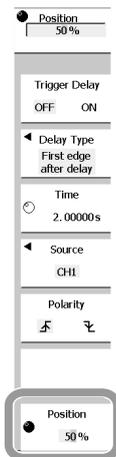
Explanation

Trigger Position

Trigger position = Trigger point + Trigger delay

You can select the location of the trigger position on the screen.

If the trigger delay is 0 s, the trigger position and the trigger point match. For the operating procedure of the trigger delay (see section 6.5).
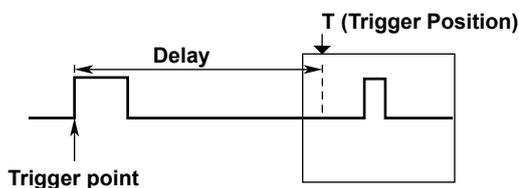
Selectable Range of Trigger Position

The trigger position can be set in the range of 0 to 100% (resolution is 1%) taking the display record length (see appendix 1) to be 100%.

Displaying the Trigger Position

A ⊣ mark that appears at the top of the screen indicates the trigger position with respect to the display record length.

Note ──────────────────────────────────

- If you change the trigger position while waveform acquisition is stopped, the new setting will not become effective until acquisition is started and the waveform is updated.
- Note that cursor time measurements are with respect to the trigger position. Changing the trigger position therefore changes the measurement values (except when in roll mode display).
- If you change the T/div setting, the time axis setting is rescaled with respect to the trigger position.

6

Triggers

6.7 Activating an Edge Trigger (Edge/State)
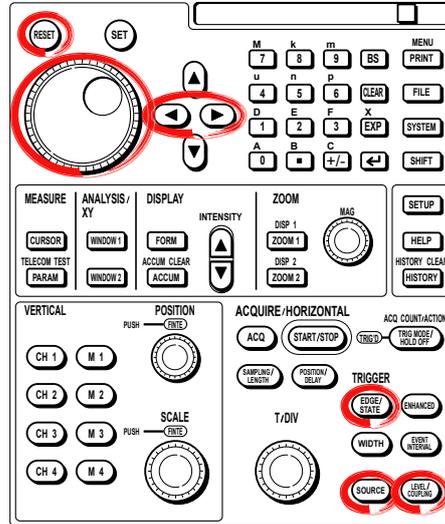
Setting the Trigger Type

1. Press **EDGE/STATE**. The Type menu appears.
2. Press the **Edge** soft key.
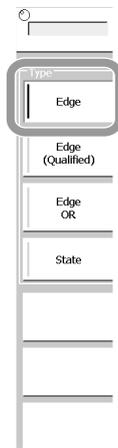
Setting the Trigger Source (When the Trigger Source is CH1 to CH4 or EXT)

3. Press **SOURCE**. The Source menu appears.

4. Press the soft key corresponding to the desired trigger source.
    Select EXT to use an external signal to activate a trigger, and select LINE to use this unit's power supply signal to activate a trigger.
    The following settings are necessary in order to use an external signal to activate a trigger.
    *   Trigger Level
    *   Trigger Slope
    *   Probe Attenuation
    *   Hold off time
    *   Window comparator (when necessary)
    The following settings are necessary in order to use the commercial power supply to activate a trigger.
    *   Hold off time
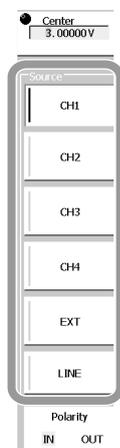
Setting the Trigger Slope (When the Trigger Source is CH1 to CH4 or EXT)

5. Press the **Polarity** soft key to select ⌐ or ⌐.
    If a channel for which window comparator has been set as the trigger source is specified, select either Enter or Exit.

Window comparator: OFF   Window comparator: ON

Setting the Trigger Level (When the Trigger Source is CH1 to CH4 or EXT)

6.   Press **SOURCE** or **LEVEL/COUPLING**.

7.   Turn the **rotary knob** to set the trigger level.

> You can use the arrow keys to change the digit that is currently being set.
>
> Pressing RESET resets the trigger level to the current offset voltage.

When window comparator is ON, the window center position setting is used.
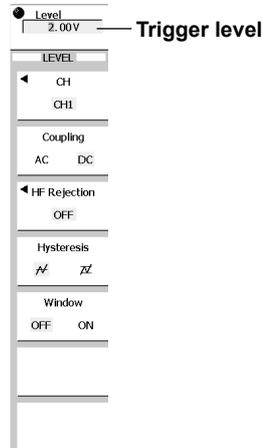
Setting the Attenuation (When the Trigger Source Is EXT)

8.   Press **LEVEL/COUPLING**.

9.   Press the **CH** soft key. A menu used to select the target appears.

10.   Press the **EXT** soft key.

11.   Press the **Gain** soft key and then select either EXT or EXT/10.
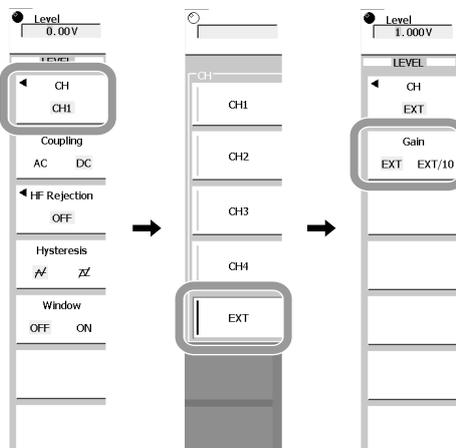
Setting Trigger Coupling (When the Trigger Source is CH1 to CH4)

12.   Set trigger coupling as described in section 6.3.

Setting HF Rejection (When the Trigger Source is CH1 to CH4)

13.   Set HF rejection as described in section 6.3.

Setting Trigger Hysteresis (When the Trigger Source is CH1 to CH4)

    14.   Set trigger hysteresis as described in section 6.3.

Setting Window Comparator

    15.   Set window comparator as described in section 6.3.

           When window comparator is ON, the trigger is activated when the trigger signal enters or leaves the specified voltage range.

Setting the Hold Off

    16.   Set hold off as described in section 6.4.

Explanation

This setting is used to activate a trigger when the input signal of a specified channel crosses the trigger level.

Trigger Source

Select from among CH1 to CH4, EXT or LINE.

Activating a Trigger with an External Signal

When using an external signal that is input to the TRIG IN terminal on the rear panel for the trigger source, set the trigger source to EXT.

Activating a Trigger with Commercial Power

When activating a trigger with the commercial power that is used to power this unit, set the trigger source to LINE.

Trigger Slope

You can select how the trigger source signal is to cross the trigger level in activating the trigger.

⌐Ꞓ	Activated when the trigger source changes from below the trigger level to above the trigger level (rising).
ꓶ_	Activated when the trigger source changes from above the trigger level to below the trigger level (falling).
Enter	Trigger when the trigger source level enters the set voltage range (When window comparator is ON)
Exit	Trigger when the trigger source level leaves the set voltage range (When window comparator is ON)

Trigger Level

- The selectable range is 8 divisions within the screen.   The resolution is 0.01 divisions. For example, the resolution for 2 mV/div is 0.02 mV.
- You can also press the RESET key to reset the trigger level to the current offset voltage.

Hold Off

See section 6.4.

6

Triggers

6.8 Activating a Qualified Edge Trigger (Edge/ State)
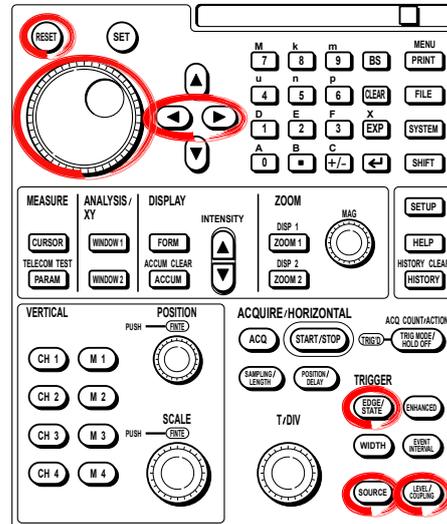
Setting the Trigger Type
1. Press **EDGE/STATE**.
2. Press the **Edge (Qualified)** soft key.
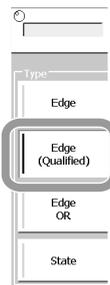
Setting the Trigger Source
3. Press **SOURCE**.
4. Press the **Source** soft key.
5. Press the soft key corresponding to the desired channel.
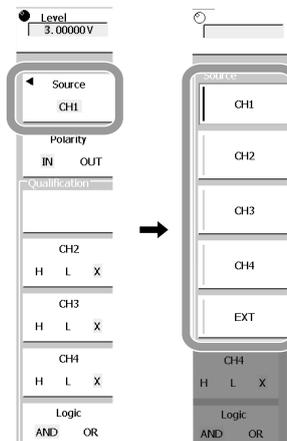
Setting the Trigger Slope

6. Press the **Polarity** soft key to select ⌐ or ⌐.

   If a channel for which window comparator has been set as the trigger source is specified, select either Enter or Exit.

Window comparator: OFF   **Window comparator: ON**

Setting the Qualify Condition Status

7. Press the soft key for the channel to be set and then select either H, L or X.
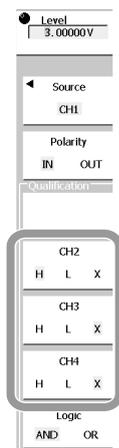
Setting the Qualify Condition Logic

8. Press the **Logic** soft key to select AND or OR.

Setting the Trigger Level (When the Trigger Source is CH1 to CH4 or EXT)

9. Press **SOURCE** or **LEVEL/COUPLING**.
10. Turn the **rotary knob** to set the trigger level.
    You can use the arrow keys to change the digit that is currently being set.
    Pressing RESET resets the trigger level to the current offset voltage.
    When window comparator is ON, the window center position setting is used.

Level
51.0mV ———— **Trigger level**

LEVEL
◄ CH
CH1

Coupling
AC   DC

◄ HF Rejection
OFF

Hysteresis

Window
OFF   ON
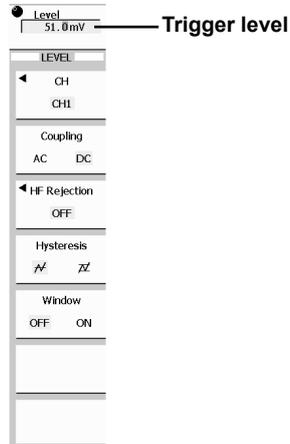
Setting Trigger Coupling (When the Trigger Source is CH1 to CH4)

11. Set trigger coupling as described in section 6.3.

Setting HF Rejection (When the Trigger Source is CH1 to CH4)

12. Set HF rejection as described in section 6.3.

Setting Trigger Hysteresis (When the Trigger Source is CH1 to CH4)

13. Set trigger hysteresis as described in section 6.3.

Setting the Window Comparator (When the Trigger Source is CH1 to CH4 or EXT)

14. Set window comparator as described in section 6.3.
    When window comparator is ON, the trigger is activated when the trigger signal enters or leaves the specified voltage range.

Setting the Hold Off (When the Trigger Source is CH1 to CH4 or EXT)

15. Set the hold off time as described in section 6.4.

Explanation

This specification is used to activate the edge trigger of a single trigger source when the input signal level of the specified channel meets the set condition.

Trigger Source
Select from among CH1 to CH4, or EXT.

Activating a Trigger with an External Signal
In order to use an external signal that is input to the TRIG IN terminal on the rear panel for the trigger source, set the trigger source to EXT.

Trigger Level, Threshold Level
- The selectable range is 8 divisions within the screen.   The resolution is 0.01 divisions. For example, the resolution for 2 mV/div is 0.02 mV.
- You can also press the RESET key to reset the trigger level to the current offset voltage.

Trigger Slope
You can select how the trigger source signal is to cross the trigger level in activating the trigger.

⌐⌐	Activated when the trigger source changes from below the trigger level to above the trigger level (rising).
⌐⌐	Activated when the trigger source changes from above the trigger level to below the trigger level (falling).
Enter	Trigger when the trigger source level enters the set voltage range (When window comparator is ON)
Exit	Trigger when the trigger source level leaves the set voltage range (When window comparator is ON)

Trigger delay
See section 6.5.

Qualify Condition
Sets the condition that enables a trigger with the channel state.

State: CH1 = H, CH2 = L, AND, Trigger source: CH3, More than
L: low level, H: high level

CH1

CH2

CH3

Trigger   Trigger

| CH1 | L | H | L | H |
| CH2 | L | H | L | | H |

Qualify false   Qualify true   Qualify false
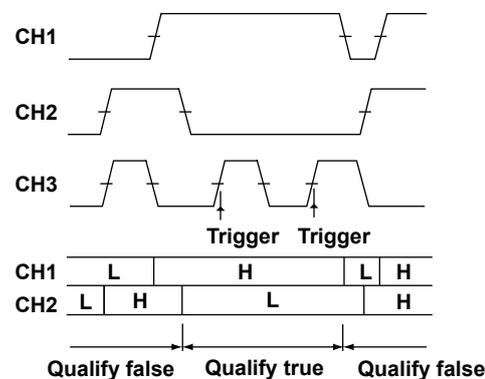
Note

The Qualify condition cannot be set for the source channel.

6.9 Activating a Trigger with the State Condition (Edge/State)
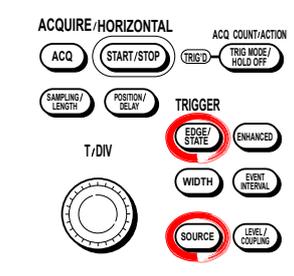
Setting the Trigger Type
1. Press **EDGE/STATE**.
2. Press the **State** soft key.
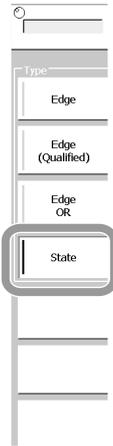
Setting the Clock Channel
3. Press the **Clock** soft key. The clock menu appears.
4. Press the soft key corresponding to the desired channel.
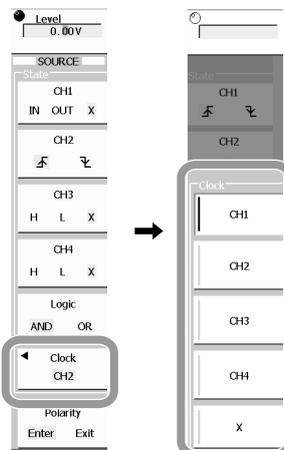
Setting the State Condition

5.   Press **SOURCE**.

6.   Press the soft key for each channel to be set and then select either H, L or X. For channels for which the Window comparator is ON, select one of IN, OUT, and X. For the channel selected to be the clock channel, select �runs or ⌐. If the Window comparator is ON for the clock channel, select either Enter or Exit.
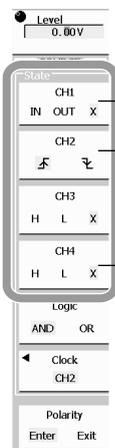
When the window comparator is set to ON

Clock channel with window comparator OFF

When the window comparator is set to OFF

Clock channel with window comparator ON

6

Triggers

Setting Logical AND or Logical OR

7.   Press the **Logic** soft key to select AND or OR.
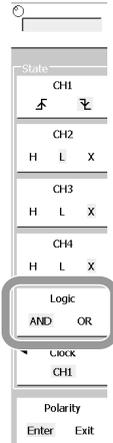
Setting the Condition

8.   Press the **Polarity** soft key to select Enter or Exit.
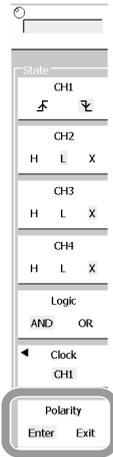
Setting the Trigger Coupling

9.   Set trigger coupling as described in section 6.3.

Setting the HF Rejection

10.   Set HF rejection as described in section 6.3.

Setting the Hysteresis

11.   Set trigger hysteresis as described in section 6.3.

Setting the Window Comparator

12.   Set window comparator as described in section 6.3.

Setting the Hold Off

13.   Set the hold off time as described in section 6.4.

Explanation

This function activates a trigger in either of the following circumstances:

- The trigger is activated when the specified input logic condition (State) is met, or ceases to be met.
- On the specified channel (clock channel) rising edge or falling edge timing, the set input logic condition (State) is checked, and the logic condition normalized (high level when the logic condition is met, and low level when it is not met). The trigger is activated when the normalized condition changes.

Trigger Source

Select from among CH1 to CH4.

State Condition

Sets the state of each channel.

Trigger delay

Set the trigger delay as described in section 6.5.

Clock Channel

When no clock channel is specified, the trigger is activated by just the State condition.
If a clock channel is specified, the trigger is activated according to the relationship of the rising edge or falling edge of the clock channel and the set State condition.

State: CH1=H, CH2=L, CH3/CH4=X, AND
Clock: None, Polarity: Enter
L: low level, H: high level

State: CH1=H, CH2=L, CH3/CH4=X, AND
Clock: None, Polarity: Exit
L: low level, H: high level

State; CH1=H, CH2=L, CH4=X, AND
Clock: CH3, rising, Polarity: Enter
L: low level, H: high level

State: CH1=H, CH2=L, CH4=X, AND
Clock: CH3, rising, Polarity: Exit
L: low level, H: high level

6
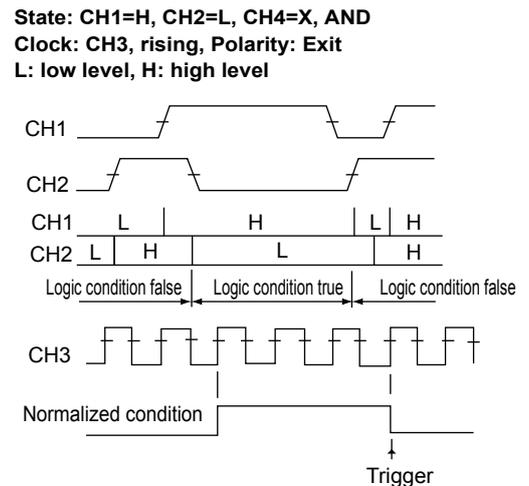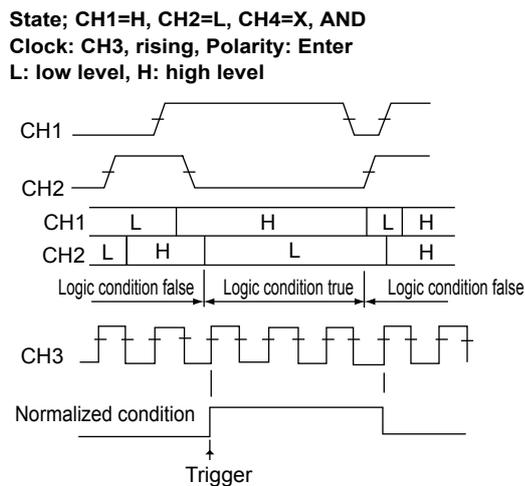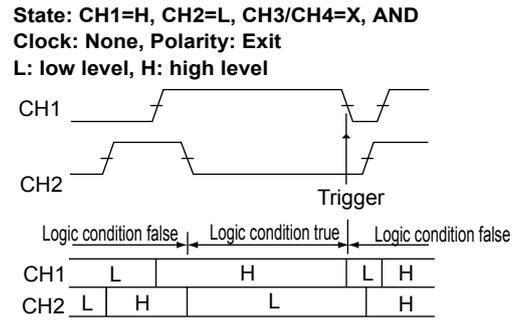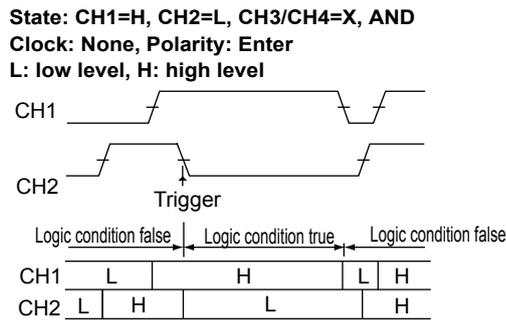
Triggers

# 6.10 Activating a Trigger by ORing Multiple Edge Triggers (Edge/State)
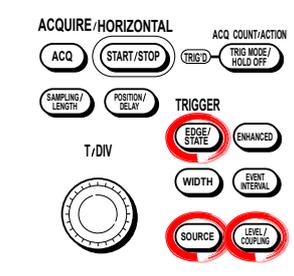
Setting the Trigger Type

1. Press **EDGE/STATE**.
2. Press the **Edge OR** soft key.
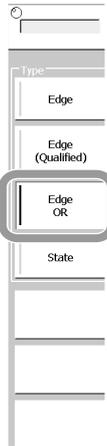
Setting the Trigger Slope

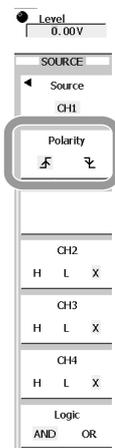3. Press **SOURCE**.
4. Press the soft key for the channel to be set and then select either ⌐, ⌐ or X.
    For channels with the Window comparator set to ON, select either Enter, Exit, or X.

When the window comparator is set to ON
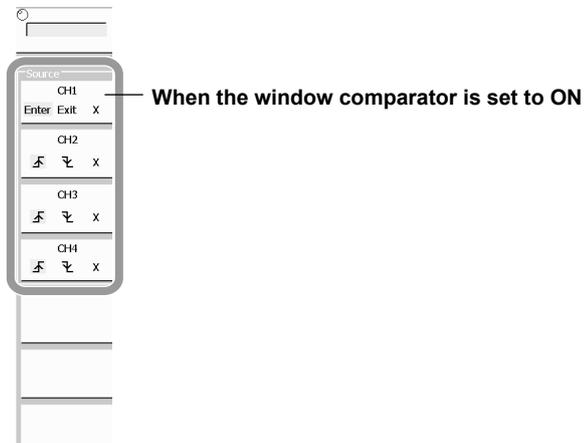
Setting the Trigger Level
5.   Press **LEVEL/COUPLING**.
6.   Press the **CH** soft key.
7.   Press the soft key corresponding to the desired channel.
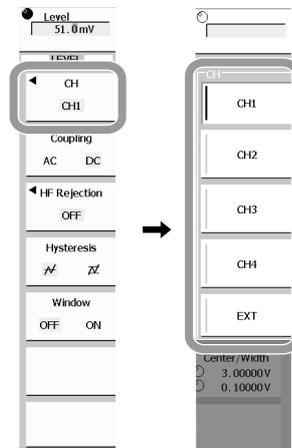
Setting the Trigger Coupling
8.   Set trigger coupling as described in section 6.3.

Setting the HF Rejection
9.   Set HF rejection as described in section 6.3.

Setting the Hysteresis
10. Set hysteresis as described in section 6.3.

Setting the Window Comparator
11. Set window comparator as described in section 6.3.
     When window comparator is ON, the trigger is activated when the trigger signal
     enters or leaves the specified voltage range.

Setting the Hold Off
12. Set the hold off time as described in section 6.4.

6

Triggers

Explanation

This specification is used to activate a trigger on the edge of multiple trigger sources.

Trigger Source

Select from among CH1 to CH4.

Trigger Slope

You can select how the trigger source signal is to cross the trigger level in activating the trigger.

⌐⌐	Activated when the trigger source changes from below the trigger level to above the trigger level (rising).
⌐⌐	Activated when the trigger source changes from above the trigger level to below the trigger level (falling).
Enter	Trigger when the trigger source level enters the set voltage range (When window comparator is ON)
Exit	Trigger when the trigger source level leaves the set voltage range (When window comparator is ON)

Hold Off

See section 6.4.

6.11 Activating a Trigger by Pulse Width (Width)

Procedure
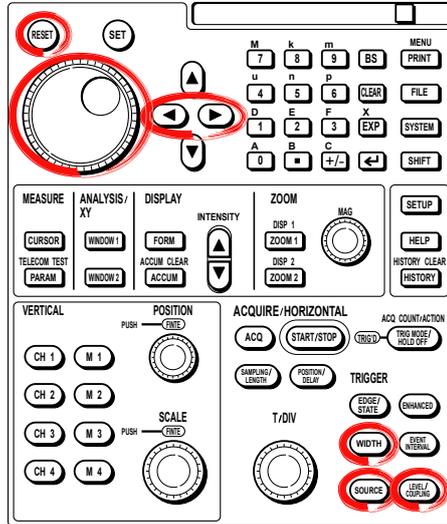
Setting the Trigger Type

1. Press the **WIDTH** key. The Type screen appears.
2. Press the **Pulse** soft key.

Setting the Trigger Mode

3. Press the **Mode** soft key.
4. Press the soft key that corresponds to the desired mode: **More than**, **Less than**, **Between**, **Out of range**, or **Time Out**.

Setting the Determination Time

5. Press **WIDTH**.

6. Turn the **rotary knob** to set the determination time.

   Pressing RESET resets the determination time to 0.0010 µs.

   You can use the arrow keys to move the digit that is currently being set.

When the time mode is set to Between or Out of Range, make two time settings.

Use the soft keys to switch which the rotary knob setting applies to.

Set to More than   **Set to Between**
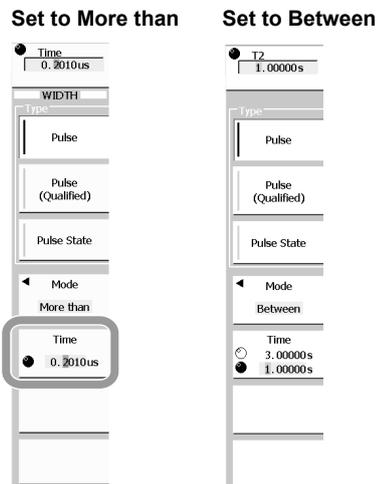
Setting the Channel

7. Press **SOURCE**. The Source menu appears.

8. Press the soft key corresponding to the channel to be set.

9. Press the **Polarity** soft key to set the polarity of the pulse signal to either Pos [positive] or Neg [negative].

10. Press **ESC**. The Source menu closes.
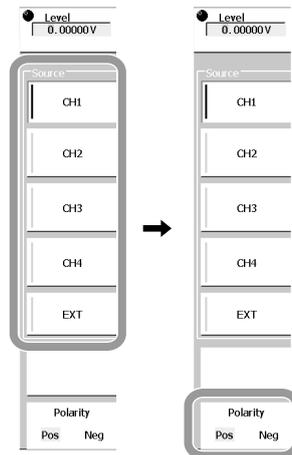
Setting the Level, Hysteresis, Trigger Coupling, and HF Rejection

11. Press **LEVEL/COUPLING**. The LEVEL menu appears.

12. Set the Level, Hysteresis, Trigger Coupling, and HF Rejection.
    When the Window comparator is ON, the trigger level setting is the setting of the center position of the window.

    For the setting procedure (see section 6.3).
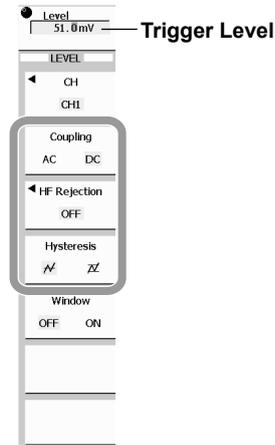
Trigger Level

13. Press **ESC**. The Level/Coupling menu closes.

Setting the Hold Off

14. Set the hold off time according to the procedures given in section 6.4.

Explanation

This setting is for activating a trigger by determining whether the time over which the specified condition is met or not met is shorter or longer than the determination time set in advance.

Pulse trigger

This function activates a trigger according to the relationship between the pulse width of a single trigger source and the specified time.

More than	The trigger is activated when the pulse width is longer than the set determination time, and the state changes.
Less than	The trigger is activated when the pulse width is shorter than the set determination time, and the state changes.
Between	The trigger is activated when the pulse width is longer than T1, the first of the two set determination times, and shorter than T2, and the state changes.
Out of Range	The trigger is activated when the pulse width is shorter than T1, the first of the two set determination times, or longer than T2, and the state changes.
Time Out	The trigger is activated when the pulse width is longer than the set determination time.

Example

More than

Trigger source

T1

t

t > T1   Trigger

Less than

Trigger source

T1

t

t < T1   Trigger

Between

Trigger source

T2

T1

t

T1 < t < T2   Trigger

Out of Range

Trigger source

T2

T1

t

t < T1 or t > T2   Trigger   Trigger

Time out

Trigger source

T1

t

t > T1   Trigger

The point where the trigger occurs differs between More than and Time Out as shown in the figure below.

More than, CH1 = H, Other CHs: X,
Time = 400 ns

CH1

500 ns

100 ns
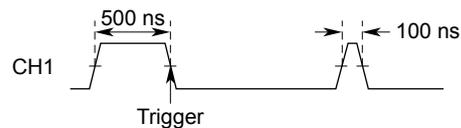
Trigger

Time Out, CH1 = H, Other CHs: X,
Time = 400 ns

CH1

400 ns

500 ns

100 ns

Trigger

Trigger Level

Item: 8 divisions on the screen
Resolution: 0.01 divisions
For example, the resolution for 2 mV/div is 0.02 mV.

Hysteresis

Sets a width to the trigger level so that triggers are not activated by small changes in the trigger signal.

⊬	Approximately 0.3 division* of hysteresis around the trigger level.
⊭	Approximately 1 division* of hysteresis around the trigger level.

* The value above is an approximate value. It is not strictly warranted.

Trigger Coupling

You can select the trigger coupling.

AC	Uses a signal that is obtained by removing the DC component from the trigger source signal.
DC	Uses the trigger source signal as-is.

Turning ON/OFF the HF Rejection

Specify 15 kHz or 20 MHz if you wish to use a signal that is obtained by removing the high frequency components (frequency components greater than 15 kHz or 20 MHz) from the trigger source signal as the trigger source.

Determination Time

The selectable range is 0.001 µs to 10 s, and the resolution is 1 ns.

Relationship to the Window Comparator

When a channel with the Window comparator set to ON is selected for the source channel, the trigger can be activated either when the waveform is within the specified voltage range, or when the waveform is outside the specified voltage range.

Hold Off

See section 6.4.

Note

The trigger may not operate correctly, if the interval between signals or the pulse width of the signal is less than 2 ns. The time accuracy of the pulse width under standard operating conditions after calibration is (0.2% of setting + 1 ns). However, the setting for T1 < Pulse < T2 is the T2 value.

6

Triggers

6.12 Activating a Trigger by Qualified Pulse Width (Width)

Setting the Trigger Type

1. Press the **WIDTH** key. The Type screen appears.
2. Press the **Pulse (Qualified)** soft key.

Setting the Trigger Mode

3. Press the **Mode** soft key.
4. Press the soft key that corresponds to the desired mode: **More than**, **Less than**, **Between**, **Out of range**, or **Time Out**.

Setting the Determination Time

5. Turn the **rotary knob** to set the determination time.

    Pressing RESET resets the determination time to 0.0010 μs.

    You can use the arrow keys to move the digit that is currently being set.

    When the time mode is set to Between or Out of Range, make two time settings.

    Use the soft keys to switch which the rotary knob setting applies to.

Setting the Channel

6. Press **SOURCE**. The SOURCE menu appears.
7. Press the **Source** soft key.
8. Press the soft key corresponding to the channel to be set.
9. Press the **Polarity** soft key to set the polarity of the pulse signal to either Pos [positive] or Neg [negative].

    If the window comparator is ON, select either IN or OUT.

Setting the Determination Conditions

10. Press the soft key for the channel to be set as a condition and then select H, L or X.

    If the window comparator is ON, select either IN, OUT or X.

11. Press the **Logic** soft key to select AND or OR.
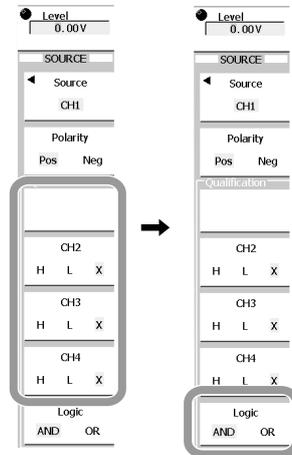
Setting the Hysteresis, Trigger Coupling, and HF Rejection

12. Press **LEVEL/COUPLING**. The LEVEL menu appears.

13. Set the Hysteresis, Trigger Coupling, and HF Rejection.

    For the setting procedure (see section 6.3).

14. Press the **Window** soft key to select ON or OFF.

15. Press **ESC**. The LEVEL menu closes.
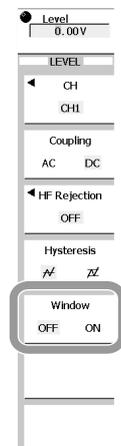
Setting the Hold Off Time

16. Set the hold off time according to the procedures given in section 6.4.

Explanation

A trigger is activated by the relationship between the pulse width of a single trigger source and the specified time while the status of each input channel satisfies the set conditions. The timing at which a trigger is activated is the same as for Pulse.

Example

State: CH1 = H, CH2 = L, AND, Trigger source: CH3, More than
L: low level, H: high level

Trigger Level

Item: 8 divisions on the screen
Resolution: 0.01 divisions
For example, the resolution for 2 mV/div is 0.02 mV.

Hysteresis

Sets a width to the trigger level so that triggers are not activated by small changes in the trigger signal.

⌐V⌐	Approximately 0.3 division* of hysteresis around the trigger level.
⌐V⌐	Approximately 1 division* of hysteresis around the trigger level.

* The value above is an approximate value. It is not strictly warranted.

Trigger Coupling

You can select the trigger coupling.

AC	Uses a signal that is obtained by removing the DC component from the trigger source signal.
DC	Uses the trigger source signal as-is.

Turning ON/OFF the HF Rejection

Specify 15 kHz or 20 MHz if you wish to use a signal that is obtained by removing the high frequency components (frequency components greater than 15 kHz or 20 MHz) from the trigger source signal as the trigger source.

Determination Time

The selectable range is 1 ns to 1 s, and the resolution is 1 ns.

6

Triggers

Relationship to the Window Comparator

When a channel with the Window comparator set to ON is selected for the source channel, the trigger can be activated either when the waveform is within the specified voltage range, or when the waveform is outside the specified voltage range.

Hold Off

See section 6.4.

Note

The trigger may not operate correctly, if the interval between signals or the pulse width of the signal is less than 2 ns. The time accuracy of the pulse width under standard operating conditions after calibration is ±(0.2% of setting + 1 ns). However, the setting for T1 < Pulse < T2 is the T2 value.

6.13 Activating a Trigger by Width During Which a State Condition Is True (Width)

Procedure
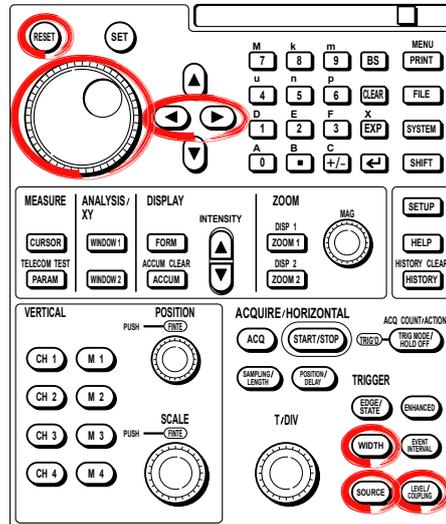
Setting the Trigger Type

1. Press **WIDTH**.
2. Press the **Pulse State** soft key.
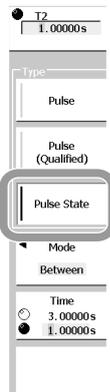
Setting the Mode

3. Press the **Mode** soft key.
4. Press the soft key corresponding to the channel to be set.

Setting the Determination Time

5. Press the **Time** soft key and set the rotary knob target to Time.

6. Turn the **rotary knob** to set the determination time.

    Pressing RESET resets the determination time to 0.0010 µs.

    You can use the arrow keys to move the digit that is currently being set.

    When the time mode is set to Between or Out of Range, make two time settings.

   Use the soft keys to switch which the rotary knob setting applies to.

Set to More than   **Set to Between**
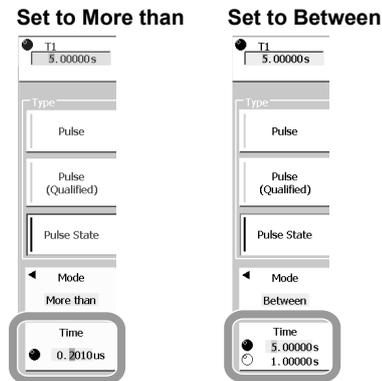
Setting the Clock Channel

7 Press **SOURCE**.

8. Press the **Clock** soft key. The clock menu appears.

9. Press the soft key corresponding to the desired channel.

Setting the State Condition

10. Press the soft key for each channel to be set and then select either H, L or X.

If the window comparator is ON either IN, OUT, or X.

For the channel selected to be the clock channel, select ⌐ or ⌐.

If the Window comparator is ON for the clock channel, select either Enter or Exit.
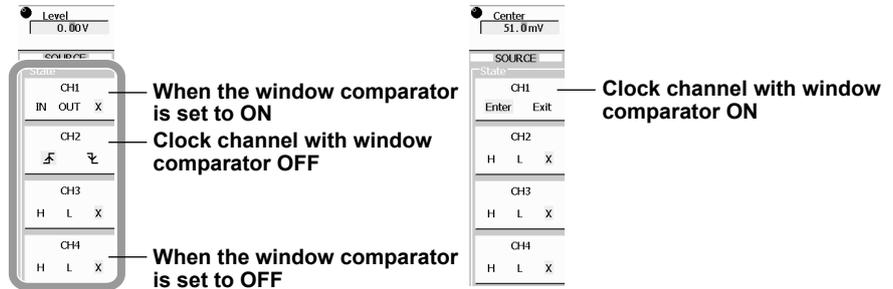
Setting Logical AND or Logical OR

11. Press the **Logic** soft key to select AND or OR.
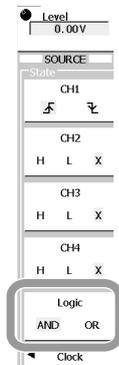
Setting the Condition

12. Press the **Polarity** soft key to select True or False.

Setting Level, Hysteresis, Trigger Coupling and HF Rejection

13. Press **LEVEL/COUPLING**.

14. Set the Level, Hysteresis, Trigger Coupling, and HF Rejection.
    For the operation procedure (see section 6.3).
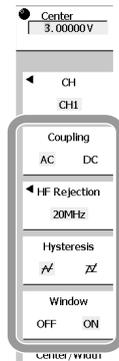
Setting the Hold Off

15. Set the hold off time according to the procedures given in section 6.4.

Explanation

This function activates a trigger in either of the following circumstances:

- When the relationship of the time width during which the logical condition (State) of the set input is met or is not met, and the specified time is established

- When the logical condition (State) of the input has been checked at either the rising edge or the falling edge of the specified channel (clock channel), and it was confirmed for the first time that the time during which the logical condition was met or not met satisfied the relationship with the specified time

More than	The trigger is activated when the time for which the logic condition holds is longer than the set determination time, and the state changes.
Less than	The trigger is activated when the time for which the logic condition holds is shorter than the set determination time, and the state changes.
Between	The trigger is activated when the time for which the logic condition holds is longer than T1, the first of the two set determination times, and shorter than T2, the second, and the state changes.
Out of Range	The trigger is activated when the time for which the logic condition holds is shorter than T1, the first of the two set determination times, or longer than T2, the second, and the state changes.
Time Out	The trigger is activated when the time for which the logic condition holds is longer than the set determination time.

Example

State: CH1 = H, CH2 = L, CH3/CH4 = X, AND
Clock: None, Polarity: True, More than
L: low level, H: high level

State: CH1 = H, CH2 = L, CH3/CH4 = X, AND
Clock: None, Polarity: False, More than
L: low level, H: high level

State: CH1 = H, CH2 = L, CH4 = X, AND
Clock: CH3, rising, Polarity: True
L: low level, H: high level

State: CH1 = H, CH2 = L, CH4 = X, AND
Clock: CH3, rising, Polarity: False
L: low level, H: high level

Trigger Level

Range: 8 divisions on the screen

Resolution: 0.01 divisions

For example, the resolution for 2 mV/div is 0.02 mV.

Hysteresis

Sets a width to the trigger level so that triggers are not activated by small changes in the trigger signal.

⊬	Approximately 0.3 division* of hysteresis around the trigger level.
⊬	Approximately 1 division* of hysteresis around the trigger level.

* The value above is an approximate value. It is not strictly warranted.

Trigger Coupling

You can select the trigger coupling.

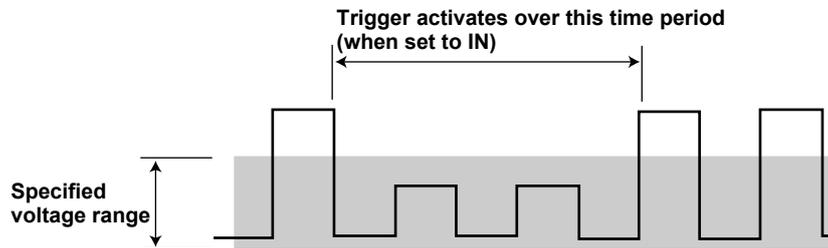|	
AC	Uses a signal that is obtained by removing the DC component from the trigger source signal.
DC	Uses the trigger source signal as-is.

Turning ON/OFF the HF Rejection

Specify 15 kHz or 20 MHz if you wish to use a signal that is obtained by removing the high frequency components (frequency components greater than 15 kHz or 20 MHz) from the trigger source signal as the trigger source.

Relationship to the Window Comparator

When a channel with the Window comparator set to ON is selected for the source channel, the trigger can be activated either when the waveform is within the specified voltage range, or when the waveform is outside the specified voltage range.

Hold Off

See section 6.4.

6.14 Activating a Trigger on an Event Signal Cycle (Event interval)
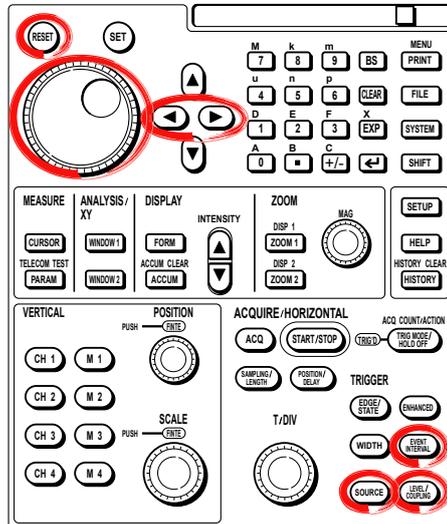
Setting the Trigger Type
1. Press **EVENT INTERVAL**.
2. Press the **Type** soft key.
3. Press the **Event Cycle** soft key.
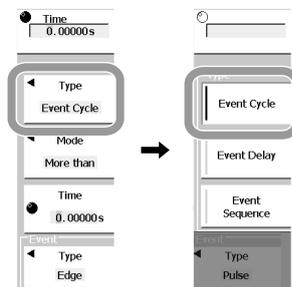
Setting the Mode
4. Press the **Mode** soft key.
5. Press the soft key corresponding to the channel to be set.

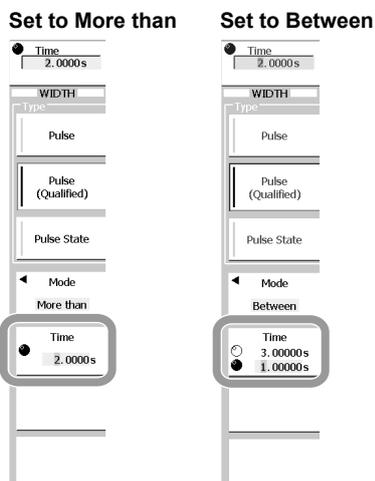**Setting the Determination Time**

6. Press the **Time** soft key.
7. Turn the **rotary knob** to set the determination time.

   Pressing RESET resets the determination time to 0.0015 µs.

   You can use the arrow keys to move the digit that is currently being set.

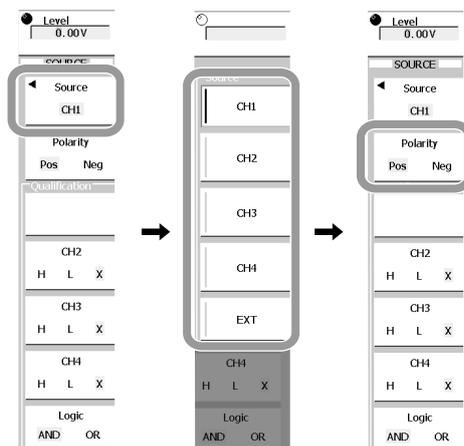   When the time mode is set to Between or Out of Range, make two time settings.

   Use the soft keys to switch which the rotary knob setting applies to.

Set to More than   **Set to Between**
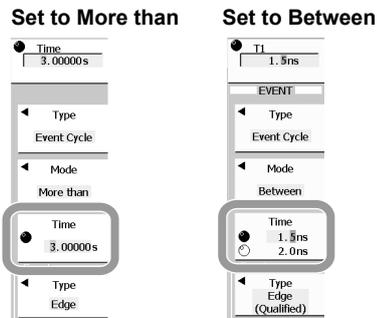
Setting the Event Type

8. Press the **Type** soft key.
9. Press the soft key corresponding to the type to be set.

   When Width is selected, select the type for Width.

When Width is selected
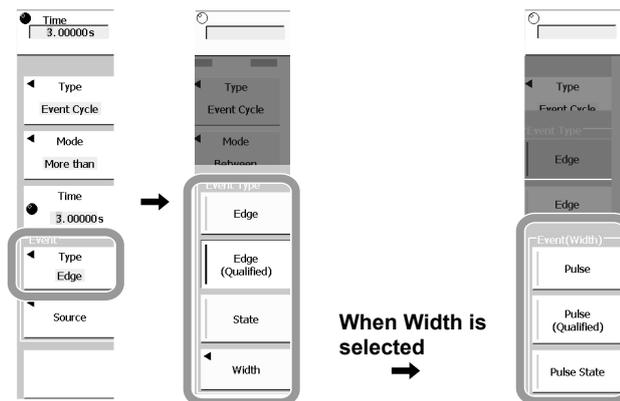
Setting the Event Time Mode and Determination Time (When event type is Width)

10. Press the **Setup** soft key.
11. Press the **Mode** soft key.
12. Press the soft key corresponding to the channel to be set.
13. Set the event determination time corresponding to the time mode.
14. Press **ESC**.
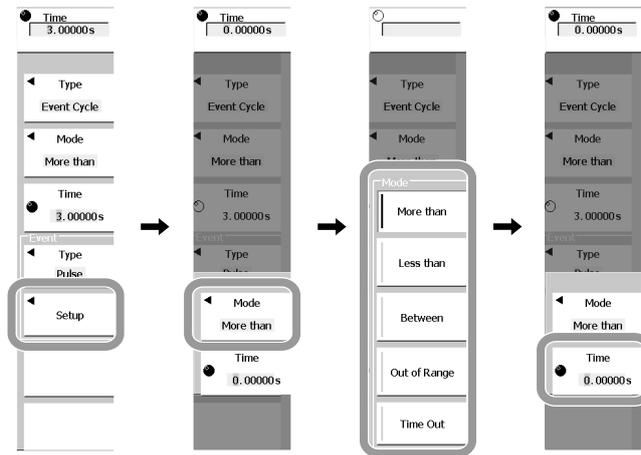
Setting the Event Source

15. If the event type is Edge, Edge (Qualified), or State, press the **Source** soft key.
    If the event type is Width, press **SOURCE** on the front panel.

Subsequent operation varies, depending on the event type setting. See the following sections for trigger source settings.

Event type	See section:
Edge	Section 6.7
Edge (Qualified)	Section 6.8
State	Section 6.9
Width-Pulse	Section 6.11
Width-Pulse (Qualified)	Section 6.12
Pulse State	Section 6.13

6

Triggers

Setting Level, Hysteresis, Trigger Coupling and HF Rejection

16. Press **LEVEL/COUPLING**.
17. Set the Level, Hysteresis, Trigger Coupling, and HF Rejection.

For the operation procedure, see section 6.3.
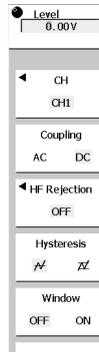
Explanation

The trigger is activated when the event cycle based on a previously described trigger (except for the Edge OR trigger and TV trigger) meets the time condition that was set.
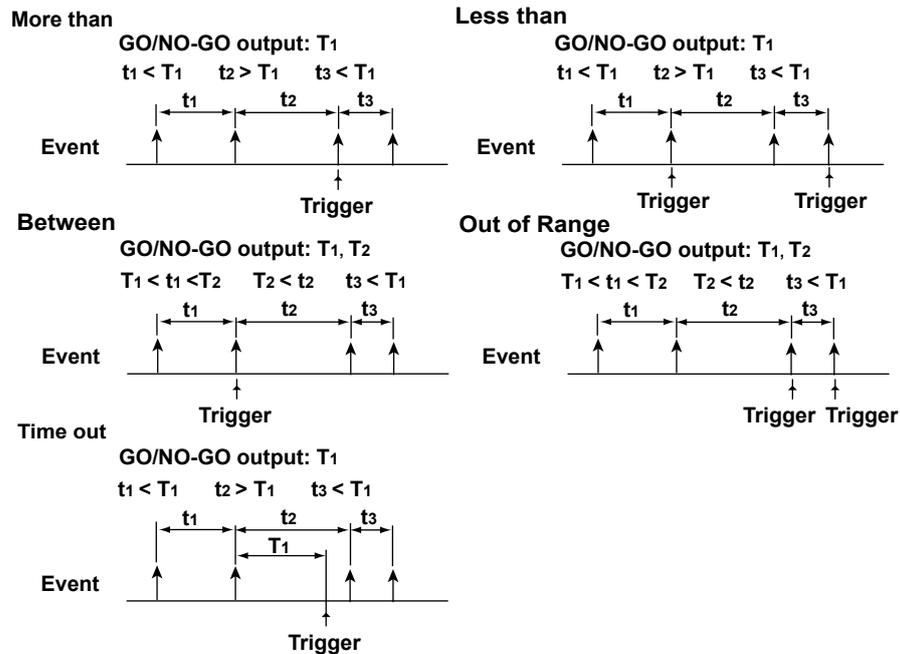
Event Mode

More than	The trigger is activated at the end of a cycle longer than the specified time.
Less than	The trigger is activated at the end of a cycle shorter than the specified time.
Between	The trigger is activated at the end of a cycle that is longer than the specified time T1 and shorter than the specified time T2.
Out of Range	The trigger is activated at the end of a cycle that is shorter than the specified time T1 or longer than the specified time T2.
Time Out	The trigger is activated when the cycle exceeds the specified time.

Event type

Handles each trigger as an event. For details on the triggers, refer to the section on each trigger.

6.15 Event Delay

Procedure
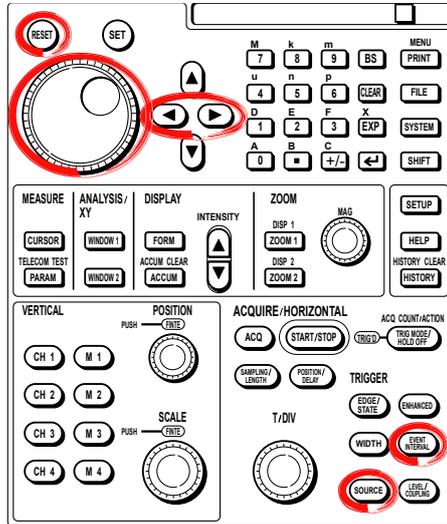
1. Press **EVENT INTERVAL**.
2. Press the **Type** soft key.
3. Press the **Event Delay** soft key.
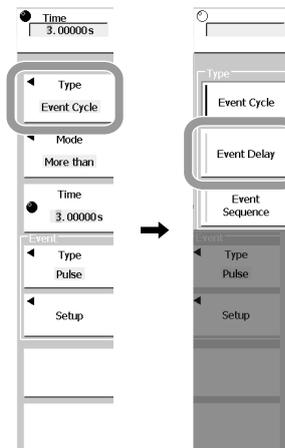
Setting the Event Mode, Try Mode

4. Press the **Mode** soft key.

5. Press the soft key corresponding to the channel to be set.

6. Press the **Try Mode** soft key to turn it ON or OFF.

    When event mode is ON, the trigger is activated by either 1st or 2nd, as selected by the following operation.

    Set to ON in order to confirm whether a trigger was activated by the 1st or 2nd event.

7. Press the **1st** or **2nd** soft key to select one or the other.

8. Press **ESC**.

Setting the Time

9. Press the **Time** soft key and set the rotary knob target to Time.

10. Turn the **rotary knob** to set the determination time.

    Pressing RESET resets the determination time to 0.0015 μs.

    You can use the arrow keys to move the digit that is currently being set.

    When the time mode is set to Between or Out of Range, make two time settings.

    Use the soft keys to switch which the rotary knob setting applies to.
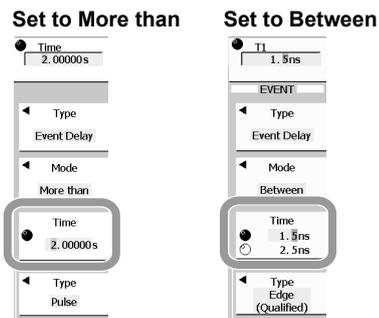
Setting the Event

11. Press the **Type** soft key for either 1st Event or 2nd Event.
12. Press the soft key corresponding to the type to be set.
    When Width is selected, select the type for Width.

When Width is selected

Setting the Event Source

13. If the event type is Edge, Edge (Qualified), or State, press the **Source** soft key.
    If the event type is Width, press SOURCE.
    Subsequent operation varies, depending on the event type setting. See the following sections for trigger source settings.

Event type	See section:
Edge	Section 6.7
Edge (Qualified)	Section 6.8
State	Section 6.9
Width-Pulse	Section 6.11
Width-Pulse (Qualified)	Section 6.12
Pulse State	Section 6.13

6

Triggers

Setting the Event Time Mode and Determination Time (When event type is Width)

14. If necessary, press **EVENT INTERVAL**.
15. Press the **Setup** soft key for either 1st Event or 2nd Event.
16. Press the **Mode** soft key.
17. Press the soft key corresponding to the mode to be set.
18. Set the event determination time corresponding to the time mode.
19. Press **ESC**.
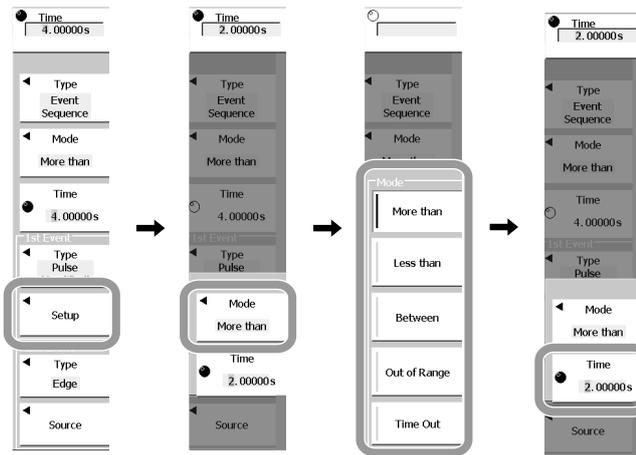
Explanation

Normally, the waveform before and after the event is displayed, but if you want to monitor the waveform for a prescribed interval after the event occurs, set the event delay. The trigger is activated when the time interval from the point when event 1 occurs until the point when event 2 first occurs satisfies the time condition that was set. If the time interval from the point when event 1 occurs until the point when event 2 first occurs does not satisfy the time condition that was set before event 1 occurs again, a new determination is made starting from the point when event 1 occurred again. The following example shows the case of "More Than."

More than

When event 2 occurs
during the determination time,
detection starts again from
the next occurrence of event 1.

Event Mode

More than	When the time interval from event 1 to event 2 is longer than the specified time, the trigger activates upon event 2.
Less than	When the time interval from event 1 to event 2 is shorter than the specified time, the trigger activates upon event 2.
Between	When the time interval from event 1 to event 2 is longer than the specified T1 time and shorter than the specified T2 time, the trigger activates upon event 2.
Out of Range	When the time interval from event 1 to event 2 is shorter than the specified T1 time or longer than the specified T2 time, the trigger activates upon event 2.
Time out	When the time interval from event 1 to event 2 exceeds the specified time, the trigger activates.

Event type

Handles each trigger as an event. For details on the triggers, refer to the section on each trigger.

Try Mode

Turn this mode ON to check whether the trigger was activated by either individual event before the trigger is activated by a combination of the 1st event and the 2nd event.

6

Triggers

6.16 Event Sequence

Procedure
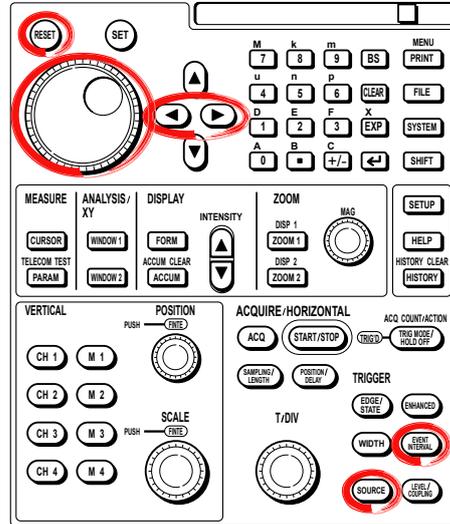
1. Press **EVENT INTERVAL**.
2. Press the **Type** soft key.
3. Press the **Event Sequence** soft key.
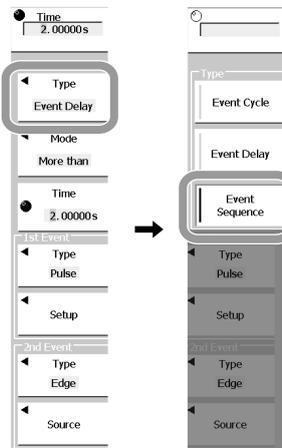
Setting the Event Time Mode and Try Mode

4. Press the **Mode** soft key.

5. Press the soft key corresponding to the channel to be set.

6. Press the **Try Mode** soft key to turn it ON or OFF.

    When event mode is ON, the trigger is activated by either 1st or 2nd, as selected by the following operation.

    Set to ON in order to confirm whether a trigger was activated by the 1st or 2nd event.

7. Press the **1st** or **2nd** soft key to select one or the other.

8. Press **ESC**.

Time Mode settings

Try Mode settings

Setting the Time

9. Press the **Time** soft key and set the rotary knob target to Time.

10. Turn the **rotary knob** to set the determination time.

    Pressing RESET resets the determination time to 0.0015 µs.

    You can use the arrow keys to move the digit that is currently being set.

    When the time mode is set to Between or Out of Range, make two time settings.

    Use the soft keys to switch which the rotary knob setting applies to.

Set to More than   Set to Between

6

Triggers

Setting the Event Type

11. Press the **Type** soft key for either 1st Event or 2nd Event.

12. Press the soft key corresponding to the type of event to be set.

When Width is selected, select the type for Width.
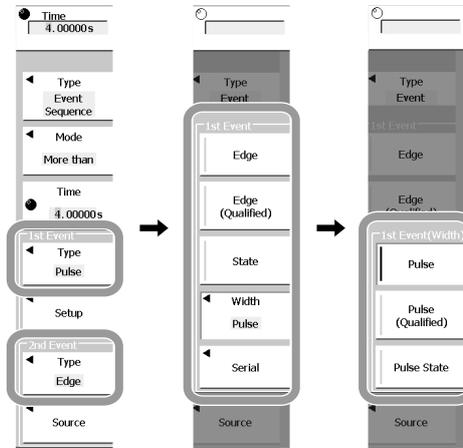
Setting the Event Source

13. If the event type is Edge, Edge (Qualified), or State, press the **Source** soft key.

If the event type is Width, press **SOURCE**.

Subsequent operation varies, depending on the event type setting. See the following sections:

Event type	See section:
Edge	Section 6.7
Edge (Qualified)	Section 6.8
State	Section 6.9
Width-Pulse	Section 6.11
Width-Pulse (Qualified)	Section 6.12
Pulse State	Section 6.13
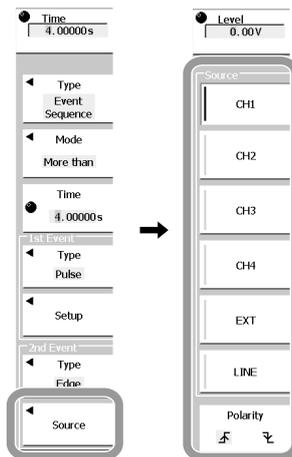
Setting the Event Time Mode and Determination Time (When event type is Width)

14. Press the **Setup** soft key for either 1st Event or 2nd Event.

15. Press the **Mode** soft key.

16. Press the soft key corresponding to the mode to be set.

17. Set the event determination time corresponding to the time mode.

18. Press **ESC**.
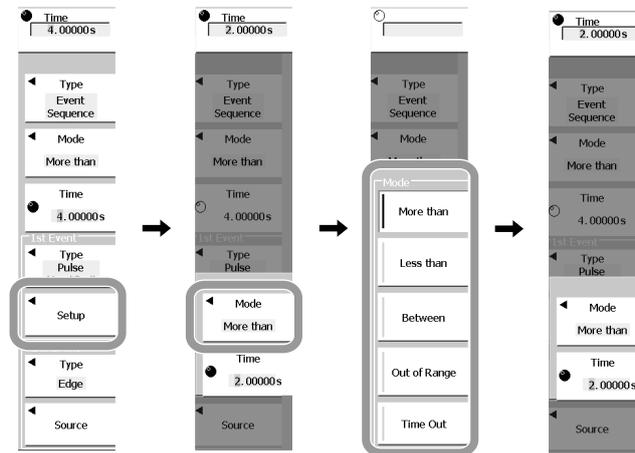
6

Triggers

Explanation

Normally, the waveform before and after the event is displayed, but if you want to monitor the waveform through a set sequence of events, set event sequence.
The trigger is activated when the time interval from the point when event 1 occurs until the point when event 2 first occurs satisfies the time condition that was set. When the time from when event 1 occurs until event 2 occurs for the first time does not satisfy the set time condition, event 2 is ignored and the trigger is activated at an event 2 that occurs when the set time condition is met. The following example shows the case of "More Than."

Event Mode

More than	When the time interval from event 1 to event 2 is longer than the specified time, the trigger activates upon event 2.
Less than	When the time interval from event 1 to event 2 is shorter than the specified time, the trigger activates upon event 2.
Between	When the time interval from event 1 to event 2 is longer than the specified T1 time and shorter than the specified T2 time, the trigger activates upon event 2.
Out of Range	When the time interval from event 1 to event 2 is shorter than the specified T1 time or longer than the specified T2 time, the trigger activates upon event 2.
Time out	When the time interval from event 1 to event 2 is longer than the specified time, the trigger activates after the specified time from event 1.

Event type
Handles each trigger as an event. For details on the triggers, refer to the section on each trigger.

Try Mode
Turn this mode ON to check whether the trigger was activated by either individual event before the trigger is activated by a combination of the 1st event and the 2nd event.

6.17 Setting the TV Trigger (ENHANCED)

Procedure
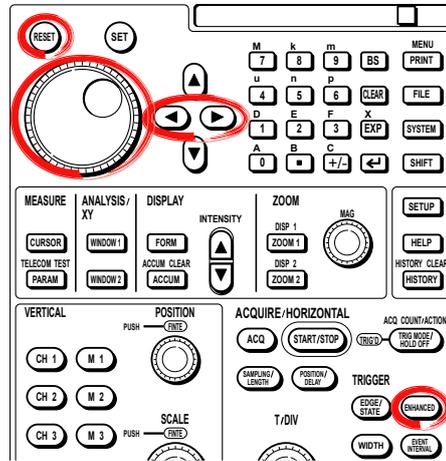
Selecting the TV Trigger
1. Press **ENHANCED**. The ENHANCED menu appears.
2. Press the **Type** soft key. The Type menu appears.
3. Press the **TV** soft key.
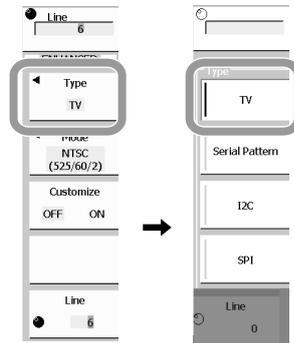
Selecting the Broadcasting Type of the Video Signal
4. Press the **Mode** soft key. The TV Type menu appears.
5. Press the soft key corresponding to the broadcast type of the desired video signal.
   If you selected User, skip to step 9.

Setting Customize (When other than User is selected in step 5)

6. Press the **Customize** soft key to select ON or OFF.

   If OFF is selected, proceed to step 12.

```
Line
      6

ENHANCED
◄    Type
       TV

◄    Mode
      NTSC
    (525/60/2)

   Customize
  OFF     ON



     Line
●      6

     Field
  1    2    X
```
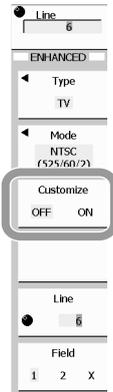
Setting the Sync Guard Frequency (When other than User is selected in step 5)

7. Press the **Sync Guard** soft key and set the rotary knob target to Sync Guard.

8. Turn the **rotary knob** to set the count.

   If RESET is pressed, sync guard is set to 75%/HSync, depending on the TV Type (broadcast system).

   You can use the arrow keys to move the digit that is currently being set.

```
Sync Guard
 75%/HSync

ENHANCED
◄    Type
       TV

◄    Mode
      NTSC
    (525/60/2)

   Customize
  OFF     ON

   Sync Guard
●  75%/HSync

     Line
○      6

     Field
  1    2    X
```
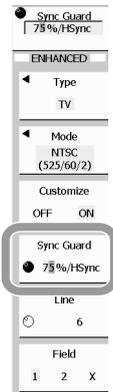
Setting the Resolution (When User is selected in step 5)

9. Press the **SD/HD** soft key, to select SD (standard definition) or HD (high definition).

```
HSync
 31.5kHz

ENHANCED
◄    Type
       TV

◄    Mode
      User

    SD/HD
  SD     HD

     HSync
●  31.5kHz

     Line
○      2

     Field
  1    2    X

   Frame Skip
  1   2   4   8
```
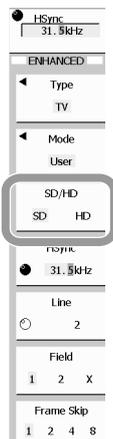
Setting the Horizontal Sync Frequency (When User is Selected in Step 5)

10. Press the **HSync** soft key, to assign the rotary knob to HSync.

11. Turn the **rotary knob**, to set the frequency.

    Pressing RESET sets the horizontal sync frequency to 31.5 kHz.

    You can change the digit being set, with the arrow keys.
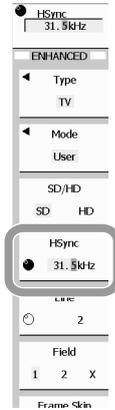
Selecting the Line Number

12. Press the **Line** soft key, and set the rotary knob target to Line.

13. Turn the **rotary knob** to select the line number.

    Pressing RESET sets the minimum line setting to 5, or 2 depending on the TV Type setting.
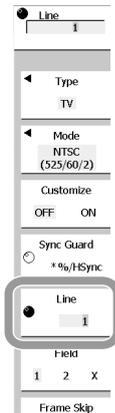
Selecting the Field Number

14. Press the **Field** soft key to select 1, 2, or X.
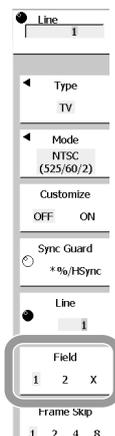
Selecting Frame Skip

15. Press the **Frame Skip** soft key to select either 1, 2, 4, or 8 for the frame skip value.
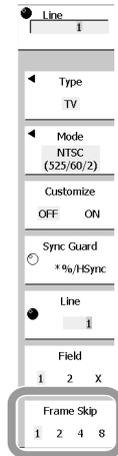
Setting the Channel

16. Press **SOURCE**. The SOURCE menu appears.
17. Press the soft key corresponding to the channel to be set.
18. Press the **Polarity** soft key to set the polarity to either Pos (positive) or Neg (negative).
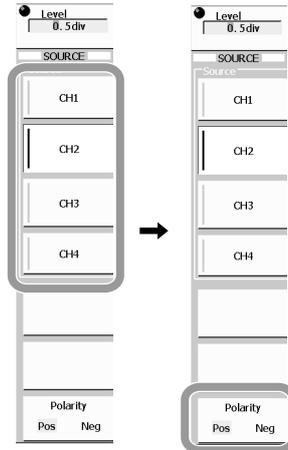
Setting the Level, Trigger Coupling, and HF Rejection

19. Press **LEVEL/COUPLING**. The Level/Coupling menu appears.
20. Set the Level, Trigger Coupling, and HF Rejection.

    For the setting procedure, see section 6.3.
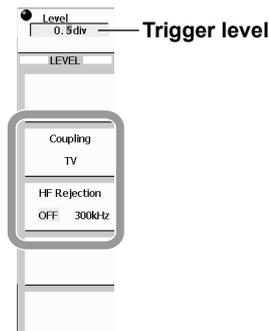
Explanation

Broadcast Types That TV Trigger Supports

You can select the broadcast type.

NTSC, PAL, HDTV(1125/60/12), USER

Field Number

You can select the field number to be detected.

1	Detect a field in which the start of the vertical sync pulse and the start of the line is at the same time.
2	Detect a field in which the start of the vertical sync pulse is delayed by 1/2 H (H is the horizontal scan interval) of the start of the line.
X	Detect both.

Line Number

A trigger is activated at the start of the line of the selected number.

For NTSC 5 to 1054

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).
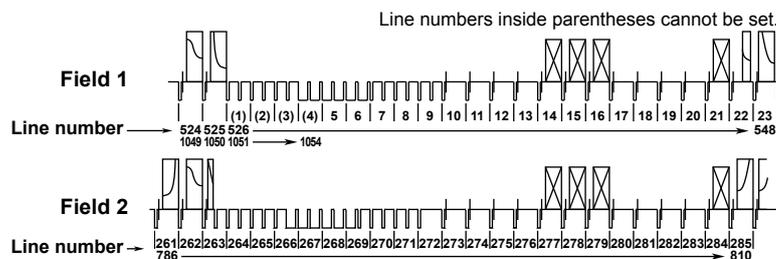
PAL or SECAM: 2 to 1251

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).
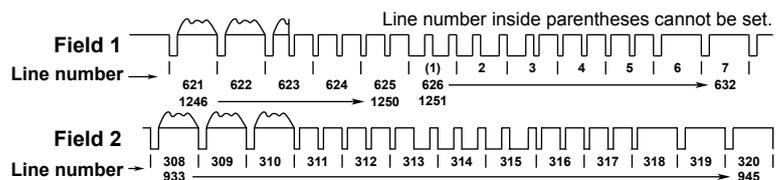
Frame Skip

This function is used to skip frames such as when the color burst is inverted every frame. You can select the number of frames at which this operation is repeated.

1	Activates a trigger at the specified field every time.
2	Skips 1 frames and activates a trigger at the specified field of the succeeding frame. This operation is repeated every 2 frames.
4	Skips 3 frames and activates a trigger at the specified field of the succeeding frame. This operation is repeated every 4 frames.
8	Skips 7 frames and activates a trigger at the specified field of the succeeding frame. This operation is repeated every 8 frames.

Note

Hold-off, trigger coupling, and HF rejection settings are ignored.

6.18 Setting the Trigger Conditions of the Serial Pattern Signal (ENHANCED)

This function can be used on products with firmware version 1.60 or higher.

Setting the Trigger Conditions of the Serial Pattern Signal

1. Press **ENHANCED** to display the ENHANCED menu.
2. Press the **Type** soft key to display the Type menu.
3. Press the **Serial** soft key.
4. Press the **Clock** soft key to select ON or OFF.
    *   ON: Proceed to step 6. You must set the CS signal, clock source, and latch source (see pages 6-70 and 6-71).
    *   OFF: Proceed to step 5.
5. Turn the **rotary knob** to set the bit rate.
6. Press the **Set Pattern** soft key to display the data setup dialog box.

7.   Set the trigger pattern according to the procedural explanation in the figure below.

Pattern data area (Up to 128 bits of data can be entered. Data exceeding 128 bits is discarded.)

The cursor position is the entry position.

When entering in hexadecimal notation

When entering in binary notation

The soft keys can also be used to select Bin or Hex, move the cursor, and delete or insert data.

Name of the signal being configured

Turn the rotary knob or arrow keys to select an operation or an entry value, and press SET. The selected operation is executed, or the value is entered in the pattern area.

←	Moves the cursor to the left.
→	Moves the cursor to the right.
↑	Moves the cursor up.
↓	Moves the cursor down.
BS	Backspace
DEL	Delete
Clr	Clears the entire entered data. Cleared data cannot be recovered.
INS	Switches between insert and overwrite mode.
0 to F	A hexadecimal value. Displayed when the Hex box is selected.
0 to 1	A binary value. Displayed when the Bin box is selected.
X	Enter X when not using the value as a condition.

The entire data is cleared. Enter new data.

For Hex entry

For Bin entry   **Insert position**

Note

If any of the binary box in each set of four bits is set to "X," the hexadecimal box displays "$."

8.   Press **SOURCE** on the front panel to display the SOURCE menu.

• **Setting the Data Source**

9.   Press the **Source** soft key to display the Data Source menu.

10.   Press any of the **CH1** to **CH4** soft keys to select the data source.

11.   Press the **Active** soft key to select H or L.

When Clock is set to OFF in step 4

When Clock is set to ON in step 4

or

or

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Triggers

Carry out steps 12 to 22 below if you set the Clock to ON in step 4 on page 6-68.

- **Setting the CS Signal**
  12. Press the **CS** soft key to display the CS menu.
  13. Press the **CS** soft key to select ON or OFF.
      - ON: Proceed to step 14.
      - OFF: Proceed to step 16.
  14 Press each channel soft key to select H, L, or X.
  15. Press the **Logic** soft key to select AND or OR.
      - AND: Determines that the CS is detected when the conditions of all channels are met.
      - OR: Determines that the CS is detected when any of channel conditions is met.
  16. Press **ESC** to return to the previous screen.
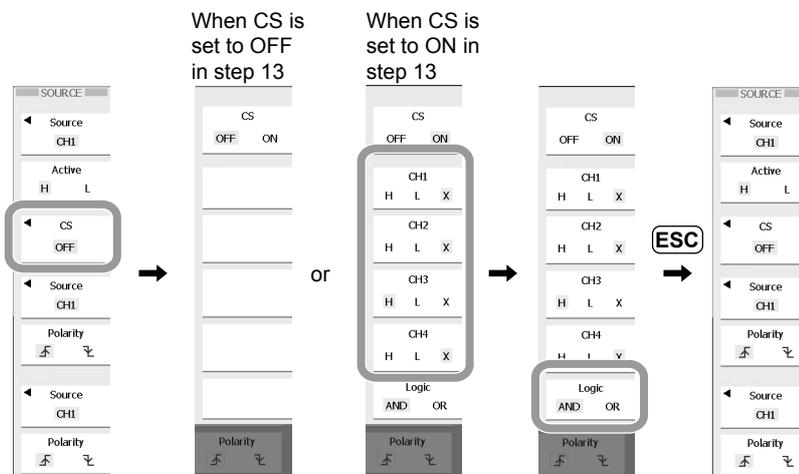
- **Setting the Clock Source**
  17. Press the **Source** soft key to display the Clock Source menu.
  18. Press any of the **CH1** to **CH4** soft keys to select the clock source.
  19. Press the **Polarity** soft key to select ⌐ or ⌐.
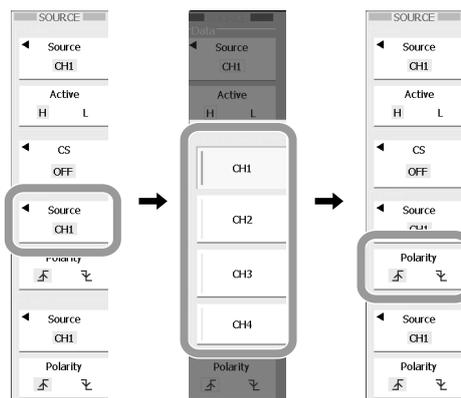
- **Setting the Latch Source**
    20.   Press the **Source** soft key to display the Latch Source menu.
    21.   Press any of the **CH1** to **CH4** and **X** soft keys to select the latch source.
    22.   Press the **Polarity** soft key to select ⌐ or ⌐.

6

Triggers
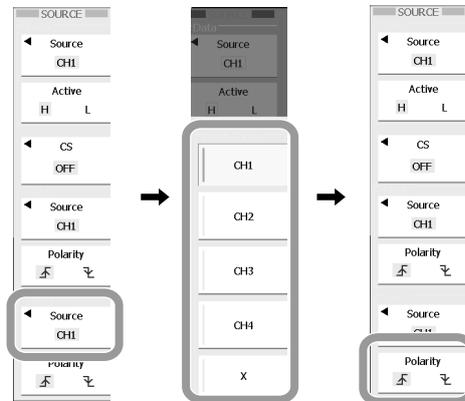
Setting the Level, Coupling, HF Rejection, and Hysteresis
    23.   Press **LEVEL/COUPLING** on the front panel to display the LEVEL/COUPLING menu.

- **Setting the Level**
    24.   Turn the **rotary knob** to set the level used to determine high/low. The level is common to all channels.

- **Selecting the Channel to Be Configured**
    25.   Press the **CH** soft key to display a channel selection menu.
    26.   Press any of the soft keys, **CH1** to **CH4**.

- **Setting the Coupling**
    The input coupling is fixed to DC.

- **Setting the HF Rejection**
    27.   Press the **HF Rejection** soft key to display a HF rejection selection menu.
    28.   Press any of the soft keys, OFF, 20MHz, or 15kHz.

- **Setting the Hysteresis**
    29.   Press the **Hysteresis** soft key to select the hysteresis.

Explanation

This is a trigger function for capturing serial pattern signals. This function can be used on products with firmware version 1.60 or higher.

Setting the Clock Source
This function detects the serial data pattern in sync with the selected clock signal.   You can select whether to synchronize to the rising or falling edge of the clock.
- ON: Select the clock source from CH1 to CH4.
- OFF: Set the bit rate in the range of 1 k to 50 Mbps instead of selecting the clock source from the channels.

Setting the Serial Data Pattern
You can specify a serial data pattern as a condition for activating a trigger. Up to 128 bits can be specified. When Pattern Format is set to Hex (hexadecimal), you can enter X, 0 to 9, or A to F in units of 4 bits. When Pattern Format is set to Bin (binary), you can enter X, 0, or 1 for each bit. Enter X when not using the value as a condition.

Setting the Data Source
Select the data source for detecting the serial data pattern from CH1 to CH4. You can also select high active or low active.

Setting the CS Signal
You can control the period over which the data source is detected with the CS signal when the clock source is turned ON.
- ON: Select the CS signal from CH1 to CH4. You can also select the signal level state (H, L, or X) when the data source is to be detected. Select X when not using the value as a condition. You can also specify AND or OR logic to the conditions of multiple channels.
- OFF: Detects the data source at all times.

Setting the Latch Source
You can select the timing when the acquired serial data pattern is compared against the pattern specified as a trigger condition when the clock source is turned ON. Select the latch source from CH1 to CH4 and X. If X is selected, comparison is made every clock. You can select whether to synchronize to the rising or falling edge for making the comparison.

Setting the Trigger Level, Trigger Coupling, Etc.
Set the trigger level, hysteresis, trigger coupling, and HF rejection of each channel.
For details on the trigger level, hysteresis, trigger coupling, and HF rejection, see section 6.3.

Example of the Trigger Condition Setting of a Serial Pattern Signal

Clock

Data 1 2 3 4 5 6 7 8 9 10

The CS signal indicates the period over which the data is detected.

CS

Point where the trigger is activated

Latch

The latch signal specifies the timing for making the comparison.
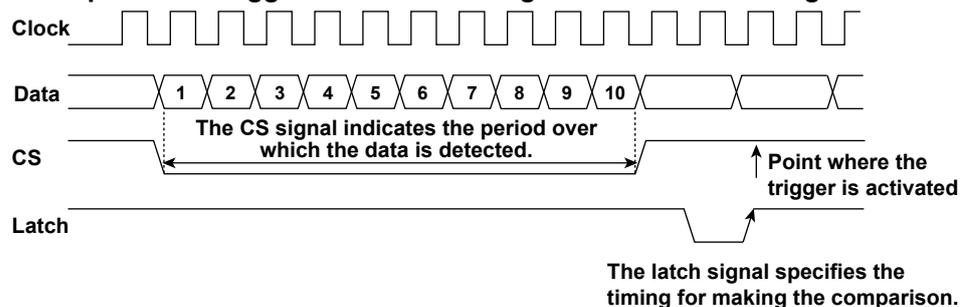
6.19 Setting the Trigger Conditions of the I²C Bus Signal (ENHANCED)

This function can be used on products with firmware version 1.60 or higher.

Setting the Trigger Conditions of the I²C Bus Signal

1. Press **ENHANCED** to display the ENHANCED menu.
2. Press the **Type** soft key to display the Type menu.
3. Press the **I²C** soft key.

4. Press the **Mode** soft key to display the Mode menu.

Proceed to the steps indicated below depending on the specified mode.
- Every Start (when a start condition is detected): The setting procedure is complete.
- ADR & Data (trigger on an address pattern or data pattern): Step 5 on the below
- NON ACK (trigger when a Nack is detected): Step 21 on page 6-77
- General Call (trigger on the general call address): Step 23 on page 6-77
- Start Byte/HS Mode (trigger on the start byte or HS mode start condition): Step 27 on page 6-78

When Activating a Trigger on the Start Condition or Address Pattern/Data Pattern

5. Press the **ADR & Data** soft key.

• **Setting the Address Type**

6. Press the **Adr Type** soft key to display the address type selection menu.

7. Press the soft key corresponding to the desired address type.

8. Press the **Set Adr** soft key to display an address pattern setting screen. The screen varies depending on the specified address type.

9. Turn the **rotary knob**, **arrow** keys, and **SET** key to set the pattern.
   You can use the soft keys to change the format to binary or hexadecimal or delete all the setting value (X).

10. Press **ESC** to return to the previous screen.

7bit Address in binary

7bit Address in hexadecimal

7bit + Sub Adr

10bit Address

6

Triggers

- **Setting the Data Pattern**
    11. Press the **Condition** soft key to display a data pattern setting menu.
    12. Press the **Data** soft key to select ON (use a data pattern) or OFF (not use a data pattern). If you select ON, continue with the steps below. If you select OFF, you are done.
    13. Press the **Condition** soft key to select True (activate a trigger when the data matches the specified data pattern) or False (activate a trigger when the data does not match the specified data pattern).
    14. Press the **Pos Mode** soft key to select X (ignore) or Select.
    15. If you select Select, use the rotary knob to specify the position in the pattern to be compared.
    16. Press any of the soft keys, **1 byte**, **2 byte**, **3 byte**, or **4 byte** to set the data size.
    17. Turn the **rotary knob** to set the data position.
    18. Press **ESC** to return to the previous screen.
    19. Press the **Set Data** soft key to display a data pattern setting screen.
    20. Turn the **rotary knob**, **arrow** keys, and **SET** key to set the pattern.
        You can use the soft keys to change the format to binary or hexadecimal or delete all the stting value (X).

When Activating a Trigger When a Nack Is Detected

21. After step 4 of page 6-74, press the **NON ACK** soft key.

22. Set whether to discard the Nack of Start byte, HS Mode, and Read Access or include them in the trigger conditions.
    Press each of the **Start byte**, **HS Mode**, and **Read Access** soft keys and select OFF (include in the trigger conditions) or ON (not include in the trigger conditions).
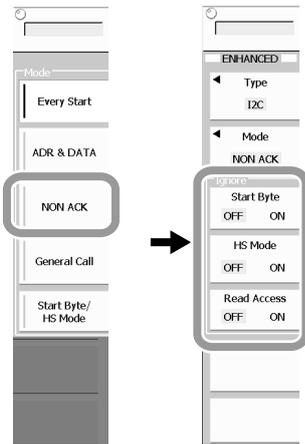
Activating Triggers on an General Call Data Pattern

23. After step 4 of page 6-74, press the **General Call** soft key.

24. Press the **Second Byte** soft key to display a menu used to select the format of the Second Byte.

25. Press a soft key corresponding to the desired Second Byte format.
    If you select X, 0000 0100, or 0000 0110, you are done.

26. If you select 7bit Master Adr, set the data pattern in the same fashion as "Setting the Data Pattern" on the previous page.
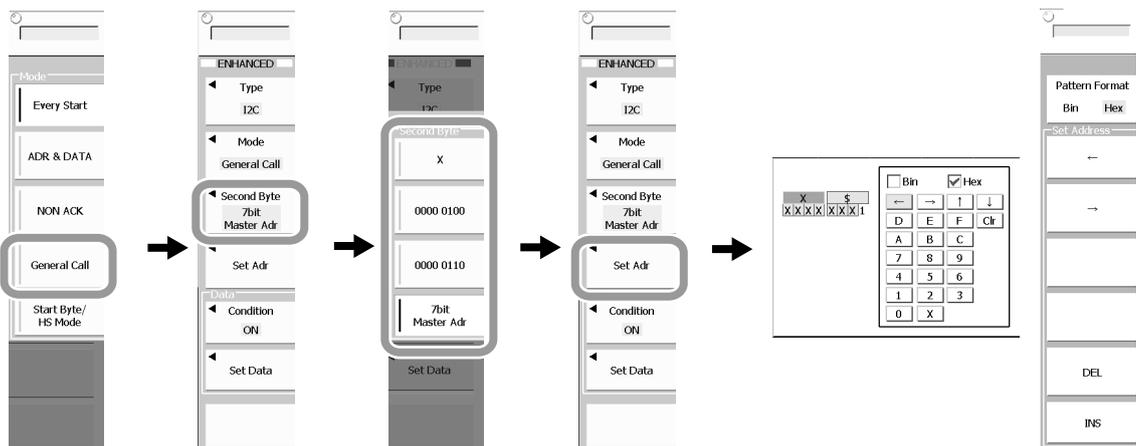
Activating a Trigger on the Start Byte or HS Mode Start Condition

27. After step 4 of page 6-74, press the **Start Byte/HS Mode** soft key.

28. Press the **Start byte** or **HS Mode** soft key to select whether to activate a trigger on the start byte or high speed mode start condition.
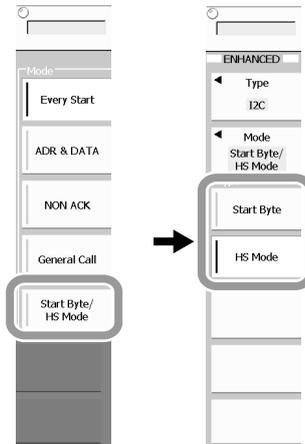
Setting the Source Channel

29. Press **SOURCE** on the front panel to display the SOURCE menu.
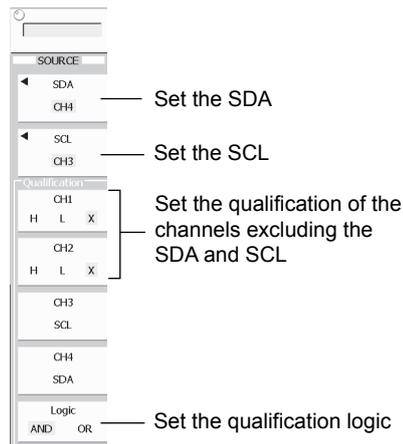
Set the SDA

30. Press the **SDA** soft key to display a menu used to select a channel to be the SDA.

31. Press any of the soft keys **CH1** to **CH4** to assign the channel to the SDA.

Set the SCL

32. Press the **SCL** soft key to display a menu used to select a channel to be the SCL.

33. Press any of the soft keys **CH1** to **CH4** to assign the channel to the SCL.

Set the qualification of the channels excluding the SDA and SCL

34. Press a channel soft key other than the SDA and SCL channels to select H (high), L (low), or X (ignore). If you select H or L, a trigger is activated on the logical sum or product of the I²C trigger and Qualification.

Setting the Qualification Logic

35. Press the **Logic** soft key to select AND (logical product) or OR (logical sum).

Setting the Level, Coupling, HF Rejection, and Hysteresis

36. Press **LEVEL/COUPLING** on the front panel to display the LEVEL/COUPLING menu.

Setting the Level

37. Turn the **rotary knob** to set the level used to determine high/low. The level is common to all channels.

Selecting the Channel to Be Configured

38. Press the **CH** soft key to display a channel selection menu.
39. Press any of the soft keys, **CH1** to **CH4**.

Setting the Coupling

The input coupling is fixed to DC.

Setting the HF Rejection

40. Press the **HF Rejection** soft key to display a HF rejection selection menu.
41. Press any of the soft keys, OFF, 20MHz, or 15kHz.

Setting the Hysteresis

42. Press the **Hysteresis** soft key to select the hysteresis.

Explanation

This is a trigger function for capturing I^{2}C bus signals. This function can be used on products with firmware version 1.60 or higher.
I^{2}C Bus is an abbreviation for Inter Integrated Circuit Bus. It is a bidirectional bus for connecting ICs. Note that the /F5 option is required to analyze I^{2}C bus signals.

I^{2}C Bus Signal Trigger Mode

Select the trigger mode from the following list.

Every Start
Activate a trigger on the start condition

ADR&Data
Activate a trigger on the address pattern or data pattern (address & data trigger)

Non-ACK
Activate a trigger when an Acknowledge bit is not present (Non-Ack trigger)

General Call
Activate a trigger on the general call address pattern

Start Byte/HS Mode
Activate a trigger on the start byte or high speed mode start condition

ADR&Data Trigger

When the data matches the specified address pattern or data pattern, a trigger is activated on the 9th falling edge of the SCL (clock) signal.
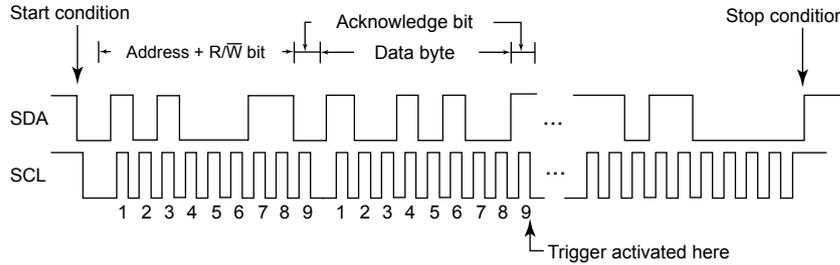
Address Type

Set the address type to 7-bit address, 7-bit + sub address, or 10-bit address.

Address

Set the pattern according to the address type. The data matching the specified pattern is one of the trigger conditions.

Data Condition

To activate a trigger on a data pattern, set Data to ON in data conditions, and set the Condition, Pos Mode, and data size items.

Select the pattern condition from below.

True	A trigger is activated when the data matches the data pattern.
False	A trigger is activated when the data does not match the data pattern.

Set the position in the pattern to be compared with Pos Mode in terms of the number of data bytes.

Example

This section will display the data sequence in bytes (hexadecimal notation) and indicate the position where the trigger will occur. The symbols used in the figures are as follows:

S: Start condition, P: Stop condition, and shading: Byte pattern to be compared

- **Activating a Trigger Only on the Address Pattern**
  Trigger Conditions

Mode	ADR & Data
Address	Adr Type: 7bit address, Set Adr: 4A
Data:	OFF
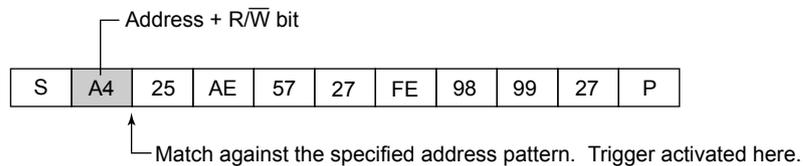
• **Activating a Trigger Only on the Data Pattern**
  Trigger Conditions

Mode	ADR & Data
Address	Set Adr : Not applicable
Data	Data: On, Condition: True, Data Size: 2 bytes: Set Data: 27 and AE

<Data Position: X>

<Data Position: 3>
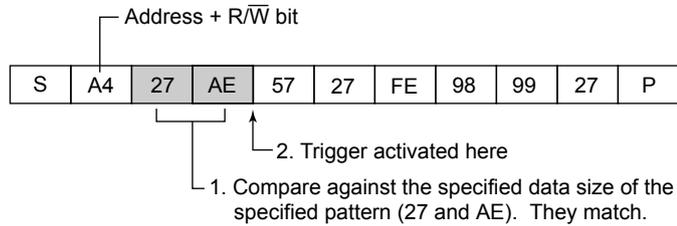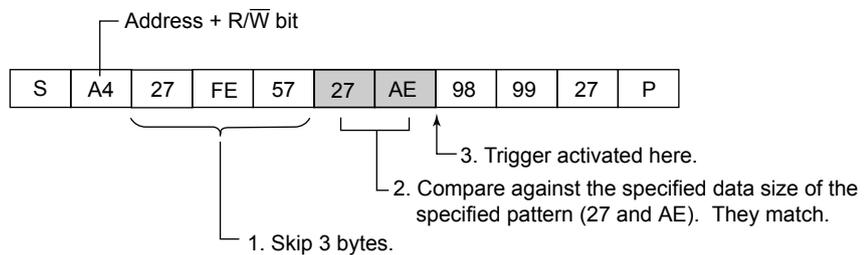
Non-ACK Trigger

Activating a Trigger When the Acknowledge Bit Is H

A trigger is activated when the Acknowledge bit is Nack (when the SDA signal is set to "H").
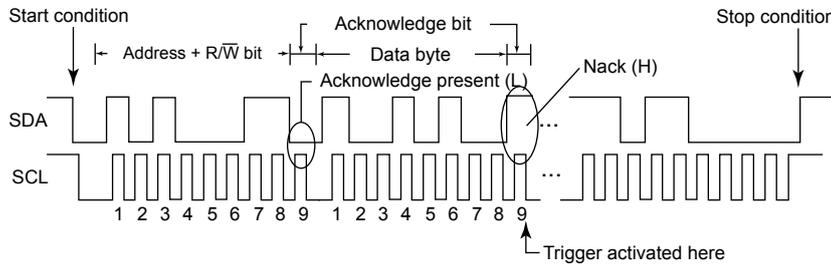
Note

You can select any of the Acknowledge bits, the status byte, HS mode master code, or read access byte, to be used for triggering.

General Call Trigger

A trigger is activated on a general call address (address: 0000 0000).

The second byte pattern after the general call address can also be used for triggering.
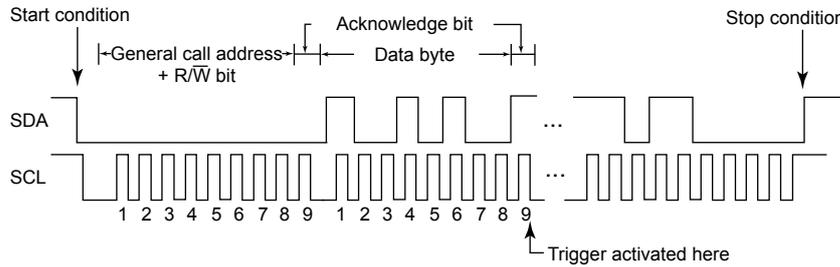
Example

This section will display the data sequence in bytes (hexadecimal notation) and indicate the position where the trigger will occur. The symbols used in the figures are as follows:

S: Start condition, P: Stop condition, and shading: Byte pattern to be compared

- **Activating a Trigger Only on the General Call Address**
  Trigger Conditions

Mode	General Call
Second Byte	Not applicable
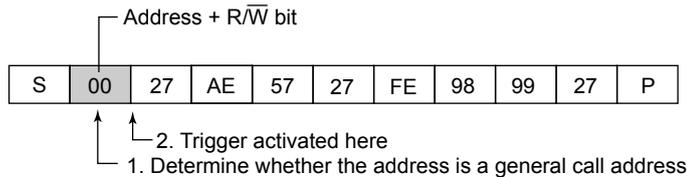
- **Activating a Trigger on the Second Byte Pattern Set to 06**
  Trigger Conditions

Mode	General Call
Second Byte	0000 0110
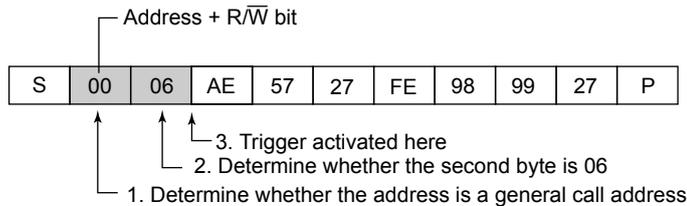
- **Activating a Trigger on an Arbitrary Pattern on the Second and Subsequent Bytes**
  Trigger Conditions

Mode	General Call
Second Byte	7bit Master Adr (0011 1010)
Data	Data: On, Condition: True, Data Size: 2 bytes, Set Data: 27 and AE

\<Data Position:X\>

<Data Position:3>

Address + R/W̄ bit

S	00	BA	27	AE	57	27	AE	98	99	P

5. Trigger activated here.

4. Compare against the specified pattern (27 and AE). They match.

3. Skip 3 bytes.

2. Compare 7-bit Master Adr to the pattern (BA). They match.

1. Determine whether the address is a general call address.
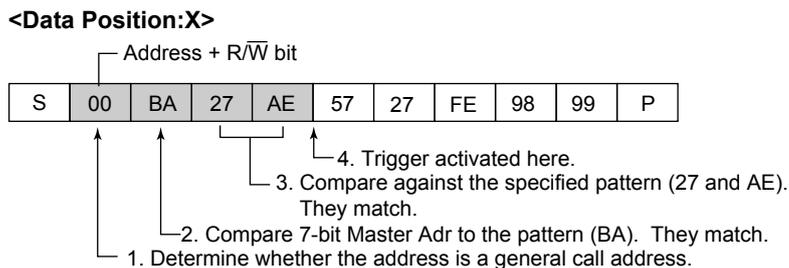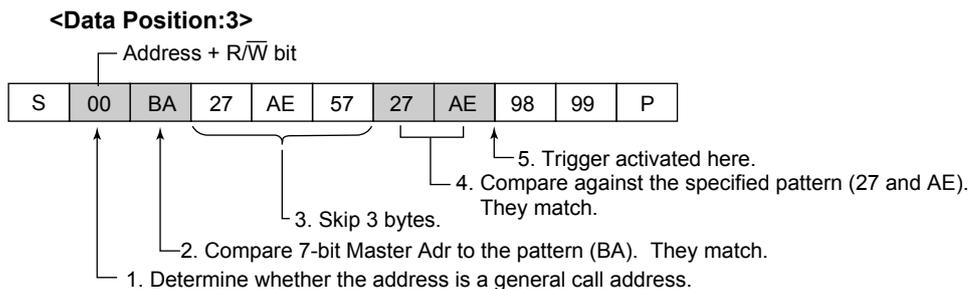
Start Byte/HS Mode Trigger

A trigger is activated on the start byte or HS mode master code.

Start Byte (Address: 0000 0000)

When a start byte is detected, a trigger is activated on the first rising edge of the SCL signal.

Trigger activated here
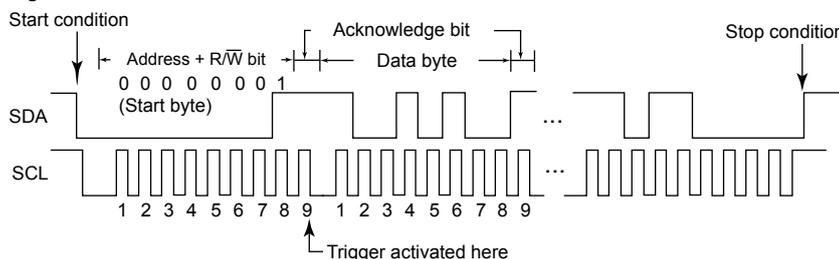
HS Mode

A trigger is activated when the master code (Address: 0000 1xxx) of HS mode (high speed mode) is detected.

Trigger activated here
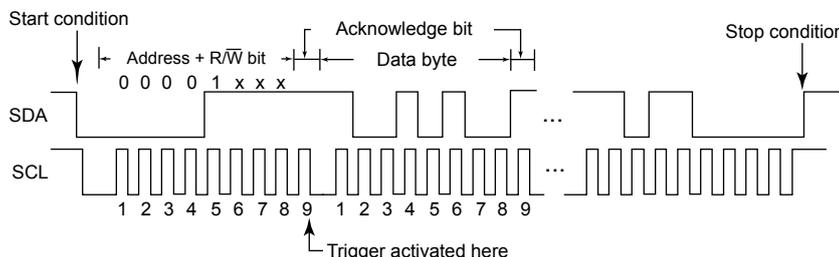
Example

- **Activating a Trigger Only on the Start Byte**
  Trigger Conditions

Mode	Start Byte/HS Mode
Type	Start byte

S	01	Sr	AE	57	27	FE	98	99	27	P

Sr: Restart

Trigger activated here

6
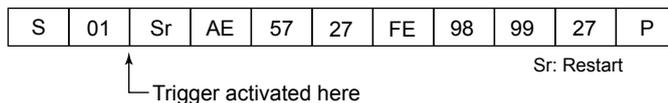
Triggers

Combining with the Qualifications of Channels Excluding the SDA and SCL

A trigger can be activated on the combination of the I²C bus signal trigger condition and the qualifications of the channels other than the SDA and SCL.

To activate a trigger only on the SCL and SDA signals (trigger condition of the I²C bus), set the status of the other channels to ignore (X).

CH3 = L, CH4 = H, and Logic = AND
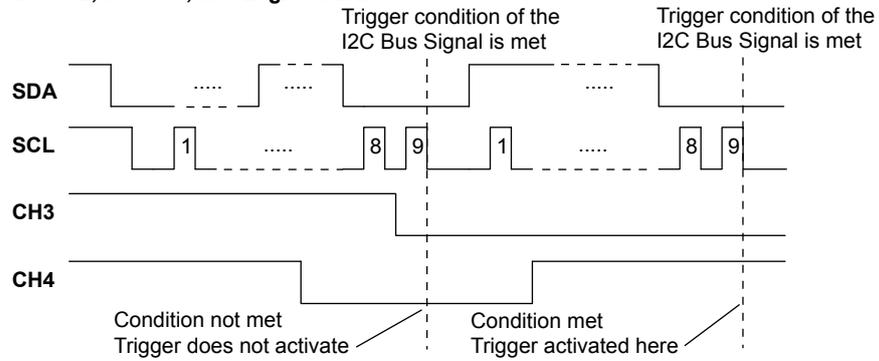
Setting the Trigger Level, Trigger Coupling, Etc. (Level/Coupling)

Set the trigger level, hysteresis, trigger coupling, and HF rejection of each channel.

For details on the trigger level, hysteresis, trigger coupling, and HF rejection, see section 6.3.

6.20 Setting the Trigger Conditions of the SPI Bus Signal (ENHANCED)

This function can be used on products with firmware version 1.60 or higher.

Procedure

Setting the Trigger Conditions of the SPI Bus Signal

1. Press **ENHANCED** to display the ENHANCED menu.
2. Press the **Type** soft key to display the Type menu.
3. Press the **SPI** soft key.

Selecting Three-Wire or Four-Wire and Selecting the Bit Order

4. Press the **Mode** soft key to select 3 wire or 4 wire.
5. Press the **Bit Order** soft key to set the read direction of the I/O data bits to MSB (MSB first) or LSB (LSB first).
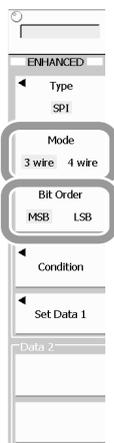
Setting the Data Conditions

*   **Setting the Conditions**

6. Press the **Condition** soft key to display a menu used to set the condition and data size.
7. Press the **Condition** soft key to select True (match the specified bit pattern) or False (not match the specified bit pattern).
8. Press a soft key corresponding to the data size of the bit pattern (a trigger condition).
9. To activate a trigger the specified number of bytes after the assertion of the CS, use the **rotary knob** to set the trigger position (data position).
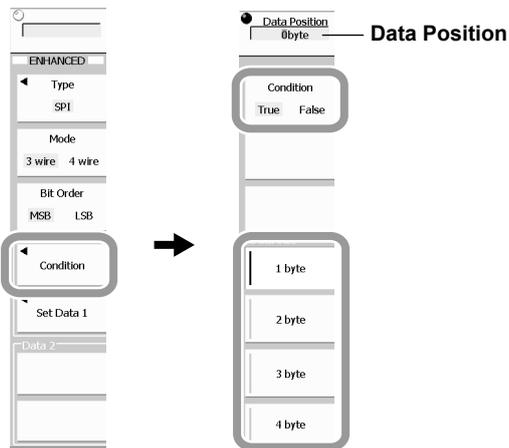
10. For four-wire, set the condition and data size for Data 2 in the same manner.
11. Press **ESC** to return to the previous screen.

- **Setting the Bit Pattern**
  12. Press the **Set Data 1** soft key to display the bit pattern setting screen.
  13. Turn the **rotary knob**, **arrow** keys, and **SET** key to set the pattern.
      You can use the soft keys to change the format to binary or hexadecimal or clear all the bits (X).
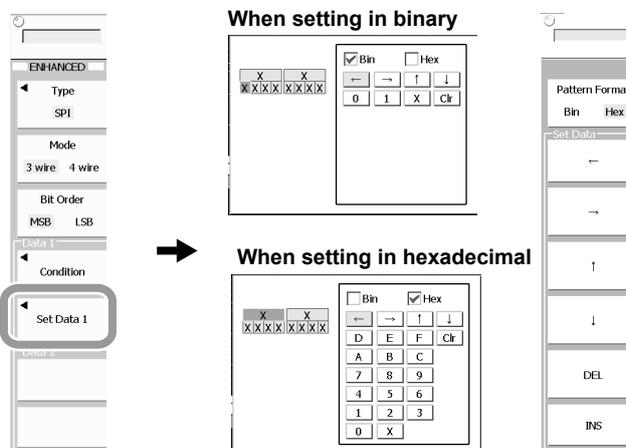
  14. Press **ESC** to return to the previous screen.
  15. For four-wire, set the bit pattern for Data 2 in the same manner.

Setting the Source Channel

  16. Press **SOURCE** to display the SOURCE menu.

- **Setting the CS**
  17. Press the **Source** soft key under CS to display the CS source channel selection menu.
  18. Press any of the soft keys **CH1** to **CH4** to assign the channel to the CS.
  19. Press the **Active** soft key to select H (high) or L (low).

- **Setting the Clock**
  20. Press the **Source** soft key under Clock to display the clock source channel selection menu.
  21. Press any of the soft keys **CH1** to **CH4** to assign the channel to the clock channel.
  22. Press the **Polarity** soft key to select rising or falling.
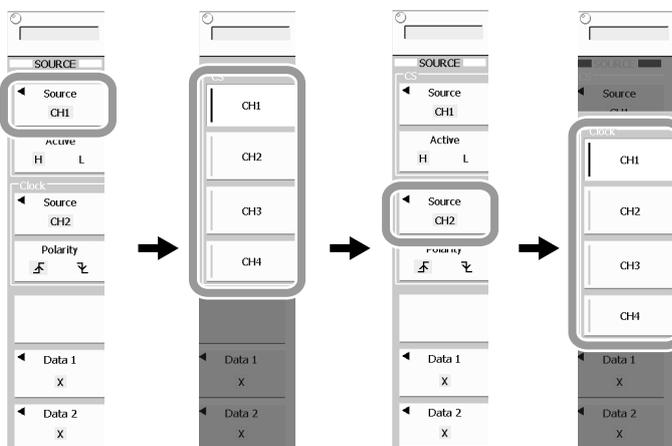
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Triggers

- **Select the Channel for Comparing the Bit Pattern**
  23. Press the **Data 1** soft key to display a menu used to select the channel to compare to the bit pattern of Data 1.
  24. Press any of the soft keys, **CH1** to **CH4**.
  25. For four-wire, select the channel for comparing the bit pattern for Data 2 in the same manner.
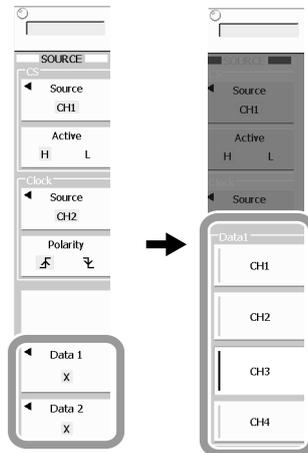
Setting the Level, Coupling, HF Rejection, and Hysteresis

26. Press **LEVEL/COUPLING** to display the LEVEL/COUPLING menu.

Setting the Level

27. Turn the **rotary knob** to set the level used to determine high/low. The level is common to all channels.

Selecting the Channel to Be Configured

28. Press the **CH** soft key to display a channel selection menu.
29. Press any of the soft keys, **CH1** to **CH4**.

Setting the Coupling

The input coupling is fixed to DC.

Setting the HF Rejection

30. Press the **HF Rejection** soft key to display a HF rejection selection menu.
31. Press any of the soft keys, OFF, 20MHz, or 15kHz.

Setting the Hysteresis

32. Press the **Hysteresis** soft key to select the hysteresis.

Explanation

This is a trigger function for capturing SPI bus signals. This function can be used on products with firmware version 1.60 or higher.
The SPI (Serial Peripheral Interface) Bus is a synchronized serial bus that is widely used for inter-IC communications and data communications. Note that the /F5 option is required to analyze SPI bus signals.

Setting Three-Wire or Four-Wire
For three-wire, triggers are activated on the Data 1 bit pattern.
For four-wire, triggers are activated on the Data 1 and Data 2 bit patterns. The Data 1 and Data 2 data patterns can also be used as independent trigger conditions.

Bit Order
You can select the bit order of Pattern A and Pattern B according to the signal flow of the input/output data. When setting the pattern in binary, set the data in the order of the flow regardless of the bit order setting. When setting the pattern in hexadecimal, enter the pattern according to the bit order setting, separated every four bits in the order of the flow.

MSB	Select this when the I/O data signal is flowing MSB first.
LSB	Select this when the I/O data signal is flowing LSB first.

Setting the Bit Pattern
*   **Condition**
    Select either of the following:

True	A trigger is activated when the data matches the specified bit pattern.
False	A trigger is activated when the data does not match the specified bit pattern.

*   **Data Size**
    Select the number of bytes (data length) of bit pattern to be specified in the range of 1 to 4 bytes.

*   **Data Position**
    Compares the pattern the specified number of bytes after the assertion of the chip select (CS). The data position can be set separately for Data 1 and Data 2. The selectable range is 0 to 9999.

*   **Pattern Format**
    Set the bit pattern format to either of the following:

Hex	Hexadecimal
Bin	Binary

*   **Bit Pattern**
    Set the bit pattern. When Pattern Format is set to Hex (hexadecimal), you can enter X, 0 to 9, or A to F in units of 4 bits. When Pattern Format is set to Bin (binary), you can enter X, 0, or 1 for each bit.

Setting the Chip Select
Select the CS from CH1 to CH4. Select whether to make the signal active when it is high or low with the Active item.

Clock Signal
Select the input signal to be the clock signal from CH1 to CH4.
The bit pattern is compared on the rising or falling edge of the signal.

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Triggers

Setting the Channel for Comparing the Bit Pattern
Select the signal for comparing the bit pattern from CH1 to CH4.

Setting the Trigger Level, Trigger Coupling, Etc.
Set the trigger level, hysteresis, trigger coupling, and HF rejection of each channel.
For details on the trigger level, hysteresis, trigger coupling, and HF rejection, see section 6.3.

Examples of SPI Bus Signal Trigger Conditions
The trigger point is set to the position indicated below depending on the clock edge polarity setting (see page 6-85).
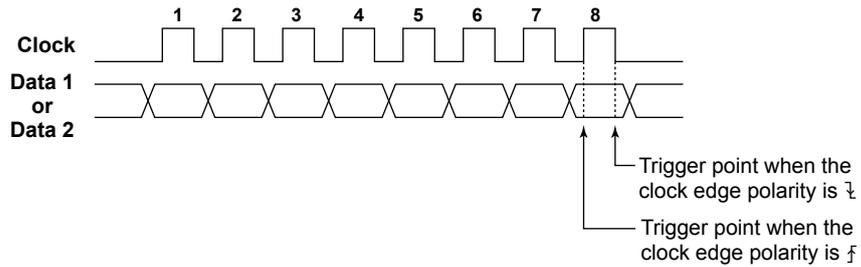
This section will display the data sequence in bytes in hexadecimal notation and indicate the position where the trigger will occur.
The shaded section is the figure indicates the byte pattern (sequence) that is compared.
We assume that CH1 is selected for comparing the bit pattern of Data 1 and CH2 is selected for comparing that of Data 2.

Trigger Conditions

CS	L
Data 1	A4 and 25, Data Byte: 2, Condition: True, and Byte Position: 0
Data 2	85 and C8, Data Byte: 2, Condition: True, and Byte Position: 6
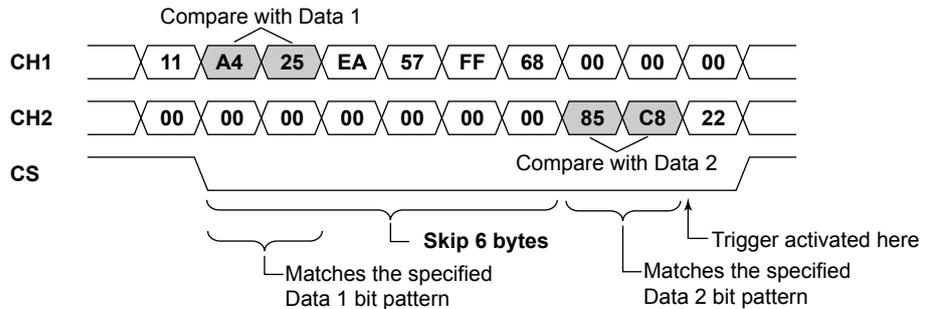
6.21 Trigger Settings of the Serial Bus Signal That Are Common to the Settings of the Serial Bus Signal Analysis and Search

On products with firmware version 1.80 or higher, the trigger settings of the serial bus signal on the menu that is entered through the ENHANCED key and the settings of the serial bus signal analysis and search on the menu entered through the WINDOW1 and ZOOM1 key are common. The CH1 to CH4 sources are the waveforms of which the settings are common.

Trigger settings of the serial bus signal that are applied to the settings of both the serial bus signal analysis and search
(The settings of the serial bus signal analysis and search are not applied to the trigger settings of the serial bus signal.)
Level and Hysteresis

Items of which the trigger settings of the serial bus signal, the settings of the serial bus signal analysis, and the settings of the serial bus signal search that are mutually applied
I2C (option)
   SDA Source and SCL Source
SPI (option)
   Mode, Bit Order, CS Source, CS Active, Clock Source, Clock Polarity, Data1, and Data2
Serial (Serial only has trigger and search settings.)
   Bitrate, Clock ON/OFF, Data Source, Data Active, CS ON/OFF, Clock Source, Clock Polarity, Latch Source, and Latch Polarity

---

Note

- M1 to M4 are does not apply to the common settings.
- The settings of the serial bus signal analysis and search on the menu entered through the WINDOW2 and ZOOM2 keys are not made common. They are independent settings.
- Even if something other than serial bus is selected in the analysis or search menu, the serial bus level and hysteresis settings are set to the same value if the trigger level or hysteresis setting is changed.
- When the trigger level or hysteresis is changed by executing auto setup, the level and hysteresis settings of the analysis and hysteresis are also set to the same new value. This also applies when the setup information is initialized.
- Trigger hysteresis $\diagup\!\!\!\!\diagup$ and $\diagup\!\!\!\!\diagup$ correspond to 0.6 division and 1.0 division, respectively, of the analysis or search.

7.1   Setting the Acquisition Mode

Procedure
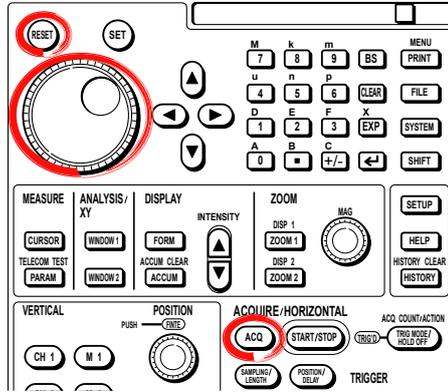
Setting the Acquisition Mode
1.   Press **ACQ**. The mode selection menu appears.
2.   Press the soft key that corresponds to the desired setting, from **Normal**, **Envelope**, and **Average**.

Setting the Number of Data Acquisitions for a Simple Average (When Mode is Average and the Trigger Mode is Single)
3.   Use the **rotary knob** to set the number of waveform acquisitions.

Setting the Damping Constant for a Sliding Average (When Mode is Average and the Trigger Mode is Auto, Auto Level or Normal)
4.   Use the **rotary knob** to set the attenuation constant (Weight). The selectable range is 2 to 1024.

Trigger mode setting (see section 6.1)

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Acquisition and Display
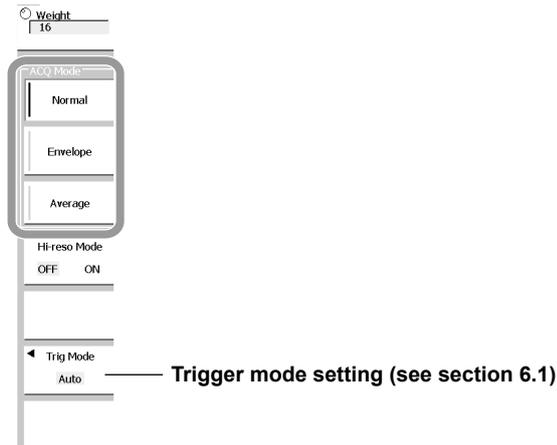
Explanation

Selecting the Acquisition Mode: Mode

You can select the acquisition mode from the following. The default setting is Normal.

- **Normal Mode**
  Sampled data is stored in the acquisition memory without special processing.

- **Envelope Mode**
  The maximum and minimum values are determined every acquisition interval from the data sampled at 2.5 GS/s (DL9040/DL9040L/DL9140/DL9140L) or 5 GS/s (DL9240/DL9240L). The maximum and minimum values are stored in the acquisition memory and an envelope waveform is displayed.

- **Averaging Mode**
  Sampled data is averaged and stored to the acquisition memory. The averaging method varies depending on the trigger mode setting.
  Exponential averaging is enabled when the trigger mode is Auto, Auto Level or Normal. You can set the concentration in a range of 2 to 1024.
  Simple averaging is enabled when the trigger mode is Single or N-Single. Set the averaging count to a range of 2 to 65536. If set to N-Single, you can specify the average count by setting the N item on the trigger mode setting menu.

• Exponential average
(when trigger is set to Auto /
Auto Level / Normal)

$$A_n = \frac{1}{N} \{(N-1)A_{n-1} + X_n\}$$

A_n: nth averaged value
X_n: nth measured value
N: Attenuation (2 to 1024, 2^n steps)

• Simple average
(when trigger is set to Single /
N-Single)

$$A_N = \frac{\sum_{n=1}^{N} X_n}{N}$$

X_n: nth measured value
N: Average count
(acquisition count, 2^n steps)

Precautions when Averaging

- Averaging is effective only for repetitive waveforms.
- Correct averaging is not possible if the waveform has imperfect triggering (incomplete synchronization), and the displayed waveform will be distorted.
- Roll mode display is disabled when averaging is used.
- If you stop waveform acquisition by pressing START/STOP, the averaging process also stops. Averaging restarts from the beginning when acquisition resumes.
- If you are using simple averaging, the DL9000 terminates acquisition automatically when it completes the specified number of acquisitions (acquisition count).
- The following is data saved in the history memory when acquiring waveforms in the averaging mode.
  When using exponential averaging (Trigger mode: Auto; Auto Level; or Normal)
    Saves averaging results for a specified amount of time in a multiple of records.
  When using simple averaging (Trigger mode: Single)
    Saves the measurements of one time in one record.
  When using simple averaging (Trigger mode: N-Single)
    Simple averages and saves data of the Nth time specified by the trigger mode.
- The maximum length of records for which averaging is possible is 625 KW for DL9040/DL9140/DL9240, and 1.25 MW for DL9040L/DL9140L/DL9240L.

7.2 Turning ON/OFF the High Resolution Mode
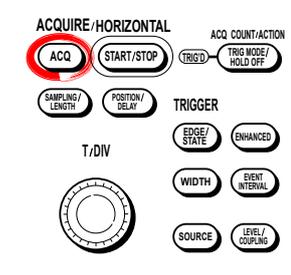
1. Press **ACQ**.
2. Press the **Hi-Res Mode** soft key to select ON or OFF.
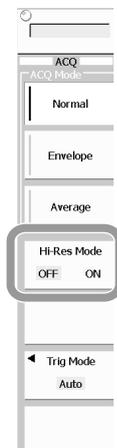
Explanation

Bandwidth filter processing reduces the data quantization noise, allowing high-resolution data, exceeding 8 bits, to be handled. Normally, data is saved in the acquisition memory as 8-bit data so high resolution data that exceeds 8 bits is lowered to 8 bits for saving. By turning high resolution mode ON, data can be saved as 16-bit data and high resolution data that exceeds 8 bits can be saved as high resolution data.

The maximum record lengths change for each instrument in the following way when high resolution mode is ON.

- 701307/701310/701312(DL9040/DL9140/DL9240):   2.5 MW → 1.25 MW
- 701308/701311/701313(DL9040L/DL9140L/DL9240L): 6.25 MW → 2.5 MW

Turning the high resolution mode ON when bandwidth limit is FULL will automatically set the instrument to a 200 MHz bandwidth limit.

7.3   Setting the Record Length
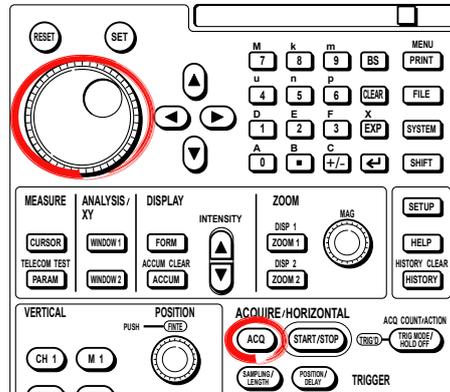
1. Press **SAMPLING/LENGTH**.
2. Use the **rotary knob** to set the record length. Press the soft key corresponding to the desired record length.
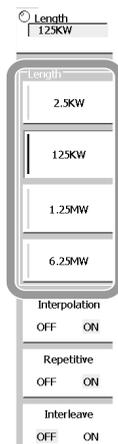
Explanation

You can set the acquisition record length (the amount of data) to be stored to the acquisition memory.
2.5 k words; 6.25 k words; 12.5 k words; 25 k words; 62.5 k words; 125 k words; 250 k words; 625 k words; 1.25 M words; 2.5 M words; 6.25 M words (DL9040L/DL9140L/DL9240L)

7.4 Turning ON/OFF Repetitive Sampling Mode
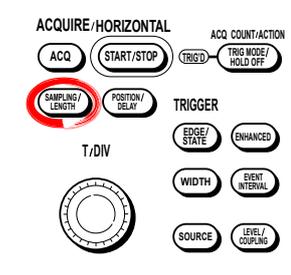
1. Press **SAMPLING/LENGTH**.
2. Press the **Repetitive** soft key to select ON or OFF.
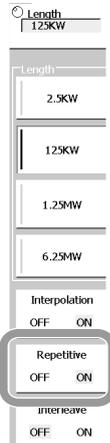
Explanation

In the repetitive sampling mode, based in a trigger point in a repeating signal, a number of cycles of the data are sampled, yielding a higher apparent sampling rate. If the repetitive sampling mode and interpolation are both ON, then at a sample rate of less than 500 GS/s interpolation takes precedence, and at sample rates of 500 GS/s and above, the repetitive sampling mode takes precedence.

Even when the repetitive sampling mode is OFF, and interpolation is OFF, if the time axis setting is such that the record length is less than 100 points, waveforms are automatically acquired in the repetitive sampling mode.

Precautions for Repetitive Sampling
Exponential averaging is applied to the averaging of repetitive sampling. Simple averaging is not used the trigger mode is Single or N-Single.

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Acquisition and Display

7.5 Turning ON/OFF the Interleave Mode
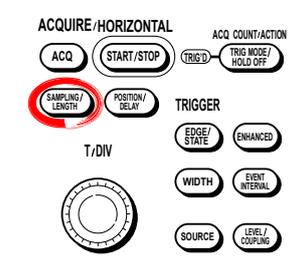
1. Press **SAMPLING/LENGTH**.
2. Press the **Interleave** soft key to select ON or OFF.
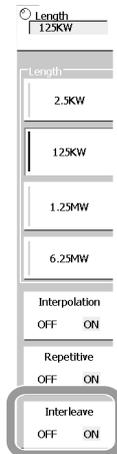
Explanation

You can turn the interleave mode ON or OFF.

If interleave mode is turned ON, there is a limit to the channels that can be used. In the realtime sampling mode, it is 5 GS/s for 701307/701308/701310/701311(DL9040/DL9040L/DL9140/DL9140L); and 10 GS/s for 701312/701313(DL9240/DL9240L). When set to 5 GS/s for 701310/701311(DL9140/DL9140L); and 10 GS/s for 701312/701313(DL9240/DL9240L), CH2 and CH4 automatically become disabled. For a description of the limitations of the record length, sample rate, and other items when the interleave mode is turned ON, see Appendix 1 Relationship between the Time Axis Setting, Sample Rate and Record Length.

7.6   Turning ON/OFF the Interpolation

ACQUIRE/HORIZONTAL
ACQ   START/STOP
TRIG'D   TRIG MODE/ HOLD OFF   ACQ COUNT/ACTION

SAMPLING/ LENGTH   POSITION/ DELAY   TRIGGER

T/DIV

EDGE/ STATE   ENHANCED

WIDTH   EVENT INTERVAL

SOURCE   LEVEL/ COUPLING
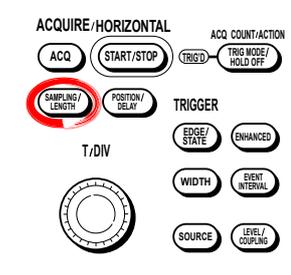
1.   Press **SAMPLING/LENGTH**.
2.   Press the **Interpolation** soft key to select ON or OFF.

Length
125KW

Length

2.5KW

125KW

1.25MW

6.25MW

Interpolation
OFF   ON

Repetitive
OFF   ON

Interleave
OFF   ON
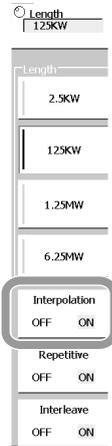
Explanation

This function interpolates actual sampled data up to 1000 times (or 2000 times when using the high resolution mode) to increase the substantial sampling speed (maximum of 2.5 TS/s).

The following outlines the relationship between interpolation and repetitive sampling when the maximum sampling rate is reached.

*   When interpolation is ON and repetitive sampling is also ON, interpolation is used if T/div is higher than 50 ns, and the sampling rate is less than 500 GS/s. When T/div is less than 50 ns and the sampling rate is higher than 500 GS/s, repetitive sampling is used.
*   When interpolation is ON, but repetitive sampling is OFF, record length is maintained and interpolated.
*   When interpolation is OFF, and repetitive sampling is ON, repetitive sampling is performed until the record length is below 1.25 MW.
*   If both interpolation and repetitive sampling are OFF, the record length after the maximum sampling rate is shortened. Repetitive sampling is performed when the record length is less than 100 W.

7.7 Displaying Accumulation
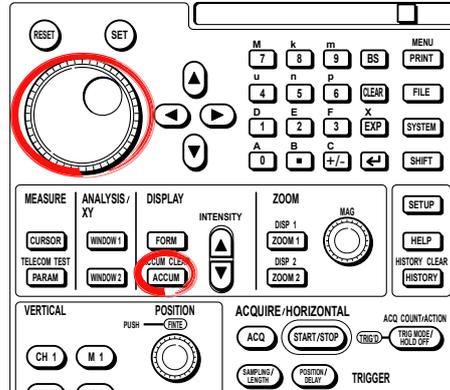
Setting the Accumulation Mode

1. Press **ACCUM**.
2. Press the **Accum** soft key to turn the mode ON.
3. Press the **Mode** soft key to select the accumulation mode.
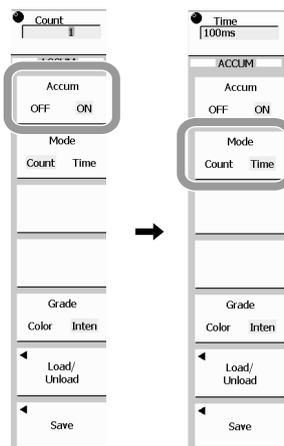
Setting the Accumulation Count and Time

4. Use the **rotary knob** to set the count and time.

   Count: 0 (unlimited)

          1 to (number of history waveforms)

   Time: Infinite

          100 ms to 1 s (100 ms intervals)

          1 s to 10 s (0.2 s intervals)

          10 s to 100 s (2 s intervals)

Set to Count Mode

Accumulation count
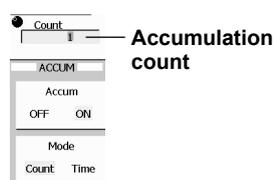
Set to Time Mode
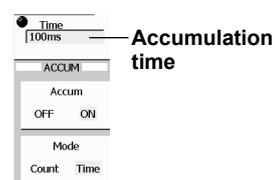
Accumulation time

Setting the Gradation Mode (Grade)

5.   Press the **Grade** soft key to select the color.

Saving and Loading an Accumulated Waveform

6.   Press the **Save** soft key. The save menu appears.

7.   Press the **Trace** soft key. A menu used to select the waveform to be saved appears.

8.   Press the soft key corresponding to the waveform to be saved.

9.   Press the soft key of the internal memory slot to use as the save destination.

10.   Press the **Load/Unload** soft key. The Load/Unload menu appears.

11.   To unload the currently loaded accumulated waveform, press the **Unload** soft key.

       To load an accumulated waveform, press the soft key of the internal memory slot where the waveform is saved. If an accumulated waveform is already loaded, it is overwritten when the new accumulated waveform is loaded.
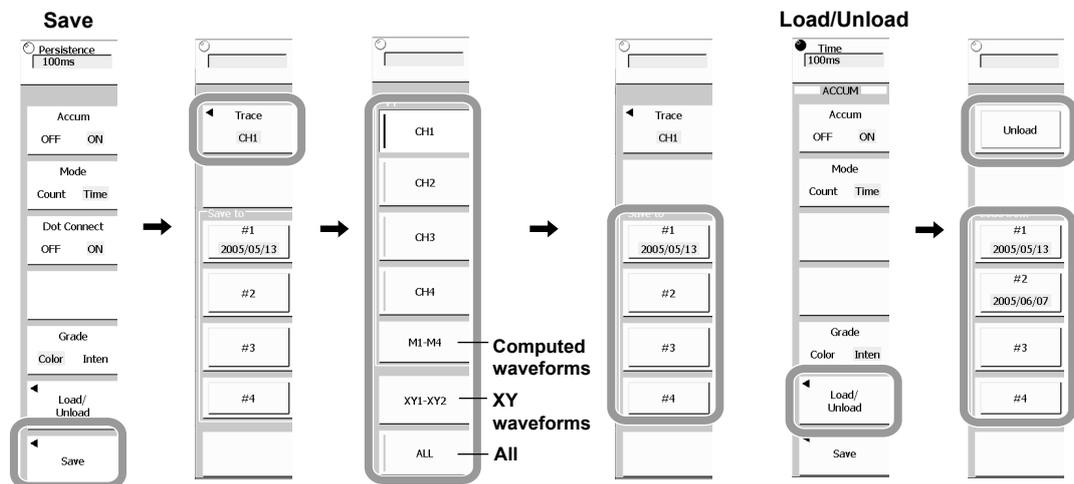
Explanation

Normally, the display is updated every time a trigger is activated making it difficult to capture transient conditions such as sudden distortion of waveforms. By using the accumulate function, the waveform display of the acquired data remains on the screen for the specified time.

Mode: Mode

Count: The specified number of the latest waveforms are superimposed.

Time: Waveforms acquired over the specified time are superimposed. The waveforms are displayed with steadily decreasing intensity.

Grade: Grade

Color: The sequence of colors blue - green - yellow - red - white is used to represent 15 levels of frequency, in ascending order.

Inten: Displays frequency with intensity.

Accumulation Count: Count

When the mode is Count, the accumulation count is set from 0 to the number of history waveforms. When 0 is selected, waveforms are superimposed indefinitely. The default value is 1 time.

Accumulation Time: Time

In the Time mode, make the setting Infinite, or in the range 100 ms to 100 s. The default value is 100 ms.

When Infinite is selected, waveforms are superimposed indefinitely.

Precautions for Accumulation

• Automated measurement of waveform parameters and GO/NO-GO determination are executed on the newest waveform.

• If waveform acquisition is stopped by pressing the START/STOP key, accumulation is temporarily interrupted. All waveforms are cleared and the system starts accumulation starts again from the beginning when accumulation is restarted.

• The following operations occur if the display format is changed while displaying accumulation.
    • During accumulation: The screen is cleared and display starts from the beginning.
    • During accumulation stop time (Time): Waveforms are not cleared.
    • During accumulation stop time (Count): Accumulates the number of history waveforms maintained when in infinite. It may not be the same screen as before. Accumulates the specified number of history waveforms when not in infinite.

Clearing Accumulated Waveforms

You can clear accumulated waveforms by pressing SHIFT + ACCUM.

Saving and Loading an Accumulated Waveform

Accumulated waveforms can be saved in four internal memory slots.

Each accumulated waveform that is saved can also be loaded for review. An accumulated waveform that is loaded appears in white.

7.8   Setting the Action-on-Trigger
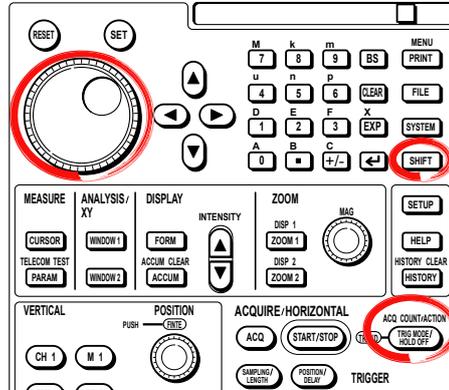
1. Press **SHIFT** + **TRIG MODE/HOLD OFF**.
2. Press the **Action on TRG** soft key.
3. Press the soft key corresponding to the desired mode.
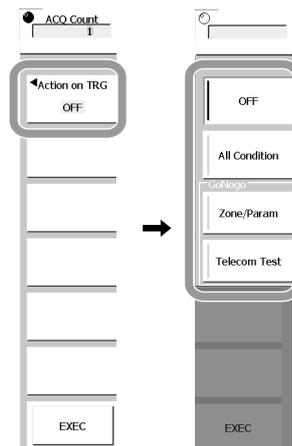
*   OFF:The specified number of waveforms are acquired. Action-on-trigger is not executed.
*   All Condition: When the trigger is activated, the waveform is acquired, and the specified action carried out. After the specified number of waveforms have been acquired, the process stops.
*   Zone/Param: See sections 7.10 to 7.15
*   Telecom Test:See section 7.16

Action When Trigger Activated

4. Press the **Action** soft key.

5. Press the soft key that corresponds to the desired item and select ON or OFF.

6. Press ESC. This returns to the Action on Trigger setting screen.
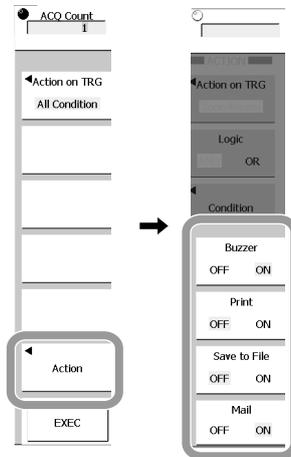
Setting the Waveform Acquisition Count

7. Turn the **rotary knob** to set the waveform acquisition count.

    You can use the arrow keys to move the digits to be set.

Executing the Action-on-Trigger

8. Press the **EXEC** soft key to start acquiring waveforms and execute the action-on-trigger. The EXEC display changes to Abort.
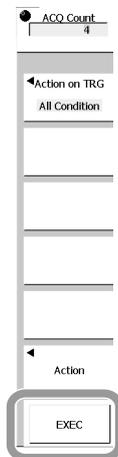
Stopping the Action-on-Trigger

9. Either press the **Abort** soft key or **START/STOP** to stop acquiring waveforms and to stop the action-on-trigger.

Explanation

Selecting the Mode

Select the timing of excuting the Action below next subheading.

* **OFF**

  Performs the acquisition for the specified number of times. Acquisition stops at the number of times specified by ACQ Count. The trigger mode this is activated is Normal.

* **All Condition**

  Press EXEC to execute the action when the trigger conditions are established. Stops when the acquisition of the ACQ Count is reached. The trigger mode operates under Normal mode. (This is independent from the "TRIG MODE" in TRIG MODE/HOLD OFF.)

* **Zone/Parameter (GoNogo)**

  Performs GO/NO-GO determination using zone or parameters. Press EXEC to execute the action each time the ZONE/PARAMETER determination conditions are established. Four conditions can be set by mixing zone and parameters. Furthermore, it is also possible to set a logic (AND/OR) for each condition. Stops either when the acquisition of the ACQ Count is reached or when the condition is established for Nogo Count. The trigger mode operates under Normal mode.

* **Telecom Test (GoNogo)**

  Performs GO/NO-GO determination using a Telecom Test. The action is executed each time the determination condition of the Telecom Test is met. Because a Telecom Test measures accumulated waveforms like a Mask Test, it is not performed at the same time as ZONE/PARAMETER.

Action to Be Performed When the Trigger Condition Is Met

The specified action (of those below) is performed whenever a trigger is activated.

* **Beep Sound: Buzzer**

  Sounds a warning tone.

* **Print Screen Image: Print**

  Prints the screen image to the destination printer (Printer: built-in printer; USB: USB printer) specified by "Copy to" in the PRINT menu, and saves the screen image data on the specified storage media.

* **Save Waveform Data: Save to File**

  The waveform data is saved to the destination (PC card, USB storage) specified in the FILE menu in binary, ASCII or floating-point format. The format used for saving is linked to the data type (see section 13.5) of the FILE menu.

  Note
  When the action-on-trigger is started with the Action Condition OFF, the specified action is performed when the trigger is activated in the normal mode regardless of the trigger mode setting.

Number of Actions: ACQ Count

1 to 1000000:   Repeats the action the specified number of counts.
Infinite: Repeats the action until waveform acquisition is stopped.

Operation When Action Is Set to Print or Save to File

The DL9000 operates according to the settings in the Print or FILE menu. For the setup procedure, see chapter 12, "Printing Screen Image", section 13.5, "Saving/Loading the Measurement Data," or section 13.8, "Saving Screen Image Data." If the auto naming function of the File menu is OFF, the file is saved using Numbering. Otherwise, the file is saved using the specified method.

7

Acquisition and Display

Trigger mode

The trigger mode is Normal.

This is independent of the trigger mode described in Chapter 6.

GO/NO-GO determination

For details on GO/NO-GO determination (see sections 7.10 to 7.16).

Note

Precautions to Be Taken When Setting Action on Trigger

- Settings cannot be changed while action-on-trigger is in progress.
- Averaging uses exponential averaging.
- GO/NO-GO determination is applied for each history waveform when repetitive sampling mode is turned ON.

Note When Action Is Set to Save to File

- Do not specify the root directory of the medium as the save destination directory.
  (Only up to 512 files can be saved to the root directory of a storage medium that has been formatted using the DL9000.)
- If you selected Numbering for the file name assignment method (Auto Name) in the FILE menu, the creation of files takes time when the number of saved files becomes large.
  In addition, the number of files that are saved when the auto naming function is set to Numbering is up to 1000. To create more than 1000 files, set the auto naming function to Date.
- If a file with the same name exists in the same directory (save destination) when saving data files using the auto naming function, the GO/NO-GO determination stops at that point. To prevent this from happening, prepare a new folder with no files in it or remove all files in the destination folder before starting the GO/NO-GO determination.
- The number of directories and files that can be displayed in the file list is 2500. If the number of directories and files in a directory exceeds 2500, the file list randomly displays 2500 of the directories and files.

7.9 Using a GO/NO-GO Determination to Apply an Action-on-Trigger

Procedure
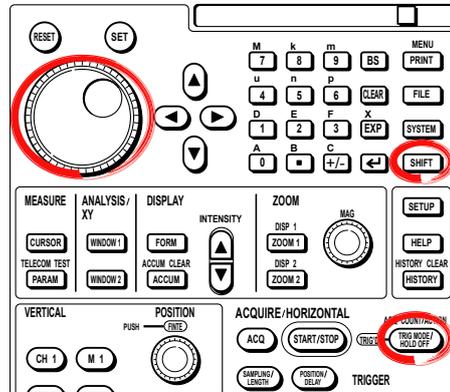
1. Press **SHIFT** + **TRIG MODE/HOLD OFF**.
2. Press the **Action on TRG** soft key. A menu for the action-on-trigger mode settings appears.
3. Press the **Zone/Param** or **Telecom Test** soft key.

Selecting the Logic for Determination

4. Press the **Logic** soft key to select either AND or OR.
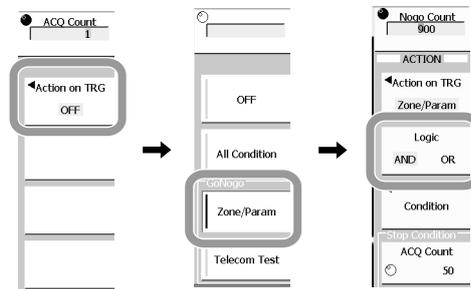
You can make a maximum of four settings for the determination conditions. The GO/NO-GO determination is based on whether all of these determination conditions hold (AND), or whether any one of them holds (OR).

Setting the Determination Count
5.　Press the **ACQ Count** soft key.
6.　Turn the **rotary knob** to set ACQ Count (determination count).
7.　Press the **Nogo Count** soft key.
8.　Turn the **rotary knob** to set the Nogo Count.
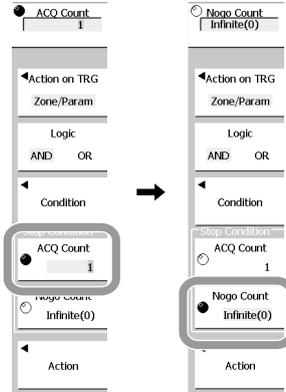
Selecting the Action After Determination
9.　Press the **Action** soft key.
10.　Press the **Buzzer**, **Print**, and **Save** soft keys to turn them ON or OFF.
11.　Press **ESC**.
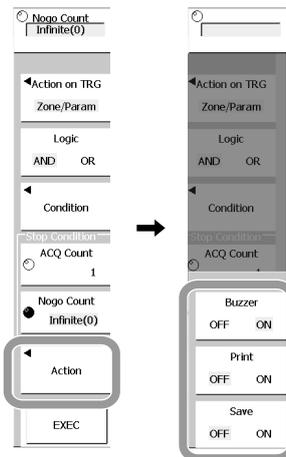
Executing Determination

12.   Press the **EXEC** soft key. This executes determination. It switches to the Abort soft key. When determination is completed, waveform acquisition automatically stops.
To abort determination, press the Abort soft key or START/STOP.
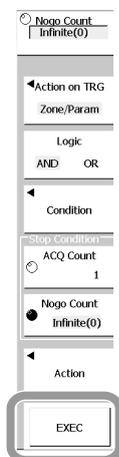
Stopping or Aborting the Determination

13.   Waveform acquisition stops automatically, when determination is finished,
To abort the GO/NO-GO determination, press the **Abort** soft key or **START/STOP**.

Explanation

When the specified GO/NO-GO determination conditions are met, the action-on-trigger is applied.
For details of the determination condition settings, see sections 7.10 to 7.16.

Selecting the Mode: Action on TRG
Select from the following.

*   **Zone/Param**
    If Zone/Param is selected, you must set additional determination conditions for each determination mode below. See sections 7.10 to 7.15.
    *   Wave: GO/NO-GO determination based on a waveform zone. For the method of setting, see section 7.10.
    *   Rect: GO/NO-GO determination based on a rectangular zone. For the method of setting, see section 7.11.
    *   Polygon: GO/NO-GO determination based on a polygonal waveform zone. For the method of setting, see section 7.12.
    *   Parameter: GO/NO-GO determination based on waveform parameter, XY waveform parameters, and FFT parameters. For the method of setting waveform parameters, see section 7.13, for setting XY waveform parameters see section 7.14, and for FFT parameters see section 7.15.
*   **Telecom Test:**
    GO/NO-GO determination based on telecom test result. For the method of setting, see section 7.16.

Setting the Determination Logic: Logic

You can make a maximum of four settings for the GO/NO-GO determination conditions. Each of these can have any of the above modes selected. Set the logical operator used to combine this maximum of four determination conditions.

- AND: NO-GO determination when all of determination conditions 1 to 4 hold
- OR: NO-GO determination when any one of determination conditions 1 to 4 holds

Setting the Determination Count: ACQ Count/Nogo Count

When the specified count for ACQ Count or Nogo Count is reached, waveform acquisition stops.

- **ACQ Count**

  Set the number of waveform acquisitions.
  - 1 to 1000000: The specified number of waveforms are acquired then the process stops.
  - Infinite (0): Waveform acquisition continues until stopped by the Abort soft key or START/STOP.

- **Nogo Count**

  When the specified number of NO-GO acquisitions has been reached, waveform acquisition is stopped.
  - 1 to 1000: Process stops after the specified number of NO-GO determinations.
  - Infinite (0): Waveform acquisition continues until stopped by the Abort soft key or START/STOP.

Action After Determination: Action

There are three actions that can occur when the condition is met.

- **Beep Sound: Buzzer**

  Sounds a warning tone.
- **Print Screen Image: Print**

  Prints the screen image to the destination printer (Printer: built-in printer; USB: USB printer) specified by "Copy to" in the PRINT menu, and saves the screen image data on the specified storage media.
- **Save Waveform Data: Save to File**

  The waveform data is saved to the destination (PC card, USB storage) specified in the FILE menu in binary, ASCII or floating-point format. The format used for saving is linked to the data type (see section 13.9) of the FILE menu.

Operation When Action Is Set to Print or Save to File

The DL9000 operates according to the settings in the Print or FILE menu. For the setup procedure, see chapter 12, "Printing Screen Image", section 13.5, "Saving/Loading the Measurement Data," or section 13.8, "Saving Screen Image Data." If the auto naming function of the File menu is OFF, the file is saved using Numbering. Otherwise, the file is saved using the specified method.

Note

Precautions for GO/NO-GO Determination
*   The results of the determination (the determination count and fail count) are displayed on the screen.
*   All keys other than the START/STOP key and the Abort soft key are disabled while determination is in progress. (When Remote is ON, the Exec (One Shot) soft key is also enabled.)
*   When GO/NO-GO determination is executed, the trigger mode is automatically changed to "Normal".

Note When Action Is Set to Save to File
*   Do not specify the root directory of the medium as the save destination directory.
    (Only up to 512 files can be saved to the root directory of a storage medium that has been formatted using the DL9000.)
*   If you selected Numbering for the file name assignment method (Auto Name) in the FILE menu, the creation of files takes time when the number of saved files becomes large.
    In addition, the number of files that are saved when the auto naming function is set to Numbering is up to 1000. To create more than 1000 files, set the auto naming function to Date.
*   If a file with the same name exists in the same directory (save destination) when saving data files using the auto naming function, the GO/NO-GO determination stops at that point. To prevent this from happening, prepare a new folder with no files in it or remove all files in the destination folder before starting the GO/NO-GO determination.
*   The number of directories and files that can be displayed in the file list is 2500. If the number of directories and files in a directory exceeds 2500, the file list randomly displays 2500 of the directories and files.

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Acquisition and Display

7.10 Setting the Waveform Zone GO/NO-GO Determination Conditions
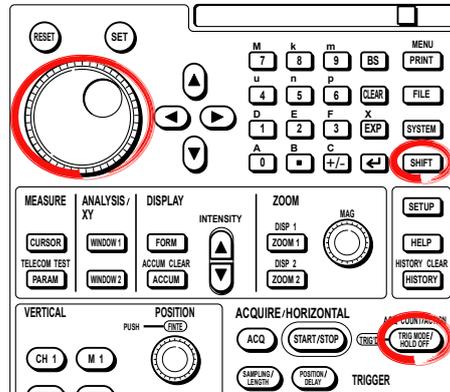
Setting the GO/NO-GO Determination Mode

1. Press **SHIFT** + **TRIG MODE/HOLD OFF**.
2. Press the **Action on TRG** soft key.
3. Press the **Zone/Param** soft key.
4. Press the **Condition** soft key. The Condition setting menu appears.

- **Setting the Determination Condition Number**
5. Press the **Select** soft key.
6. Select the determination condition number. Press the soft key corresponding to the number.
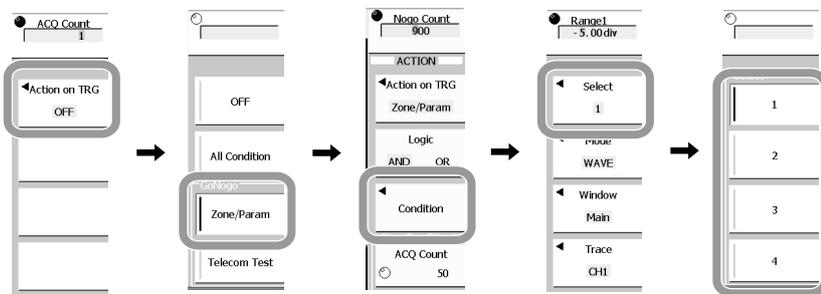
- **Setting the Determination Mode**
7. Press the **Mode** soft key. The Mode setting menu appears.
8. Press the **WAVE** soft key. The waveform zone setting menu appears.
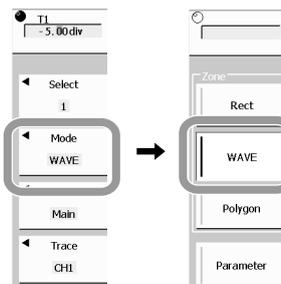
Selecting the Window for the Determination

9. Press the **Window** soft key. The menu for setting the Window for the determination appears.

10. Select the Window for the determination from Main, Zoom1, and Zoom2.
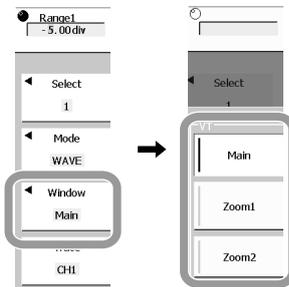
Selecting the Waveform Targeted for Determination

11. Press the **Trace** soft key.

12. Select a channel. Press the soft key corresponding to CH1 to CH4. To select M1 to M4, press the **M1-M4** soft key. Select one after it is switched.

Creating a New Determination Zone

13. Press the **Edit** soft key.
14. Press the **New REF Trace** soft key.
15. Specify the trace to be used as the zone base. Press the soft key corresponding to the desired channel to be traced. To trace M1 to M4, press the **M1-M4** soft key. After it is switched, press the corresponding soft key again.
16. Press the **Whole/Part** soft key to specify the range to edit. To edit the entire zone, select Whole; To edit a portion of the zone, select Part.
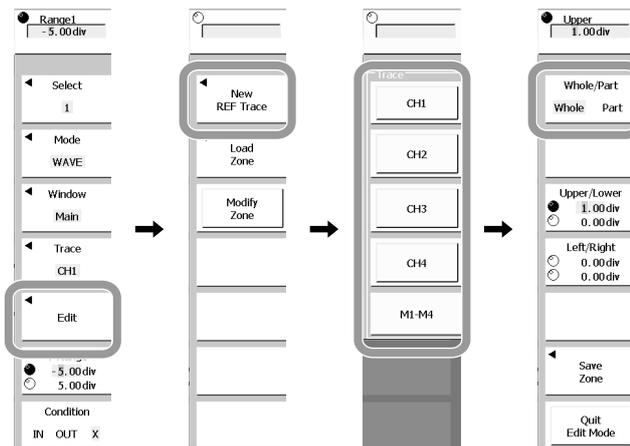
- **Editing the Whole Zone**
  17. Press the **Upper/Lower** or **Left/Right** soft key to select direction to set the zone.
  18. Use the **rotary knob** to create a zone.
  19. Repeat steps 17 to 18 to edit the zone.
  20. To save the zone, press the **Save Zone** soft key. This will open a menu for setting the location to register the zone you edited.
  21. Specify the destination for the zone to be registered. Press the soft key corresponding to #1 to #4.
  22. Press the **Quit Edit Mode** soft key to confirm the registration.
     To edit part of the zone, proceed to step 23. To quit creating zones, proceed to step 39.
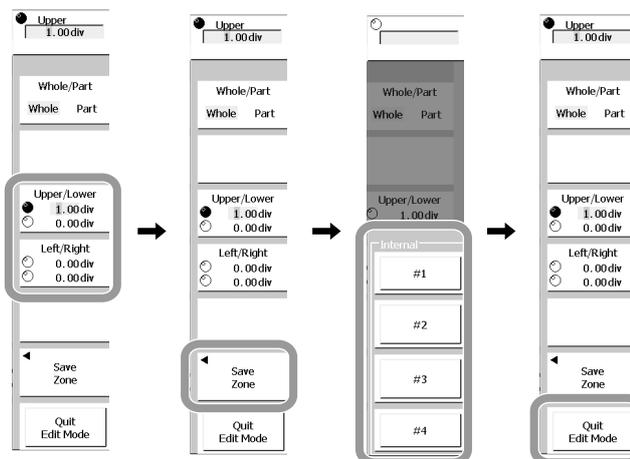
• **Editing Part of the Zone**

23. Press the **Whole/Part** soft key, then select Part.
24. Press the **Edit Range** soft key to select the left or the right cursor.
25. Use the **rotary knob** to set the right and left edges of the part of the zone. Similarly, set the left or right edge settings that have not yet been set, to specify the range to create the zone.
26. Press the **Upper/Lower** soft key to select the direction to set the zone.
27. Use the **rotary knob** to create a zone.
28. Repeat steps 24 to 27 to edit the zone.
29. To save the zone, press the **Save Zone** soft key. This will open a menu for setting the location to register the zone you edited. Specify the destination for the zone to be registered. Press the soft key corresponding to #1 to #4.
30. Press the **Quit Edit Mode** soft key to confirm the registration.
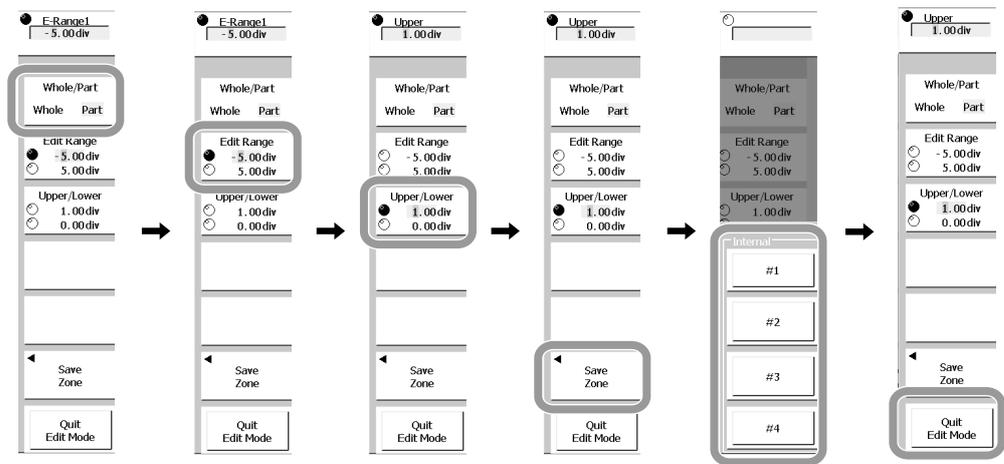
• **Modifying a Zone**

31. To edit a previously registered zone, press the **Load Zone** soft key. To edit the currently used zone, skip to step 33.
32. Specify the registration location of the determination zone to modify. Press the soft key corresponding to #1 to #4. The determination zone saved before is loaded.
33. Press the **Modify Zone** soft key.
34. Modify the waveform according to the steps 15 to 30.
35. When you finish the modifications, press the **Quit Edit Mode** soft key.
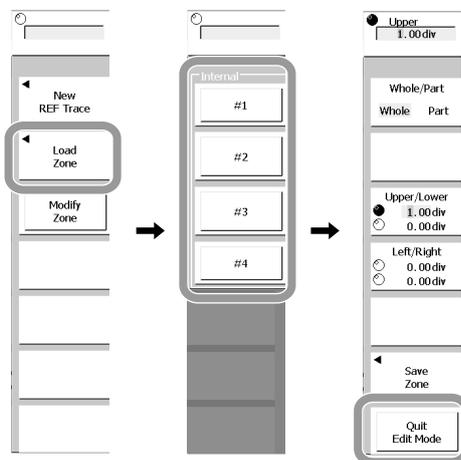
Setting the Determination Interval

36. Press the **Time Range** soft key.

37. Use the **rotary knob** to set the determination interval.
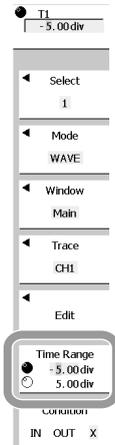
Selecting the Reference for Determination

38. Press the **Condition** soft key to select from IN, OUT or X.

39. Press **ESC** to return to the GO/NO-GO menu.
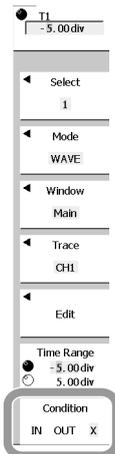
If necessary, repeat the steps above for the determination condition numbers 1 to 4.

Explanation

This section explains creating a zone based on a reference waveform and performing GO/NO-GO determination on whether the waveform exits or enters that zone.

Selecting the Basic Waveform: Edit

Select the basic waveform to create a determination zone. Select the basic waveform from CH1 to CH4 and M1 to M4 that is displayed as a trace. You cannot select traces that are not displayed.

Creating a Determination Zone: New REF Trace

Up to four determination zones can be set. The following shows the setting range.
*   Setting range in the up and down directions: ±8 divisions from the basic waveform
*   Setting range in the left and right directions: ±5 divisions from the screen center
Targeted waveforms that are determined using the determination zone registered in determination condition numbers 1 to 4, can be selected from the input signal waveforms (CH1 to CH4) and operation waveforms (M1 to M4). Zones that are enabled by the condition settings are displayed on the screen.

Setting the Determination Conditions: Condition

*   **Selecting the Target Waveform: Trace**
    Select from the CH1 to CH4 and M1 to M4 waveforms.

*   **Setting the Determination Conditions: Select**
    Select the determination condition number for setting the determination condition. Each of the four determination conditions can be set.

*   **Setting the Determination Interval: Time Range**
    In the initial settings, the ±5 divisions in the frame displayed for the time axis are the determination range. However, this can be limited to any desired range. Consider the determination range to be the same as the setting range for the cursor display position in cursor measurements.

*   **Setting the Reference for Determination: Condition**
    *   IN: Performs NO-GO when the targeted waveform enters the determination zone.
    *   OUT: Performs NO-GO when the targeted waveform exits the determination zone.
    *   X: GO/NO-GO determination is not performed.

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Acquisition and Display

7.11 Setting the Rectangular Zone GO/NO-GO Determination Conditions
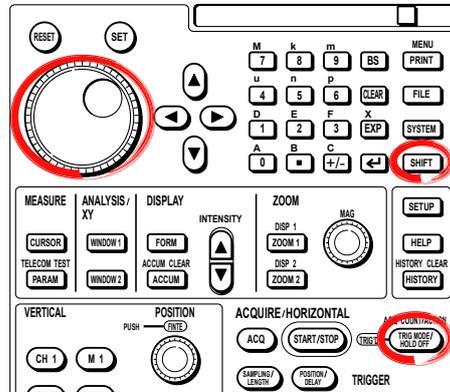
Setting the GO/NO-GO Determination Mode

1. Press **SHIFT** + **TRIG MODE/HOLD OFF**.
2. Press the **Action on TRG** soft key.
3. Press the **Zone/Param** soft key.
4. Press the **Condition** soft key.

- **Selecting the Determination Condition Number**
  5. Press the **Select** soft key.
  6. Select the determination condition number. Press the soft key corresponding to the number to be set.

- **Setting the Determination Mode**
  7. Press the **Mode** soft key. The Mode setting menu appears.
  8. Press the **RECT** soft key. The rectangular zone setting menu appears.
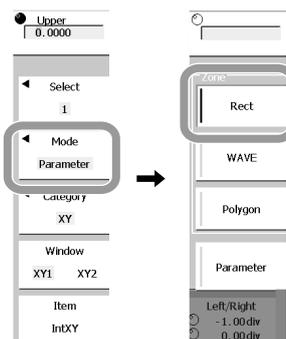
Selecting the Reference for Determination

9. Press the **Condition** soft key to select from IN, OUT or X. When you select IN or OUT, the zone appears on the screen.
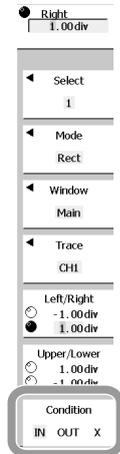
Setting a Determination Zone

10. Press the **Left/Right** or **Upper/Lower** soft key to select the direction to set the zone.

11. Use the **rotary knob** to create a zone.

12. Repeat steps 10 to 11 to edit the zone.

7

Acquisition and Display

Setting the Determination Conditions
- **Selecting the Window Targeted for Determination**
  13. Press the **Window** soft key.
  14. Select the window to target for determination. Press the soft key corresponding to the desired window to target for determination.
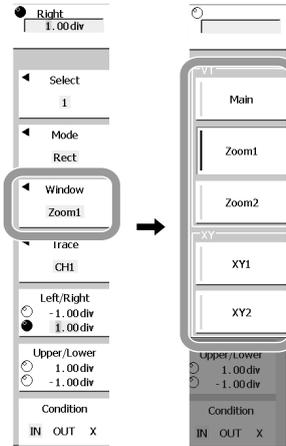
- **Selecting the Target Waveform**
  15. Press the **Trace** soft key.
  16. Select a channel. Press the soft key corresponding to CH1 to CH4. To select M1 to M4, press the **M1-M4** soft key. Select one after it is switched.
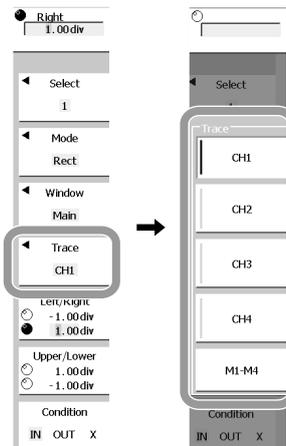
  17. Press **ESC** to return to the GO/NO-GO menu.
      If necessary, repeat the steps above for the determination condition numbers 1 to 4.

Explanation

Create a rectangular waveform by setting the up/down, and left/right limit values on the screen. GO/NO-GO determination is performed either when the waveform enters into that range or does not enter that range.

Setting a Determination Zone: Left/Right, Upper/Lower

Sets the range for determining determination conditions. One determination zone can be set. The setting range is shown below.

- Setting range in the up and down directions: Setting resolution of ±5 divisions (±4 divisions when using XY waveforms) from the basic waveform: 0.01 div
- Setting range in the left and right directions: Setting resolution of ±4 divisions from the screen center: 0.01 div

Note

The rectangular zone disappears when Condition is set to X, or the display of the relevant waveform is set to OFF.

Setting the Determination Conditions: Select

Select the determination condition number for setting the determination condition. Each of the four determination conditions can be set.

- **Selecting the Window Targeted for Determination: Window**
  - Main: Targets normal waveforms.
  - Zoom1: Targets zoom box 1 waveforms.
  - Zoom2: Targets zoom box 2 waveforms.
  - XY1: Targets XY window 1 waveforms.
  - XY2: Targets XY window 2 waveforms.
  See section 8.6 for Zoom 1 and Zoom 2.

- **Selecting the Target Waveform: Trace**
  Select from the CH1 to CH4 and M1 to M4 waveforms.

- **Selecting the Reference for Determination: Condition**
  - IN: Performs NO-GO when the targeted waveform enters the determination zone.
  - OUT: Performs NO-GO when the targeted waveform exits the determination zone.
  - X: GO/NO-GO determination is not performed.

7

Acquisition and Display

7.12 Performing GO/NO-GO Determination Using a Polygon Waveform
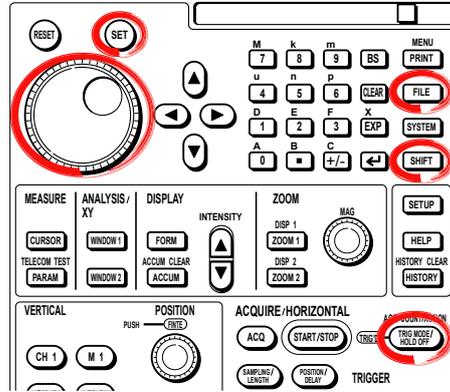
Loading a Polygon Figure

This section describes simply how to load a polygon. For more details, see section 13.7, "Saving/Loading Zone Waveforms."

1. Press **FILE**.
2. Select the directory of the PC card or USB memory where the polygon figure file is saved.
3. Press the **Open** soft key.
4. Select the targeted file and press **SET**.
5. Press the **Load** soft key. Displays a menu used to load files.
6. Press the **Type** soft key. Displays a menu used to select polygon figure or mask pattern.
7. Press the **Zone Polygon** soft key.
8. Press the soft key corresponding to the zone number of the destination for loading.
9. Press the **Load EXEC** soft key. The selected file is loaded.
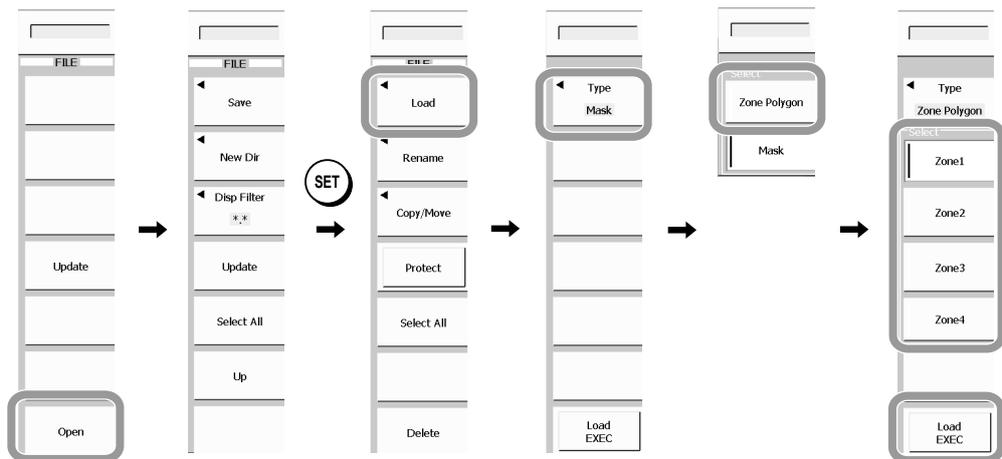
Setting the GO/NO-GO Determination Mode

10. Press **SHIFT** + **TRIG MODE/HOLD OFF**.

11. Press the **Action on TRG** soft key.

12. Press the **Zone/Param** soft key.

13. Press the **Condition** soft key.

- **Selecting the Determination Condition Number**

14. Press the **Select** soft key.

15. Select the determination condition number. Press the soft key corresponding to the number to be set.
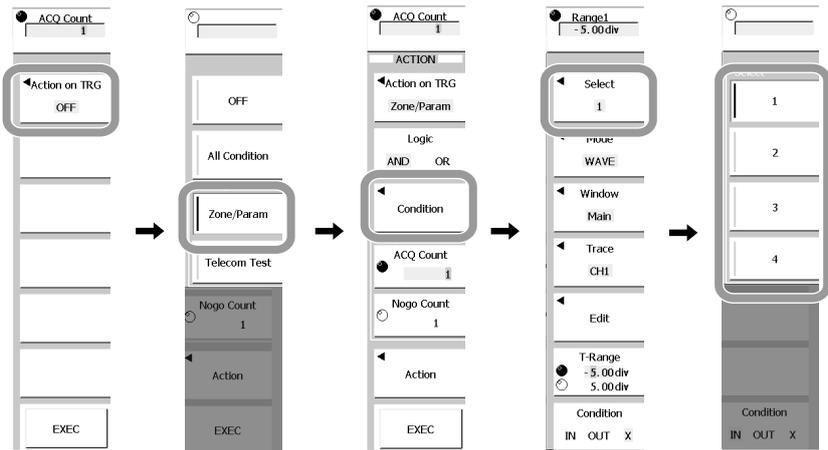
- **Setting the Determination Mode**

16. Press the **Mode** soft key.
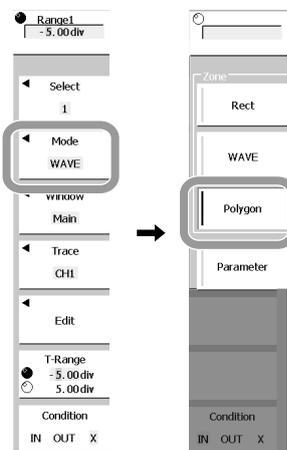
17. Press the **Polygon** soft key.

7

Acquisition and Display

Setting the Determination Conditions

• **Selecting the Window Targeted for Determination**

18. Press the **Window** soft key.
19. Select the window to target for determination. Press the soft key corresponding to the desired window to target for determination.
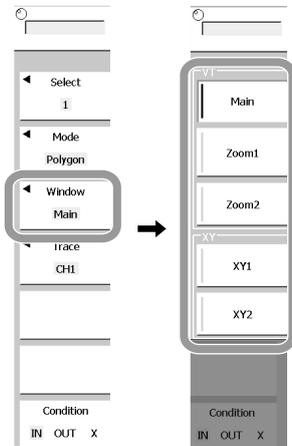
• **Selecting the Target Waveform**

20. Press the **Trace** soft key.
21. Select a channel. Press the soft key corresponding to CH1 to CH4. To select M1 to M4, press the **M1-M4** soft key. Select one after it is switched.
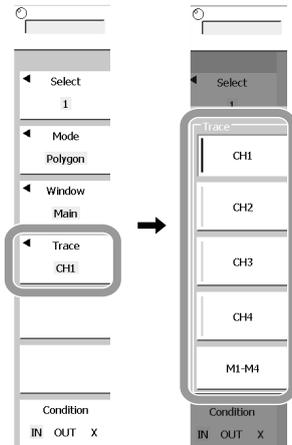
• **Selecting the Reference for Determination**
22. Press the **Condition** soft key to select from IN, OUT or X.
23. Press **ESC** to return to the GO/NO-GO menu.
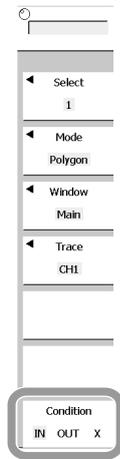
```
                    ◄   Select
                           1

                    ◄   Mode
                        Polygon

                    ◄   Window
                         Main

                    ◄   Trace
                         CH1



                        Condition
                       IN  OUT  X
```

If necessary, repeat the steps above for the determination condition numbers 1 to 4.

Explanation

Load the polygon figure generated on your PC. GO/NO-GO determination is performed either when the figure enters into that range or does not enter that range.

Loading a Polygon Figure
Load a polygon figure in advance. Use a dedicated software application on your PC to generate a polygon figure.

Setting the Determination Conditions: Select
Select the condition number for setting the determination condition. Each of the four determination conditions can be set.

• **Selecting the Window Targeted for Determination: Window**
   • Main: Targets normal waveforms.
   • Zoom1: Targets zoom box 1 waveforms.
   • Zoom2: Targets zoom box 2 waveforms.
   • XY1: Targets XY window 1 waveforms.
   • XY2: Targets XY window 2 waveforms.
   See section 8.6 for Zoom 1 and Zoom 2.

• **Selecting the Target Waveform: Trace**
   Select from the CH1 to CH4 and M1 to M4 waveforms.

• **Selecting the Reference for Determination: Condition**
   • IN: Performs NO-GO when the targeted waveform enters the determination zone.
   • OUT: Performs NO-GO when the targeted waveform does not enter the determination zone.
   • X: GO/NO-GO determination is not performed.

7.13 Setting the Waveform Parameter GO/NO-GO Determination Conditions
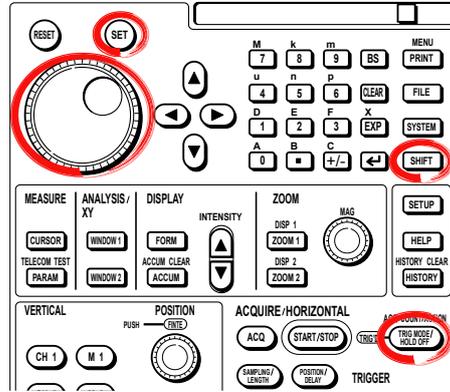
Setting the GO/NO-GO Determination Mode

1. Press **SHIFT** + **TRIG MODE/HOLD OFF**.
2. Press the **Action on TRG** soft key.
3. Press the **Zone/Param** soft key.
4. Press the **Condition** soft key.

- **Selecting the Determination Condition Number**

5. Press the **Select** soft key.
6. Select the determination condition number. Press the soft key corresponding to the number to be set.
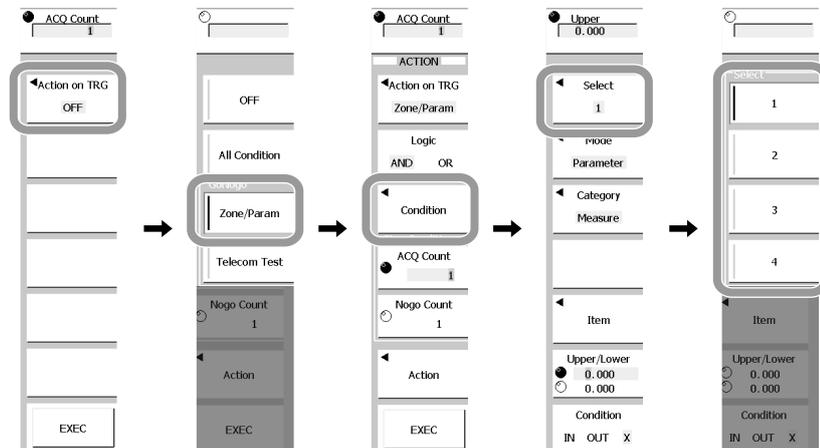
- **Setting the Determination Mode**

7. Press the **Mode** soft key.
8. Press the **Parameter** soft key.

- **Setting a Category**

    9.   Press the **Category** soft key.

          Displays a menu used to select a category.

    10.   Press the **Measure** soft key.
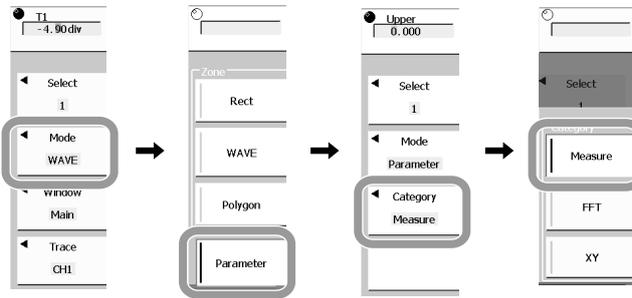
Selecting the Area Targeted for Determination

    11.   Press the **Item** soft key.

    12.   Press the **Area** soft key to select Area 1 or Area 2.
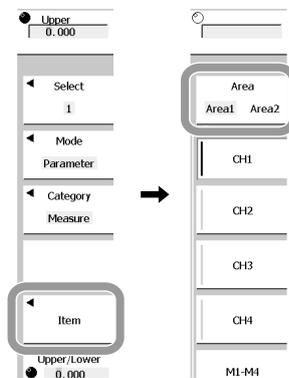
Selecting the Target Waveform

    13.   Select a channel. Press the soft key corresponding to CH1 to CH4 or M1 to M4.

          To select M1 to M4, press the **M1-M4** soft key. Select one after it is switched.

    14.   Turn the **rotary knob** to select an item. Then press SET.

7

Acquisition and Display

Selecting a Computation

15. Use **Calc** soft key to select a computation value that uses the waveform parameter value for that item.

16. Turn the **rotary knob** to select an equation. Then press SET. Select an equation from among those set by automatic measurement of waveform parameters.

17. Press **ESC**.
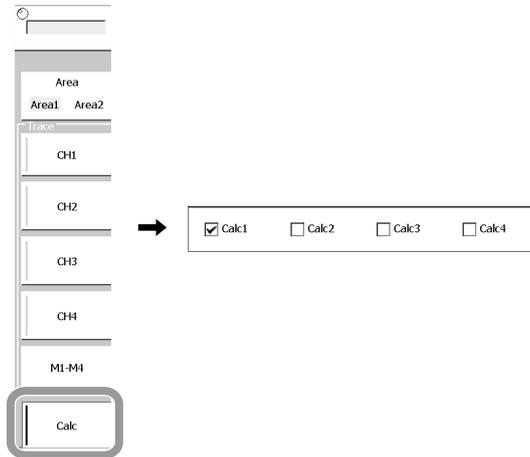
Setting a Determination Zone

18. Press the **Upper/Lower** soft key to select the item to set a range.

19. Use the **rotary knob** to set the Upper and Lower.
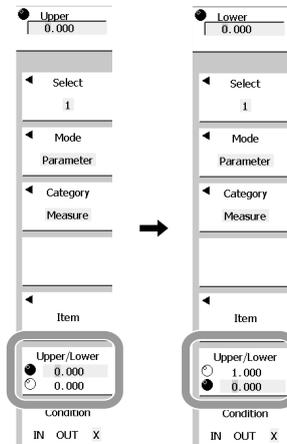
Selecting the Reference for Determination

20.   Press the **Condition** soft key to select from IN, OUT or X.

21.   Press **ESC** to return to the GO/NO-GO menu.

```
●  Upper
   ┌──────────┐
   │   1.000  │
   └──────────┘

◄       Select
           1

◄        Mode
       Parameter

◄       Category
        Measure

◄        Item

       Upper/Lower
●         1.000

       Condition
       IN   OUT   X
```
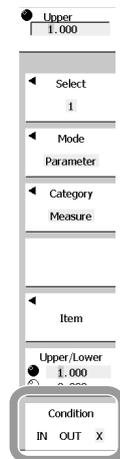
If necessary, repeat the steps above for the determination condition numbers 1 to 4.

Explanation

GO/NO-GO determination is performed either when the values enter into the specified range or they are outside of that range, using the automatically measured values of the waveform parameter.

Setting the Determination Conditions: Select
Specify the determination condition number. Each of the four determination conditions can be set.

Selecting the Area Targeted for Determination: Area
Select from Area 1 and Area 2.

Selecting the Reference for Determination: Condition
• IN: Performs NO-GO when the value of the waveform parameter targeted for determination is within the upper and lower limit values.
• OUT: Performs NO-GO when the value of the waveform parameter targeted for determination is outside of the upper and lower limit values.
• X: GO/NO-GO determination is not performed.

7

Acquisition and Display

7.14 Setting the FFT Parameter GO/NO-GO Determination Conditions

Setting the GO/NO-GO Determination Mode

1. Press **SHIFT** + **TRIG MODE/HOLD OFF**.
2. Press the **Action on TRG** soft key.
3. Press the **Zone/Param** soft key.
4. Press the **Condition** soft key.

- **Selecting the Determination Condition Number**

5. Press the **Select** soft key.
6. Select the determination condition number. Press the soft key corresponding to the number to be set.

7. Press the **Mode** soft key.

8. Press the **Parameter** soft key.

9. Press the **Category** soft key.

10. Press the **FFT** soft key.
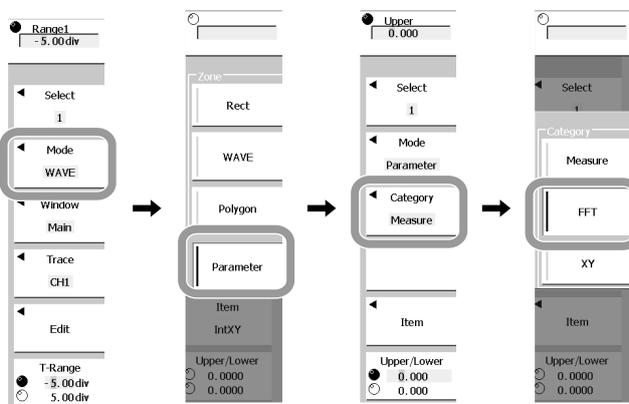
Setting the Determination Conditions

· **Selecting a Window of a Targeted Item**

11. Press the **Window** soft key to select FFT 1 (result of Window 1 analysis) or FFT 2 (result of Window 2 analysis).
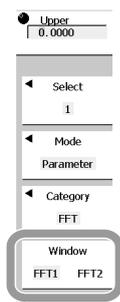
· **Selecting an Item**

12. Press the **Item** soft key.

13. Press the **Basic** soft key.

14. Select an item from the dialog box that is displayed. Use the **rotary knob** to select the item. Then, press SET to apply a check mark.

- **Setting a Computation**
  15. Use Calc soft key to select a computation value that uses an FFT value for that item.
  16. Select the Calc to use to apply a check mark.
      Turn the **rotary knob** to select the item. Then, press SET to apply a check mark. Select an equation from among those set by FFT analysis.
  17. Press **ESC**.
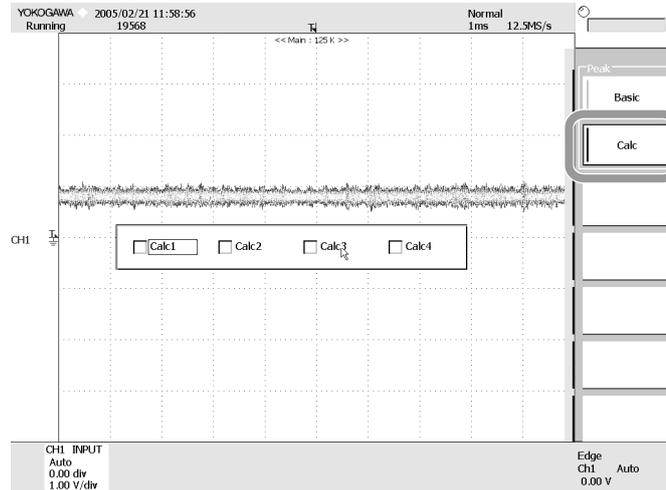
- **Setting the Determination Range**
  18. Press the **Upper/Lower** soft key to select the item to set a range.
  19. Use the **rotary knob** to set either the Upper or the Lower.

• **Selecting the Reference for Determination**
20. Press the **Condition** soft key to select from IN, OUT or X.
21. Press **ESC** to return to the GO/NO-GO menu.

Lower
0.0000

◄ Select
1

◄ Mode
Parameter

◄ Category
FFT

Window
FFT1   FFT2

◄ Item

Upper/Lower
○ 0.0000
● 0.0000
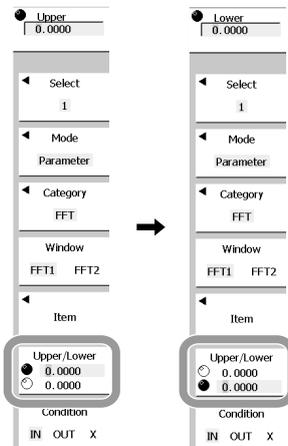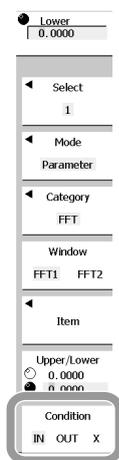
Condition
IN   OUT   X

If necessary, repeat the steps above for the determination condition numbers 1 to 4.

Explanation

GO/NO-GO determination is performed either when the values enter into the specified range or they do not enter that range using the item of the measurements of FFT, or the results of the computation that used that item.

Determination Conditions: Condition

• **Setting the Determination Conditions: Select**
Select the determination condition number for setting the determination condition. Each of the four determination conditions can be set.

• **Selecting the Window Targeted for Determination: Window**
Use the marker loaded values of the selected FFT window.
See section 11.6 for details on setting using FFT.

• **Selecting a Search Item: Item**
Select the item to use in determination from the measured items of the window selected using the window to target for determination.
• Basic: Select one from the six types.
• Calc: Select when using a computation that uses the computed values of FFT. Select from Calc 1 to Calc 4.
See section 11.6 for details on setting each item.

• **Setting the Determination Range: Upper/Lower**
Sets the upper and lower limit values for the values of the specified determination item.

• **Selecting the Reference for Determination: Condition**
• IN: Performs NO-GO when the value of the item targeted for determination is within the upper and lower limit values.
• OUT: Performs NO-GO when the value of the item targeted for determination is outside of the upper and lower limit values.
• X: GO/NO-GO determination is not performed.

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Acquisition and Display

7.15 Setting the XY Waveform Parameter GO/NO-GO Determination Conditions

Setting the GO/NO-GO Determination Mode

1. Press **SHIFT** + **TRIG MODE/HOLD OFF**.
2. Press the **Action on TRG** soft key.
3. Press the **Zone/Param** soft key.
4. Press the **Condition** soft key.

- **Selecting the Determination Condition Number**

5. Press the **Select** soft key.
6. Select the determination condition number. Press the soft key corresponding to the number to be set.

- **Setting the Determination Mode**
    7.   Press the **Mode** soft key.
    8.   Press the **Parameter** soft key.
    9.   Press the **Category** soft key.
    10. Press the **XY** soft key.
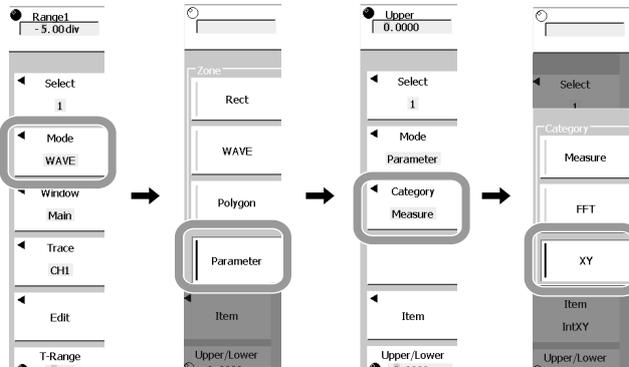
Setting the Determination Conditions

- **Selecting the Window Targeted for Determination**
    11. Press the **Window** soft key to select XY1 (XY of Window 1) or XY2 (XY of Window 2).
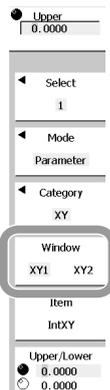
- **Setting the Determination Range**
    12. Press the **Upper/Lower** soft key to select the item to set a range.
    13. Use the **rotary knob** to set either the Upper or the Lower.

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Acquisition and Display

- **Selecting the Reference for Determination**
  14.   Press the **Condition** soft key to select from IN, OUT or X.
  15.   Press **ESC** to return to the GO/NO-GO menu.
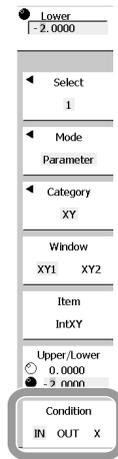
```
●  Lower
   - 2. 0000

◄    Select
       1

◄    Mode
     Parameter

◄  Category
       XY

     Window
   XY1    XY2

     Item
     IntXY

   Upper/Lower
○    0. 0000
●  - 2. 0000

    Condition
   IN   OUT   X
```

If necessary, repeat the steps above for the determination condition numbers 1 to 4.

Explanation

Perform GO/NO-GO determination is performed either when the values enter into the specified range or they are outside of that range using the measured XY waveform value.

Determination Conditions: Condition

- **Setting the Determination Conditions: Select**
  Select the determination condition number for setting the determination condition.
  Each of the four determination conditions can be set.

- **Selecting the Window Targeted for Determination: Window**
  - XY1: Targets XY window 1 waveforms.
  - XY2: Targets XY window 2 waveforms.

- **Setting the Determination Range: Upper/Lower**
  Sets the upper and lower limit values for the values of the specified determination item.

- **Selecting the Reference for Determination: Condition**
  - IN: Performs NO-GO when the value of the item targeted for determination is within the upper and lower limit values.
  - OUT: Performs NO-GO when the value of the item targeted for determination is outside of the upper and lower limit values.
  - X: GO/NO-GO determination is not performed.

7.16 Setting the Telecom Test GO/NO-GO Determination Conditions

Setting the GO/NO-GO Determination Mode
1. Press **SHIFT** + **TRIG MODE /HOLD OFF**.
2. Press the **Action on TRG** soft key.
3. Press the **Telecom Test** soft key.
4. Press the **Condition** soft key.

· **Selecting the Determination Condition Number**
5. Press the **Select** soft key.
6. Select the determination condition number. Press the soft key corresponding to the number.

- **Setting the Item**
  7. Press the **Item** soft key. The item setting menu appears.
  8. Press the soft key corresponding to the element to be set.
  9. With the rotary knob, move the cursor to the item, from Wave Count, Wave Count %, Sampling Point Count, and Sampling Point Count %, to be set for the GO/NO-GO determination.
  10. Press **SET**. This places a check mark in the checkbox.
  11. Repeat steps 8 to 10 as required, to set other elements.
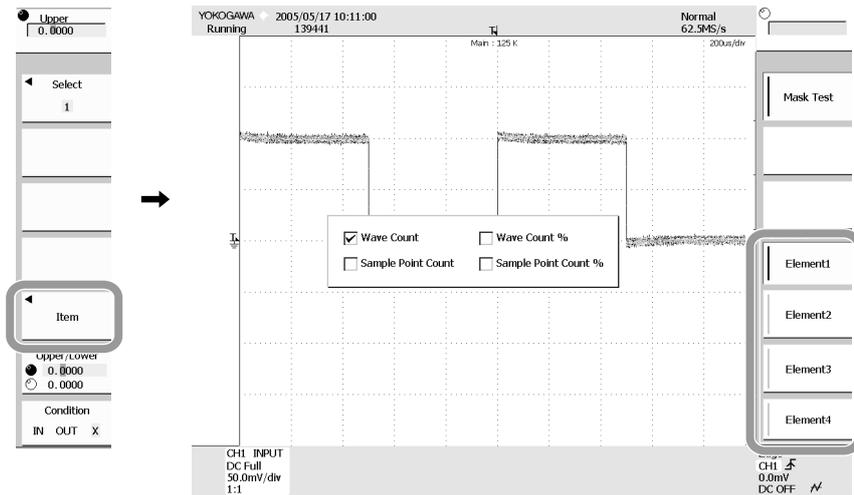
- **Setting the Determination Range**
  12. Press the **Upper/Lower** soft key, and select the item for which the range is to be set.
  13. With the **rotary knob**, select Upper or Lower.
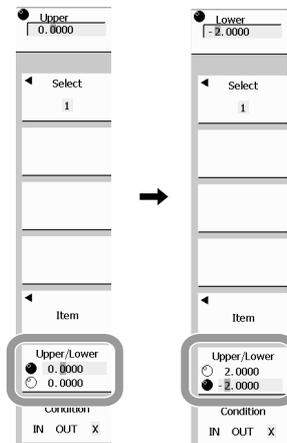
• **Selecting the Determination Criterion**
14. Press the **Condition** soft key, and select IN, OUT, or X.
15. Press **ESC**, and return to the GO/NO-GO menu.

Lower
- 2.0000

◄ Select
1

◄ Item

Upper/Lower
○ 2.0000

Condition
IN OUT X

Carry out the above procedure for determination conditions numbers 1 to 4 as required.

Explanation

Using the telecom test parameters, the GO/NO-GO determination is based on being within the range or outside the range.

Determination Condition: Condition

• **Setting the Determination Condition: Select**
Select the number of the determination condition for the determination condition to be set. Each of four determination conditions can be set.

• **Selecting the Item: Item**
The following items can be set for each of Element1 to Element4.
• Wave Count: Error count of acquisition
• Wave Count %: Error rate with respect to acquisition count
• Sampling Point Count: Error count of sample data for the element
• Sampling Point Count %: Error rate with respect to number of data samples for the element

• **Setting the Determination Range: Upper/Lower**
Set upper and lower limits for the value of the specified determination item.

• **Selecting the Determination Criterion: Condition**
• IN: When the value of the item in the determination is within the range of upper and lower limits, this is a NO-GO result.
• OUT: When the value of the item in the determination is outside the range of upper and lower limits, this is a NO-GO result.
• X: The GO/NO-GO determination is not made.

8.1　Changing the Display Format

Procedure

Setting the Display Format

1. Press **FORM**. The Format menu appears.
2. Press the **VT Form** soft key.
3. Press the soft key for the desired format, from **Single** through **Quad**.

Setting the Waveform Mapping

4. Press the **Mapping** soft key.
5. Select either Auto or Manual. If you select Auto, proceed to step 8.
6. Press the desired channel from among CH1 to CH4 and M1 to M4.
   To select M1 to M4, first switch press the **M1-M4** soft key.
7. Select the area to display the selected waveform.
8. Press **ESC**.

Mapping: When Manual is selected

8

Display

Explanation

Select the number of windows for displaying the analog waveforms. The position for the waveform of each channel varies depending on the display format.

Display Format

Single: 1 window   Triad: 3 windows
Dual: 2 windows   Quad: 4 windows

Waveform Mapping

· **Auto**
The waveforms are mapped in the order CH1, CH2, CH3, CH4, M1, M2, M3, and M4, from the top of the divided screen. When the mapping reaches the bottom of the divided screen it begins again from the top. Channels with displays that are turned OFF are excluded.

· **Manual**
Specify where to map CH1 to CH4 and M1 to M4.
The number of points that can be displayed within 8 div vertically depends on the display format (when the Main window only is displayed). The vertical resolution remains unchanged.
Single(☐): 640 points   Triad(☰): 208 points
Dual(☐): 320 points   Quad(☰): 160 points

8.2 Setting the Interpolation Method

Procedure
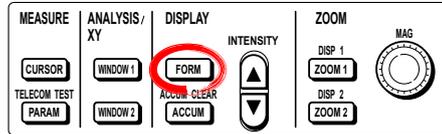
1. Press **FORM**.

Setting the Interpolation Method

2. Press the **Dot Connect** soft key.
3. Press the **OFF**, **Pulse**, **Line**, or **Sine** soft key to select the interpolation method.
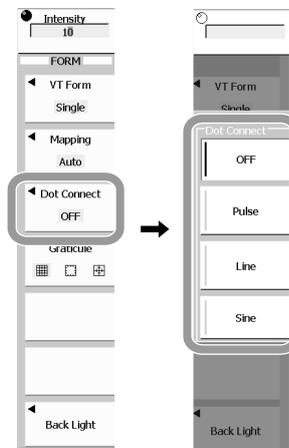
Explanation

Setting the Interpolation Method: Dot Connect

Set the method by which sampled data are connected to display the waveform. If the Main and ZOOM1 or ZOOM2 display record length is as follows, the sampled data are only connected in the vertical direction. There is no difference between Sine, Line, and Pulse.

• 4 kWord, 5 kWord
• 10 kWord or higher

If the display record length is higher than the above, new interpolation points are generated between sampled data according to the specified interpolation method, and the interpolation points are connected in the vertical axis direction.

Sine: Interpolates between two points using the (sin x)/x function.

Line: Linearly interpolates between two points.

Pulse: Interpolates between two points by drawing a horizontal line to the time of the next data point, then connecting the end of the horizontal line to the next data point with a vertical line.

OFF: No interpolation.

Interpolation Image
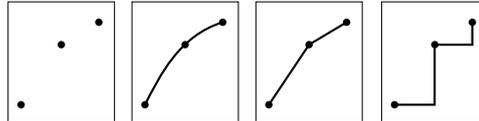
Dot Connect: OFF   Sine   Line   Pulse

8.3 Changing the Graticule

Procedure
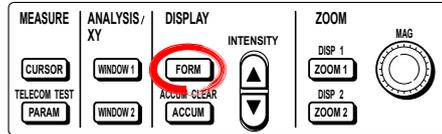
1. Press **FORM** to display the FORM menu.
2. Press the **Graticule** soft key to select the graticule.

Menu on products with firmware version 1.80 or higher
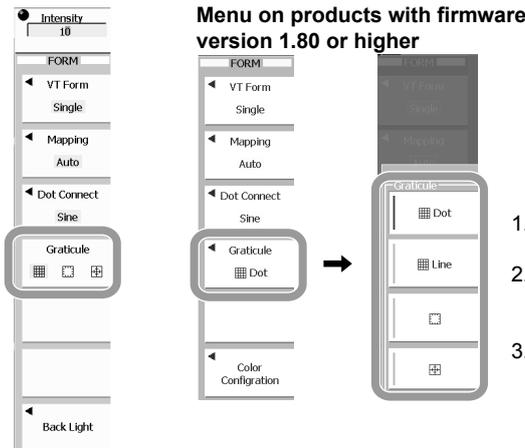
1. Press **FORM** to display the FORM menu.

2. Press the **Graticule** soft key.
   The Graticule menu appears.

3. Press the soft key corresponding to the graticule you wish to display.

Explanation

Select from the following four types. The line setting can be used on products with firmware version 1.80 or higher.

⊞ Dot
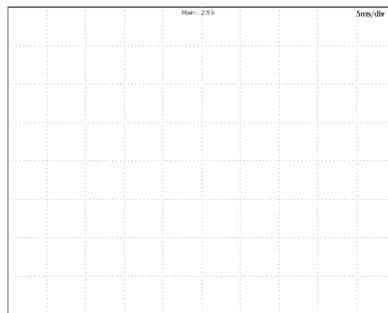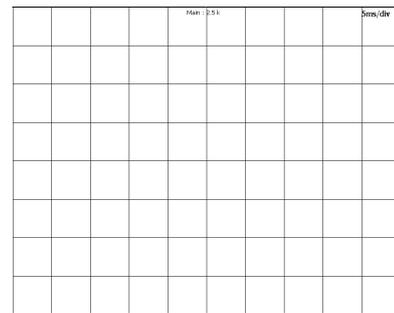
⊞ Line
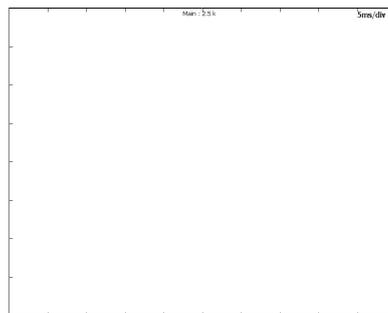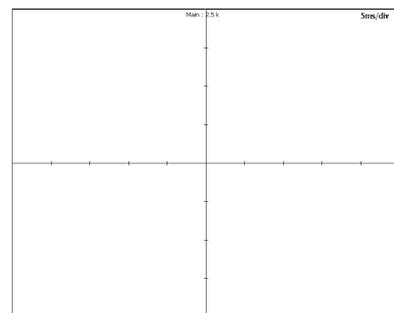
8.4 Adjusting the Backlight
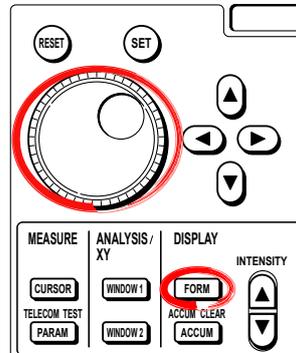
1. Press **FORM**.
2. Press the **Back Light** soft key. The LCD menu appears.

Setting Auto OFF for the Backlight

3. Press the **Auto OFF** soft key to select ON or OFF.
   If you select ON, continue with step 4.
4. Push the **Time Out** soft key to view the rotary knob.
5. Use the **rotary knob** to set the time when the backlight automatically goes off.

Setting the Backlight Brightness

6. Push the **Brightness** soft key to view the rotary knob.
7. Use the **rotary knob** to set the backlight brightness.

Turning the Backlight ON/OFF

8. Press the **LCD OFF** soft key. The backlight turns OFF.
   Press any key to return to the measurement screen.
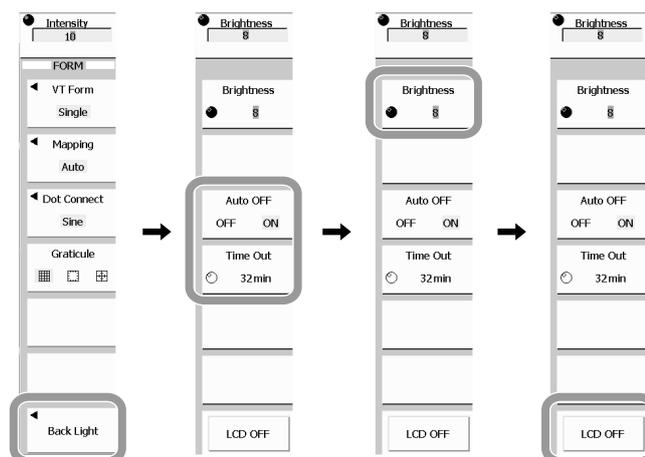
Explanation

Setting Auto OFF for the Backlight: Auto OFF, Time Out

The backlight automatically turns OFF if there is no panel key operation for the specified time.
If any key is pressed the backlight turns ON.

Setting the Backlight Brightness: Brightness

You can change the brightness of the backlight. Set it in the range from 1 (dark) to 8 (bright).
You can prolong the lifetime of the backlight by setting it to dark or turning it off when screen observation is not necessary.

Turning the Backlight ON/OFF: LCD OFF

You can turn the LCD backlight ON/OFF. If any key is pressed when the backlight is turned OFF, it turns ON.

8

Display

8.5 Setting Waveform Labels
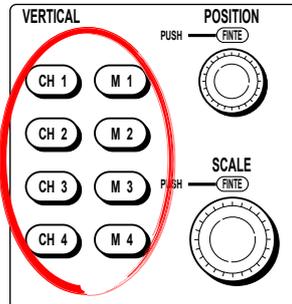
1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Press the **Next 1/2** soft key.
3. Press the **Label** soft key.

Turning the Waveform Label Display ON/OFF
4. Press the **Trace Label** (waveform label) soft key to select ON or OFF.

Setting the Waveform Label
5. Press the **Define Label** soft key. A keyboard appears.
6. Input the waveform label according to the procedure given in section 4.2.
7. When input is complete, press **ESC**.
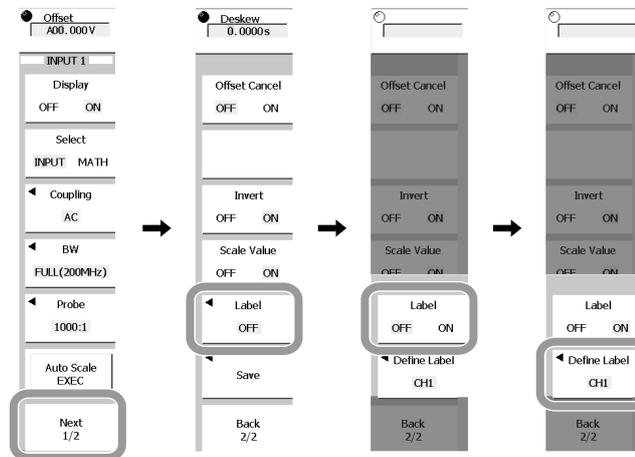
Setting the Waveform Label: Define Label
You can arbitrary set the waveform label of each channel using up to eight characters.

Turning the Waveform Label Display ON/OFF: Label
You can select whether to display the channel for the displayed waveform.

> ***Note***
>
> The waveform label may not be displayed if the waveform display area is small, depending on the display format and zoom format.

8.6 Zooming the Waveform
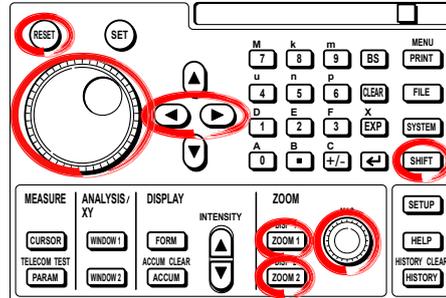
Setting the Display Format for Zoomed Waveforms

1. Push **SHIFT** + **ZOOM1** or **ZOOM2**.
2. Press the **Format** soft key.
3. Press the soft key corresponding to the desired format.
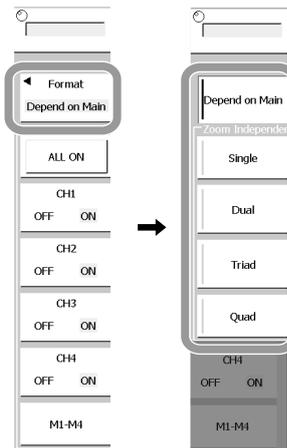
Setting the Waveform to be Displayed

4. Press the soft key for the desired waveform and select ON or OFF. To select M1 to M4, first press the **M1-M4** soft key.

8

Display

Selecting the Zoom Method

5. Push **ZOOM1** or **ZOOM2**.

6. Press the **Zoom** soft key and select ON or OFF.

   If you select OFF, the following operations have no effect.
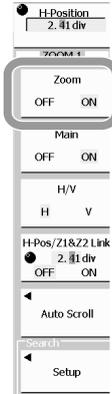
Selecting Whether to Display the Main Screen

7. Press the **Main** soft key and select ON or OFF. (If OFF is selected for Zoom then this can't be turned OFF.)
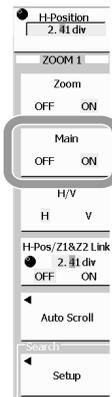
Selecting the Zoom Method

8. Press the **H/V** soft key to select the zoom method.

   H: time direction

   V: voltage direction

Time direction   **Voltage direction**
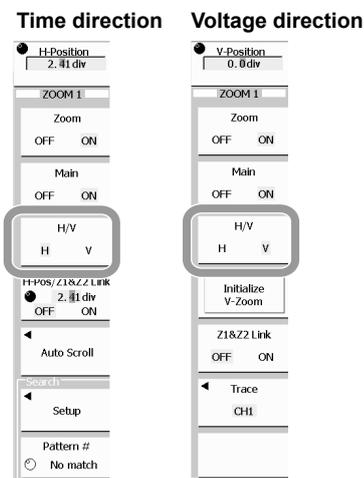
Selecting the Zoom Method

9. Set the zoom ratio with the **MAG dial**. The zoom ratio is displayed in the upper right of the screen.
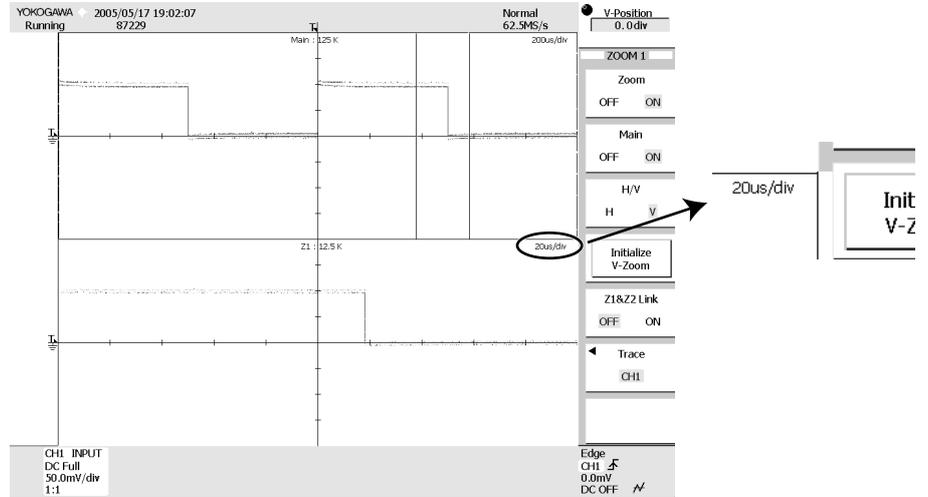
Setting the Zoom Position (in the Time Direction)

10. Set the zoom position with the **rotary knob**.

    If you press RESET, the zoom position is reset to 0.00 div.

    The column can be moved with the arrow keys.

Time direction   **Voltage direction**
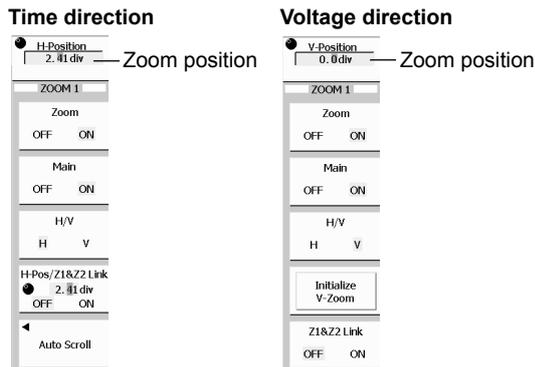
Auto Scrolling the Waveform Zoom

The procedure after selecting H for the zoom method in step 8 on page 8-10.

11. Press the **Auto Scroll** soft key.

12. Press the **Down** or **Up** soft key to switch the scroll speed.

13. Press the < , < Play , Play > , > , Stop (|◀, ◀, ▶, ▶|, ∎ on products with firmware version 1.80 or higher) soft key to execute or stop the auto scroll operation.

Menu on products with firmware version 1.80 or higher

Down — Decrease the scroll speed

Up — Increase the scroll speed

|◀ — Move to the oldest waveform

◀ — Scroll toward the older waveforms

▶ — Scroll toward the newer waveforms

▶| — Move to the most recent waveform

∎ — Stop scrolling

8

Display
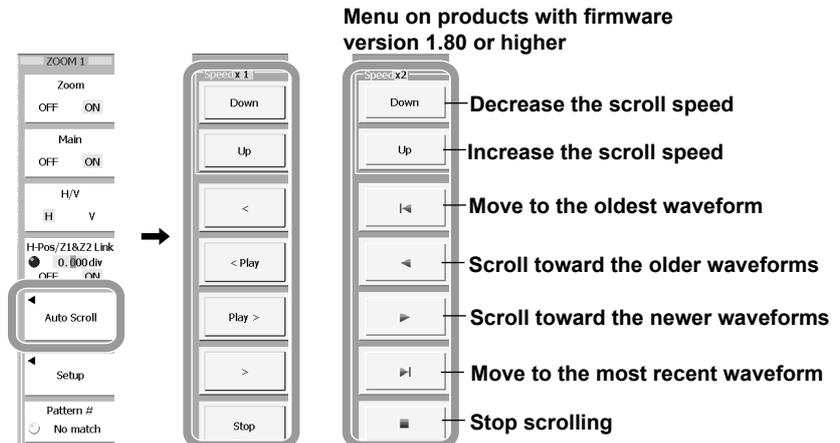
Setting the Linking of ZOOM1 and ZOOM2

11. Press the **H/V** soft key and set it to H or V.
12. When H is selected press the **H-Pos/Z1&Z2 Link** soft key, and when V is selected press the **Z1&Z2 Link** soft key, to select ON or OFF.

Time direction   **Voltage direction**
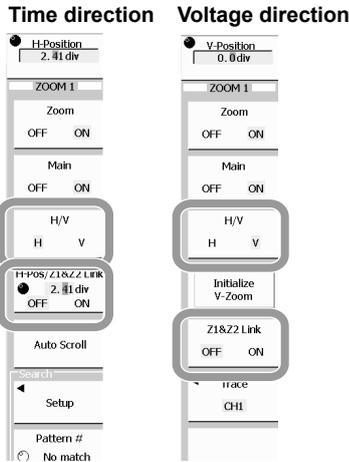
Selecting Tracing in the Voltage Direction

13. Press the **Trace** soft key.
14. Press the soft key corresponding to the desired channel. To select M1 to M4, first switch by pressing the **M1-M4** soft key.
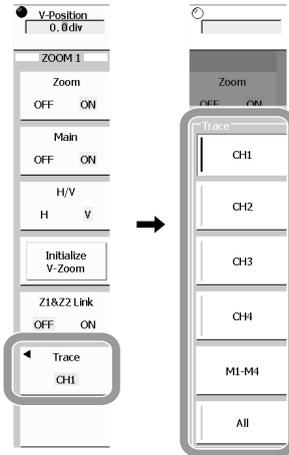
Initializing the Voltage Zoom

15. Press the **Initialize V-Zoom** soft key.
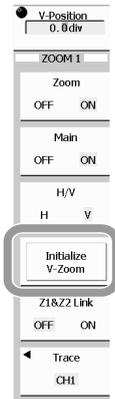
Explanation

Zoomed waveforms in two locations can be displayed simultaneously (dual zoom). You can also specify which channels to zoom. Zooming is not possible if there are less than ten points displayed on the screen (or less than 50 points for FFT waveforms).

Selecting the Waveform Zoom Method: Zoom
OFF: Displays only the main (unzoomed) waveform.
ON: Displays only the zoomed waveform of zoom box Z1 or Z2.

Selecting the Trace to be Zoomed: SHIFT + ZOOM1/ZOOM2
Traces whose Allocations were turned ON in step 4 are zoomed. Traces whose Allocations have been turned OFF are not zoomed. You cannot zoom traces whose displays are turned OFF.

Display Format of Zoomed Waveforms: Format
As for unzoomed waveforms, you can select among six display formats (Depend on Main*, Single, Dual, Triad, and Quad).
>   *   If "Depend on Main" is selected then the same DISPLAY menu as for the Main Format appears.

Zoom Ratio: MAG Dial
*   Specify the factor for the horizontal (H Zoom) and vertical (V Zoom) directions of ZOOM1 and ZOOM2.
*   The zoom can be increased such that up to ten data points can be displayed horizontally in the Window, and up to a factor of 10 can be displayed vertically.
*   You can specify independent horizontal and vertical zoom factors for ZOOM1 or ZOOM2.
*   The horizontal zoom applies to the entire waveform displayed in the window.
*   The vertical zoom applies only to the one waveform in the window that is specified.

Zoom Position: H-Position / V-Position
*   The zoom position can be set by specifying the zoom center position (center of the zoom box) in the range of –5 to +5 divisions with the center of the waveform display frame set to 0 div. The following step is used.
    Zoom position step: T/div × 10 / (display record length)
*   The zoom box enclosed by solid lines is Z1 and the one enclosed by dashed lines is Z2. Since each box is independent, you can set the positions separately.

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Display

Setting Linked Zoom: H-Pos/Z1&Z2 Link, Z1&Z2 Link

ON: Set it while preserving the difference between the ZOOM1 and ZOOM2 voltage positions.

OFF: Do not preserve the difference between the ZOOM1 and ZOOM2 voltage positions.

Voltage Zoom Initialization: Initialize V-Zoom

Initialize the settings for the voltage zoom ratio and zoom position.

8.7 Zooming a Searched Portion

Procedure
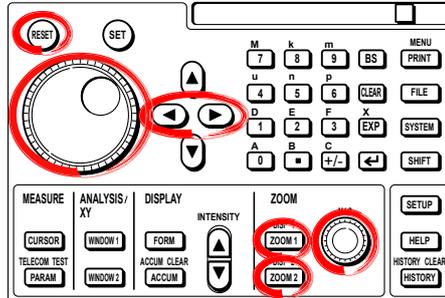
1. Push **ZOOM1** or **ZOOM2**. The ZOOM menu appears.
2. Press the **H/V** soft key, and select H.
3. Press the **Setup** soft key. This displays a menu used to set the search conditions.
4. Press the **Search Type** soft key. The menu appears for selecting the Search Type. Search types are the same as trigger types.
5. Press the soft key for the search condition.
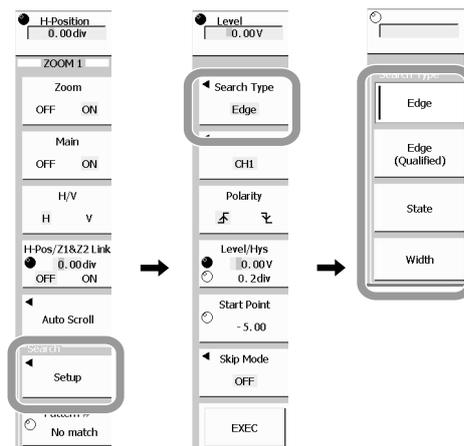
Searching for an Edge

6. Select Edge in step 5.

Setting the Desired Waveform

7. Press the **Source** soft key. The menu appears for selecting the desired waveform.
8. Push the soft key for any of CH1 to CH4 or M1 to M4.
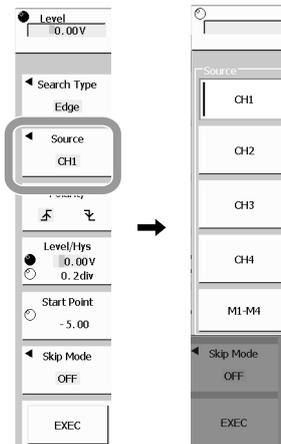
Setting the Slope

9. Press the **Polarity** soft key to select Rising or Falling.

Setting the Status Determination Level and Hysteresis

10. Press the **Level/Hys** soft key.
11. Use the **rotary knob** to set the search level and hysteresis. Pressing the soft key switches the rotary knob between the determination level and the hysteresis.

Setting the Search Start Point

12. Press the **Start Point** soft key.
13. Set the search start point with the **rotary knob**.

Setting Skip Mode

14. Set skip mode when necessary.

    Press the **Skip Mode** soft key. The Skip Mode menu appears.

15. Press the soft key for **OFF**, **Hold Off**, or **Decimation**.

16. Press **ESC** to return to the previous screen.

17. Use the **rotary knob** to set the skip time or the number of searches.

Skip time (Hold Off) or
Skip number (Decimation)
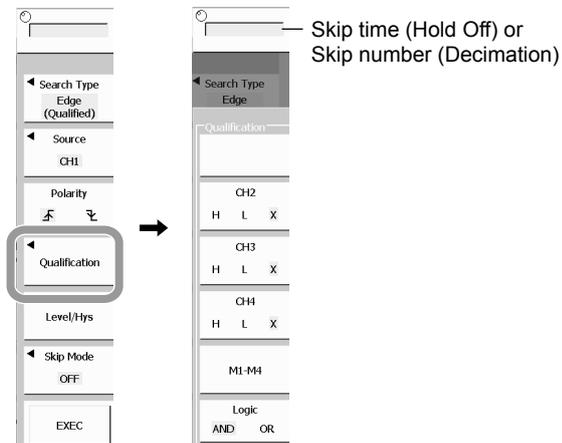
Executing the Search

18. Press the **EXEC** soft key. The portion that satisfies the search condition is displayed in the zoom screen.

Searching for an Edge (Qualified)

19. Select Edge (Qualified) in step 5.

Setting the Waveform

20. Press the **Source** soft key. The menu appears for selecting the desired waveform.

21. Push the soft key for any of CH1 to CH4 or M1 to M4.
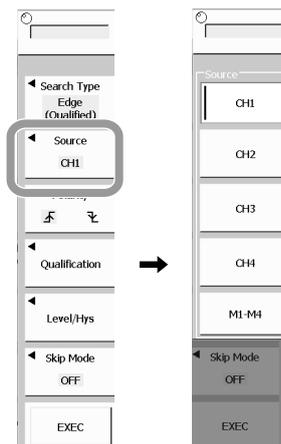
Setting the Slope

22. Press the **Polarity** soft key to select Rising or Falling.

Setting the Qualification

23. Press the **Qualification** soft key. This displays a menu used to set the qualification.
24. Use the soft key to set the status of CH1 to CH4 and M1 to M4.
      H: High   L: Low   X: No effect
25. Press the **Logic** soft key to select AND or OR.
26. Press **ESC** to return to the previous screen.
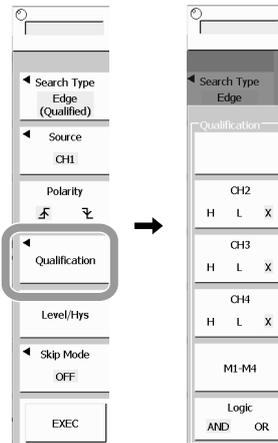
Setting the Status Determination Level and Hysteresis

27. Press the **Level/Hys** soft key. The menu appears for setting the determination level and hysteresis.
28. Press the soft key for the waveform and use the **rotary knob** to set the determination level and hysteresis. Pressing the soft key switches the rotary knob between the determination level and the hysteresis.
29. Press **ESC** to return to the previous screen.
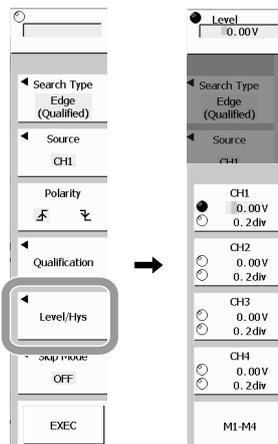
Setting Skip Mode

30. Set skip mode when necessary.
      Press the **Skip Mode** soft key. The Skip Mode menu appears.
31. Press the soft key for **OFF**, **Hold Off**, or **Decimation**.
32. Use the **rotary knob** to set the skip time or the number of searches.
33. Press **ESC** to return to the previous screen.

Executing the Search

34. Press the **EXEC** soft key. The portion that satisfies the search condition is displayed in the zoom screen.

Searching for a State

35. Select State in step 5.

Setting the State

36. Press the **State** soft key. This displays a menu used to set the state.
37. Use the soft key to set the status of CH1 to CH4 and M1 to M4.

   H: High   L: Low   X: No effect

   Set the slope for the clock channel.
38. Press the **Logic** soft key to select AND or OR.
39. Press the **Clock** soft key. Displays a menu used to select the clock channel.
40. Press the soft key for the waveform to set for the clock channel.
41. Press **ESC** to return to the previous screen.
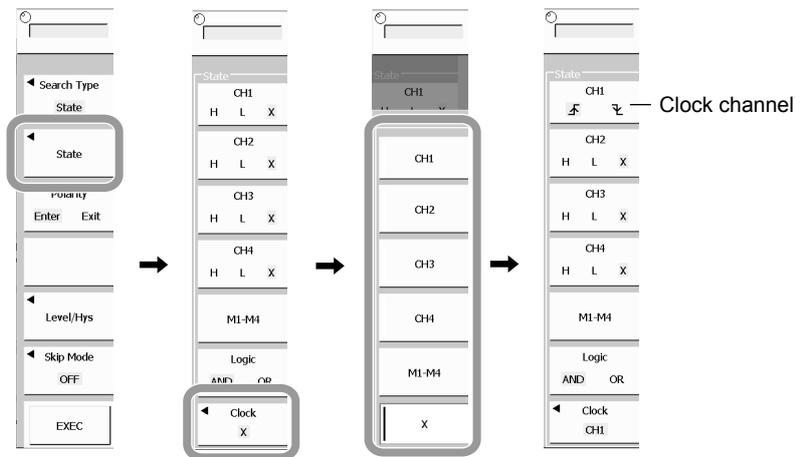
Setting the Conditions

42. Press the **Polarity** soft key and select Enter or Exit.

Setting the Status Determination Level and Hysteresis

43. Press the **Level/Hys** soft key. The menu appears for setting the determination level and hysteresis.
44. Press the soft key for the waveform and use the **rotary knob** to set the determination level and hysteresis. Pressing the soft key switches the rotary knob between the determination level and the hysteresis.
45. Press **ESC** to return to the previous screen.
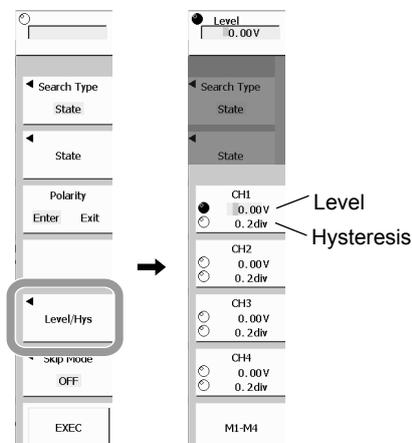
Setting Skip Mode

46.   Set skip mode when necessary.
      Press the **Skip Mode** soft key. The Skip Mode menu appears.
47.   Press the soft key for **OFF**, **Hold Off**, or **Decimation**.
48.   Use the **rotary knob** to set the skip time or the number of searches.
49.   Press **ESC** to return to the previous screen.

Executing the Search

50.   Press the **EXEC** soft key. The portion that satisfies the search condition is displayed in the zoom screen.

Searching for a Pulse Width

51.   Select Width in step 5.

Setting the Type

52.   Press the **Setup** soft key. This displays a menu used to set the type.
53.   Press the **Pulse** soft key to set the type to Pulse.

Setting the Mode

54.   Press the **Mode** soft key. The menu appears for setting the determination method for the specified time.
55.   Press the soft key for one of **More than**, **Less than**, **Between**, **Out of Range**, and **Time Out**.

Setting the Determination Standard Time

56.   Press the **Time** soft key and use the rotary knob to set the determination standard time.
57.   Press **ESC** to return to the previous screen.
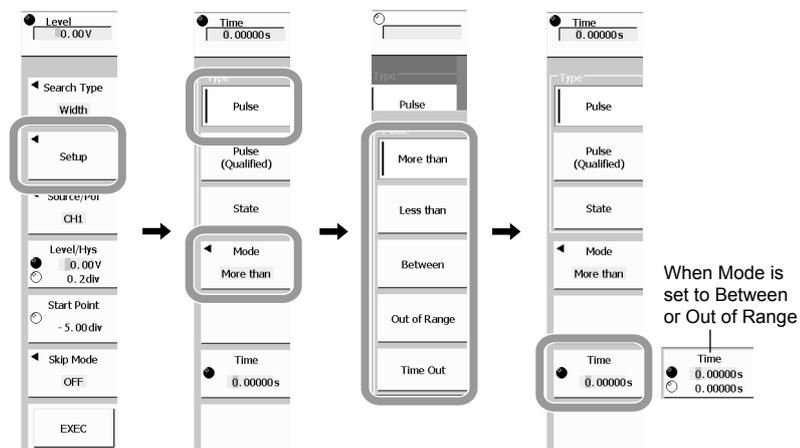
Setting the Waveform and State Polarity

58. Press the **Source/Pol** soft key. The menu appears for selecting the desired waveform.

59. Push the soft key for any of CH1 to CH4 or M1 to M4.

60. Press the **Polarity** soft key and set the state polarity to Pos or Neg.

61. Press **ESC** to return to the previous screen.
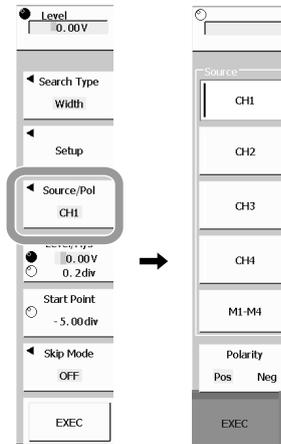
Setting the Status Determination Level and Hysteresis

62. Press the **Level/Hys** soft key.

63. Use the **rotary knob** to set the determination level and hysteresis. Pressing the soft key switches the rotary knob between the determination level and the hysteresis.

Setting the Search Start Point

64. Press the **Start Point** soft key.

65. Set the search start point with the **rotary knob**.

Setting Skip Mode

66. Set skip mode when necessary.
     Press the **Skip Mode** soft key. The Skip Mode menu appears.

67. Press the soft key for **OFF**, **Hold Off**, or **Decimation**.

68. Use the **rotary knob** to set the skip time or the number of searches.

69. Press **ESC** to return to the previous screen.

Executing the Search

70. Press the **EXEC** soft key. The portion that satisfies the search condition is displayed in the zoom screen.

8

Display

Searching for a Pulse Width (Qualified)

71. Select Width in step 5.

Setting the Type

72. Press the **Setup** soft key. This displays a menu used to set the type.
73. Press the **Pulse (Qualified)** soft key to set the type to Pulse (Qualified).

Setting the Mode

74. Press the **Mode** soft key. The menu appears for setting the determination method for the specified time.
75. Press the soft key for one of **More than**, **Less than**, **Between**, **Out of Range**, and **Time Out**.

Setting the Determination Standard Time

76. Press the **Time** soft key and use the rotary knob to set the determination standard time.
77. Press **ESC** to return to the previous screen.
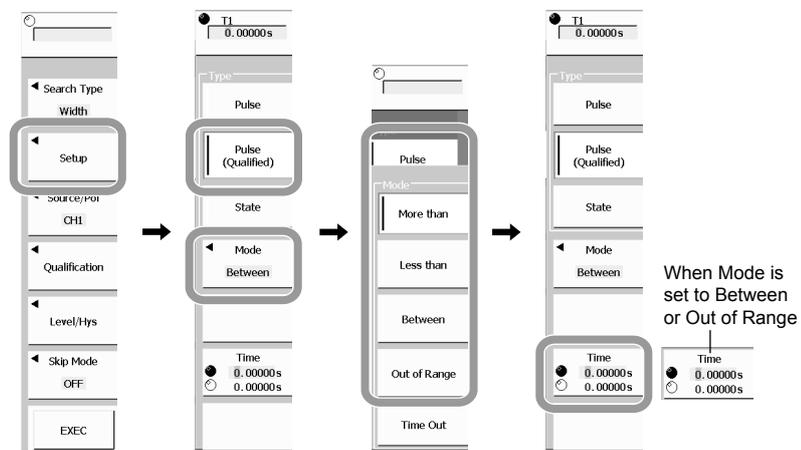
Setting the Waveform and State Polarity

78. Press the **Source/Pol** soft key. The menu appears for selecting the desired waveform.
79. Push the soft key for any of CH1 to CH4 or M1 to M4.
80. Press the **Polarity** soft key and set the state polarity to Pos or Neg.
81. Press **ESC** to return to the previous screen.
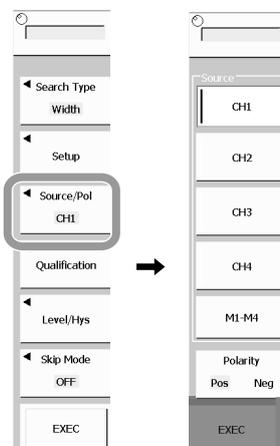
Setting the Qualification
82. Press the **Qualification** soft key. This displays a menu used to set the qualification.
83. Use the soft key to set the status of CH1 to CH4 and M1 to M4.
    H: High   L: Low   X: No effect
84. Press the **Logic** soft key to select AND or OR.
85. Press **ESC** to return to the previous screen.
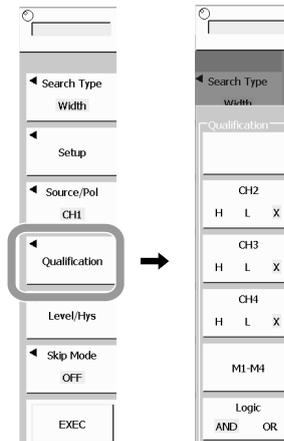
Setting the Status Determination Level and Hysteresis
86. Press the **Level/Hys** soft key. The menu appears for setting the determination level and hysteresis.
87. Press the soft key for the waveform and use the **rotary knob** to set the determination level and hysteresis. Pressing the soft key switches the rotary knob between the determination level and the hysteresis.
88. Press **ESC** to return to the previous screen.
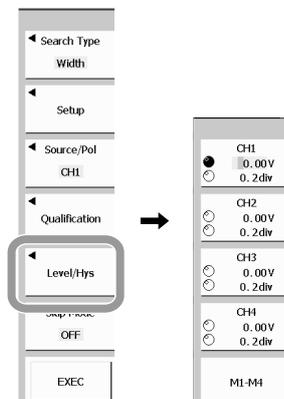
Setting Skip Mode
89. Set skip mode when necessary.
    Press the **Skip Mode** soft key. The Skip Mode menu appears.
90. Press the soft key for **OFF**, **Hold Off**, or **Decimation**.
91. Use the **rotary knob** to set the skip time or the number of searches.
92. Press **ESC** to return to the previous screen.

Executing the Search
93. Press the **EXEC** soft key. The portion that satisfies the search condition is displayed in the zoom screen.

Search for a State Condition Width

94. Select Width in step 5.

Setting the Type

95. Press the **Setup** soft key. This displays a menu used to set the type.
96. Press the **Pulse** soft key to set the type to State.

Setting the Mode

97. Press the **Mode** soft key. The menu appears for setting the determination method for the specified time.
98. Press the soft key for one of **More than**, **Less than**, **Between**, **Out of Range**, and **Time Out**.

Setting the Determination Standard Time

99. Press the **Time** soft key and use the rotary knob to set the determination standard time.
100. Press **ESC** to return to the previous screen.
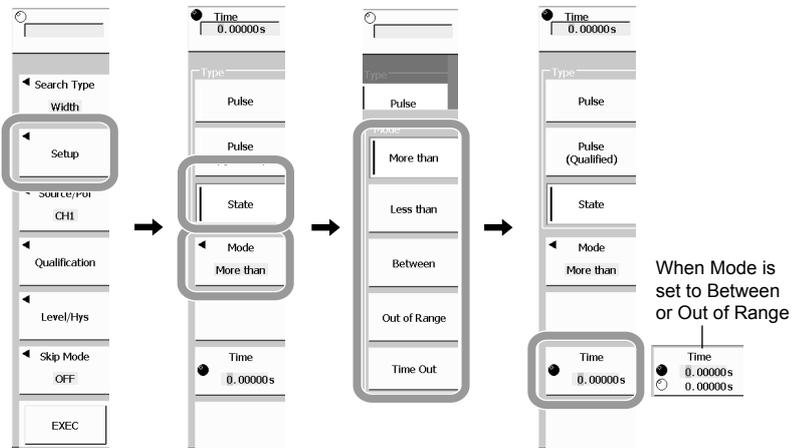
Setting the State

101. Press the **State** soft key. This displays a menu used to set the state.
102. Use the soft key to set the status of CH1 to CH4 and M1 to M4.

   H: High   L: Low   X: No effect

   Set the slope for the clock channel.
103. Press the **Logic** soft key to select AND or OR.
104. Press the **Clock** soft key. This displays a menu used to select the clock channel.
105. Press the soft key for the waveform to set for the clock channel.
106. Press **ESC** to return to the previous screen.
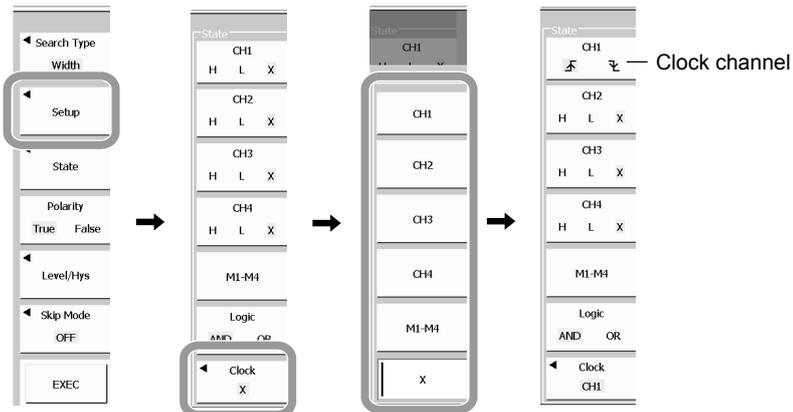
Setting the Waveform and State Polarity

107. Press the **Polarity** soft key and set the state condition to True or False.

Setting the Status Determination Level and Hysteresis

108. Press the **Level/Hys** soft key. The menu appears for setting the determination level and hysteresis.

109. Press the soft key for the waveform and use the **rotary knob** to set the determination level and hysteresis. Pressing the soft key switches the rotary knob between the determination level and the hysteresis.

110. Press **ESC** to return to the previous screen.
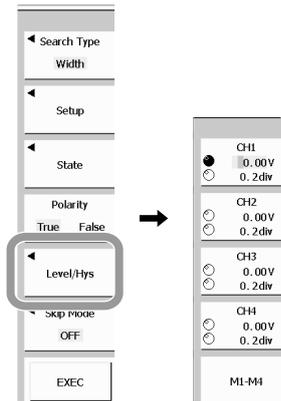
Setting Skip Mode

111. Set skip mode when necessary.
     Press the **Skip Mode** soft key. The Skip Mode menu appears.

112. Press the soft key for **OFF**, **Hold Off**, or **Decimation**.

113. Use the **rotary knob** to set the skip time or the number of searches.

114. Press **ESC** to return to the previous screen.

Executing the Search

115. Press the **EXEC** soft key. The portion that satisfies the search condition is displayed in the zoom screen.

Explanation

Search for a portion of the displayed trace that satisfies a certain condition and magnify it.

Search Type

There are the following four types of searches. The search method is the same as for the Edge, State, or Width trigger. For details see section 2.4 or chapter 6.

- **Edge**

  Search for a position where the trace of the specified channel crosses (rising or falling) a certain level. This is the same as the Edge trigger. (See section 6.7.)

- **Edge(Qualified)**

  Search for a position such that the state of the trace satisfies the specified condition and the trace of a separately specified channel rises or falls to a certain level. This is the same as the Edge (Qualified) trigger. (See section 6.8.)

- **State**

  Search for a position where the AND or OR of the trace states does or does not hold. This is the same as the State trigger. (See section 6.9.)

- **Width**

  Search for a position where the trace pulse width satisfies a fixed condition. The following five conditions are available.

  - More than: search for the final edge of a pulse longer than the specified time.
  - Less than: search for the final edge of a pulse shorter than the specified time.
  - Between: Search for the final edge of a pulse longer than the specified time T1 and shorter than T2.
  - Out of Range: Search for the final edge of a pulse shorter than a specified time T1 or longer than T2.
  - Time Out: Search for a position where the pulse width has exceeded the specified time.

  There are the following three additional types of pulse widths.

  - Pulse: Search for a relationship between the pulse width of a single source and a specified time.
  - Pulse (Qualified): While each trace state satisfies a given condition, search for a relationship between the pulse width of a single source trace and a specified time.
  - State: Searches for one of the following positions.
    - The position where there is a relationship between the time during which a logical condition (state) of a specified trace has been satisfied, or not satisfied, and a specified time.
    - Checks the logical condition (state) of a specified trace with the rising or falling timing of a specified trace (clock channel) and normalizes that logical condition (if the logical condition is satisfied then H, if not satisfied then L). The position is where it is first confirmed that the relationship is satisfied between the time that the normalized condition holds or doesn't hold and the specified time.

Skip

After searching for a position where the search condition is satisfied, skip by a fixed time or to the position such that the search condition has held a specified number of times.

- OFF: Search for all the portions that satisfy the search condition.
- Hold Off: Skip searching for the specified time.
- Decimation: Skip search positions for a specified number of times.

8.8   Taking and Clearing Snapshots

Procedure
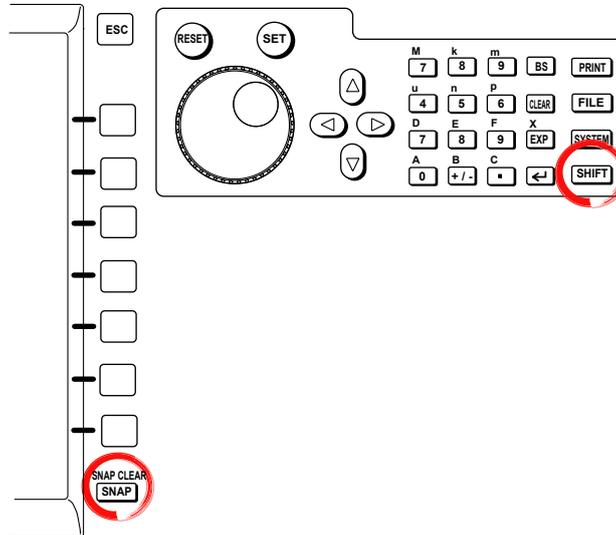
Taking a Snapshot

Press **SNAP**. The snapshot is taken.

Clearing a Snapshot

Press **SHIFT** + **SNAP**. The waveform is cleared.

Explanation

Snapshot

The snapshot function keeps the current displayed waveform on the screen. You can update the display without stopping the waveform acquisition. This function is useful in situations such as when you wish to compare waveforms.

*   You cannot perform the following operations on snapshot waveforms.
    Cursor measurements, automated measurement of waveform parameters, zoom, and computation
*   Snapshot waveforms can be saved and loaded in bitmap format. (See section 13.8.)

Clearing Snapshots

*   Clears all the snapshot waveforms that are currently displayed on the screen.

Conditions That Disable the SNAP and SNAP CLEAR Keys

*   When printing, during auto setup, and while the storage medium is being accessed.
*   When GO/NO-GO determination, action-on-trigger, or waveform search is in progress.

8.9 Setting the Waveform Display Color and the Brightness of the Grid, Zoom Box, Cursor, and Marker
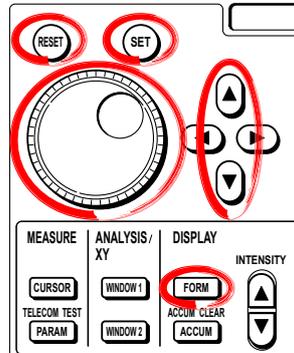
1. Press the **FORM** soft key.
2. Press the **Color Configuration** soft key.

Setting the Waveform Display Color

3. Press the **Waveform** soft key to display the Waveform menu.
4. Press the **CH1** to **CH4**, **REF1**-**REF4**, **MATH1**-**MATH4** soft key to select the waveform of which you wish to change the color.
   - Pressing the REF1-REF4 soft key opens the REF1, REF2, REF3, and REF4 soft keys.
   - Pressing the MATH1-MATH4 soft key opens the MATH1, MATH2, MATH3, and MATH4 soft keys.
5. Turn the **rotary knob** or **up and down arrow keys** to select the display color.
6. Press **SET** to confirm the color.
   To reset to the default value, press **RESET**. Only the brightness of the waveform selected in step 4 is reset to its default value.
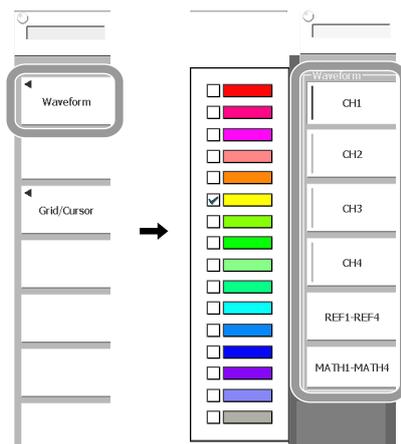
Setting the Brightness of the Grid, Zoom Box, Cursor, and Marker

3. Press the **Grid/Cursor** soft key.

4. Press any of the **Grid, Zoom Box, Cursor, and Marker** soft keys to select the item of which you wish to change the brightness.

5. Turn the **rotary knob** to set the brightness.
    To reset to the default value, press **RESET**. Only the brightness of the item selected in step 4 is reset to its default value.
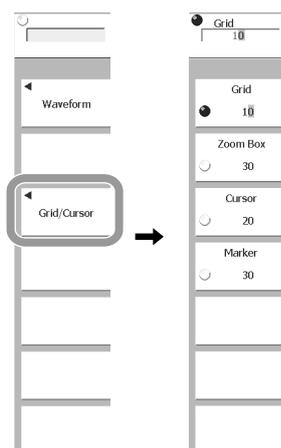
Explanation

You can set the waveform display color and the brightness of the grid, zoom box, cursor, and marker. This function can be used on products with firmware version 1.80 or higher.

Setting the Waveform Display Color

The waveform color of input waveforms CH1 to CH4*, reference waveforms REF1 to REF4, and computation waveforms MATH1 to MATH4 can be selected from 16 colors.

*   If computation waveforms are assigned to input channels, CH1 to CH4 correspond to MATH5 to MATH8, respectively. And, the colors of CH1 to CH4 are assigned to the corresponding computation channels.

Setting the Brightness of the Grid, Zoom Box, Cursor, and Marker

You can set the brightness of the grid, zoom box, cursor, and marker.
Selectable range: 0 to 31

Resetting

Press RESET to reset the waveform display color or the brightness of the grid, zoom box, cursor, or marker to the default value.

9.1   Linear Scaling

Procedure
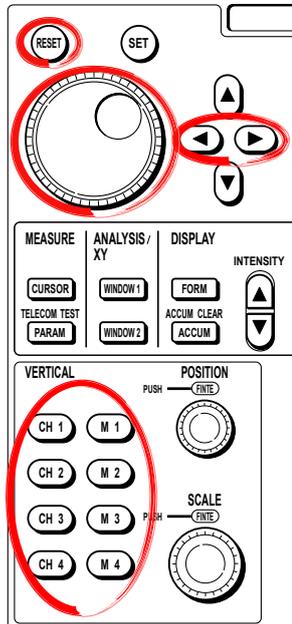
1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Press the **Select** soft key and select MATH.
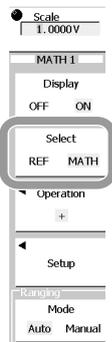
Selecting the Operator

3. Press the **Operation** soft key.
4. Press the **Filter** soft key.
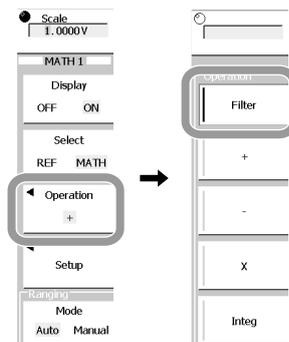
Setting the Operation

5. Press the **Setup** soft key.
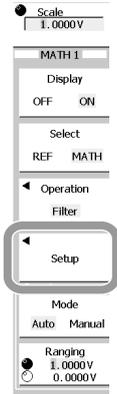
- **Setting the Waveform To Be Computed**
    6. Press the **Source** soft key. A menu used to select the waveform to be computed appears. When CH1 to CH4 on the front panel are set, the waveform to be computed is fixed to the channel that is set.
    7. Press the soft key corresponding to the desired waveform to be computed.
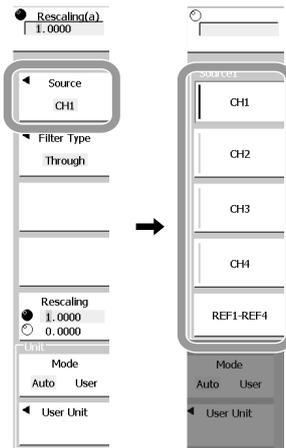
- **Setting the Filter Type**
    8. Press the **Filter Type** soft key.
    9. Press the **Through** soft key.
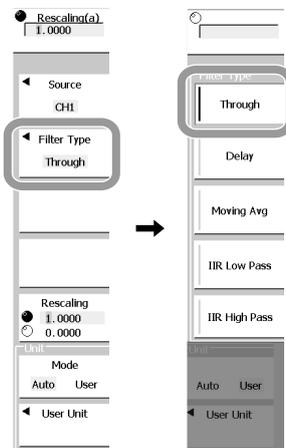
- **Setting Scalling for the Operation Results**

  10.   Press the **Rescaling** soft key.

  11.   Turn the **rotary knob** and set a and b in the linear scaling equation y = ax + b.

        Pressing RESET resets the values.

        You can use the arrow keys to move the digit that is currently being set.
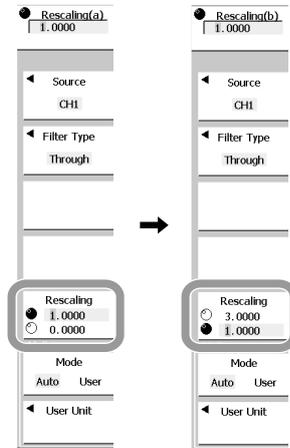
Setting the Unit

  12.   Press the **Mode** soft key to select Auto or User.

        If Auto is selected, proceed to step 15.

  13.   Press the **User Unit** soft key.

  14.   See section 4.2. Enter the unit and press the **Enter** soft key.

  15.   Press **ESC**.

9

Computation
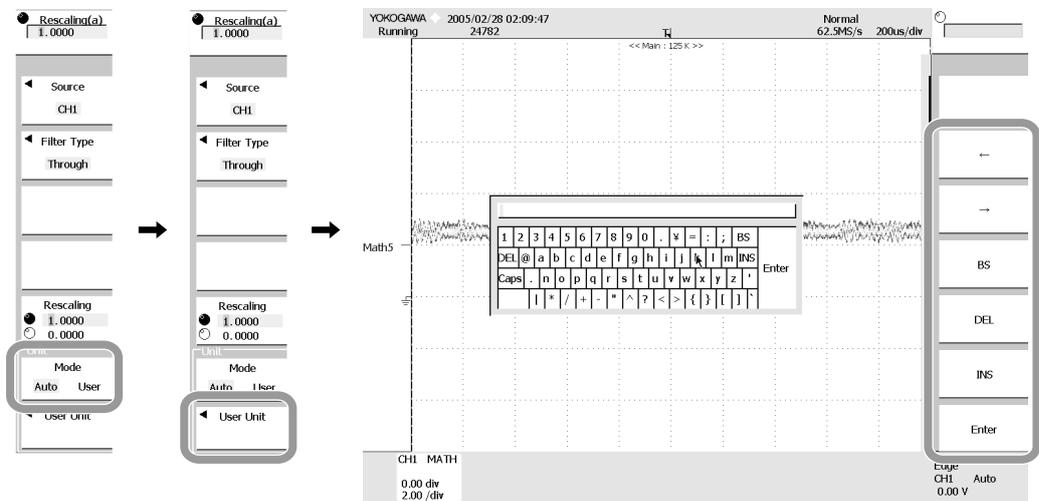
Scale Conversion (setting the display range)

16. Press the **Mode** soft key to select Auto or Manual.
17. If Manual is selected, press the **Ranging** soft key and use the rotary knob to set the voltage per division and the center position voltage.

```
●  Scale                          ●  Scale
   1.0000V                           1.0000V

   MATH 1                            MATH 1

   Display                           Display
   OFF    ON                         OFF    ON

   Select                            Select
   REF   MATH                        REF   MATH

◄  Operation            ►        ◄  Operation
   Filter                            Filter

◄                                 ◄
   Setup                             Setup

   Ranging                           Ranging
   Mode                              Mode
   Auto   Manual                     Auto   Manual

●  Ranging                        ●  Ranging ─── Voltage per division
   1.0000V                           1.0000V
○  0.0000V                        ○  0.0000V ─── Center position

   Next                              Next
   1/2                               1/2
```
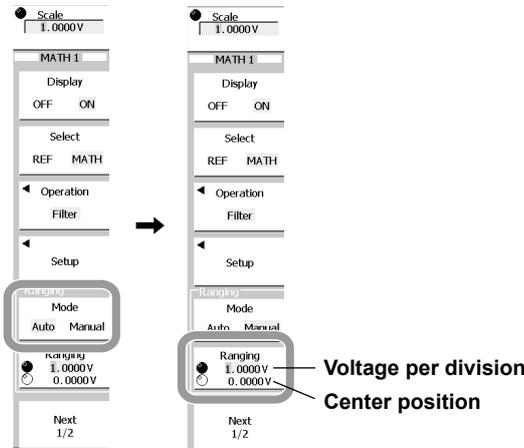
Explanation

Using the set scaling factor A and offset value B, the following expression is evaluated, and the scaled value obtained is used to display cursor measurement values and values from automatic waveform parameter measurement. It is also possible to add a unit indication to the scaled value.

Y = AX + B (X = measured value; Y = linear scaling result)

Setting Scaling Coefficient A and Offset Value B

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

Waveform to Be Computed

Select from among CH1 to CH4, or REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

Scale Conversion (Ranging)

Set the waveform display range.

Auto: The waveform display range is automatically determined based on the V/div, operator, offset value, etc., of the target waveform.

Manual: The waveform display range is determined based on the setting of the voltage per division and the center position voltage on the screen. If the operator is changed, the Auto display range changes automatically in accordance with the operator that was changed. The mode remains set to Manual.

Unit

Auto: Uses the initial value.
        Initial value: V, A, VV, AA, VA

User: A character string of up to four characters can be set.

Displaying the Scale Value

The upper and lower limits of the vertical axis of each channel can be displayed using scaled values (the Ranging function). For the procedure of displaying scale values (see section 5.12).

9.2   Performing Arithmetic Functions

Procedure
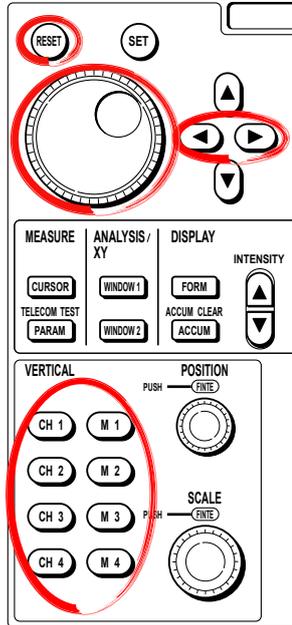
1.   Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2.   Press the **Select** soft key and select MATH.
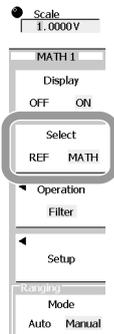
Selecting the Operator

3.   Press the **Operation** soft key.
4.   Select the operator from among CH1 **+**, **–**, or **×** and press the corresponding soft key.
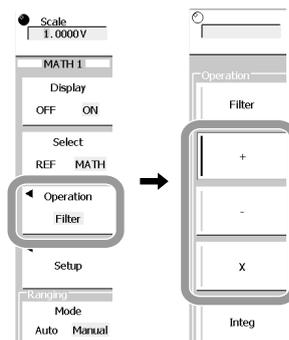
Setting the Operation

5. Press the **Setup** soft key.
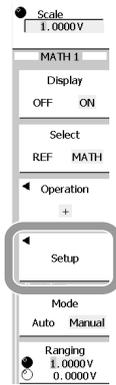
- **Selecting the Target Waveform**

6. Press the **Source1** soft key. When CH1 to CH4 on the front panel are set, the target waveform for the operation is fixed to the channel that is set.

7. Press the soft key corresponding to the target waveform. To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.
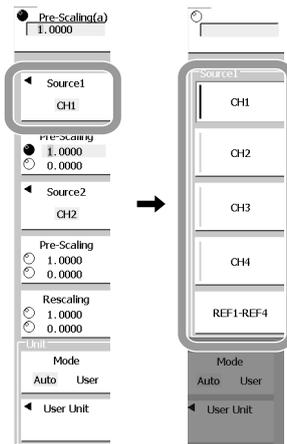
8. Press the **Source2** soft key.

9. Press the soft key corresponding to the target channel. To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.
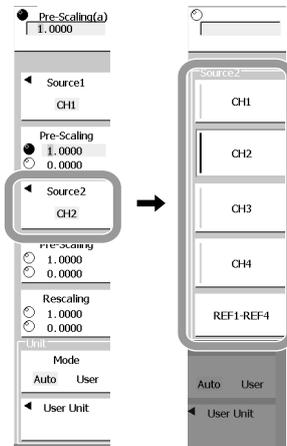
- **Setting Pre-Scaling**
  10. Press the **Pre-Scaling** soft key corresponding Source 1 or Source 2 as necessary in order to set the rotary knob target.
  11. Turn the **rotary knob** and set a and b in the scaling equation y = ax + b.
     Pressing RESET resets the values.
     You can use the arrow keys to move the digit that is currently being set.
  12. Repeat steps 8 and 9 as necessary, setting Source 1 and Source 2.
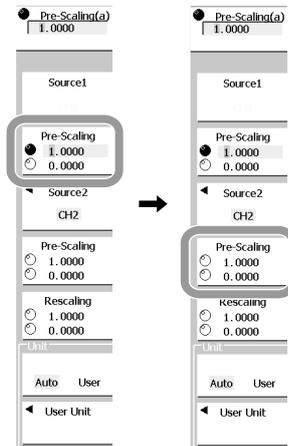
- **Setting Scaling for the Operation Results**
  13. Press the **Rescaling** function if necessary.
  14. Turn the **rotary knob** and set a and b in the scaling equation y = ax + b.
     Pressing RESET resets the values.
     You can use the arrow keys to move the digit that is currently being set.

9

Computation

Setting the Unit

15. Press the **Mode** soft key to select Auto or User.

  If you select Auto, proceed to step 18.

16. Press the **User Unit** soft key.

17. See section 4.2. Enter the unit and press the **Enter** soft key.

18. Press **ESC**.

Ranging (setting the display range)

19. Press the **Mode** soft key to select Auto or Manual.

20. If Manual is selected, press the **Ranging** soft key and use the rotary knob to set the voltage per division and the center position voltage.

Explanation

The arithmetic operation is performed on the specified trace waveform.

Waveform to Be Computed: Source1/Source2

Select from among CH1 to CH4, or REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

Scaling Prior To the Operation: Pre-Scaling

This sets scaling on pre-operation values for individual sources.

Scaling Computed Results: Rescaling

This sets scaling on computed results.

Unit

Auto: Uses the initial value.

Initial value: V, A, VV, AA, VA

User: A character string of up to four characters can be set.

Ranging

Set the waveform display range.

Auto: The waveform display range is automatically computed based on the V/div, operator, offset value, etc., of the target waveform.

Manual: The waveform display range is determined based on the setting of the voltage per division and the center position voltage on the screen.

If the operator is changed, the Auto display range changes automatically in accordance with the operator that was changed. The mode remains set to Manual.

9

Computation

9.3 Integrating

1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Press the **Select** soft key and select MATH.

Selecting the Operator

3. Press the **Operation** soft key.
4. Press the **Integ** soft key.
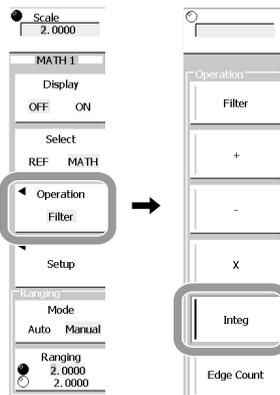
Setting the Operation

5. Press the **Setup** soft key.
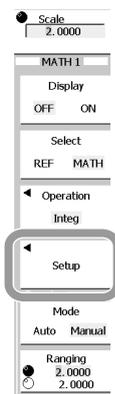
- **Setting the Target Waveform for the Operation**

6. Press the **Source** soft key. When CH1 to CH4 on the front panel are set, the target waveform for the operation is fixed to the channel that is set.

7. Press the soft key corresponding to the target waveform. To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.
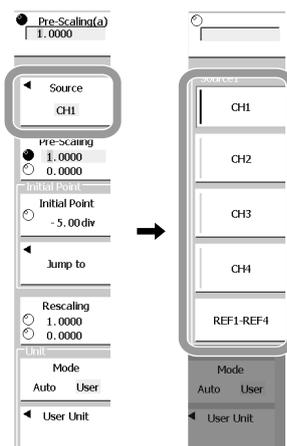
- **Setting the Input Source Scaling Prior to the Operation**

8. Press the **Pre-Scaling** soft key and change the rotary knob target.

9. Turn the **rotary knob** to set pre-scaling.

    Pressing RESET resets the values.

    You can use the arrow keys to move the digit that is currently being set.
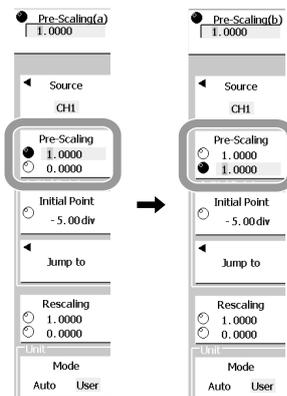
- **Setting the Operation Initial Point**
    10.   Press the **Initial Point** soft key.
    11.   Either turn the **rotary knob** to set the initial point, or else press the Jump to soft key.
    12.   If you pressed the Jump to soft key, select the Jump destination. Press the Jump destination soft key.

Setting the
initial point

Selecting the
Jump destination

- **Setting Scaling for the Operation Results**
    13.   Press the **Rescaling** soft key.
    14.   Turn the **rotary knob** to set rescaling.

        Pressing RESET resets the values.

        You can use the arrow keys to move the digit that is currently being set.

Setting the Unit

15. Press the **Mode** soft key to select Auto or User.

    If you select Auto, proceed to step 18.

16. Press the **User Unit** soft key.

17. See section 4.2. Enter the unit and press the **Enter** soft key.

18. Press **ESC**.

Ranging (setting the display range)

19. Press the **Mode** soft key to select Auto or Manual.

20. If Manual is selected, press the **Ranging** soft key and use the rotary knob to set the voltage per division and the center position voltage.

Voltage per division
Center position

9

Computation

Explanation

The specified trace waveform is integrated.

Operation Target Waveform: Source

Select from among CH1 to CH4, or REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

Setting the Operation Initial Point: Initial Point

Set the initial point of the operation.
- Item: –5 div to 5 div
- Initial value for div resolution: –5 div

The following points can be set directly (Jump to).

Trig Pos (trigger position), –5 div, 0 divisions, Zoom1 (Center of Zoom 1 enlarged position), Zoom2 (Center of Zoom 2 enlarged position)

Scaling Computed Results: Rescaling

This sets scaling on computed results.

Unit

Auto: Uses the initial value.
        Initial value: Vs, As, VVs, AAs, VAs
User: A character string of up to four characters can be set.

Ranging

Set the waveform display range.
Auto: The waveform display range is automatically computed based on the V/div, operator, offset value, etc., of the target waveform.
Manual: The waveform display range is determined based on the setting of the voltage per division and the center position voltage on the screen.
          If the operator is changed, the Auto display range changes automatically in accordance with the operator that was changed. The mode remains set to Manual.

9.4 Shifting the Phase

Procedure

1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Press the **Select** soft key and select MATH.

Selecting the Operator

3. Press the **Operation** soft key.
4. Press the **Filter** soft key.

Setting the Operation

5.   Press the **Setup** soft key.

- **Selecting the Target Waveform**
  6.   Press the **Source** soft key. When CH1 to CH4 on the front panel are set, the target waveform for the operation is fixed to the channel that is set.
  7.   Press the soft key corresponding to the target waveform. To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.
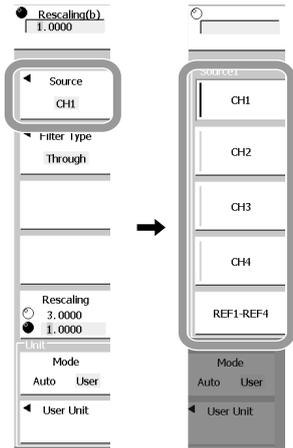
- **Setting the Filter Type**
  8.   Press the **Filter Type** soft key.
  9.   Press the **Delay** soft key.
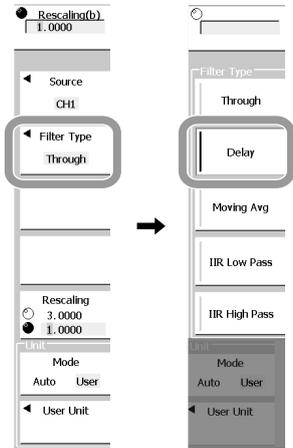
• **Setting the Time for Shifting the Phase**

10. Press the **Delay** soft key and change the rotary knob target.

11. Turn the **rotary knob** and set the time for shifting the waveform phase.

   Pressing RESET resets the values.

   You can use the arrow keys to move the digit that is currently being set.
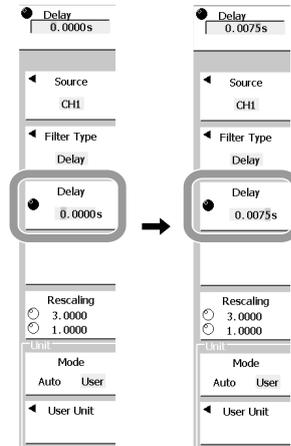
• **Setting Scaling for the Operation Results**

12. Press the **Rescaling** soft key.

13. Turn the **rotary knob** to set rescaling.

   Pressing RESET resets the values.

   You can use the arrow keys to move the digit that is currently being set.

9

Computation
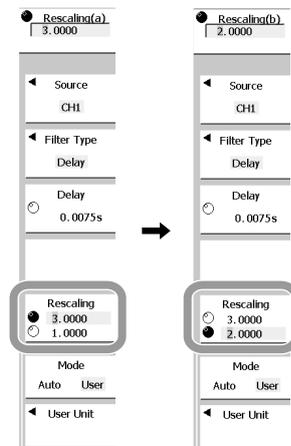
Setting the Unit

14. Press the **Mode** soft key to select Auto or User.

    If you select Auto, proceed to step 17.

15. Press the **User Unit** soft key.

16. See section 4.2. Enter the unit and press the **Enter** soft key.

17. Press **ESC**.
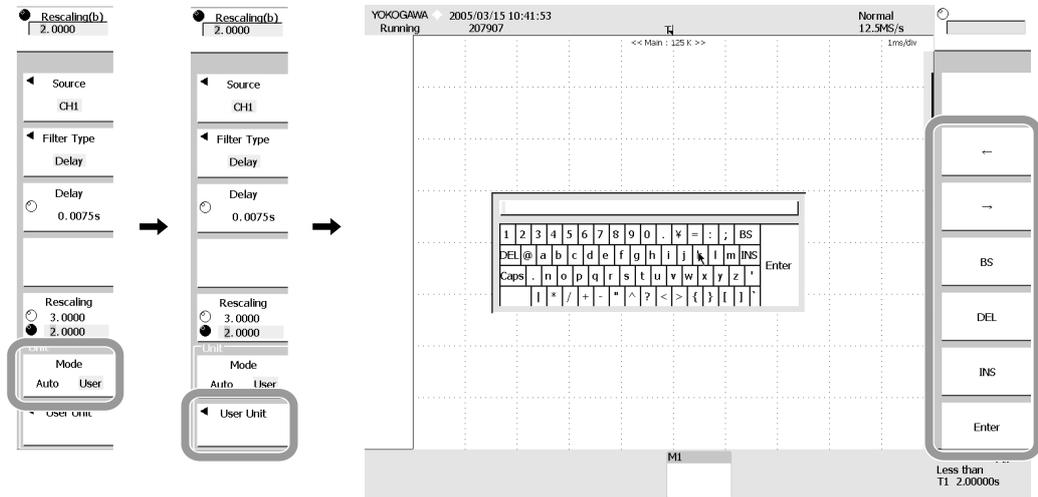
Ranging (setting the display range)

18. Press the **Mode** soft key to select Auto or Manual.

19. If Manual is selected, press the **Ranging** soft key and use the rotary knob to set the voltage per division and the center position voltage.
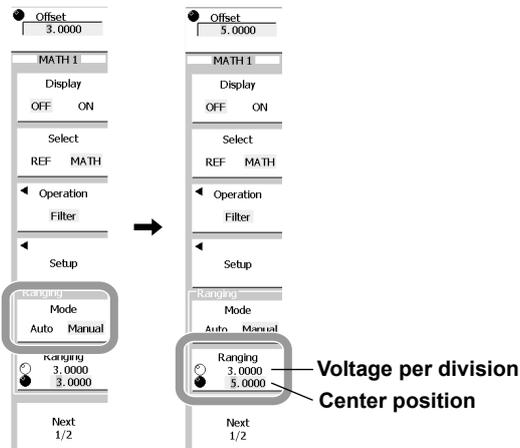
Explanation

The target waveform can be displayed with phase shift.

Waveform to Be Computed

Select from among CH1 to CH4, or REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

Setting the Delay Time: Delay

The delay can be set over a range equivalent to ±5 divisions.

Scaling Computed Results: Rescaling

This sets scaling on computed results.

Unit

Auto: Uses the initial value.
          Initial value: V, A, VV, AA, VA
User: A character string of up to four characters can be set.

Ranging

Set the waveform display range.

Auto: The waveform display range is automatically computed based on the V/div, operator, offset value, etc., of the target waveform.
Manual: The waveform display range is determined based on the setting of the voltage per division and the center position voltage on the screen.
             If the operator is changed, the Auto display range changes automatically in accordance with the operator that was changed. The mode remains set to Manual.

9

Computation

9.5   Setting a Filter (IIR Filter)

1.   Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2.   Press the **Select** soft key and select MATH.

Selecting the Operator

3.   Press the **Operation** soft key.
4.   Press the **Filter** soft key.

Setting the Operation

5.   Press the **Setup** soft key.

- **Selecting the Target Waveform**

6.   Press the **Source** soft key. When CH1 to CH4 on the front panel are set, the target waveform for the operation is fixed to the channel that is set.

7.   Press the soft key corresponding to the target waveform. To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.

- **Setting the Filter Type**

8.   Press the **Filter Type** soft key.

9.   Press the **IIR Low Pass** or **IIR High Pass** soft key.

9

Computation

・ **Setting the Cutoff Frequency**

10. Press the **Cut off** soft key and change the rotary knob target.

11. Turn the **rotary knob** to set the cutoff frequency.

Pressing RESET resets the values.

You can use the arrow keys to move the digit that is currently being set.

Cut off
10.000MHz

Source
CH1

Filter Type
IIR Low Pass

Cut off
10.000MHz

Filter Order
1   2

Rescaling
3.0000
2.0000

Mode
Auto   User
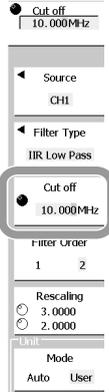
・ **Selecting the Filter Order**

12. Press the **Filter Order** soft key to select 1 or 2.

Cut off
9.7950MHz

Source
CH1

Filter Type
IIR Low Pass

Cut off
9.7950MHz

Filter Order
1   2

Rescaling
3.0000
2.0000

Mode
Auto   User

・ **Setting Scaling for the Operation Results**

13. Press the **Rescaling** soft key.

14. Turn the **rotary knob** to set rescaling.

Pressing RESET resets the values.

You can use the arrow keys to move the digit that is currently being set.

Rescaling(a)
3.0000

Source
CH1

Filter Type
IIR Low Pass

Cut off
9.7950MHz

Filter Order
1   2

Rescaling
3.0000
2.0000

Mode
Auto   User

| User Unit |

→

Rescaling(b)
1.0000

Source
CH1

Filter Type
IIR Low Pass

Cut off
9.7950MHz

Filter Order
1   2

Rescaling
3.0000
1.0000

Mode
Auto   User

| User Unit |

Setting the Unit

15. Press the **Mode** soft key to select Auto or User.
    If you select Auto, proceed to step 18.
16. Press the **User Unit** soft key.
17. See section 4.2. Enter the unit and press the **Enter** soft key.
18. Press **ESC**.

Ranging (setting the display range)

19. Press the **Mode** soft key to select Auto or Manual.
20. If Manual is selected, press the **Ranging** soft key and use the rotary knob to set the voltage per division and the center position voltage.

9

Computation

Explanation

Low Pass Filter and High Pass Filter can be set by combining a temporary low pass filter and a differentiator.

Waveform to Be Computed

Select from among CH1 to CH4, or REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

Setting the Cutoff Frequency: Cut off

Can be set to a value up to 1 GHz.

Selecting the Filter Order: Filter Order

The setting differs, depending on the specified filter type.

Filter Type	Filter order	Phase change
High Pass	1	The phase advances.
Low Pass	1	The phase is delayed.
High Pass/Low Pass	2	Phase 0

Scaling Computed Results: Rescaling

This sets scaling on computed results.

Unit

Auto: Uses the initial value.
    Initial value: V, A, VV, AA, VA
User: A character string of up to four characters can be set.

Ranging

Set the waveform display range.
Auto: The waveform display range is automatically computed based on the V/div, operator, offset value, etc., of the target waveform.
Manual: The waveform display range is determined based on the setting of the voltage per division and the center position voltage on the screen.
        If the operator is changed, the Auto display range changes automatically in accordance with the operator that was changed. The mode remains set to Manual.

Note

In the filter calculation (IIR filter), since 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.

9.6 Smoothing Waveforms (Using a Moving Average)
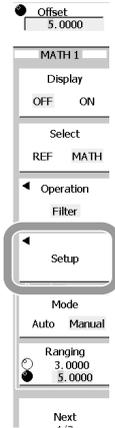
Procedure

1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Press the **Select** soft key and select MATH.

Selecting the Operator

3. Press the **Operation** soft key.
4. Press the **Filter** soft key.

Setting the Operation

5.　Press the **Setup** soft key.

・ **Selecting the Target Waveform**

6.　Press the **Source** soft key. When CH1 to CH4 on the front panel are set, the target waveform for the operation is fixed to the channel that is set.

7.　Press the soft key corresponding to the target waveform. To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.
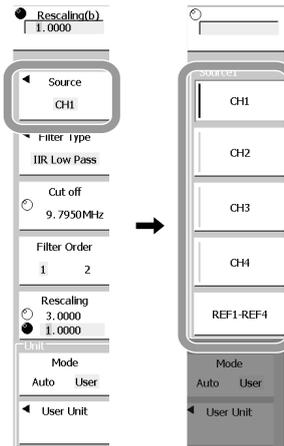
・ **Setting the Filter Type**

8.　Press the **Filter Type** soft key.

9.　Press the **Moving Avg** soft key.
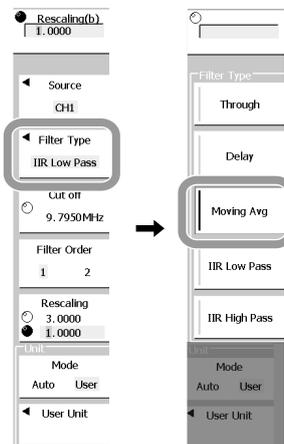
· **Setting Weighted Points**

10.   Use the rotary knob to set the number of weighted points used to calculate the weighted moving average.
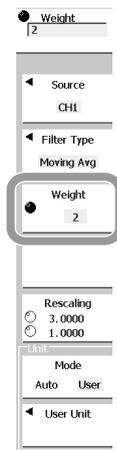
· **Setting Scaling for the Operation Results**

11.   Press the **Rescaling** soft key.

12.   Turn the **rotary knob** to set rescaling.

Pressing RESET resets the values.

You can use the arrow keys to move the digit that is currently being set.

9

Computation

Setting the Unit

13. Press the **Mode** soft key to select Auto or User.

  If you select Auto, proceed to step 16.

14. Press the **User Unit** soft key.

15. See section 4.2. Enter the unit and press the **Enter** soft key.
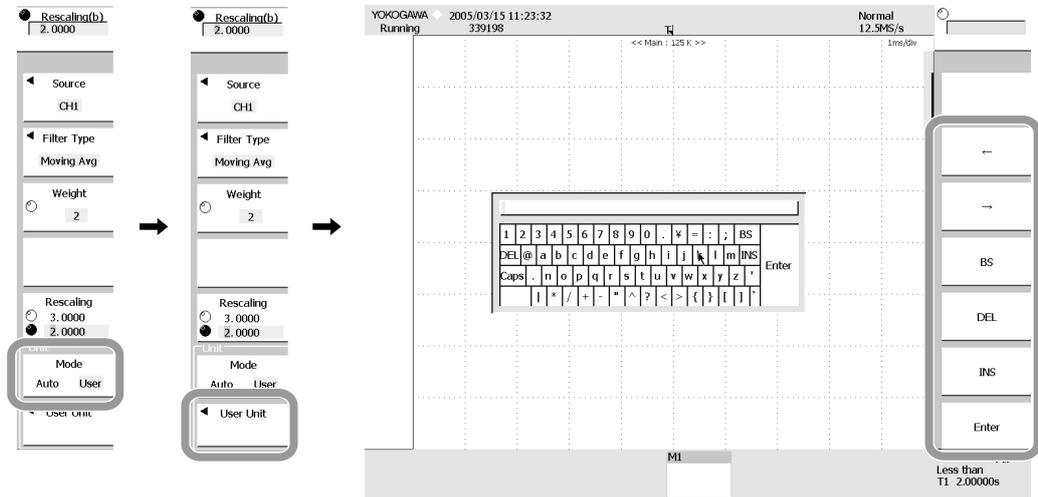
16. Press **ESC**.

Ranging (setting the display range)

17. Press the **Mode** soft key to select Auto or Manual.

18. If Manual is selected, press the **Ranging** soft key and use the rotary knob to set the voltage per division and the center position voltage.
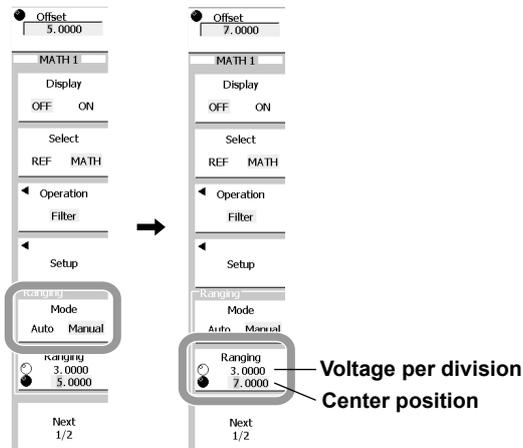
Explanation

Moving Average (Smoothing)
The averaging is carried out using the following formula.

$$\mathbf{X_n} = (\sum_{i=n-N}^{n+N-1} X_i + \sum_{i=n-N+1}^{n+N} X_i)/(2N \times 2)$$

(When Weight is set to 2N)

Weighted Points
Sets the number of points to be smoothed.
A value ranging from 2 to $128(2^7)$ can be set.

Waveform to Be Computed
Select from among CH1 to CH4, or REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

Scaling Computed Results: Rescaling
This sets scaling on computed results.

Unit
Auto: Uses the initial value.
　　　Initial value: V, A, VV, AA, VA
User: A character string of up to four characters can be set.

Ranging
Set the waveform display range.
Auto: 　The waveform display range is automatically computed based on the V/div, operator, offset value, etc., of the target waveform.
Manual: 　The waveform display range is determined based on the setting of the voltage per division and the center position voltage on the screen.
　　　　　If the operator is changed, the Auto display range changes automatically in accordance with the operator that was changed. The mode remains set to Manual.

9

Computation

9.7 Edge Count

This function can be used on products with firmware version 1.60 or higher.
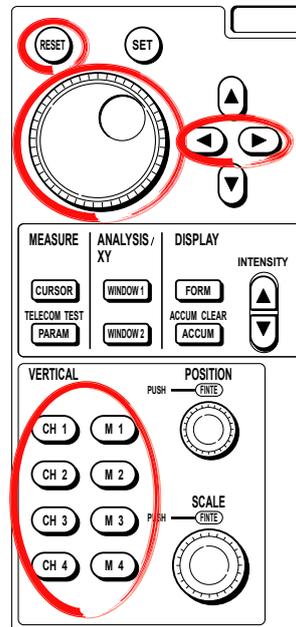
1. Press any of the **CH1** to **CH4** and **M1** to **M4** keys to select the channel to be configured.
2. Press the **Select** soft key to select MATH.

Selecting the Operator

3. Press the **Operation** soft key to display the Operation menu.
4. Press the **Edge Count** soft key.
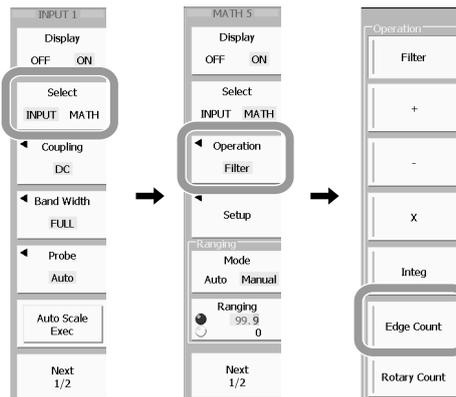
Setting the Count Conditions

5. Press the **Setup** soft key.
6. Press the **Source** soft key.
7. Turn the **rotary knob** to set the threshold level for detecting edges.
8. Press the **Polarity** soft key to select ⌐ or ⌐.
9. Turn the **rotary knob** to set the hysteresis.

10. Press the **Initial Point** soft key.

11. Turn the **rotary knob** to set the count start point. Or, press the **Jump to** soft key to show a preset menu, and set the count start point.
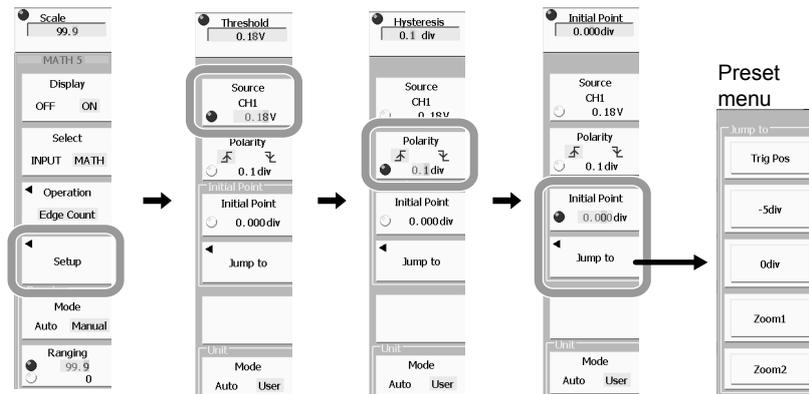
Setting the Unit

12. Press the **Mode** soft key to select Auto or User.
    If Auto is selected, proceed to step 15.

13. Press the **User Unit** soft key.

14. Refer to section 4.2. Then, press the **Enter** soft key.

15. Press **ESC** to return to the previous screen.
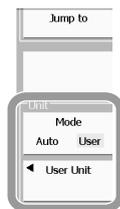
Ranging (Setting the Display Range)

16. Press the **Mode** soft key to select Auto or Manual.

17. If Manual is selected, press the **Ranging** soft key and turn the **rotary knob** to set the number of counts per division and the count value at the center position.

Number of counts per division
Counter value at the center position
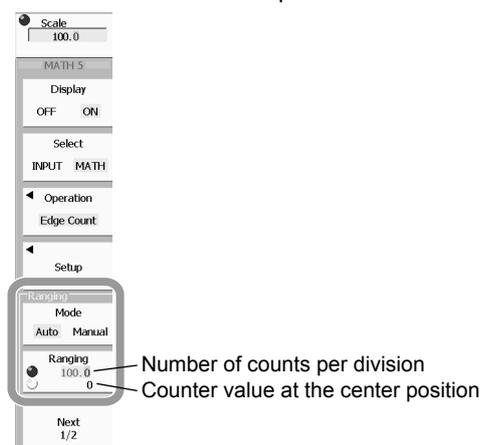
Explanation

The waveform edge can be counted. This function can be used on products with firmware version 1.60 or higher.

Setting the Count Conditions

- **Waveform to Be Computed (Source)**
  Select CH1 to CH4 or REF1 to REF4. If you press CH1 to CH4 on the front panel, the selected channel becomes the waveform to be computed.

- **Detection Level**
  When the waveform passes through the specified level, it is detected as an edge.

- **Polarity**
  Select the slope of the waveform on which to detect the edge.
  ⌐ : Detects edges when the waveform slope is rising.
  ⌐ : Detects edges when the waveform slope is falling.

- **Hysteresis**
  Sets a width to the detection level so that edges are not detected by small changes.
  Selectable range: 0.0 divisions to 4.0 divisions
  Resolution: 0.1 division

- **Setting the Count Start Point (Initial Point)**
  Sets the start point for counting edges.
  Selectable range: −5.00 divisions to 5.00 divisions
  Resolution: 0.01 division
  You can also set the following points (Jump to).
      Trig Pos (trigger position), −5div, 0div, Zoom1 (center position of Zoom1), or Zoom2 (center position of Zoom2)

Unit
Auto: Uses the default value.
            Default value: Blank
User: Set an arbitrary character string using up to 4 characters.

Ranging
Set the waveform display range.
Auto: Automatically determines the waveform display range from the V/div setting,operator, offset value, and so on of the source waveform.
Manual: Determines the waveform display range by setting the voltage per division and the voltage at the center of the display.
            If you change the operator, the display range changes to the auto range corresponding to the new operator. The mode remains at Manual.

9.8 Rotary Count

This function can be used on products with firmware version 1.60 or higher.
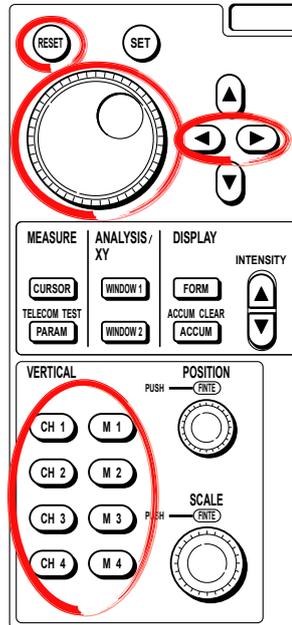
Procedure

1. Press any of the **CH1** to **CH4** and **M1** to **M4** keys to select the channel to be configured.
2. Press the **Select** soft key to select MATH.

Selecting the Operator

3. Press the **Operation** soft key to display the Operation menu.
4. Press the **Rotary Count** soft key.
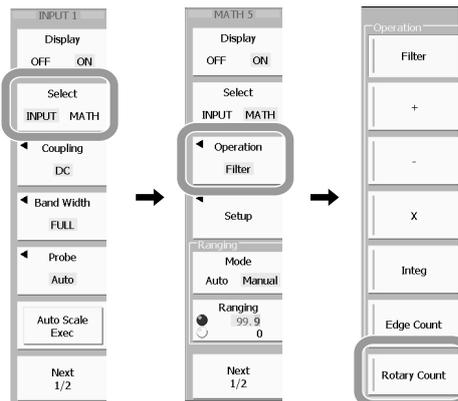
Setting the Count Conditions

5. Press the **Setup** soft key.
6. Press the **Source1** soft key.
7. Turn the **rotary knob** to set the determination level of phase A.
8. Press the **Source2** soft key twice to display the Source2 menu.
9. Press any of the **CH1** to **CH4** and **REF1-REF4** soft keys to select Source2. Press the REF1-REF4 soft key to open the REF1, REF2, REF3, and REF4 soft keys.
10. Turn the **rotary knob** to set the determination level of phase B.
11. Press the **Initial Point** soft key.
12. Turn the **rotary knob** to set the count start point. Or, press the **Jump to** soft key to show a preset menu, and set the count start point.
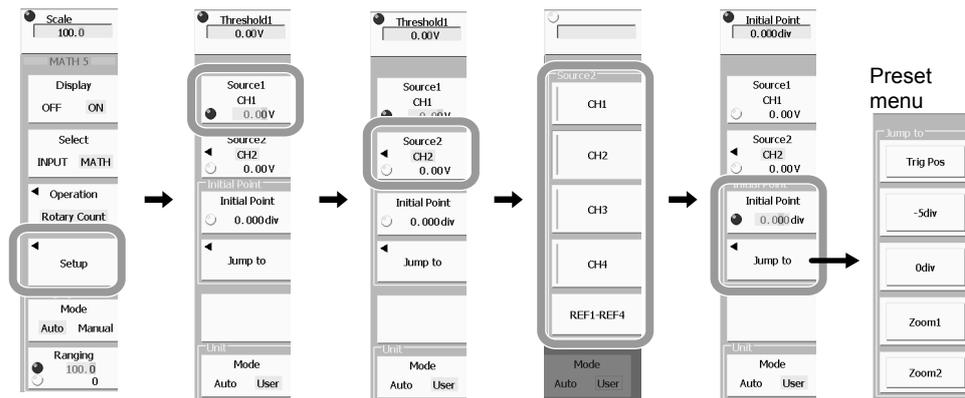
Setting the Unit

13. Press the **Mode** soft key to select Auto or User.
    If Auto is selected, proceed to step 16.
14. Press the **User Unit** soft key.
15. Refer to section 4.2 in the *DL9000 User's Manual IM701310-01E*, and enter the unit. Then, press the **Enter** soft key.
16. Press **ESC** to return to the previous screen.

Ranging (Setting the Display Range)

17. Press the **Mode** soft key to select Auto or Manual.
18. If Manual is selected, press the **Ranging** soft key and turn the **rotary knob** to set the number of counts per division and the count value at the center position.

```
        ● Scale
           100.0
       ┌─────────────┐
       │   MATH 5    │
       │   Display   │
       │  OFF   ON   │
       │             │
       │   Select    │
       │ INPUT  MATH │
       │ ◄           │
       │  Operation  │
       │ Rotary Count│
       │ ◄           │
       │             │
       │   Setup     │
       │ ┌─────────┐ │
       │ │ Ranging │ │
       │ │  Mode   │ │
       │ │Auto Manual│
       │ │         │ │
       │ │ Ranging │ │
       │ │●  100.0 │ │──── Number of counts per division
       │ │○     0  │ │──── Counter value at the center position
       │ └─────────┘ │
       │   Next      │
       │   1/2       │
       └─────────────┘
```
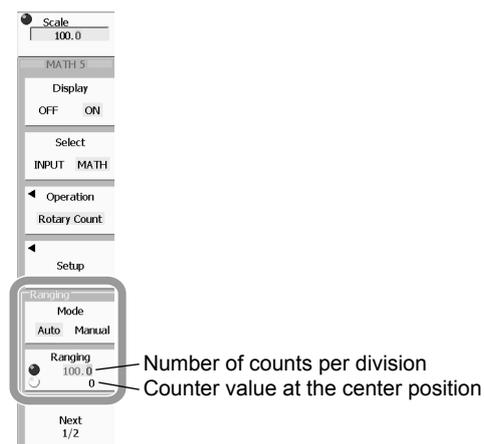
Explanation

Rotary count can be used. The counter is increased or decreased according to the phase change of phase A and B. This function can be used on products with firmware version 1.60 or higher.

Setting the Count Conditions

- **Waveform to be Computed of Phase A (Source1)**
  Select CH1 to CH4 or REF1 to REF4. If you press CH1 to CH4 on the front panel, the selected channel becomes the waveform to be computed.

- **Determination Level of Phase A**
  The state in which the waveform of phase A exceeds the specified level is 1 and 0 otherwise.

- **Waveform to be Computed of Phase B (Source2)**
  Select CH1 to CH4 or REF1 to REF4.

- **Determination Level of Phase B**
  The state in which the waveform of phase B exceeds the specified level is 1 and 0 otherwise.

- **Changes in the Phase of Phase A and Phase B**
  The counter is increased or decreased according to the phase change (change in the 0 and 1 states) in phase A and phase B as shown below.

```
        A phase ─┐  ┌─ B phase
                 │  │
      +1        ( 0 0 )        +1
            ╱              ╲
         −1                 −1  ── Direction of change
      ( 0 1 )            ( 1 0 )
            ╲              ╱
         −1                 −1
      +1        ( 1 1 )        +1
```

9 Computation
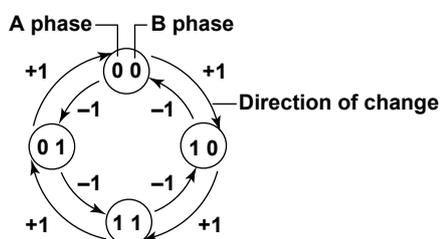
- **Setting the Count Start Point (Initial Point)**
  Sets the start point of counting.
  Selectable range: –5.00 divisions to 5.00 divisions
  Resolution: 0.01 division
  You can also set the following points (Jump to).
      Trig Pos (trigger position), –5div, 0div, Zoom1 (center position of Zoom1), or Zoom2 (center position of Zoom2)

Unit

Auto: Uses the default value.
          Default value: Blank
User: Set an arbitrary character string using up to 4 characters.

Ranging

Set the waveform display range.

Auto: Automatically determines the waveform display range from the V/div setting, operator, offset value, and so on of the source waveform.

Manual: Determines the waveform display range by setting the voltage per division and the voltage at the center of the display.
          If you change the operator, the display range changes to the auto range corresponding to the new operator. The mode remains at Manual.

10.1 Making Cursor Measurements

Procedure
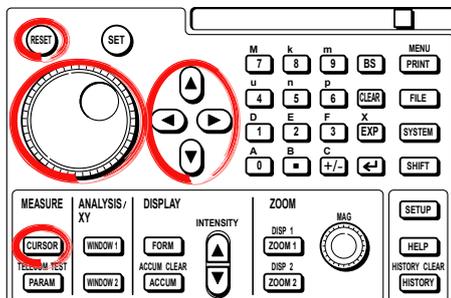
1. Press **CURSOR**.
    The cursors appear.

Selecting the Cursor Type

2. Press the **Type** soft key. The cursor selection menu appears.
3. Press the **Vertical** soft key.

Vertical cursors (page 10-2)

Horizontal cursors (page 10-4)

H&V cursors (page 10-7)

VT cursor (page 10-10)

Marker cursors (page 10-11)

Serial cursors (page 10-13)
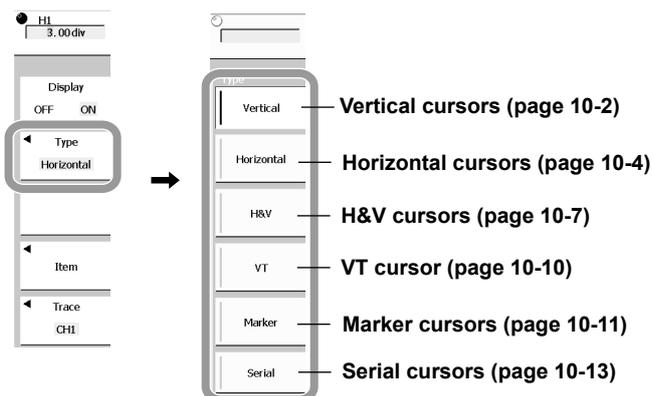
Vertical Cursors

Selecting the Measurement Item

4. Press the **Item** soft key.

• **Selecting the Basic Measurement Item**

5. Press the **Basic** soft key.

6. With the **rotary knob**, select the item for which you want to display the result, and press SET to add a check mark.
    With [ALL ON] selected, press SET to add check marks to all items.
    With [ALL OFF] selected, press SET to remove check marks from all items.

• **Setting Equations (To Calculate from Cursor Measurements)**

7. Press the **Calc** soft key.

8. With the **rotary knob** select the calculation number, and press **SET** to add a check mark.

9. With the **rotary knob**, move the cursor to the equation whose calculation number is checked, and press **SET**. A screen for entering the equation appears.

10. With the **numeric keypad**, **rotary knob**, and **SET** on the panel, enter the calculation equation. When equation entry is completed, press ENTER to confirm the equation.

11. Press **ESC**. This returns to the screen.

For Basic:

For Calc:

Moving the Cursors

12. Press the **T1**/**T2** soft key, to assign the rotary knob to T1.

13. With the **rotary knob** or **up and down arrow keys**, move T1.
      Press RESET to reset the value.
      With the left and right arrow keys you can change the digit to be set.

14. Move T2 similarly.
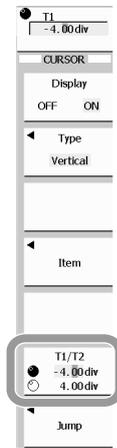
Jump Setting

15. Press the **Jump** soft key. A menu appears for selecting the zoom window to jump to.

16. Press the **To Zoom1** or **To Zoom2** soft key to select the zoom window to jump to.

10

Waveform Analysis
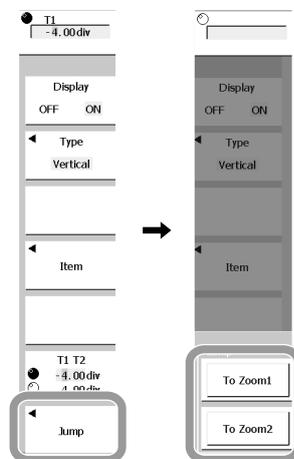
Horizontal Cursors

Selecting the Measurement Item

4.   Press the **Item** soft key.

• **Selecting the Basic Measurement Item**

5.   Press the **Basic** soft key.

6.   With the **rotary knob**, select the item for which you want to display the result, and press SET to add a check mark.
     With [ALL ON] selected, press SET to add check marks to all items.
     With [ALL OFF] selected, press SET to remove check marks from all items.

• **Setting Equations (To Calculate from Cursor Measurements)**

7.   Press the **Calc** soft key.

8.   With the **rotary knob** select the calculation number, and press **SET** to add a check mark.

9.   With the **rotary knob**, move the cursor to the equation whose calculation number is checked, and press **SET**. A screen for entering the equation appears.

10. With the **numeric keypad**, **rotary knob**, and **SET** on the panel, enter the calculation equation. When equation entry is completed, press ENTER to confirm the equation.

11. Press **ESC**. This returns to the screen.

Selecting the Target Waveform

12. Press the **Trace** soft key. The waveform selection menu appears.
13. Press the soft key for the waveform you want to select.

Moving the Cursors

14. Press the **H1/H2** soft key, to assign the rotary knob to H1.
15. With the **rotary knob** or **up and down arrow keys**, move H1.
    Press RESET to reset the value.
    With the left and right arrow keys you can change the digit to be set.
16. Move H2 similarly.

Jump Setting

17. Press the **Jump** soft key. A menu appears for selecting the zoom window to jump to.

18. Press the **To Zoom1** or **To Zoom2** soft key to select the zoom window to jump to.
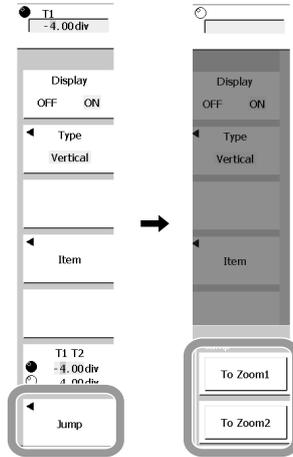
H&V Cursors

Selecting the Measurement Item
4. Press the **Item** soft key.

· **Selecting the Basic Measurement Item**
5. Press the **Basic** soft key.
6. With the **rotary knob**, select the item for which you want to display the result, and press SET to add a check mark.
    With [ALL ON] selected, press SET to add check marks to all items.
    With [ALL OFF] selected, press SET to remove check marks from all items.

· **Setting Equations (To Calculate from Cursor Measurements)**
7. Press the **Calc** soft key.
8. With the **rotary knob** select the calculation number, and press **SET** to add a check mark. You can set a calculation equation using the Calc1 and Calc2 voltage values or a calculation formula using the Calc3 and Calc4 times.
9. With the **rotary knob**, move the cursor to the equation whose calculation number is checked, and press **SET**. A screen for entering the equation appears.
10. With the **numeric keypad**, **rotary knob**, and **SET** on the panel, enter the calculation equation. When equation entry is completed, press ENTER to confirm the equation.
11. Press **ESC**. This returns to the screen.

For Basic:

For Calc:

Calc1/Calc2: Calculation using voltage
Calc3/Calc4: Calculation using time

10

Waveform Analysis
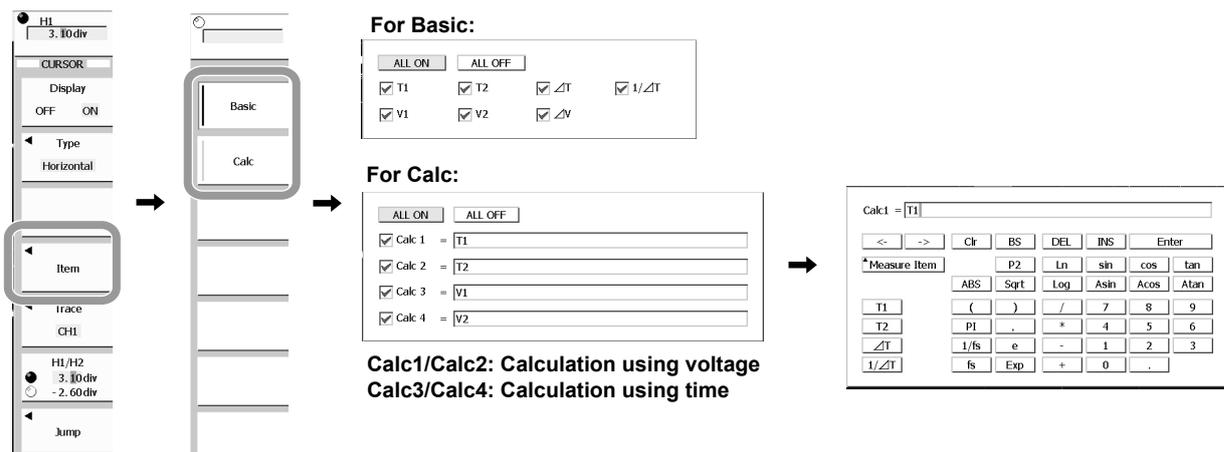
Selecting the Target Waveform

12. Press the **Trace** soft key. The waveform selection menu appears.

13. Press the soft key for the waveform you want to select.
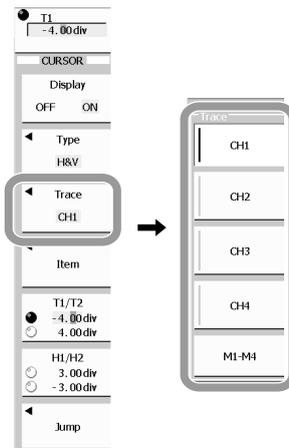
Moving the Cursors

- **Moving the Horizontal Cursors**

   14. Press the **T1**/**T2** soft key, to assign the rotary knob to T1.

   15. With the **rotary knob** or **up and down arrow keys**, move T1.

      Press RESET to reset the value.

      With the left and right arrow keys you can change the digit to be set.

   16. Move T2 similarly.

- **Moving the Vertical Cursors**

   17. Press the **H1/H2** soft key, to assign the rotary knob to H1.

   18. With the **rotary knob** or **up and down arrow keys**, move H1.

      Press RESET to reset the value.

      With the left and right arrow keys you can change the digit to be set.

   19. Move H2 similarly.
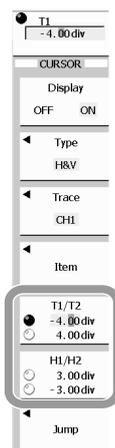
Jump Setting

20. Press the **Jump** soft key. A menu appears for selecting the zoom window to jump to.
21. Press the **To Zoom1** or **To Zoom2** soft key to select the zoom window to jump to.

10

Waveform Analysis
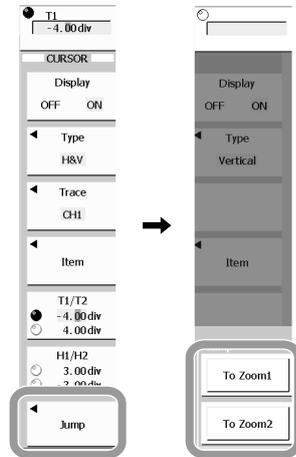
VT Cursor

Selecting the Measurement Item

4. Press the **Item** soft key.

• **Selecting the Basic Measurement Item**

5. Press the **Basic** soft key.
6. With the **rotary knob**, select the item for which you want to display the result, and press SET to add a check mark.
   With [ALL ON] selected, press SET to add check marks to all items.
   With [ALL OFF] selected, press SET to remove check marks from all items.

• **Setting Equations (To Calculate from Cursor Measurements)**

7. Press the **Calc** soft key.
8. With the **rotary knob** select the calculation number, and press **SET** to add a check mark.
9. With the **rotary knob**, move the cursor to the equation whose calculation number is checked, and press **SET**. A screen for entering the equation appears.
10. With the **numeric keypad**, **rotary knob**, and **SET** on the panel, enter the calculation equation. When equation entry is completed, press ENTER to confirm the equation.
11. Press **ESC**. This returns to the screen.

Moving the Cursor

12. Move the cursor with the **rotary knob** or **up and down arrow keys**.
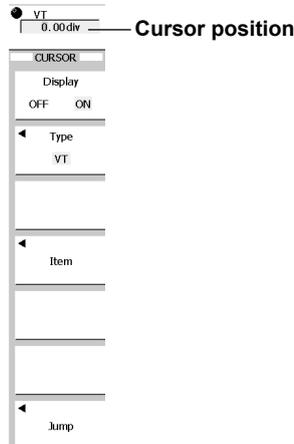
Marker cursors

Selecting the Measurement Item
4.   Press the **Item** soft key.

·   **Selecting the Basic Measurement Item**
5.   Measurement items can be selected for each of the four markers, **MC1** to **MC4**. Press the soft key for the marker you want to use.
6.   With the **rotary knob**, select the item for which you want to display the result, and press SET to add a check mark.
With [ALL ON] selected, press SET to add check marks to all items.
With [ALL OFF] selected, press SET to remove check marks from all items.

·   **Setting Equations (To Calculate from Cursor Measurements)**
7.   Press the **Calc** soft key.
8.   With the **rotary knob** select the calculation number, and press **SET** to add a check mark.
9.   With the **rotary knob**, move the cursor to the equation whose calculation number is checked, and press **SET**. A screen for entering the equation appears.
10.   With the **numeric keypad**, **rotary knob**, and **SET** on the panel, enter the calculation equation. When equation entry is completed, press ENTER to confirm the equation.
11.   Press **ESC**. This returns to the screen.

Selecting the Marker
12.   Press the **Select** soft key.
13.   You can select from the four markers, MC1 to MC4. Press the soft key for the marker you want to use.

10

Waveform Analysis
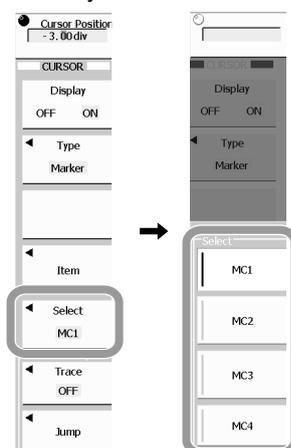
Selecting the Target Waveform

14. Press the **Trace** soft key. The waveform selection menu appears.

15. Press the soft key for the waveform for which you want to use the marker.

Moving the marker

16. Move the marker with the **rotary knob** or **up and down arrow keys**.

Press RESET to reset the value.

With the left and right arrow keys you can change the digit to be set.
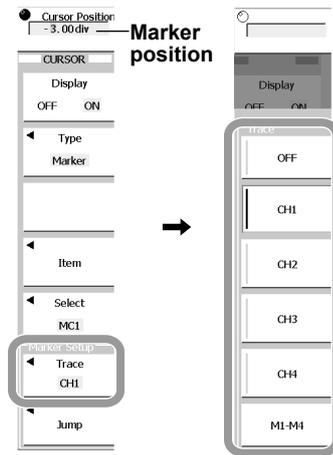
Jump Setting

17. Press the **Jump** soft key. A menu appears for selecting the zoom window to jump to.

18. Press the **To Zoom1** or **To Zoom2** soft key to select the zoom window to jump to.
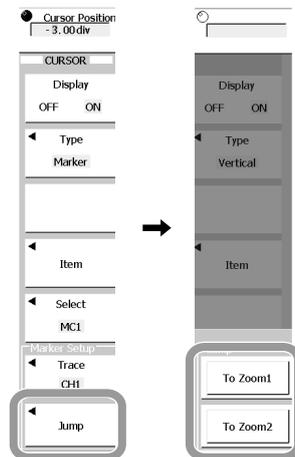
Serial Cursors

Selecting and Setting Serial Cursors

4. Press the **Select** soft key, to select SC1 or SC2.

    You can select SC1 or SC2 as the serial cursor.

5. Press the **Setup** soft key. The Setup menu appears.
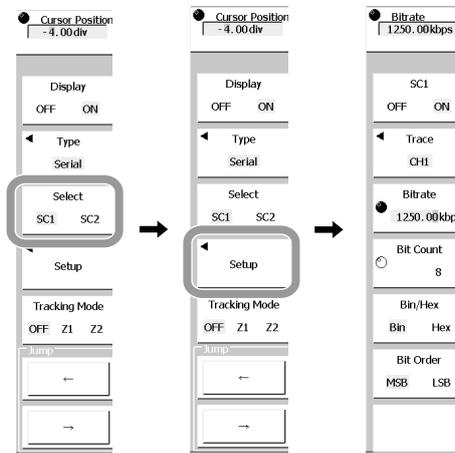
- **Selecting the Target Waveform**

6. Press the **Trace** soft key.

7. Press the soft key for the waveform for the serial cursor.

8. Press the **Active** soft key, to select H or L.

9. Press the **Level/Hys** soft key, to switch the rotary knob to Level.

10. Turn the **rotary knob** to set the level.

    Press RESET to reset the value.

    With the left and right arrow keys you can change the digit to be set.

11. Press the **Level/Hys** soft key, to assign the rotary knob to Hys.

12. Turn the **rotary knob**, to set the hysteresis.

    Press RESET to reset the value.

    With the left and right arrow keys you can change the digit to be set.

13. Press **ESC.** This returns to the setup menu.

10
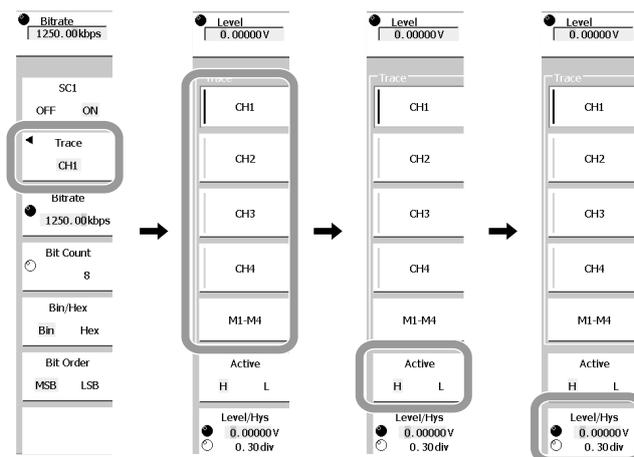
Waveform Analysis

- **Setting the Bitrate**
  14. Press the **Bitrate** soft key.
  15. Turn the **rotary knob**, to set the bitrate.
       Press RESET to reset the value.
       With the left and right arrow keys you can change the digit to be set.

```
  ● Bitrate
  │ 1250.00kbps

        SC1
    OFF     ON

  ◄   Trace
        CH1

      Bitrate
  ●  1250.00kbps

      Bit Count
  ○
            8

      Bin/Hex
    Bin     Hex

      Bit Order
    MSB     LSB
```
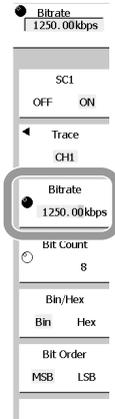
- **Setting the Bit Count**
  16. Press the **Bit Count** soft key.
  17. Turn the **rotary knob**, to set the bit count.

```
  ● Bit Count
  │      8

        SC1
    OFF     ON

  ◄   Trace
        CH1

      Bitrate
  ○  1250.00kbps

      Bit Count
  ●
            8

      Bin/Hex
    Bin     Hex

      Bit Order
    MSB     LSB
```
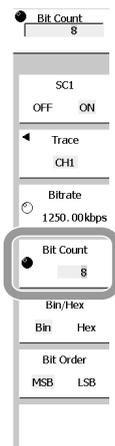
- **Selecting the Notation**
  18. Press the **Bin/Hex** soft key, to select Bin or Hex.

```
  ● Bit Count
  │      8

        SC1
    OFF     ON

  ◄   Trace
        CH1

      Bitrate
  ○  1250.00kbps

      Bit Count
  ●
            8

      Bin/Hex
    Bin     Hex

      Bit Order
    MSB     LSB
```
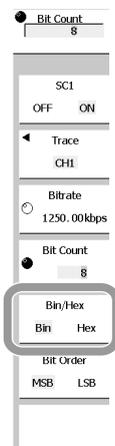
- **Specifying the Bit Order**
  19.   Press the **Bit Order** soft key, to select MSB or LSB.
  20.   Press **ESC**. This returns to the serial cursor menu.
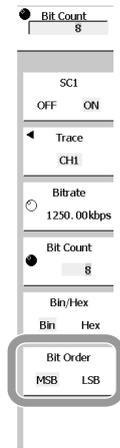
Selecting the Tracking Mode
  21.   Press the **Tracking Mode** soft key. A menu appears for selecting the tracking mode.
  22.   Press the **OFF**, **Zoom1** or **Zoom2** soft key to select the tracking mode.
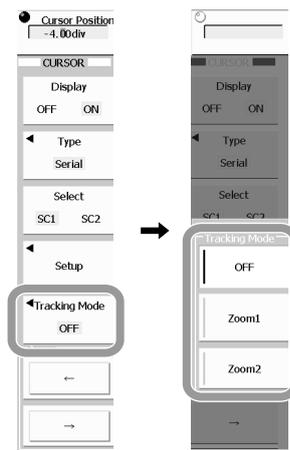
Moving the Cursor
  23.   Move the cursor with the **rotary knob** or **up and down arrow keys**.

10

Waveform Analysis
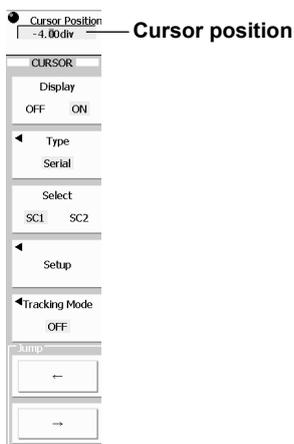
Explanation

Limitations

It is not possible to measure the following waveforms.

- Snapshot waveforms
- Accumulated waveforms other than the most recent

Cursors and Measurement Items

- **Vertical (V) cursors**

  Measure the position of the cursor on the X-axis. You can select the order of data values.

  T1: X-axis value of the T1 cursor

  T2: X-axis value of the T2 cursor

  ΔT: X-axis value difference between the T1 and T2 cursors

  1/ΔT: Reciprocal of the X-axis value difference between the T1 and T2 cursors

- **Horizontal (H) cursors**

  Measure the position of the cursor on the Y-axis.

  V1: Y-axis value of V1

  V2: Y-axis value of V2

  ΔV: Y-axis value difference between V1 and V2

- **Horizontal and Vertical Cursors: H&V**

  Measure the value on the X-axis at the cursor position, and the value on the Y-axis at the cursor position.

  X-axis

  T1: X-axis value of the T1 cursor

  T2: X-axis value of the T2 cursor

  ΔT: X-axis value difference between the T1 and T2 cursors

  1/ΔT: Reciprocal of the X-axis value difference between the T1 and T2 cursors

  Y-axis

  V1: Y-axis value of V1

  V2: Y-axis value of V2

  ΔV: Y-axis value difference between V1 and V2

- **Vertical time (VT) cursor**

  Measures the time from the trigger position to the VT cursor, and the value of the waveform data selected by the VT cursor.

  V(CH1): Y-axis value of CH1

  V(CH2): Y-axis value of CH2

  V(CH3): Y-axis value of CH3

  V(CH4): Y-axis value of CH4

  V(M1): Y-axis value of M1

  V(M2): Y-axis value of M2

  V(M3): Y-axis value of M3

  V(M4): Y-axis value of M4

  T: X-axis value

•   **Marker Cursors**
    By moving the cursors over the waveform data, you can measure data values. MC1
    (Marker 1) to MC4 (Marker 4) can be set on different waveforms.
    T1:   MC1 X-axis (horizontal axis) value
    T1-T2:   X-axis value difference between MC1 and MC2
    T1-T3:   X-axis value difference between MC1 and MC3
    T1-T4:   X-axis value difference between MC1 and MC4
    V1:   MC1 Y-axis (vertical axis) values
    V1-V2:   Y-axis value difference between MC1 and MC2
    V1-V3:   Y-axis value difference between MC1 and MC3
    V1-V4:   Y-axis value difference between MC1 and MC4

•   **Serial cursors**
    Searches the waveform serial pattern (1s and 0s) at the specified bit rate from the
    serial cursor position. The search range is the display range (10 divisions). You can
    select the threshold level used to determine 1 and 0 and assign high or low with
    respect to the threshold level to 1. There are two serial cursors: SC1 and SC2. The
    two cursors cannot be displayed simultaneously, but the serial patterns can be.

Movement Range of Cursors

• **H cursor**
    With the center of the waveform display area as 0 div, the range from –4 to +4 div can
    be set. The setting step is 0.01 div.

• **V cursors, marker cursors, VT cursor, Serial cursors**
    With the center of the waveform display area as 0 div, the range from –5 to +5 div can
    be set. The setting step is 0.01 div. When the zoom window is displayed, when the
    cursor enters the zoom window, the resolution becomes 0.01 div of the zoom window.

Serial Cursor Display Format
When measuring with the serial cursors, you can set the following items.

•   **Selecting the Notation for Cursor Measurement Values: Bin/Hex**
    You can select the notation system used to display measured values.
    Bin: Show in binary
    Hex: Show in hexadecimal

•   **Read Direction of Bit Data: Bit Order**
    You can select the read direction of the bits according to the signal flow.
    MSB First: Select this when the I/O data signal is flowing MSB first.
    LSB First: Select this when the I/O data signal is flowing LSB first.

Data

0   1   1   1   0   1   1   0   0   0   1   0
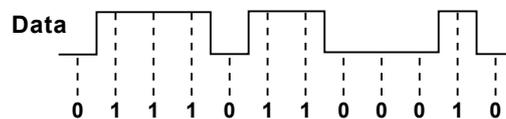
When set to MSB First: 762
When set to LSB First: 46E

•   **Handling of Non-displayed Bits**
    •   In binary notation, an X is displayed for the bit.
    •   In hexadecimal notation, the value is displayed as though the bit does not exist.

10

Waveform Analysis

Serial Cursor Tracking Mode

Set the handling when the cursor goes outside the zoom range.

OFF: If the cursor goes outside the zoom range, the zoom window does not track it.

Zoom1/Zoom2:   If the cursor goes outside the Zoom1 or Zoom2 zoom range, then Zoom1 or Zoom2 scrolls so that the center position is at the cursor position.

Cursor Jump

You can jump the cursor to the center of the zoom waveform display window. The procedure for jumping is as follows.

• **Vertical cursors, horizontal cursors, H&V cursors, VT cursors, marker cursors**
   To Zoom1:   Make the selected cursor jump to the Z1 window.
   To Zoom2:   Make the selected cursor jump to the Z2 window.

• **Serial cursors**
   ←/→:   Jump by the set bit length in the specified direction
          If the window is Z1 or Z2, move to the Zoom window

Notes on Cursor Measurement

• Measurement values on the time axis are with respect to the trigger position.
• If there is data that cannot be measured, the measurement value is shown as "***".
• When the Main and ZOOM1 or ZOOM2 display record length is less than 10 k words (but not 4 k or 5 k), and when Dot Connect is not OFF, the display is interpolated between the sampled data. Therefore, there may be no sampled data at the position of the vertical cursor.
• For the serial cursors, if the sample rate (S/s) divided by the bitrate (bit/s) exceeds 1,000,000, then all bits of the measurement result appear as X.

10.2 Automated Measurement of Waveform Parameters

Procedure
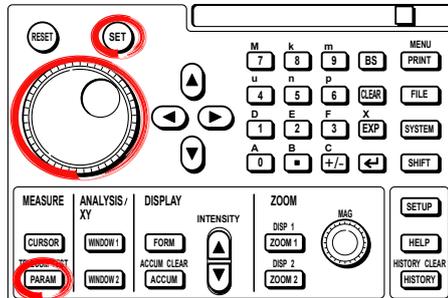
1. Press **PARAM**. The waveform parameter setting menu appears. If waveform parameters are already set, the waveform parameter measurement values appear.
2. Press the **Mode** soft key.
3. Press the **Basic** soft key.
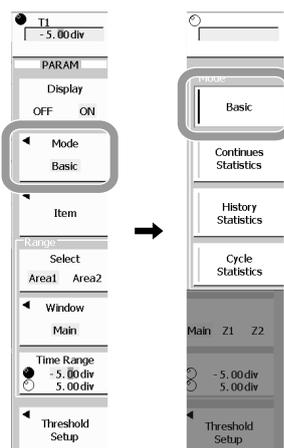
Setting Measurement Items

4. Press the **Item** soft key.
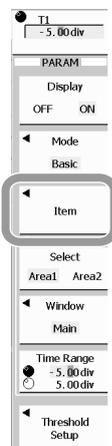
- **Selecting the Area**
  5. Press the **Area** soft key to select Area1 or Area2.
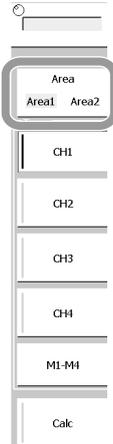
Area
Area1 Area2

CH1

CH2

CH3

CH4

M1-M4

Calc

- **Selecting the Target Waveform**
  6. Press the soft key for the measurement waveform, to select the waveform.

Area
Area1 Area2

CH1

CH2

CH3

CH4

M1-M4

Calc
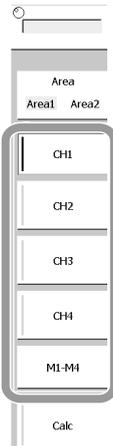
- **Selecting the Measurement Items**
  7. With the **rotary knob**, select the items in the measurement item dialog box.
  8. Press **SET** to switch ON/OFF.
     Select ALL OFF and press **SET** to switch all items off.
     Select Copy to All Trace and press **SET** to copy the current settings to all traces within the same area.
  9. Repeat steps 6 to 8 as many times as required.
     To set the calculation formula, press **ESC** and continue to step 24.
     To set Raise/Fall, or Delay, continue to the next step.

ALL OFF	Copy to All Trace		
☑ Max	☑ Min	☐ High	☐ Low
☐ P-P	☐ Hi-Low	☐ +Over	☐ -Over
☐ Rms	☐ Mean	☐ Sdev	☐ IntegTY
☐ C.Rms	☐ C.Mean	☐ C.Sdev	☐ C.IntegTY
☐ Freq	☐ 1/Freq	☐ Count	☐ Burst
☐ +Width	☐ -Width	☐ Period	☐ Duty
☐ Rise	☐ Fall	Rise/Fall Setup	
☐ Delay		Delay Setup	

- **Rise/Fall Settings (Setting Distal/Proximal Values)**
  10. With the **rotary knob**, select Raise/Fall Setup, and press **SET**. The Raise/Fall Setup menu appears.
  11. Press the **V/%** soft key, and set the units to V or %. The display units for the Distal and Proximal values change accordingly.
  12. Press the **Distal** soft key, to assign the rotary knob. With the rotary knob, set the distal value.
  13. Press the **Proximal** soft key, to assign the rotary knob. With the rotary knob, set the proximal value.
  14. Press the **ESC** soft key to return to the Item screen.

- **Setting the Delay (Edge Count and Reference Waveform Settings)**
  15. With the **rotary knob**, select Delay Setup, and press **SET**. The Delay Setup menu appears.
  16. Press the **Polarity** soft key, to select whether to count rising or falling edges.
  17. Press the **Count** soft key, to assign the rotary knob. With the rotary knob, set the edge detection count (how many edge counts the measurement point is delayed).
  18. Press the **Reference** soft key, to set the reference point to Trig Pos (trigger position) or Edge. If you select Trig Pos, the following step is not required.

- **Setting the Reference Point**
  19. Press the **Trace** soft key.
  20. Press the soft key for the reference waveform to select the reference waveform.
  21. Press the **Polarity** soft key, to select whether the reference edge is rising or falling.
  22. Press the **Count** soft key, and with the rotary knob select the edge detection count (the number of edges up to the reference point).
  23. Press the **ESC** soft key to return to the Item screen.

10
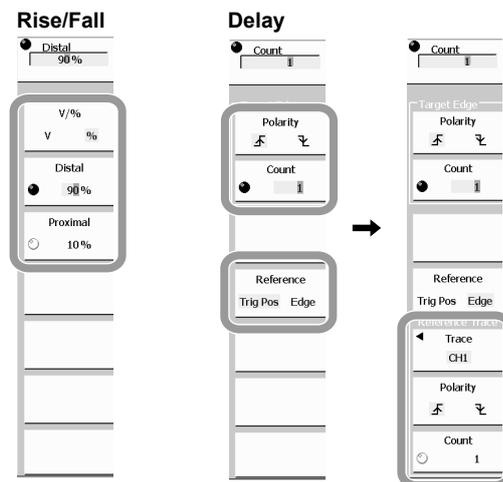
Waveform Analysis

- **Equation Settings (When Calculating with Waveform Parameters)**
  24. Press the **Calc** soft key.
  25. With the **rotary knob**, select the calculation number, and press SET to add a check mark.
  26. With the **rotary knob**, move the cursor to the equation whose calculation number is checked, and press SET. A screen for entering the equation appears.
  27. Press the numerals on the panel to enter numerals. Use the **rotary knob** to select functions and operators to be used, and press SET. When equation entry is completed, press ENTER to confirm the equation.
  28. Press **ESC**. This returns to the screen.
  29. Press **ESC** to return to the item setting screen.
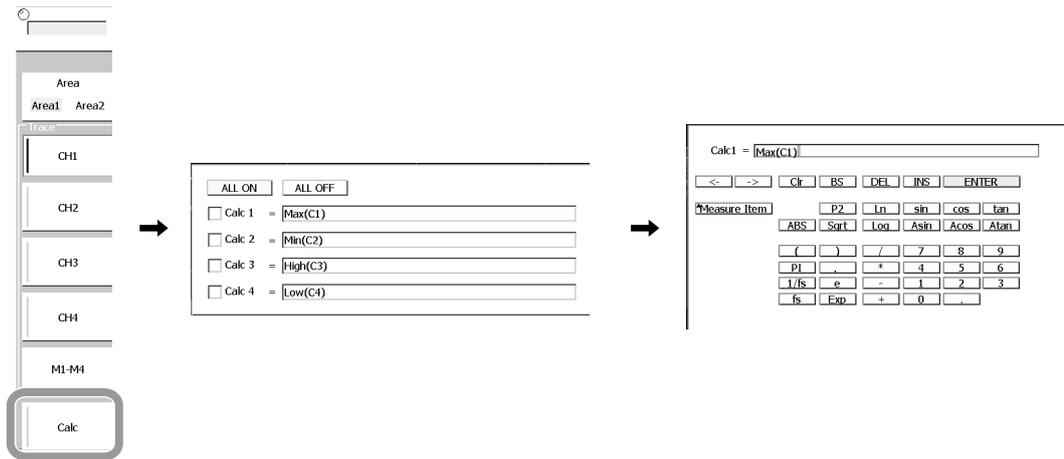
Setting Measurement Ranges

- **Setting the Measurement Area**
  30. Press the **Select** Area1/Area2 soft key, to select the area.
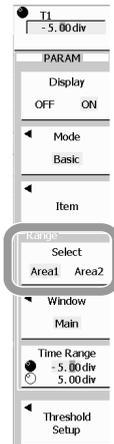
- **Selecting the Window for the Range**
  31. Press the **Window** soft key. The Window setting menu appears.
  32. Press the **Main**, **Zoom1**, **Zoom2** soft key, to select the window.
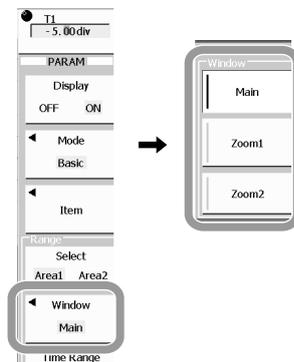
- **Specifying the Range**
  33. Press the **Time Range** soft key, to assign the rotary knob.
  34. With the **rotary knob**, set the start point T1 of the range.
  35. Repeat steps 33 and 34 to set the end point T2 of the range.

Note _____

The measurement is from –5 div to +5 div.
_____
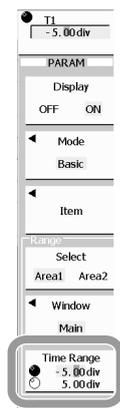
Setting the Threshold Value (Threshold Setting for Items other than Rise and Fall)
  36. Press the **Threshold Setup** soft key. The menu appears.

10

Waveform Analysis
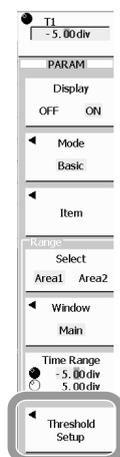
• **Selecting the Measurement Waveform**
  37. Press the soft key for the measurement waveform, to select the waveform.
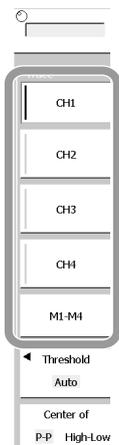
• **Selecting the Method of Setting Threshold Values**
  38. Press the **Threshold** soft key.
  39. Select the setting method, and press the corresponding soft key.
     If you select Auto, continue to step 40.
     If you select Level/Hys, continue to step 41.
     If you select Upper/Lower, continue to step 45.

• **Auto**
  40. Press the **Center of** soft key, to select P-P or High-Low.

• **Level/Hys**
  41. Press the **Level/Hys** soft key, to assign the rotary knob to the threshold level.
  42. Turn the **rotary knob**, to set the threshold level.
  43. Press the **Level/Hys** soft key, to assign the rotary knob to the threshold hysteresis.
  44. Turn the **rotary knob**, to set the threshold hysteresis.

• **Upper/Lower**
  45. Press the **Upper/Lower** soft key, to assign the rotary knob to the threshold upper limit.
  46. Turn the **rotary knob**, to set the threshold upper limit.
  47. Press the **Level/Hys** soft key, to assign the rotary knob to the threshold lower limit.
  48. Turn the **rotary knob**, to set the threshold lower limit.
  49. Press **ESC**. This returns to the Measure menu.
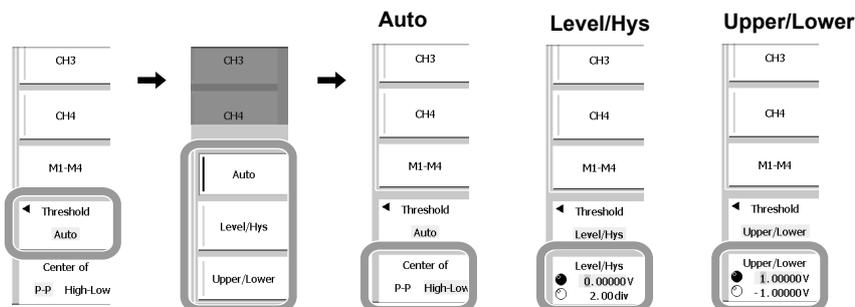
Explanation

Limitations

Automated measurement of waveform parameters cannot be performed on the following waveforms.

*   Snapshot waveforms
*   Accumulated waveforms other than the most recent

Measurement Items

Select from the following 26 measurement items and delay measurement items (parentheses indicate onscreen terms). A maximum of 100,000 data values can be saved in all areas and all traces (CH1 to CH4, M1 to M4). (The screen display can show a maximum of 16 waveforms in total.)

*   **Measurement Items on the Voltage-Axis**

Max (Max):	**Max voltage [V]**
Min (Min):	**Min voltage [V]**
High (High):	**High voltage [V]**
Low (Low):	**Low voltage [V]**
P-P (P-P):	**P-P value (Max – Min) [V]**
Hi-Low (Hi-Low):	**High voltage – Low voltage [V]**
+Over (+Over):	**Amount of overshoot [%]**
	(Max – High)/(High – Low) × 100
–Over (–Over):	**Amount of undershoot [%]**
	(Low – Min)/(High – Low) × 100

Rms (Rms):	**RMS voltage [V] $(1/\sqrt{n})(\Sigma(xI^2)^{1/2}$**
Mean (Mean):	**Average voltage [V] $(1/n)\Sigma xI$**
Sdev (Sdev):	**Standard deviation**
	[V] $((\Sigma xI^2 - (\Sigma xI)^2/n)/n)^{1/2}$
IntegTY (ITY):	**Total area for both positive and negative amplitudes [Vs]**
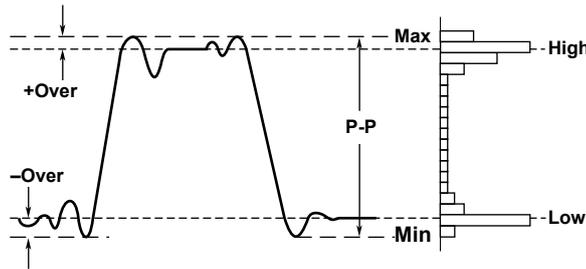
*   **Measurement Items on the Time-Axis**

C.Rms (CRms):	**Rms value of the integer multiple of the period for the specified range [V]**
C.Mean (CMean):	**Average voltage of the integer multiple of the period for the specified range [V]**
C.Sdev (CSdev):	**Standard deviation of the integer multiple of the period for the specified range [V]**
C.IntegTY (CITY):	**Total area for both positive and negative amplitudes of each period for the specified range [Vs]**

Freq (Freq):	**Average frequency [Hz]**
1/Freq (1/FR):	**Average period [s]**
Count (Count):	**Edge count [No units]**
Burst (Burst):	**Burst width [s]**

10
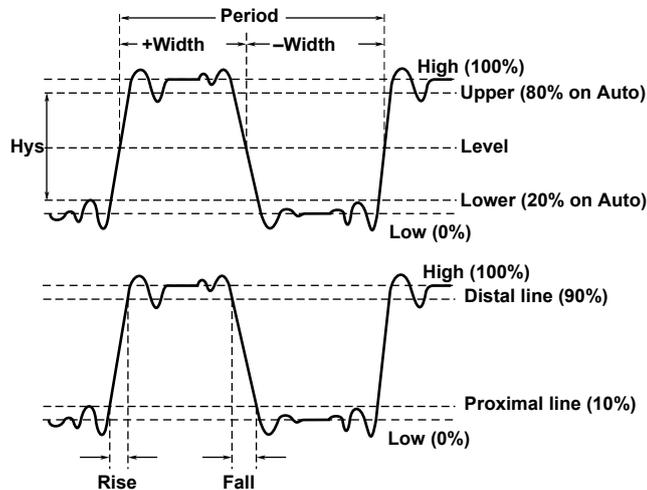
Waveform Analysis

Count: Edge count

When the lower threshold is crossed first, and then the upper threshold
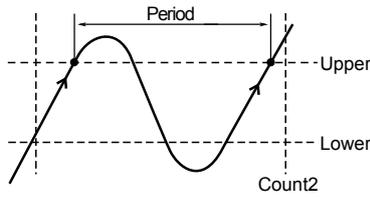
When the upper threshold is crossed first, and then the lower threshold
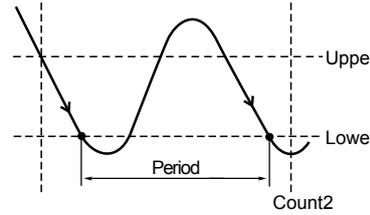
Burst: Burst width [s]   Set the measurement range (T-Range) according to the burst width you wish to measure.
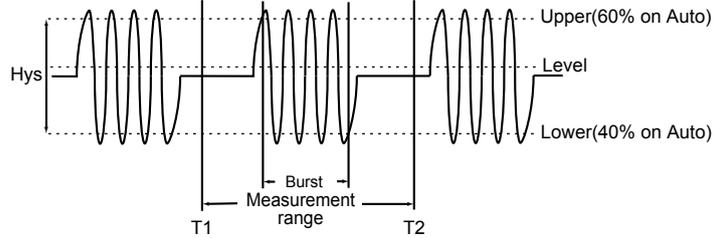
- **Other Measurement Items**

  + Width (+ Width):   Searching from the measurement start point, the time interval from first going above the Upper limit to first going below the Lower limit [s]

  – Width (– Width):   Searching from the measurement start point, the time interval from first going below the Lower limit to first going above the Upper limit [s]

  Period (Period):   Period [s]

  Duty (Duty):   Duty ratio [%]

  Rise (Rise):   Rise time [s]

  Fall (Fall):   Fall time [s]

  Delay (Dly):   Delay time [s]

Delay Setup

The time difference between trace waveforms or from the trigger to a rising or falling edge is termed the inter-channel delay. The following example shows the case of a rising edge.
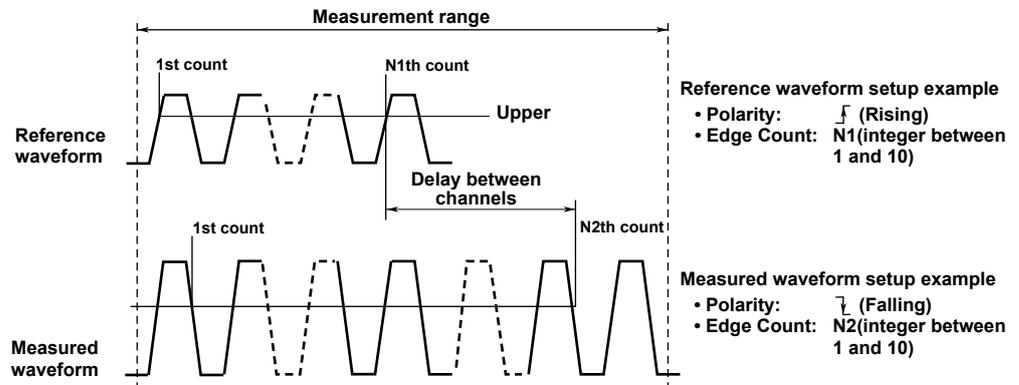
- The reference position changes with the Reference setting.
  Edge: The delay between waveforms is shown as a time.
  Trig Pos: The delay from the trigger position is shown as a time.
- With Edge Polarity, select whether the detected edge is $\mathcal{f}$ (rising) or $\mathcal{L}$ (falling). The default value is rising.
- With Edge Count, set the number of the edge taken as the detection point. The selectable range is an integer from 1 to 9. The default value is 1.
- The voltage level of the detection point is the Upper limit when rising, and the Lower limit when falling.
- When the measurement value is displayed, the measurement item name is "Dly".

Setting the Measurement Range

In the default setting, the measurement range is ±5 div of the time axis display frame, but the range can be restricted. The measurement range is determined by the two vertical cursors. The fine broken line position is the measurement start point, and the coarse broken line position is the measurement end point.
The measurement range can be thought of in the same way as the setting range of the cursor display positions for cursor measurement.

Threshold Settings
- Auto: The threshold values are found from P-P or High-Low, and set automatically.
- Level/Hys: Set with the rotary knob.
- Upper/Lower: Set with the rotary knob (for burst measurement).

Notes on Automatic Measurement of Waveform Parameters
- If measurement is not possible, the measurement value is shown as "***".
- For waveforms of small amplitude, correct measurements may not be possible.
- If there are two or more cycles of the waveform within the measurement range, the time axis parameters (+Width, –Width, Period, Duty) are measured for the first cycle.
- To stop automatic measurement, set Mode to OFF. The processing stops at that point.

10

Waveform Analysis

10.3 Performing Statistical Processing of the Measured Values of Waveform Parameters
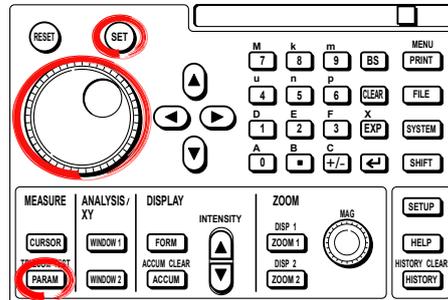
Normal Statistical Processing Settings

1. Press **PARAM**.
2. Press the **Mode** soft key.
3. Press the **Continuous Statistics** soft key.
4. Press the **Item** soft key.
5. Press the soft key for the measurement waveform, to select the waveform.
6. With the **rotary knob**, move the cursor to the item you want to set to ON.
7. Follow steps 8 to 23 of the procedure for automatic measurement of waveform parameters (pages 10-18 to 10-19), to set the measurement items.
8. Repeat steps 5 to 7 as many times as required. Press **ESC**.
9. With the **rotary knob**, set Count (number of statistical operations).
10. To clear the statistics results, and restart statistical processing, press the **Restart** soft key.

Other setting items are the same as for automatic measurement of waveform parameters (See Section 10.2, steps 24 and following).
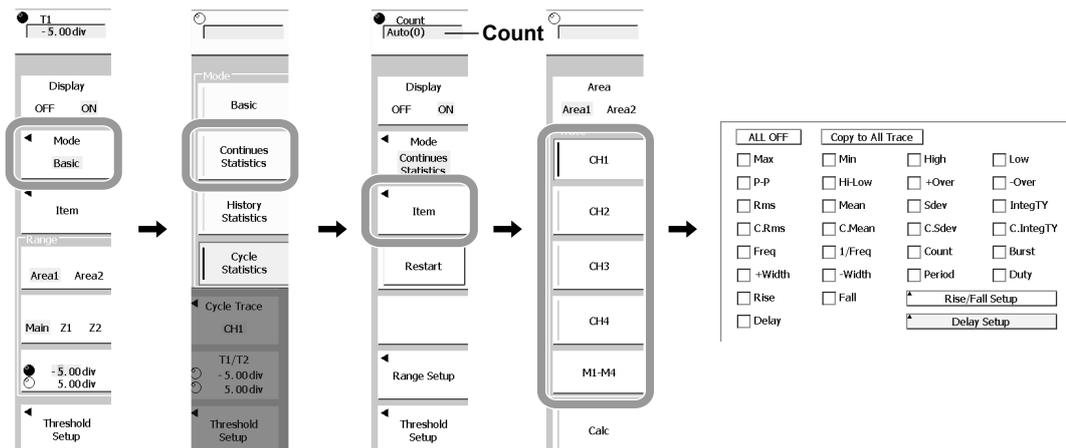
Cycle Statistics Processing Settings
1. Press **PARAM**.
2. Press the **Mode** soft key.
3. Press the **Cycle Statistics** soft key.
4. Press the **Item** soft key.
5. Press the soft key for the measurement waveform, to select the waveform.
6. With the **rotary knob**, move the cursor to the item you want to set to ON. Follow steps 8 to 23 of the procedure for automatic measurement of waveform parameters (pages 10-18, 10-19), and set the measurement items.
7. Press the **Cycle Trace** soft key. A cycle waveform selection menu appears.
8. Press the soft key corresponding to the cycle channel.

Other setting items are the same as for automatic measurement of waveform parameters (Excluding Area. See Section 10.2, steps 10 and following).

Carrying Out Statistical Processing
9. Press the **EXEC** soft key. This carries out the statistical processing. The EXEC legend changes to "Abort". To abort the measurement and statistical processing, press the Abort soft key. This aborts measurement/statistical processing, and the Abort legend changes to "EXEC".

10
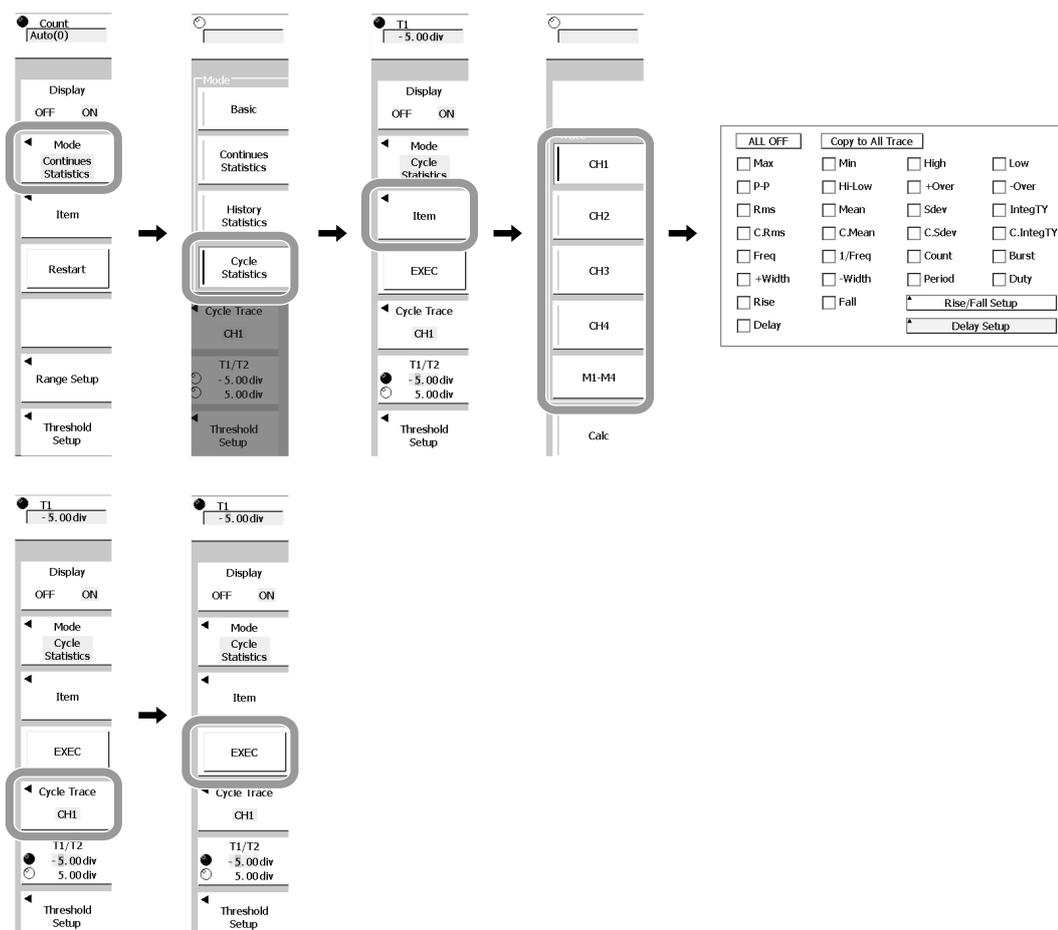
Waveform Analysis

Settings for Statistical Processing of History Data

1. Press **PARAM**.
2. Press the **Mode** soft key.
3. Press the **History Statistics** soft key.
4. Press the **Item** soft key.
5. Select the waveform to be measured from **CH1** to **CH4** and **M1** to **M4**, and press the corresponding soft key.
6. With the **rotary knob**, move the cursor to the item you want to set to ON.
7. Follow steps 8 to 23 of the procedure for automatic measurement of waveform parameters (pages 10-18, 10-19), and set the measurement items.

   Other setting items are the same as for automatic measurement of waveform parameters (See Section 10.2, steps 10 and following).

Carrying Out Statistical Processing

8. Press the **EXEC** soft key. This carries out the statistical processing. The EXEC legend changes to "Abort". To abort the measurement and statistical processing, press the Abort soft key. This aborts measurement/statistical processing, and the Abort legend changes to "EXEC".
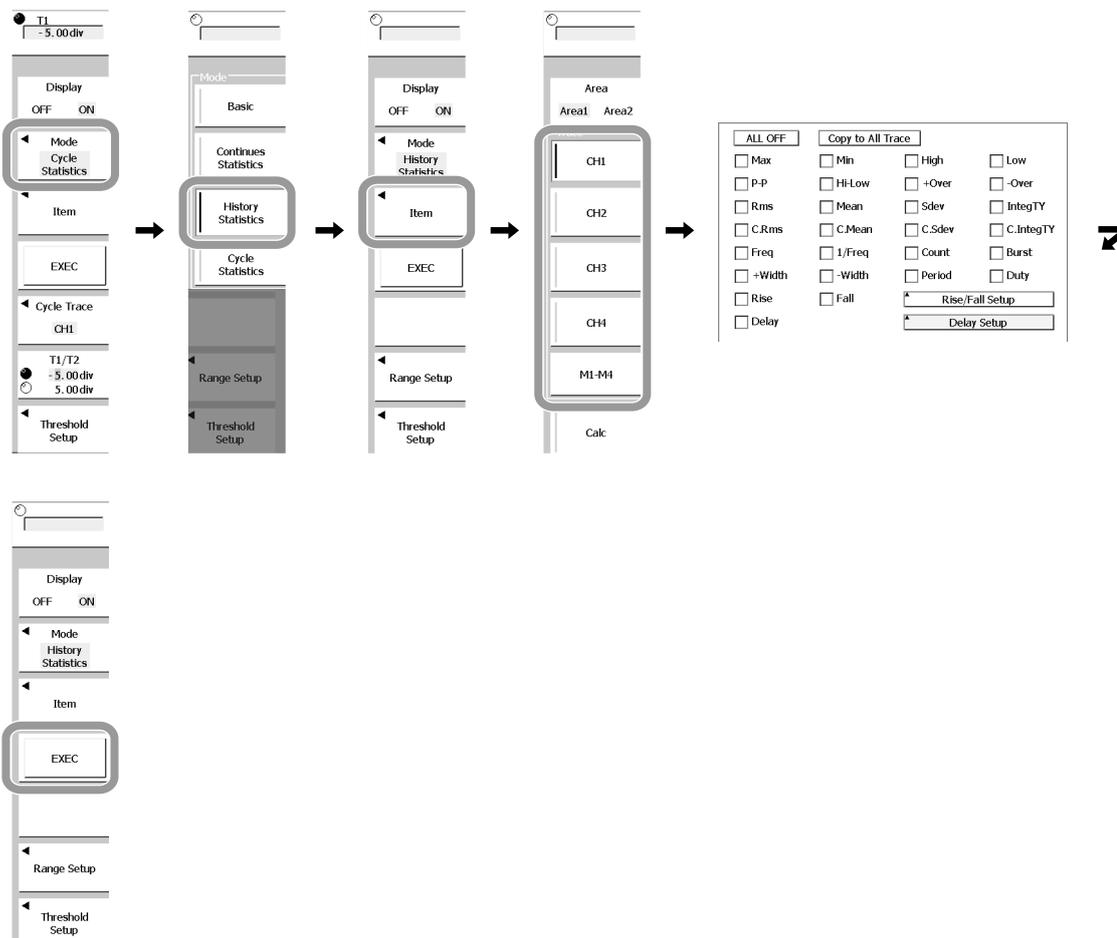
Explanation

Statistical processing is performed on the same measurement items as those of the automated measurement of waveform parameters. For the measurement values of the three automatic measurement items, the following five statistical results are shown.
- Max: Maximum value
- Min: Minimum value
- Mean: Average value
- σ: Standard deviation
- Cnt: Number of measured values used in the statistical processing

For example, if you selected P-P of CH1 as a measurement parameter, the maximum, minimum, average, standard deviation, and the number of measured values used in the statistical processing of the P-P of CH1 are displayed.
Two statistical results can be shown for each of the automatic measurement items.
If three or more automatic measurement items are selected, the first two items are shown, in ascending order of channel, and in the sequence in the Item Setup automatic measurement item selection menu (P-P, Amp, Max, Min..., Init1XY, Init2XY).
Example 1: With CH1: P-P, Amp, CH2: Min, CH3: Max, Min selected
                 Display shows CH1: P-P, CH2: Min
Example 2: With CH1: Max, Min, CH2: P-P, Amp selected
                 Display shows CH1: Max, Mix

Statistical results not displayed can be read by the following methods.
- Using the communications function to read into a computer.
- Saving the statistical results as automatic measurement of waveform parameters (see Section 13.9), then reading into a computer.

There are three types of statistical processing: normal statistical processing, cycle statistical processing, and history data statistical processing.

Normal Statistical Processing (Continuous Statistics)
While acquiring a waveform, statistical processing is carried out on the entire waveform up to the current point. The number of measurement values (Cnt) to which statistical processing applies is the number of waveform samples acquired up to this point.
Setting a new automatic measurement item for statistical processing, either during waveform acquisition, or while waveform acquisition is stopped, resets the count (Cnt) to 1.

Cycle Statistical Processing (Cycle Statistics)
The cycle of the displayed waveform is determined in order from the oldest data, the selected parameters for automated measurement are measured on the data within the cycle, and statistical processing is performed. The cycle is determined in the same fashion as the Period for the normal waveform parameters. The period of the specified waveform is applied to all waveforms.
- CH1 to CH4, M1 to M4: Performs automated measurement of waveform parameters on all target waveforms per cycle of the specified channel, and performs statistical processing.

Statistical processing is carried out for each cycle in sequence from the oldest data for the displayed waveforms.

The following parameters are not measured.
- For the waveform from which the cycle is found:
  Freq (average frequency), 1/Freq (average period), Count (edge count), Delay

10

Waveform Analysis

History Data Statistical Processing (History Statistics)

Statistical processing is carried out on automatic measurement items for waveforms acquired using the history memory function. Statistical processing is carried out in sequence from the oldest waveform. The waveforms for statistical processing are the waveforms displayed with ShowMap.

Target Waveforms

CH1 to CH4, M1 to M4

Automatic Measurement Items for Statistics

Statistical processing applies to the waveform automatic measurement parameters in Section 10.2. Statistical processing results can only be displayed for two automatic measurement items.

Measurement Range for Statistics

This is the same as the measurement range set for automatic measurement of waveform parameters (See Section 10.2).

Notes on Statistical Processing

During statistical processing, all soft keys other than Abort are disabled.

10.4 Telecom Testing
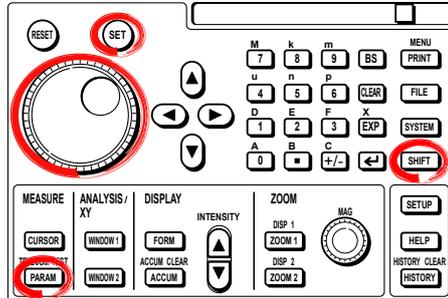
1. Press **SHIFT** + **PARAM**.

Selecting the Window to Which the Test Applies
2. Press the **Window** soft key. The Window setting menu appears.
3. Press one of the **Main**, **Zoom1**, and **Zoom2** soft keys, to make the selection.
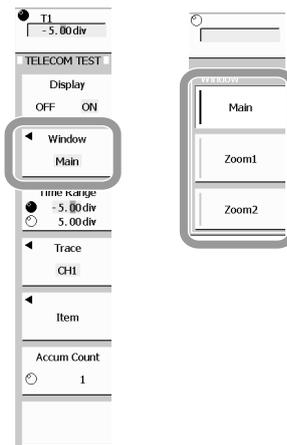
Selecting the Time Ranges to Which the Test Applies
4. Press the **Time Range** soft key.
5. Turn the **rotary knob**, to set the time range.
6. Repeat steps 4 and 5, to set the time ranges.

10

Waveform Analysis
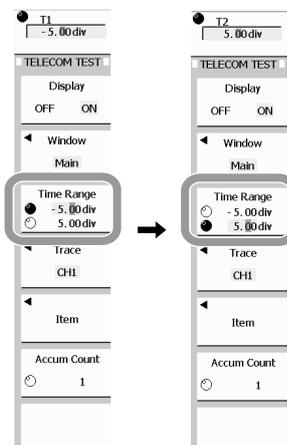
Selecting the Trace to Which the Test Applies

7. Press the **Trace** soft key.
8. Press the soft key corresponding to the channel to which the test applies, from CH1 to CH4, and M1 to M4. To select from M1 to M4, press the **M1-M4** soft key to change the selection.
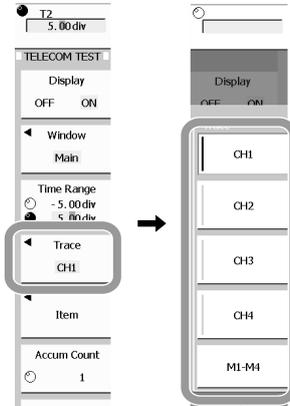
Selecting the Test Item

9. Press the **Item** soft key.
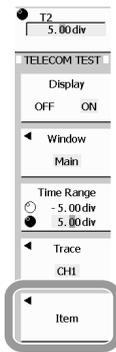
- **Setting the Mask Test Item**
  10. Press the **Mask Test** soft key.
  11. Turn the **rotary knob**, to select the item to be ON, and press SET.
      Press SET once more to set the item to OFF.
  12. Select the element from Element1 to Element4, and press the corresponding soft key.
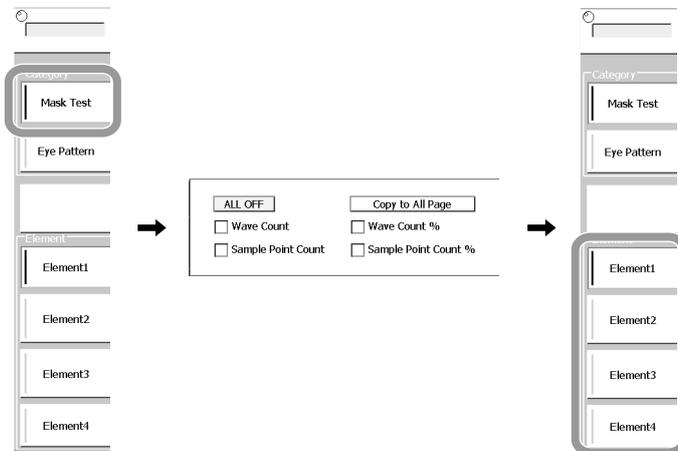
13. Press **ESC** to return to the previous screen.

Setting the Accumulated Count

14. Press the **Accum Count** soft key.

15. Turn the **rotary knob**, to set the accumulated count.

```
●  T2
    5.00 div

TELECOM TEST

    Display
  OFF   ON

◄   Window
      Main

  Time Range
◌  - 5.00 div
●    5.00 div

◄   Trace
      CH1

◄    Item

  Accum Count
◌        1
```
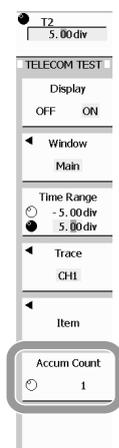
<div style="border:1px solid; padding:4px; display:inline-block;">**Explanation**</div>

For the four masks (elements) created on a computer, the mask test determines an error if the trace being tested enters the element.

Window to which the test applies

Can be selected from Main, Z1, and Z2.

Time range to which the test applies

Can be set to a range of ±5.00 div.

Trace to which the test applies

Can be selected from CH1 to CH4, and M1 to M4.

Mask test items

ALL OFF: Do not display all items.
Copy to All Page: Copy current settings to all elements.
Wave Count: Number of errors per acquisition
Sample Point Count: For the number of sample data values for the element, the
                        number of errors/total number display
Wave Count %:   Error rate against number of acquisitions (%)
Sample Poin Count %:   For the number of sample data values for the element, error rate
                        display (%)

Notes on the telecom test

• When the telecom test is carried out, for waveforms other than the waveform being tested, if the waveform has data interpolation set to OFF, it is shown as P-P compressed data.

• When GO/NO/GO or history search is being carried out. Cannot be done during a mask test.

• When the telecom test is set to ON (open the setting menu), accumulate is also set to ON. The accumulate mode is Count.

10

Waveform Analysis

10.5 Viewing Phase Differences Between Measured Waveforms (XY display)
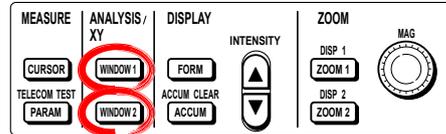
1. Press **WINDOW1** or **WINDOW2**.
2. Press the **Type** soft key.
3. Press the **XY** soft key.
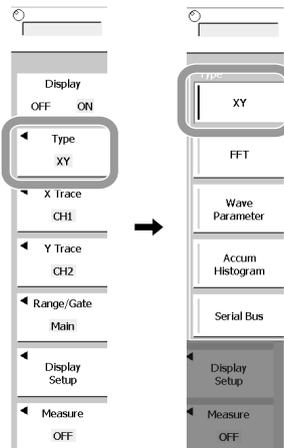
Setting the X-axis Trace

4. Press the **X Trace** soft key.
5. Select the channel to set the **X Trace**, from CH1 to CH4, and M1 to M4, and press the corresponding soft key. To select from M1 to M4, press the M1-M4 soft key to change the selection.
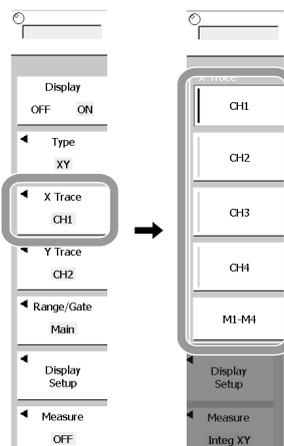
Setting the Y-axis Trace

6. Press the **Y Trace** soft key.

7. Select the channel to set the **Y Trace**, from CH1 to CH4, and M1 to M4, and press the corresponding soft key. To select from M1 to M4, press the M1-M4 soft key to change the selection.
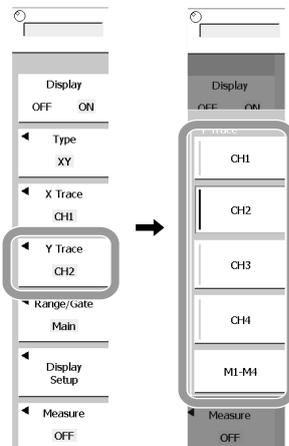
Setting the Time Axis Range

8. Press the **Range/Gate** soft key.

9. Select **Main**, **Zoom1**, or **Zoom2**, and press the corresponding soft key.

10. Press the **Time Range** soft key.

11. Turn the **rotary knob**, to set the time range.

12. Repeat steps 10 and 11, to set the time range.

13. Press the **Gate CH** soft key.

14. Select the channel to be set as **Gate CH**, from OFF, CH1 to CH4, and M1 to M4, and press the corresponding soft key. To select from M1 to M4, press the M1-M4 soft key to change the selection. If you select OFF, continue to step 19.

15. Press the **Active Level** soft key, and select H or L.

16. Press the **Level/Hys** soft key.

17. Turn the **rotary knob** to set the level.

18. Repeat steps 16 and 17 to set the threshold values.

19. Press **ESC**.

10

Waveform Analysis

Setting the Display Format

20. Press the **Display Setup** soft key.
21. Press the **VT** soft key to select ON or OFF.
22. Press **ESC**.
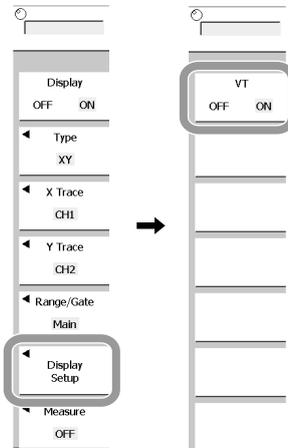
Setting the Analysis Function

23. Press the **Measure** soft key.
24. Select **OFF**, **Cursor**, or **Integ XY**, and press the corresponding soft key.

    If you select OFF, proceed to step 34.

    If you select Cursor, continue to step 25.

    If you select Integ XY, continue to step 32.

- **Setting the Cursors**
  25. Press the **X1/X2** soft key, to assign the rotary knob to X1.
  26. With the **rotary knob** or **up and down arrow keys**, move the X1 cursor.
  27. Similarly, move the X2 cursor.
  28. Press the **Y1/Y2** soft key, to assign the rotary knob to Y1.
  29. With the **rotary knob** or **up and down arrow keys**, move the Y1 cursor.
  30. Similarly, move the Y2 cursor.
  31. Press **ESC**.
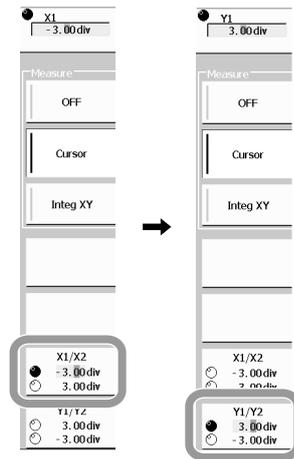
- **Setting Integ XY**
  32. Press the **Loop** soft key to select Open or Close.
  33. Press the **Polarity** soft key to select CW or CCW.
  34. Press **ESC**.

10

Waveform Analysis
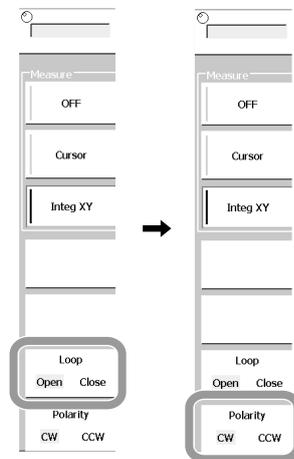
Explanation

X-axis Trace: X Trace
Select from CH1 to CH4, and M1 to M4.

Y-axis Trace: Y Trace
Select from CH1 to CH4, and M1 to M4.

Setting the Time Axis Range: Range/Gate
Target Window (Window):   Select the window for which to set the display range from Main, Zoom1, Zoom2.

Time axis range (Time Range): Specify the range within the selected window.

Selection range: ±5.00 div

• **Gate trace: Gate CH**
  XY analysis is carried out when the gate trace is above or below the active level.
  Specify the gate channel.

• **Active level: Active Level**
  H: Valid at or above the level
  L: Valid at or below the level

• **Level/hysteresis: Level/Hys**
  Set the level used to determine the active level, and the hysteresis.

Setting the Display Format: Display Setup
Select the VT waveform to be displayed or not displayed.

Setting the Analysis Function: Measure

• **OFF**
  No analysis carried out.

• **Cursors**
  You can simultaneously specify two cursors for each of the X-axis and Y-axis, for a total of four cursors.
  X1/X2:   Measure the values on the X-axis with the X1 and X2 cursors.
           Setting range ±4. div, setting resolution 0.01 div
  Y1/Y2:   Measure the values on the Y-axis with the Y1 and Y2 cursors.
           Setting range ±4. div, setting resolution 0.01 div

• **Integ XY**
  Find the sum total of the area of the XY waveform.
  Loop: Select the method of finding the area from Open (trapezoid sum total) or Close (triangular sum total).
  Polarity: Select the positive direction from CW (clockwise) and CCW(counterclockwise).
  For details, see Appendix 2.

10.6 Fast Fourier Transform (FFT)
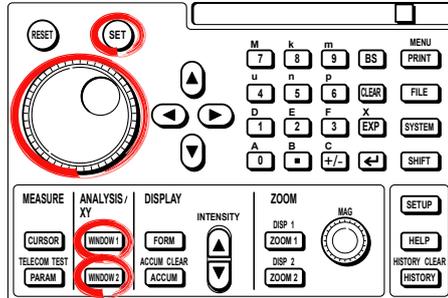
1. Press **WINDOW1** or **WINDOW2**.
2. Press the **Type** soft key.
3. Press the **FFT** soft key.
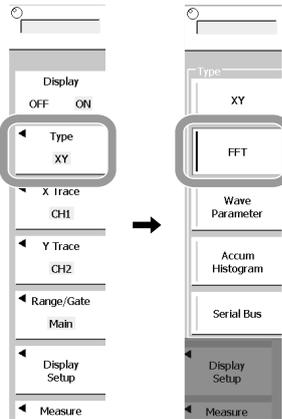
When setting the FFT calculation proceed to step 4, when setting the FFT display proceed to step 15, and when setting the FFT analysis proceed to step 27.

Setting the FFT calculation

4. Press the **Setup** soft key.
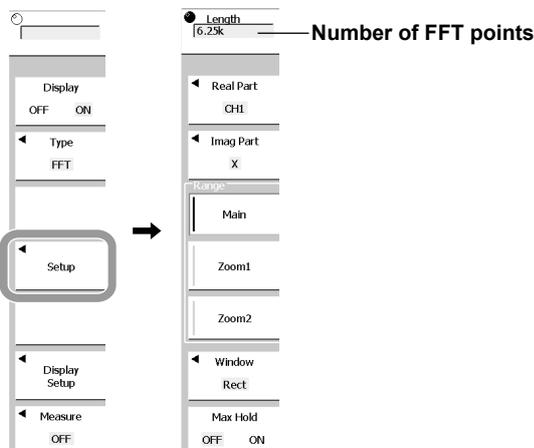
5. With the **rotary knob**, set the number of FFT points.
   Select from 2.5 k, 6.25 k, 12.5 k, 25 k, 62.5 k, 125 k, and 250 k.

Trace Selection

6. Press the **Real Part** soft key.

7. Select the channel for Real Part, from CH1 to CH4, and M1 to M4, and press the corresponding soft key. To select from M1 to M4, press the **M1-M4** soft key to change the selection.
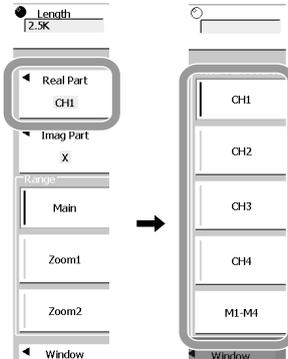
Selecting the Imaginary Part

8. Press the **Imag Part** soft key.

9. Select the channel for Imag Part, from CH1 to CH4, M1 to M4, and X, and press the corresponding soft key. To select from M1 to M4, press the **M1-M4** soft key to change the selection.
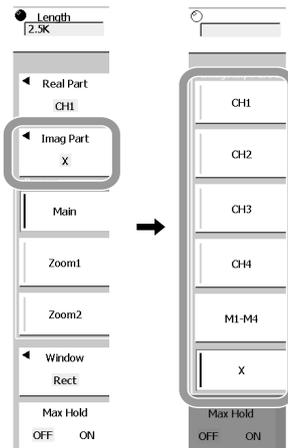
Selecting the Calculation Range

10. Select the Main, Zoom1, or Zoom2 window for calculation, and press the corresponding soft key.
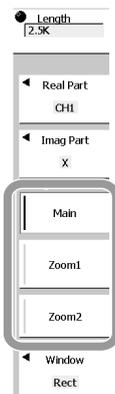
Selecting the Time Window (Time Window Function)

11. Press the **Window** soft key.

12. Select **Rect**, **Hanning**, or **Flat top**, and press the corresponding soft key.
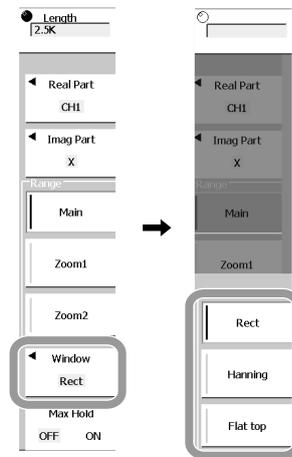
Setting the Maximum Value Hold

13. Press the **Max Hold** soft key to select ON or OFF.

14. Press **ESC**. This returns to the original menu.

Waveform Analysis
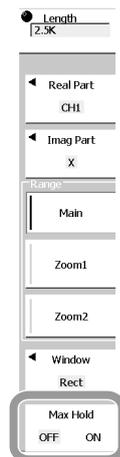
Setting the Display Format

15. Press the **Display Setup** soft key.

16. Press the **VT** soft key, to select ON (display time axis waveforms) or OFF (do not display time axis waveforms).
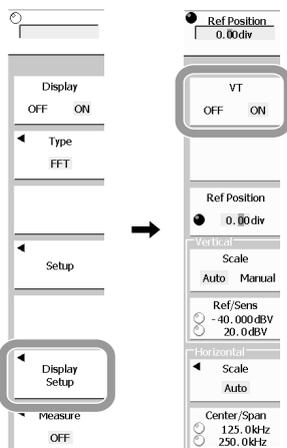
- **Setting the Reference Position**

17. Press the **Ref Position** soft key.

18. With the **rotary knob**, set the range.
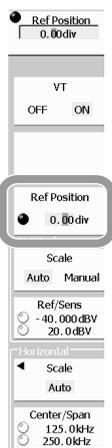
- **Setting the Vertical Axis Display**

19. Press the **Scale (Vertical)** soft key, and select Auto or Manual.

20. Press the **Ref/Sens (Vertical)** soft key.

21. With the **rotary knob**, set Ref Level (level at the center of enlargement) and Sens (sensitivity).

    When Scale is Default, changing the Ref/Sens setting switches the Scale to Manual.

• **Setting the Horizontal Axis Display**

22. Press the **Scale (Horizontal)** soft key.

23. Select **Auto**, **Center/Span**, or **Left/Right**, and press the corresponding soft key.

24. Press the **Center/Span** soft key (Left/Right when Scale is Left/Right).

25. With the **rotary knob**, set the Center and Span (display range width).

   When Scale is set to Left/Right, set Left and Right.

26. Press **ESC**. This returns to the original menu.

Setting the Analysis Function

27. Press the **Measure** soft key.

28. Select **OFF**, **Marker**, or **Peak**, and press the corresponding soft key.
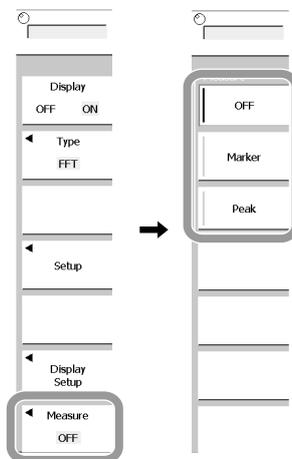
- **Setting the Computation Item**

  (Set the item when Marker or Peak is selected in step 28 on page 10-46.)

29. Press the **Item** soft key.

30. Press the **Basic** soft key.

31. Turn the **rotary knob** to select the item to be turned ON, and press **SET**.
    Press SET again to turn the item OFF.
    (Of the choices, F(F1), F(F2), and ΔF can be used on products with firmware version 1.80 or higher.)

32. To calculate using FFT analysis values, press the **Calc** soft key.

33. Turn the **rotary knob** to select the equation number to be turned ON. Press **SET** to select the check box.

34. Select the equation area, press **SET**, and enter the equation.
    (Operator buttons F(F1), F(F2), and ΔF can be used on products with firmware version 1.80 or higher.)

35. Press **ESC** to return to the analysis function setting screen.
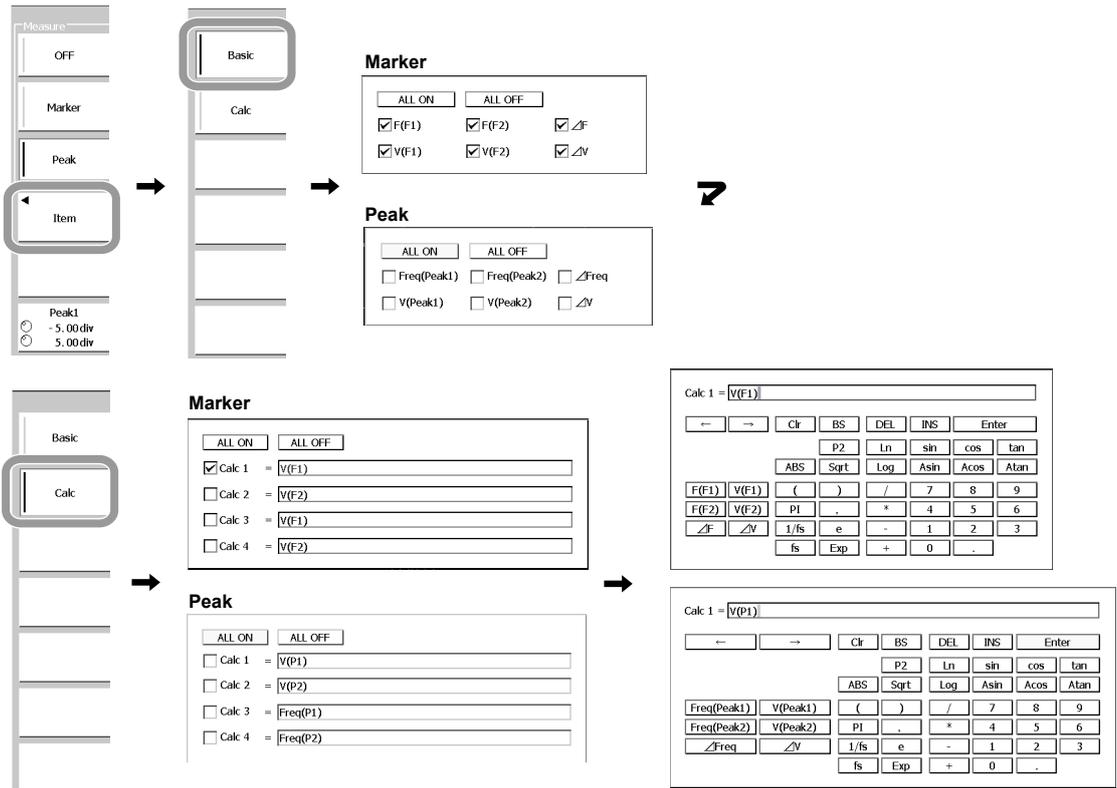
- **Moving the Cursor (When set the Measure to Marker)**
  36. Press the **F1 Position** soft key.
  37. Turn the **rotary knob** to move the F1 cursor.
  38. Press the **F2 Position** soft key.
  39. Turn the **rotary knob** to move the F2 cursor.
  40. Press **ESC**. This returns to the FFT analysis setting screen.
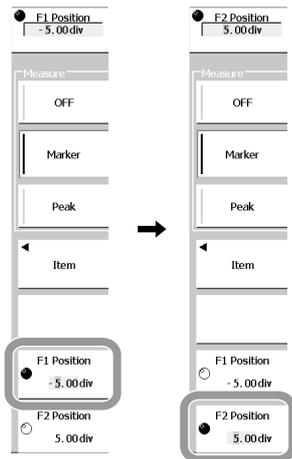
- **Setting the Peak Range (When set the Measure to Peak)**
    41. Press the **Peak1** soft key.
    42. With the **rotary knob**, set the Peak1 start point and end point.
    43. Press the **Peak2** soft key.
    44. Turn the **rotary knob**, to set the Peak2 start point and end point.
    45. Press **ESC**. This returns to the FFT analysis setting screen.
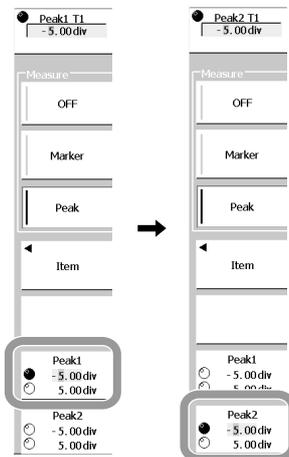
Explanation

Number of FFT points
Can be selected from 2.5k, 6.25k, 12.5k, 25k, 62.5k, 125k, and 250k.

Trace Selection: Real Part
Select from CH1 to CH4, and M1 to M4.

Imaginary Part Selection: Imag Part
Select from CH1 to CH4, M1 to M4, and X.

Calculation Range Selection: Range
Select the range for FFT calculation, from Main, Zoom1, and Zoom2.

Setting the Time Window: Window
Select the time window for FFT calculation.
Rect: Rectangular
Hanning: Hanning
Flat top: Flat top

Maximum Value: Max Hold
Select whether or not to hold and display the maximum value of the various frequencies from the start of calculation to the present.

Setting the Display Format: Display Setup
- **VT**
  Select whether to display or not display the VT waveform.
- **Ref Position**
  Se the reference position on the vertical axis.
  Setting range ±4 div
- **Setting the Vertical Axis: Vertical**
  Default: Set the predetermined axis.
  Manual: Select when the axis is set by the user.

• **Setting the Horizontal Axis: Horizontal**
Default:　　Set the predetermined center point and span.
Center/Span: Select this when the horizontal axis has the center value and span set
　　　　　　to arbitrary values.
Left /Right:　Select this when the horizontal axis has the left and right ends set to
　　　　　　arbitrary values.

Setting the Measure Item

• **OFF**
Does not perform the analysis.

• **Marker**
Set the positions of the two markers (F1: Xmarker and F2: +marker). The FFT values
(frequency and level) at the markers and the difference between the markers are
computed.
　• FFT frequency value: F(F1), F(F2)
　• FFT level value: V(F1), V(F2)
　• Difference between markers:ΔF = Difference between F(F1) and F(F2)
　　　　　　　　　　　　　　ΔV = Difference between V(F1) and V(F2)
　• F1 Position and F2 Position: Sets each marker position.
　• Selectable range: $\pm$ 5.00 div
　　*　F (F1), F (F2), and ΔF can be used on products with firmware version 1.80 or higher.

• **Peak**
Set two ranges along the frequency axis (horizontal axis). The peak values (P1 and
P2) of the FFT values (frequency and level) in the two ranges and the difference
between the peaks are calculated.
　• FFT frequency value: Freq(Peak1), Freq(Peak2)
　• FFT level value: V(Peak1), V(Peak2)
　• Difference between the peaks:
　　　ΔFreq = Difference between Freq(Peak1) and Freq(Peak2)
　　　ΔV = Difference between V(Peak1) and V(Peak2)
　• Peak1/Peak2: Sets each range.
　• Selectable range: $\pm$ 5.00 div

Table of selectable computation items and the corresponding names used to display
the computed results

Selectable Computation Items	Names Used to Display the Computed Results
Marker	
FFT frequency value	
F(F1)	F1
F(F2)	F2
FFT level value	
V(F1)	V1
V(F2)	V2
Difference between markers:	
ΔF	ΔF
ΔV	ΔV
Peak	
FFT frequency value	
Freq(Peak1)	Freq(P1)
Freq(Peak2)	Freq(P2)
FFT level value	
V(Peak1)	V(P1)
V(Peak2)	V(P2)
Difference between the peaks:	
ΔFreq	ΔPeak(Hz)
ΔV	ΔPeak(V)

10
Waveform Analysis

10.7 Displaying Graphs and Lists of Automatic Measurement Waveform Parameters
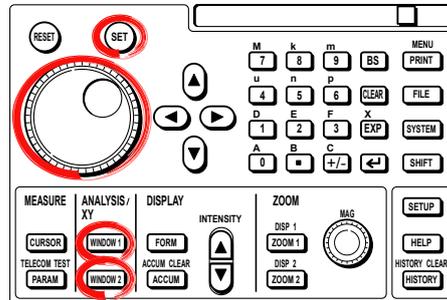
1. Press **WINDOW1** or **WINDOW2**.
2. Press the **Type** soft key.
3. Press the **Wave Parameter** soft key.
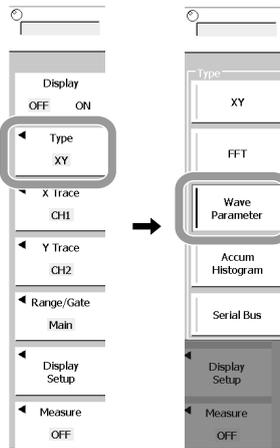
Histogram Display

Selecting the Histogram

4. Press the **Mode** soft key.
5. Press the **Histogram** soft key.
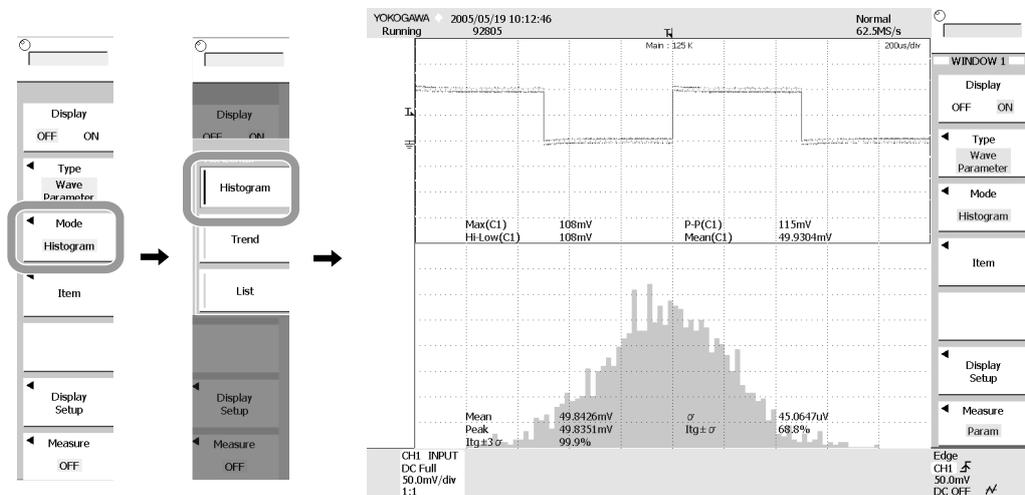
Setting Display Items

1. Press the **Item** soft key.
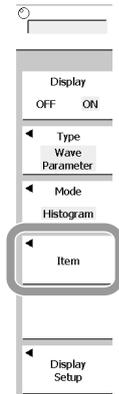
- **Selecting the Area/Trace**

2. Press the **Area** soft key to select Area1 or Area2. When the waveform parameter mode is Cycle Statistics (see Section 10.2), the Area setting is not possible.

3. Select the channel for the trace, from CH1 to CH4, and M1 to M4, and press the corresponding soft key. To select from M1 to M4, press the **M1-M4** soft key to change the selection.
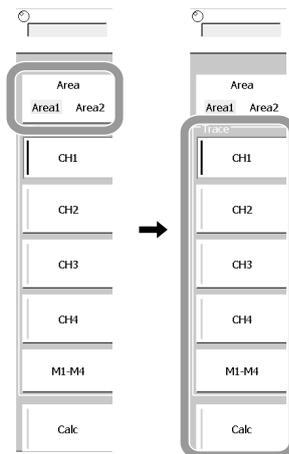
- **Selecting the Item**

4. With the **rotary knob**, select the item to be set, and press **SET**. Only one item can be selected.

☑ Max	☐ Min	☐ High	☐ Low
☐ P-P	☐ Hi-Low	☐ +Over	☐ -Over
☐ Rms	☐ Mean	☐ Sdev	☐ IntegTY
☐ C.Rms	☐ C.Mean	☐ C.Sdev	☐ C.IntegTY
☐ Freq	☐ 1/Freq	☐ Count	☐ Burst
☐ +Width	☐ -Width	☐ Period	☐ Duty
☐ Rise	☐ Fall		
☐ Delay			

10

Waveform Analysis

- **Setting the Calculation**
  5. To display a calculation result from waveform parameters as a histogram, press the **Calc** soft key.
  6. With the **rotary knob**, select the equation and press **SET**. Select the equation from the equations set for automatic measurement of waveform parameters.
  7. Press **ESC**.
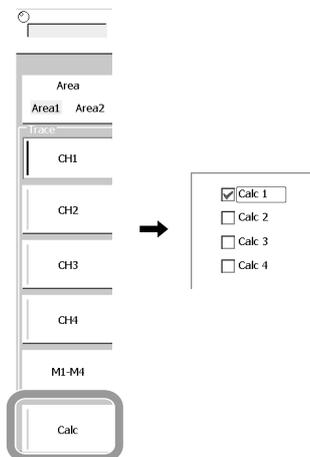
Setting the Display Format
  8. Press the **Display Setup** soft key.
  9. Press the **VT** soft key to select ON or OFF. When set to ON, in the upper half of the screen the normal voltage/time-axis display waveform appears.
  10. Press **ESC**.
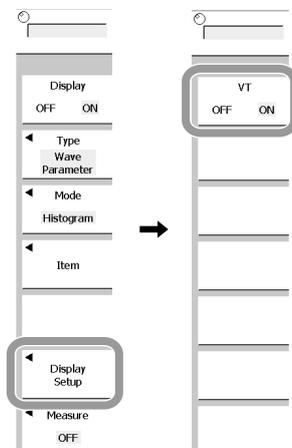
Setting the Analysis Function

11. Press the **Measure** soft key. A menu used to set whether to display the waveform parameters appears.

12. Press **OFF**, **Cursor**, or **Param** soft key to select the data source.
    If you select OFF, proceed to step 16.
    If you select Cursor or Param, proceed to step 13.
    (The Cursor setting can be used on products with firmware version 1.80 or higher.)
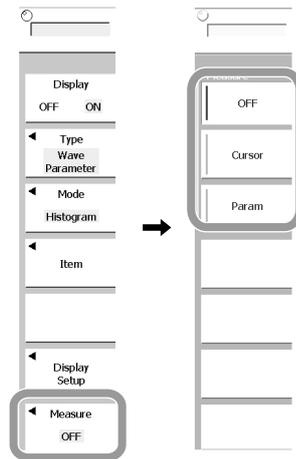
- **Selecting the Measurement Item**

13. Press the **Item** soft key.

14. Turn the **rotary knob** to select the item to be displayed, and press SET. The check box is selected.
    Press SET again to turn the item OFF.

15. Press **ESC** to return to the analysis function setting screen.

16. Press **ESC** to return to the Wave Parameter setting screen.

10

Waveform Analysis
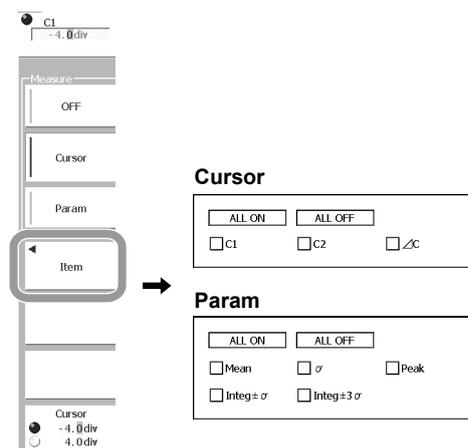
Trend Display

Selecting the Trend

17. Press the **Mode** soft key.
18. Press the **Trend** soft key.

```
  ┌─────────┐     ┌─────────┐
  │ ○       │     │ ○       │
  │ ┌─────┐ │     │ ┌─────┐ │
  └─┴─────┴─┘     └─┴─────┴─┘

    Display          Display
   OFF    ON       OFF    ON
                  ┌Horizontal──
   ◄  Type        │ Histogram
      Wave        │
   Parameter      │
                  │   Trend
   ◄  Mode        │
    Histogram     │   List
                  │
   ◄
      Item
```
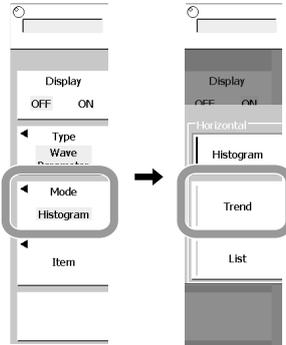
Selecting the Display Item

19. Press the **Item** soft key.

```
  ┌─────────┐
  │ ○       │
  │ ┌─────┐ │
  └─┴─────┴─┘
   WINDOW 1
    Display
   OFF    ON
   ◄  Type
      Wave
   Parameter
   ◄  Mode
      Trend

   ◄
      Item

   ◄
    Display
     Setup
```
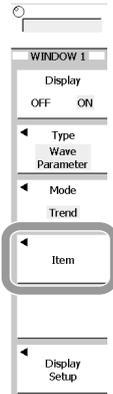
- **Selecting the Trace**

    20. Press the soft key **Area**, to select Area1 or Area2. When the waveform
         parameter mode is Cycle Statistics (see Section 10.2) Area cannot be set.
    21. Select the channel for the trace, from CH1 to CH4, and M1 to M4, and press the
         corresponding soft key. To select from M1 to M4, press the **M1-M4** soft key to
         change the selection.

☑ Max	☐ Min	☐ High	☐ Low
☐ P-P	☐ Hi-Low	☐ +Over	☐ -Over
☐ Rms	☐ Mean	☐ Sdev	☐ IntegTY
☐ C.Rms	☐ C.Mean	☐ C.Sdev	☐ C.IntegTY
☐ Freq	☐ 1/Freq	☐ Count	☐ Burst
☐ +Width	☐ -Width	☐ Period	☐ Duty
☐ Rise	☐ Fall		
☐ Delay			

```
  ┌─────────┐
  │ ○       │
  │ ┌─────┐ │
  └─┴─────┴─┘
     Area
   Area1  Area2
  ┌─────────┐
  │   CH1   │
  │         │
  │   CH2   │
  │         │
  │   CH3   │
  │         │
  │   CH4   │
  │         │
  │  M1-M4  │
  │         │
  │   Calc  │
  └─────────┘
```
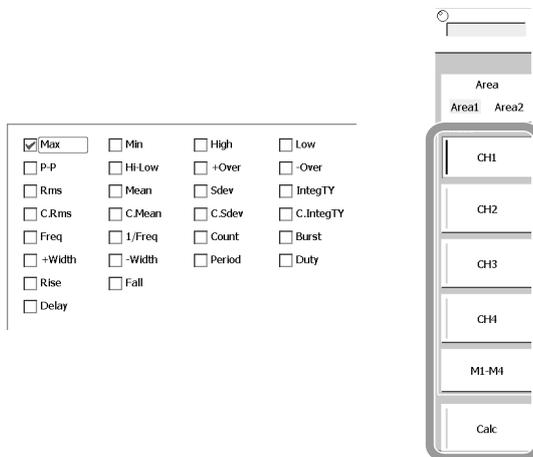
- **Selecting the Item**
    22. With the **rotary knob**, select the item to be set, and press **SET**. Only one item can be selected.

Note

Only one item can be selected.

Setting the Calculation
    23. To display a calculation result from waveform parameters as a histogram, press the **Calc** soft key.
    24. With the **rotary knob**, select the equation, and press **SET**. Select the equation from the equations set for automatic measurement of waveform parameters.
    25. Press **ESC**.
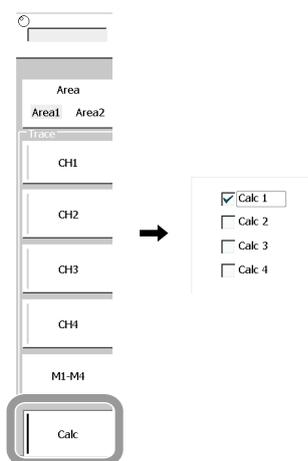
Setting the Display Format
    26. Press the **Display Setup** soft key.
    27. Press the **VT** soft key to select ON or OFF. When set to ON, in the upper half of the screen the normal voltage/time-axis display waveform appears.
         Set the display range.
         Press the **Auto Scale EXEC** soft key to automatically set the display range.
    28. Press the **Upper/Lower** soft key.
    29. With the **rotary knob**, set Upper (upper limit) and Lower (lower limit).
    30. Press the **H Span** soft key.
    31. With the **rotary knob**, set the horizontal axis range.

10

Waveform Analysis
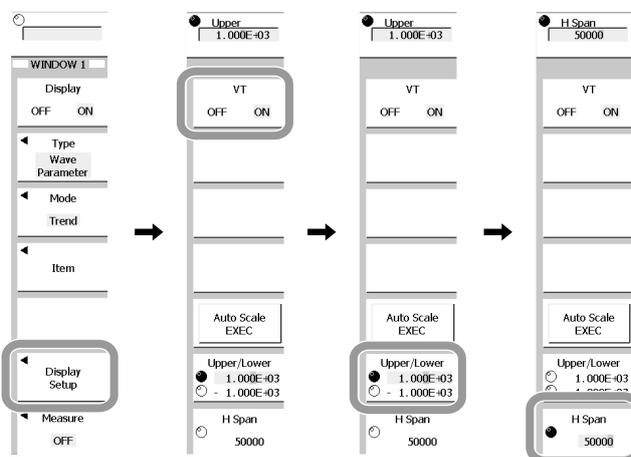
Setting the Analysis Function

32. Press the **Measure** soft key.
33. Select **OFF** or **Cursor**, and press the corresponding soft key.
    If you select OFF, proceed to step 37.
    If you select Cursor, continue to step 34.
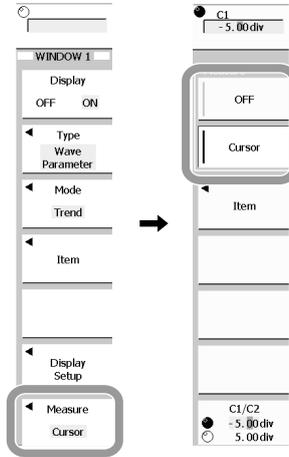
- **Selecting the Measurement Item**
34. Press the **Item** soft key.
35. Turn the **rotary knob** to select the item to be ON, and press **SET**.
    Press **SET** once more, to set the item to OFF.
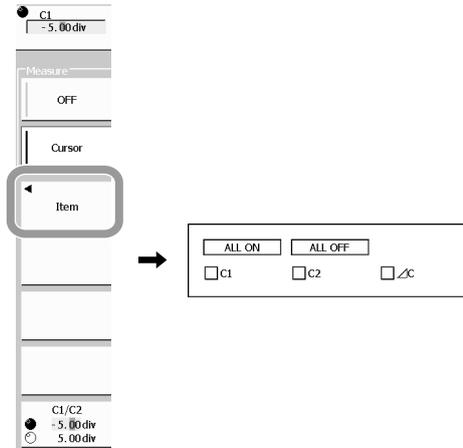
36. Press **ESC**. This returns to the analysis function setting screen.

- **Moving the Cursors**
    37.   Press the **C1/C2** soft key.
    38.   With the **rotary knob**, move the cursor to C1 or C2.
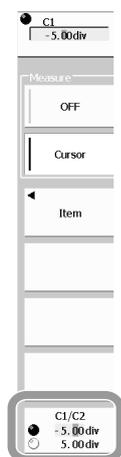
    39.   Press **ESC**. This returns to the Wave Parameter setting screen.

List Display

Selecting the List
    40.   Press the **Mode** soft key.
    41.   Press the **List** soft key.

10

Waveform Analysis
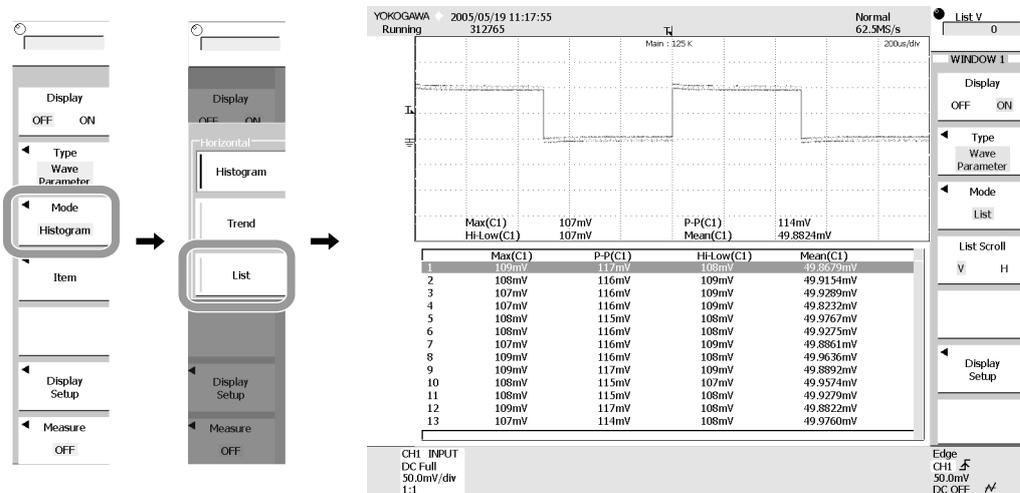
Setting the List Scrolling Direction

42. Press the **Scroll** (**List Scroll** on products with firmware version 1.60 or higher)
soft key to select V (vertical direction) or H (horizontal direction).
    - **V** (vertical direction):   You can scrolll the list vertically using the **rotary knob**
      or the **up and down** arrow keys. You can also specify the list number directly
      using List V at the top of the menu. List numbers cannot be specified directly
      for products with firmware version 1.60 or higher.
    - **H** (horizontal direction):You can scrolll the list horizontally using the **rotary
      knob** or the **up and down** arrow keys.
    - On products with firmware version 1.60 or higher, you can press the Setup
      soft key and select the scroll amount from **1**, **10**, **100**, **1000**, and **10000**.
    - * The same V Scroll Weight menu appears regardless of whether you select H or V
      with the Scroll soft key. Select the scroll amount on the menu.

Menu on products with firmware version 1.60 or higher

Directly input the list number
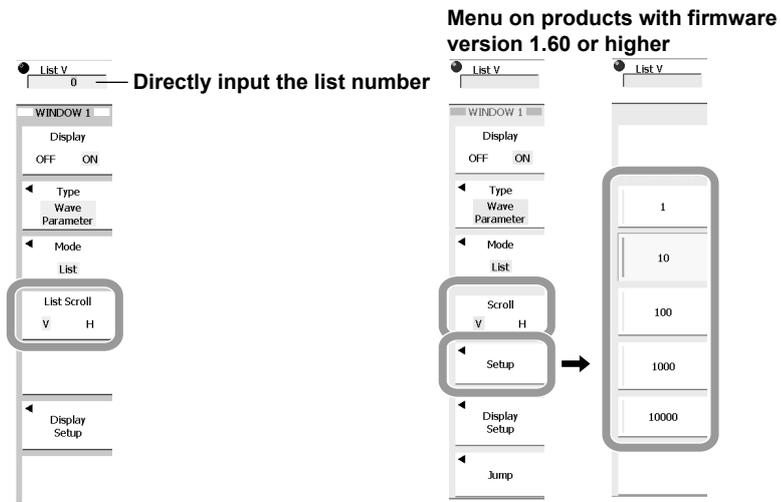
Setting the Display Format

43. Press the **Display Setup** soft key.
44. Press the **VT** soft key to select ON or OFF. If ON is specified, the waveform is
displayed on a normal voltage-time axis.
45. Press **ESC**.
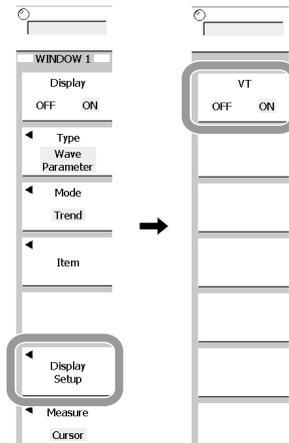
Jumping to the Maximum or Minimum Value among the Selected Items or the Latest or Oldest Data in the List

(This function can be used on products with firmware version 1.60 or higher.)

46. Press the **Jump** soft key to display the Jump menu.

    The same Jump menu appears regardless of whether you select H or V with the Scroll soft key.

47. Select the **Latest**, **Oldest**, **Max**, or **Min** soft key to select the jump destination.

    The display jumps to the selected data.

    • Latest: The latest data in the list
    • Oldest: The oldest data in the list
    • Max: The maximum value among the selected items
    • Min: The minimum value among the selected items
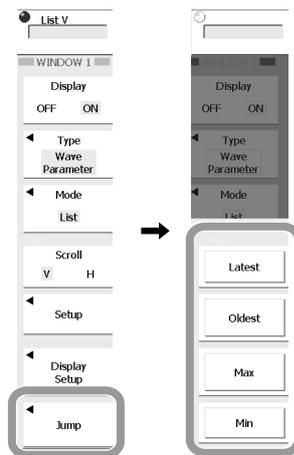
Explanation

Selecting the Method of Graph Display: Mode

Histogram: Show results as a histogram display.

Trend: Show results as a trend display.

List: Show results as a list. All items selected for automatic measurement of waveform parameters appear.

Selecting the Display Item: Item

Select the channels for which the items are displayed, and the items to display.

Setting the Display Format: Display Setup

Switch the VT waveform display on or off.

H-Span: Set this for a trend display. From the latest measurement result, the specified number of data values are shown in a trend display. The maximum value is 100000/(number of items selected).

10

Waveform Analysis

Setting the Analysis Function: Measure

- **OFF**
  No analysis carried out.

- **Param**
  The item parameters can be set.
  Mean: Average value
  σ: Standard deviation of histogram
  Peak: Peak value of histogram
  Integ ±σ: Proportion within one standard deviation (%)
  Integ ±3σ: Proportion within three standard deviations (%)
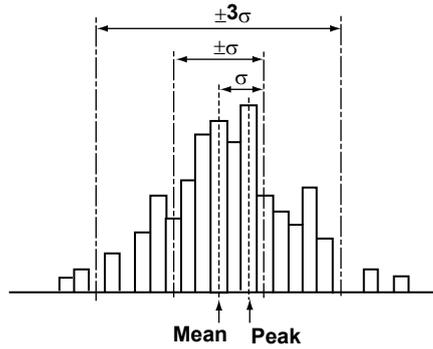
- **Cusor(Histogram, Trend)**
  C1: Show cursor C1 measurement value
  C2: Show cursor C2 measurement value
  ΔC: Difference between the measured values of cursors C1 and C2
  On the histogram display, the Cursor setting can be used on products with firmware version 1.80 or higher.)

Display range (trend)

When the Mode is Trend, carrying out Auto Scale results in Upper/Lower and H-Span settings as follows.

Upper/Lower: Set so that the difference between waveform parameter Max and Min is 80% of the waveform display area.

H-Span: Set so that the waveform parameters measured before carrying out Auto Scale are all displayed.
             When the Mode for automatic measurement of waveform parameters is Basic or Continuous Statistics, if the number of measured waveform parameters is 100 or less it is set to 100.

10.8 Displaying Frequency Distribution for a Specified Area (Accum Histogram)
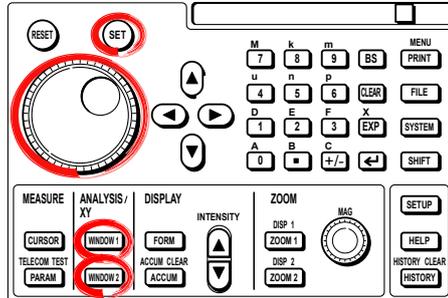
1. Press **WINDOW1** or **WINDOW2**.
2. Press the **Type** soft key.
3. Press the **Accum Histogram** soft key.
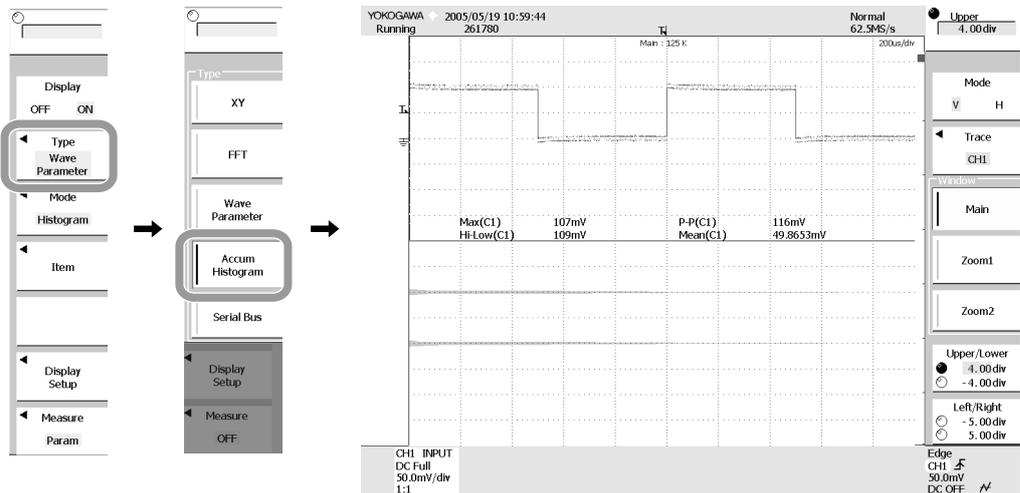
Setting the Item

4. Press the **Setup** soft key.

10

Waveform Analysis

- **Selecting the Axis**
  5.   Press the **Mode** soft key to select V or H. When set to V, a histogram on the Y-axis is display. When set to H, a histogram on the X-axis is displayed.
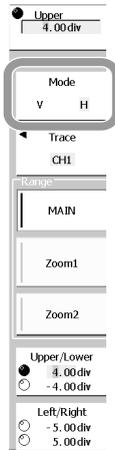
- **Selecting the Trace for Analysis**
  6.   Press the **Trace** soft key.
  7.   Select the channel for the trace, from CH1 to CH4, and M1 to M4, and press the corresponding soft key. To select from M1 to M4, press the **M1-M4** soft key to change the selection.
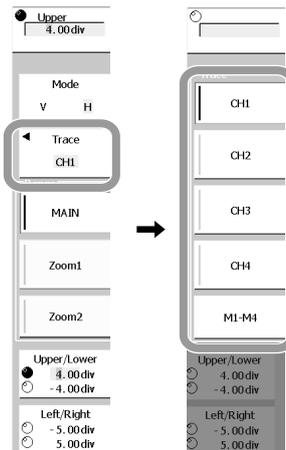
- **Setting the Window for the Range**
  8.   Select Window from **Main**, **Zoom1**, and **Zoom2**, and press the corresponding soft key.

- **Setting the Upper and Lower Limits**
  9.   Press the **Upper/Lower** soft key.
  10.   With the **rotary knob**, set the upper limit and lower limit.
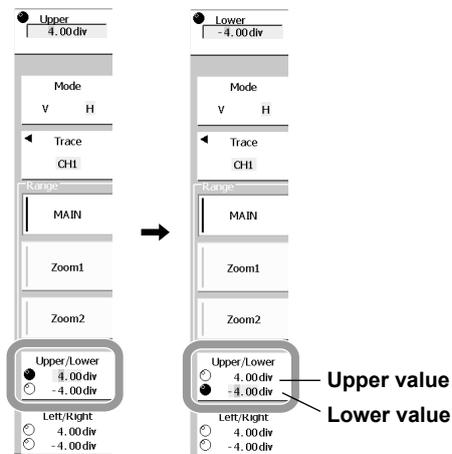
- **Setting the Left and Right End Values**
  11.   Press the **Left/Right** soft key.
  12.   With the **rotary knob**, set the left and right end values.
  13.   Press **ESC**.

10

Waveform Analysis

Setting the Display Format

14. Press the **Display Setup** soft key.
15. Press the **VT** soft key to select ON or OFF. When set to ON, in the upper half of the screen the normal voltage/time-axis display waveform appears.
16. Press **ESC**.
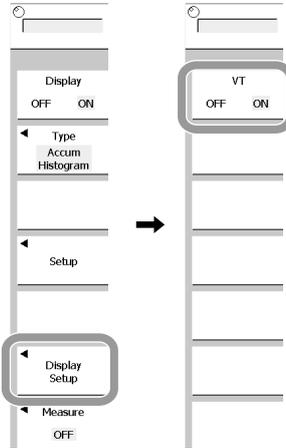
Setting the Analysis Function

17. Press the **Measure** soft key.
18. Select **OFF**, **Cursor**, or **Param**, and press the corresponding soft key.

    If you select OFF, proceed to step 44.

    If you select Cursor, continue to step 19.

    If you select Param, proceed to step 31.
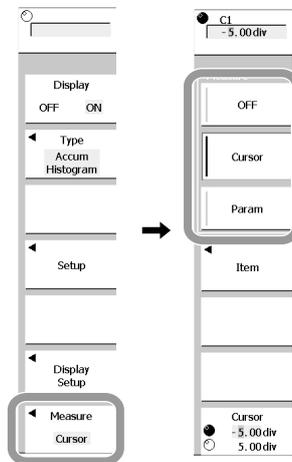
Setting the Cursors

- **Selecting the Cursor Measurement Items**
    19. Press the **Item** soft key.
    20. Press the **Basic** soft key.
    21. Turn the **rotary knob** to select the item to be ON, and press **SET**. This adds a check mark.
    Press SET once more, to set the item to OFF.
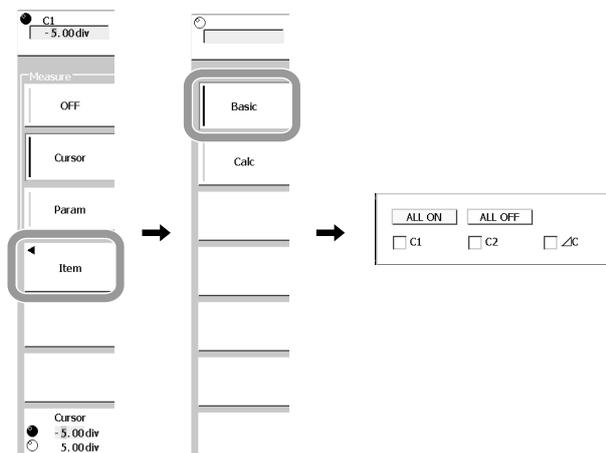
- **Setting the Cursor Calculation (When Calculating Using Cursor Measurement Values)**
    22. Press the **Calc** soft key.
    23. Turn the **rotary knob** to select the calculation number, and press SET. This adds a check mark.
    24. With the **rotary knob**, select the equation area, press SET, and enter the equation.
    25. When the input is completed, press **ENTER** to confirm the equation.
    26. Press **ESC**.
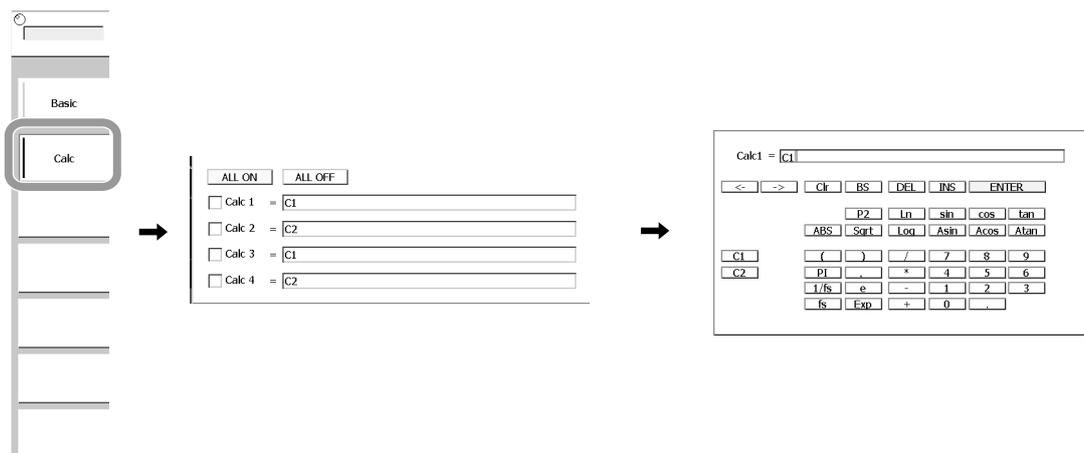
10

Waveform Analysis

- **Setting the Cursor Positions**
  27. Press the **Cursor** soft key.
  28. Turn the **rotary knob** to set the cursor position.
  29. Repeat steps 27 to 28 to set the cursor positions.
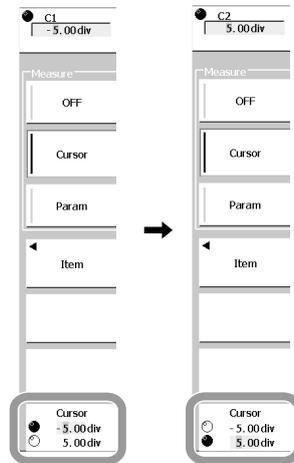
  30. Press **ESC**.

Setting the Parameter Analysis

- **Setting the Parameter Analysis Items**
  31. Press the **Item** soft key.
  32. Select the area for setting the item, from Area1 and Area2, and press the corresponding soft key.
  33. Turn the **rotary knob**, to select the item to be ON, and press **SET**. This adds a check mark.
       Press **SET** once more, to set the item to OFF.
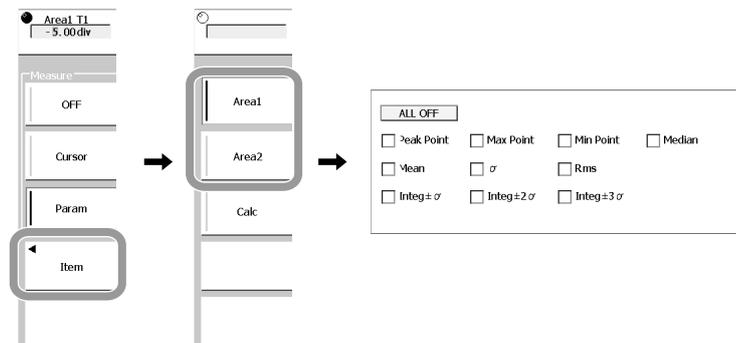
• **Setting the Calculation**

34. Press the **Calc** soft key.

35. Turn the **rotary knob** to select the calculation number, and press **SET**. This adds a check mark.

36. With the **rotary knob**, select the equation area, press **SET**, and enter the equation.

37. When the input is completed, press ENTER to confirm the equation.

38. Press **ESC**.
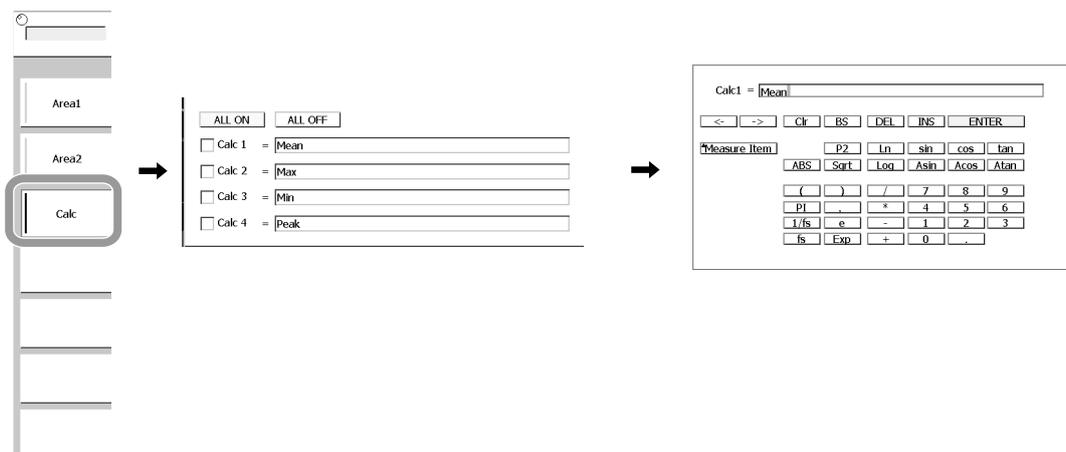
• **Setting the Area**

39. Press the **Area1** soft key.

40. Turn the **rotary knob**, to set the Area1 range.

41. Repeat steps 39 and 40 to set the Area1 ranges.

42. Press the **Area2** soft key.

43. Turn the **rotary knob**, to set the Area2 range.

44. Repeat steps 42 and 43 to set the Area2 ranges.

45. Press **ESC**.

10

Waveform Analysis
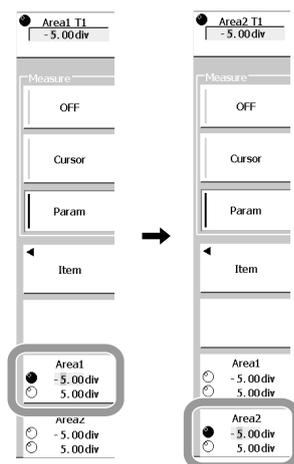
Explanation

Axis Selection: Mode

Select the axis for taking a histogram.
V: Vertical axis
H: Horizontal axis

Trace for Analysis: Trace

Select from CH1 to CH4, and M1 to M4.

Window Range: Window

Select the window for analysis, from Main, Zoom1, and Zoom2.

*   **Upper/Lower**
    Set the range on the X-axis to specify the box for the area to generate the histogram.
    Setting range ±4 div

*   **Left/Right**
    Set the range on the Y-axis to specify the box for the area to generate the histogram.
    Setting range ±4 div
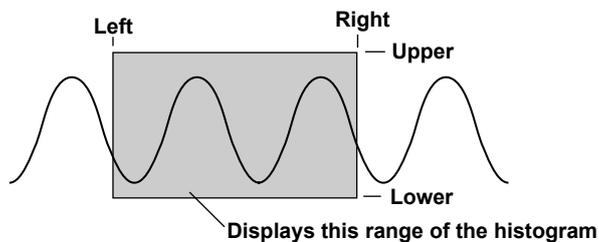
Setting the Display Format: Display Setup

Switch the VT waveform display on or off.

Setting the Analysis Function: Measure

*   **OFF**
    No analysis carried out.

*   **Cursor**
    When the Mode is H, set the two vertical cursors, and measure the Y-axis values at the cursor positions.
    When the Mode is V, set the two horizontal cursors, and measure the X-axis values at the cursor positions.

- **Param**

  The item parameters can be set.

  Peak: Peak value

  Max Point: Maximum value

  Min Point: Minimum value

  Median: Median value*

  Mean: Average value

  σ: Standard deviation of histogram

  Rms: Effective value

  Integ ±σ: Proportion within one standard deviation (%)

  Integ ±2σ: Proportion within two standard deviations (%)

  Integ ±3σ: Proportion within three standard deviations (%)

  * The value of the sample that is midway between the minimum and the maximum
    (counting from the minimum) when the samples are arranged in sequence from
    minimum to maximum.

10

Waveform Analysis
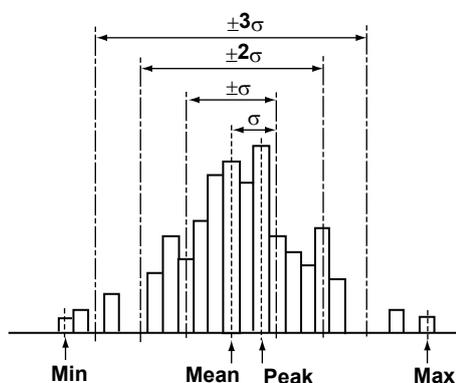
10.9 Automated Measurement of Waveform Parameters of Eye Patterns

This function can be used on products with firmware version 1.60 or higher.
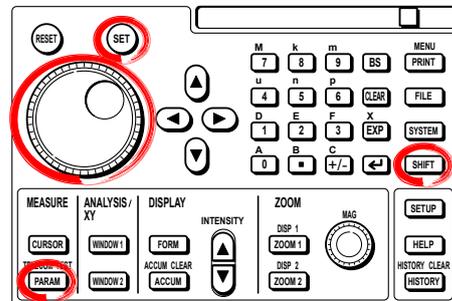
1. Press **SHIFT** + **PARAM**.

Selecting the Measured Items of Eye Patterns

2. Press the **Item** soft key to display the Category menu.
3. Press the **Eye Pattern** soft key.
4. Turn the **rotary knob** to select the item to be turned ON, and press **SET**.
   Press SET again to turn the item OFF.
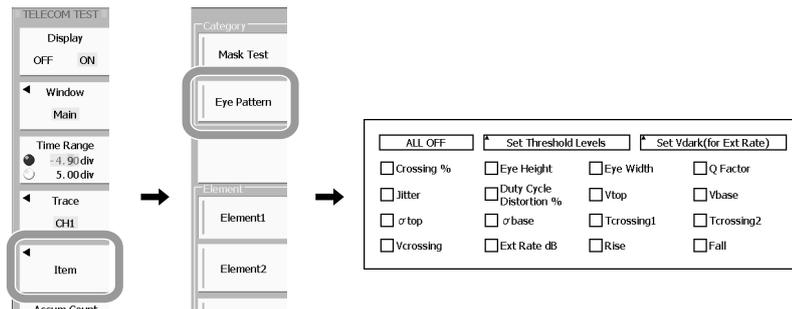
Setting the Threshold Level

5. Turn the **rotary knob** to select Set Threshold Levels, and press **SET**. The Thresh Levels menu appears.
6. Press the **%/V** soft key to set the unit of the threshold level to % or V.
   - %: Set the level in the range of 0 to 100% in step 8 and 10. The difference between Vtop and Vbase is taken to be 100%.
   - V: Set the level in the range of ±10 divisions in step 8 and 10. The unit varies depending on the specified conditions.
7. Press the **Upper** soft key.
8. Turn the **rotary knob** to set the high voltage threshold level.
9. Press the **Lower** soft key.
10. Turn the **rotary knob** to set the low voltage threshold level.
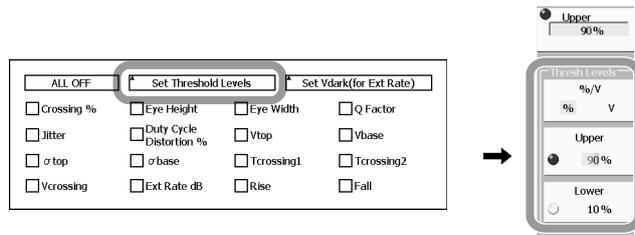
11. Press **ESC** to return to the previous screen.

Setting the Dark Level

12. Turn the **rotary knob** to select Set Vdark (for Ext Rate), and press **SET**.
13. Turn the **rotary knob** to set the dark level (zero light level).
14. Press **ESC** to return to the previous screen
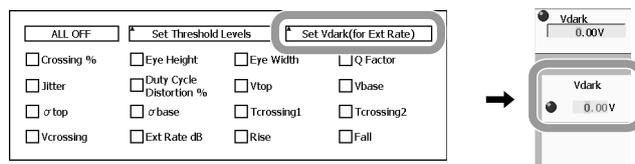
Explanation

You can select the automated measurement parameters of the eye pattern waveform and display the measured results. For the procedure to set the window, time range, trace, and accumulation count, see section 10.4.

Measurement Item
There are 16 measurement items. For the definition and computing equation of each item, see section 2.8.

Setting the Threshold Level (High Level and Low Level)
You can set the threshold as a percentage or a physical value.The threshold level is applied when measuring the Rise (time for the signal to change from lower level to upper level) and the Fall (time for the signal to change from upper level to lower level) items of eye pattern measurement.

%:   The level can be set in the range between 0 to 100%. The difference between Vtop and Vbase is taken to be 100%.

V: The level can be set in the range between ±10 divisions. The unit varies depending on the specified conditions.

Setting the Dark Level
You can set the dark level (zero light level).The dark level is applied when measuring the Ext Rate dB (extinction rate dB) item in eye pattern measurement.
The level can be set in the range between ±10 divisions. The unit varies depending on the specified conditions.

10

Waveform Analysis

11.1 Displaying History Waveforms

Procedure
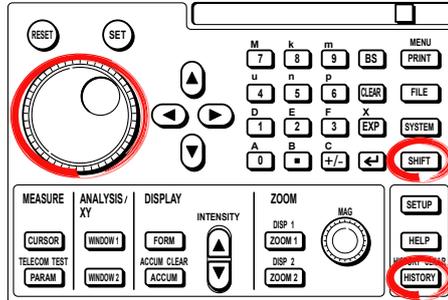
1.   Press **HISTORY**.
     If you press HISTORY during waveform acquisition, waveform acquisition stops.

Setting the History Waveform To Be Displayed

2.   Press the **Start/End** soft key and use the rotary knob to select either Start or End.
3.   With the **rotary knob**, select the record number of the first history waveform to be displayed, or the last record number.

11
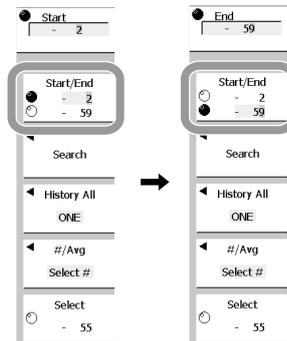
Displaying and Searching History Waveforms

Selecting the Display Mode

4. Press the **History All** soft key.
5. Press the soft key corresponding to the display mode for the history waveform to be set.

ONE — Displays a single specified waveform

All Half Tone — History waveforms other than those highlighted are displayed in overlapping fashion and in a half-tone.

All Inten — History waveforms are accumlated and by brightness according to frequency of data generation.

All Color — History waveforms are accumlated and by color according to frequency of data generation.

Selecting the Highlight Waveform

6. Press the **#/Avg** soft key.
7. Select either **Select #** or **Average**, and then press the soft key corresponding to the waveform for highlight display.
   If you selected #, select the history number.
   If you selected Average, the average value of the displayed history waveform is highlighted.
8. If # was selected in the highlighted waveform settings, press the **Select** soft key.
9. Turn the **rotary knob** and input the value for the highlighted waveform.

When set to Select #
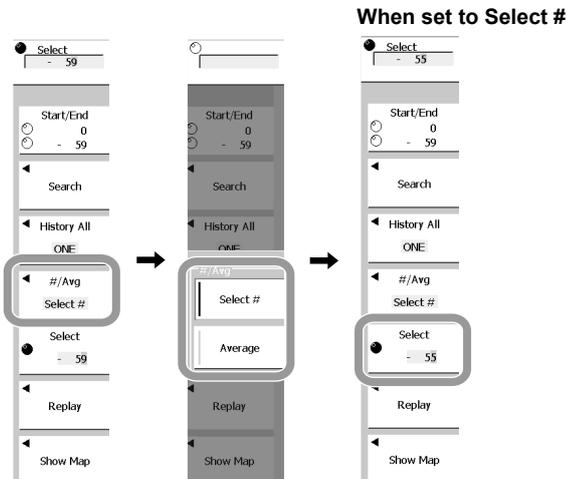
Replaying History Waveforms

10. Press the **Replay** soft key.
11. Press the **Down** soft key or the **Up** soft key to switch the display speed.
12. Use the **rotary knob** to select the first history waveform to be played back. The waveform number is displayed in the menu area (Select #).
    Press the < soft key to select the oldest history waveform.
    Press the > soft key to select the newest history waveform.
13. Press **< Play** to begin playback in the direction of the oldest waveform.
    Press **Play >** to begin playback in the direction of the newest waveform.
    Press the Stop soft key to stop playback.
14. Press **ESC** to return to the previous menu.

Menu on products with firmware version 1.80 or higher

Slow down switching of waveforms

Speed up switching of waveforms

Go to oldest waveform

Play in the direction of older waveforms

Play in the direction of newer waveforms

Go to newest waveform

Stop playback
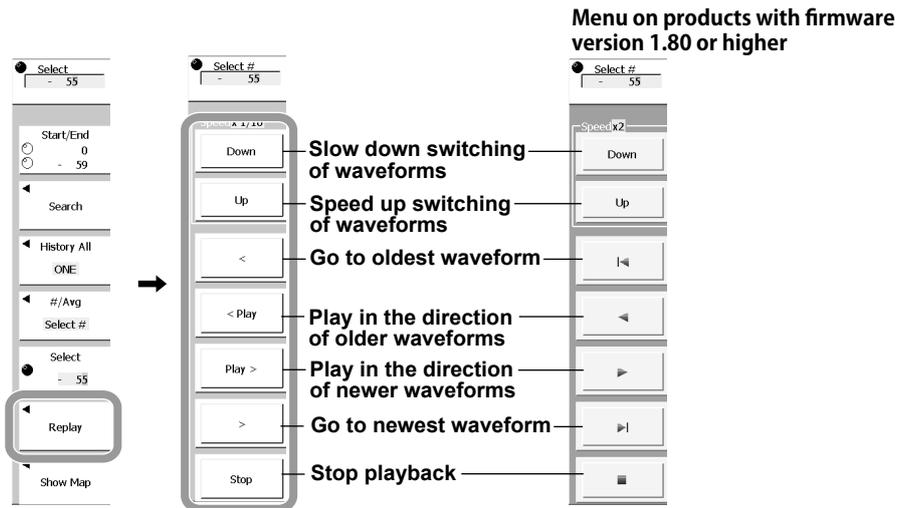
Note
- During playback, you can jump to the oldest or newest history waveform and continue playback from there by pressing either the < soft key or the > soft key. The playback direction remains the same as it was before the jump.
- It is also possible to change the playback speed while playback is in progress.
- Playback is not possible if the highlighted waveform was acquired in Average mode.

Displaying a Time Stamp List
15. Press the **Show Map** soft key.
16. Use the **rotary knob** to select the waveform to be displayed and then press SET.
    Press ESC to hide the list.
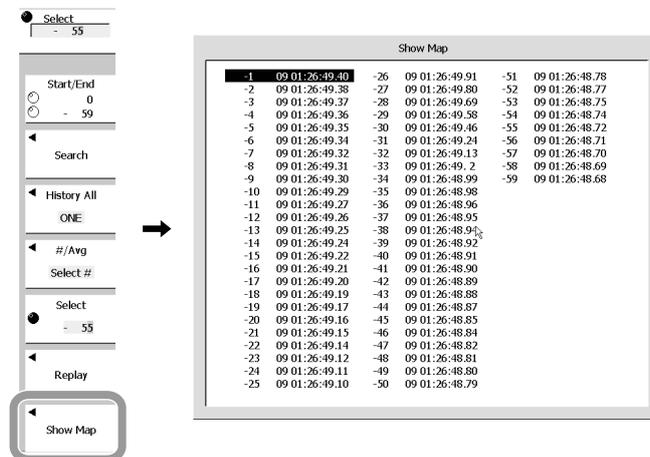
Clearing the History Map
17. Press the **SHIFT** + **HISTORY** key. During waveform acquisition, this clears the memory immediately.   When waveform acquisition is stopped, the memory is cleared the next time waveform acquisition is started.

Note
The only operations that are allowed during waveform acquisition are ShowMap and clearing the history map.

11

Displaying and Searching History Waveforms

Explanation

Display Mode: History All

ONE: Only the waveform with the selected record number is displayed.

All Half tone: Waveforms other than highlighted waveforms are accumulated, and all of the selected waveforms are accumlated.

All Inten: The frequency of data generation is represented by brightness, and all of the selected waveforms are accumulated.

All Color: The frequency of data generation is displayed by changing the color, and all of the selected waveforms are accumlated.

Highlighted Waveforms: #/Avg

Select #: Waveform with the specified history number

Average: Average value

Displayed Waveforms: Select

The setting range is from 0 to – (number of waveforms acquired –1) The most recent waveform is assigned record No. 0, and earlier waveforms are number –1, –2, –3, etc. Specify the number of the history waveform to be displayed.

The number of waveforms that can be stored depends on the record length.

Record Length	DL9040L/DL9140L/DL9240L	DL9040/DL9140/DL9240
2.5KW	2000	1000
6.25KW	1000	500
12.5KW	500	250
25KW	250	120
62.5KW	120	60
125KW	60	30
250KW	30	10
625KW	10	5
1.25MW	5	2
2.5MW	2	1
6.25MW	1	-

* The number of waveforms is not affected by whether interleave or high resolution mode is ON/OFF.

Replay: Replay

Waveforms are displayed in sequence, starting from the specified waveform, in the direction of older waveforms or newer waveforms.

< Play: Displays past waveforms, with the most recent first.

Play >: Displays newer waveforms in order.

Time Stamp List: Show Map

The numbers of the waveform data that are acquired in the acquisition memory and the trigger times are displayed in a list.

Information on 75 units of data is displayed on one screen. The rotary knob can be used to scroll the data.

Clearing the History Map
*   Deletes all of the waveforms in acquisition memory.
*   Once waveform data has been deleted, it cannot be restored.

*   **Notes When Setting the History Memory Function**
    *   History waveforms are acquired on each display update cycle when using averaging mode, roll mode or repetitive sampling mode.
    *   If a waveform is acquired in averaging mode or repetitive sampling mode while the trigger mode is Single, multiple waveforms are acquired before a single waveform is completed, but the only waveform that is stored in history memory is the completed waveform.
    *   If waveform acquisition is interrupted, the waveform that activated the trigger is displayed as the valid waveform.
    *   If the trigger mode is not Single, then once waveform acquisition is started, the data that was stored in the history memory before the change is cleared.
        For details on waveform acquisition conditions, see section 4.6, "Starting/Stopping Waveform Acquisition."

*   **Notes When Calling Up Data Using the History Memory Function**
    *   When the history memory menu is displayed, waveform acquisition stops. History waveforms cannot be displayed while waveform acquisition is in progress.
    *   You can start waveform acquisition even when the history memory menu is displayed. However, while acquisition is in progress, you cannot change the setting of the history memory function such as Select Record.
    *   Settings are restricted by the following condition: End Record ≤ Select Record ≤ Start Record.
    *   If waveform data is loaded from a file stored on the specified storage medium, the history waveforms up to that point are cleared. The loaded waveform data is always recalled to the record number 0 position of the history memory. If a file containing multiple waveforms is loaded, the newest waveform is recalled in the record number 0 position, the next newest waveform in –1, and so on.
    *   Computation and automated measurement of waveform parameters are performed on the waveform of the record number specified by Select Record. Old data can be analyzed as long as you do not resume acquisition and overwrite the contents of the history memory. In the case of average display (Ave), analysis is performed on the average waveform.
    *   Turning OFF the power clears the history waveforms.

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Displaying and Searching History Waveforms

11.2 Searching the History Waveforms Using Waveform Zones (Wave History Search)

1. Press **HISTORY**.

Selecting the Search Logic

2. Press the **Search** soft key.
3. Press the **Logic** soft key to select AND or OR.

Selecting the Search Condition Number

4. Press the **Condition** soft key.
5. Press the **Select** soft key.
6. Select the condition number for setting the search condition and then press the corresponding soft key.

Setting the Search Mode

7.   Press the **Mode** soft key.

8.   Press the **WAVE** soft key.
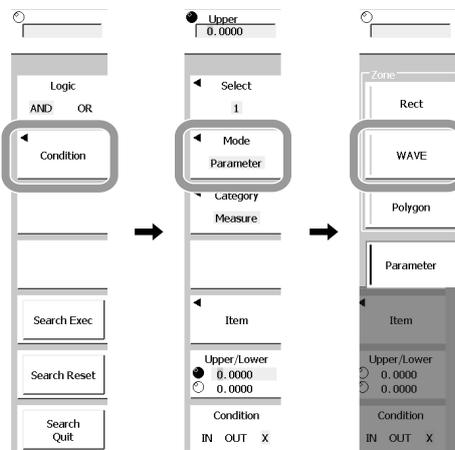
Selecting the Search Target Window

9.   Press the **Window** soft key.

10. Select from among **Main**, **Zoom1** and **Zoom2** and press the corresponding soft key.
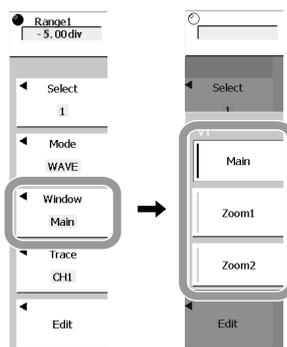
Setting the Search Channel

11. Press the **Trace** soft key.

12. Select the target trace to be searched for from among CH1 to CH4 and M1 to M4 and press the corresponding soft key. To select M1 to M4, first switch to **M1-M4** by pressing the corresponding soft key.

11

Displaying and Searching History Waveforms

Creating a New Search Zone

13. Press the **Edit** soft key.
14. Press the **New REF Trace** soft key.
15. Specify the trace that is to be the source for the zone. Press the soft key corresponding to the channel to be traced. To trace M1 to M4, first switch to M1 to M4 by pressing the **M1-M4** soft key and then press the corresponding soft key.
16. Press the **Whole/Part** soft key and specify the editing range. To edit the whole zone, select Whole; to edit part of the zone, select Part.
    If editing part of a zone, proceed to step 23.
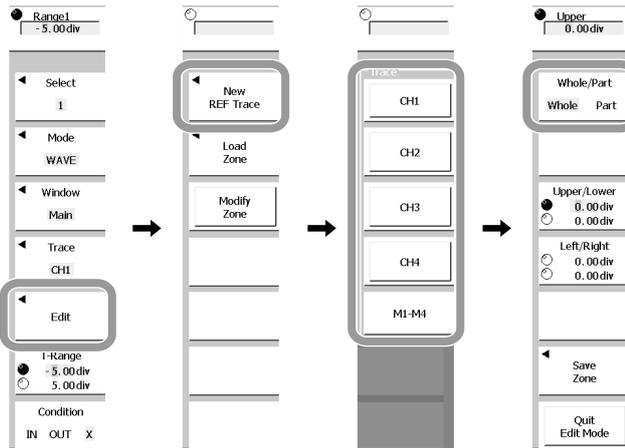
- **Editing the Whole Zone**
  17. Press the **Upper/Lower** or **Left/Right** soft key to select the direction in which to set the zone.
  18. Using the **rotary knob**, select the zone.
  19. Repeat steps 17 and 18 to edit the zone.
  20. Press the **Save Zone** soft key to open the registration destination setting menu for the edited zone.
  21. Select the registration destination by pressing the soft key corresponding to #1 to #4.
  22. Press **ESC** to return to the previous screen.
  23. Press the **Quit Edit Mode** soft key to confirm the registration.
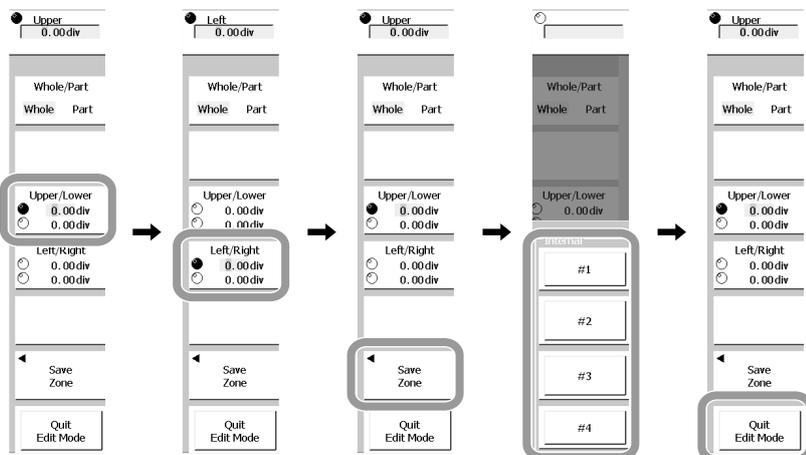
- **Editing a Partial Zone**
    24. Press the **Whole/Part** soft key, to select Part.
    25. Press the **Edit Range** soft key, to select the right cursor or left cursor.
    26. With the **rotary knob**, set the left or right edge of the partial zone.
         Similarly, set the other of the left and right edges, to specify the range of the zone.
    27. Press the **Upper/Lower** soft key, to select the direction for setting the zone.
    28. With the **rotary knob**, create the zone. By turning the rotary knob, you can create a waveform zone with the specified range.
    29. Repeat steps 24 to 27, to edit the zone.
    30. To save the zone, Press the **Save Zone** soft key, opening a menu for selected where to save the edited zone.
         Select where to save the zone. Press one of the soft keys corresponding to #1 to #4 to make the selection.
    31. Press **ESC** to return to the previous screen.
    32. Press the **Quit Edit Mode** soft key to confirm the registration.
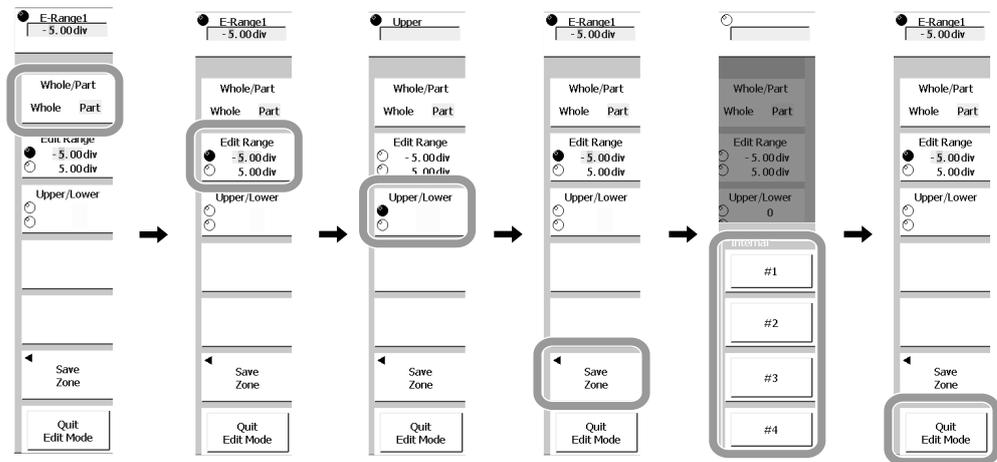
- **Modifying the Zone**
    33. To modify a previously saved zone, press the **Load Zone** soft key. To modify the zone currently being used, press the **Modify Zone** soft key, and skip to step 35.
    34. Select the number of the determination zone to be modified. Press one of the soft keys corresponding to #1 to #4 to make the selection. This loads the previously saved zone.
    35. Follow steps 17 to 29, to modify the zone.
    36. Once all modifications have been completed, press the **Quit Edit Mode** soft key.
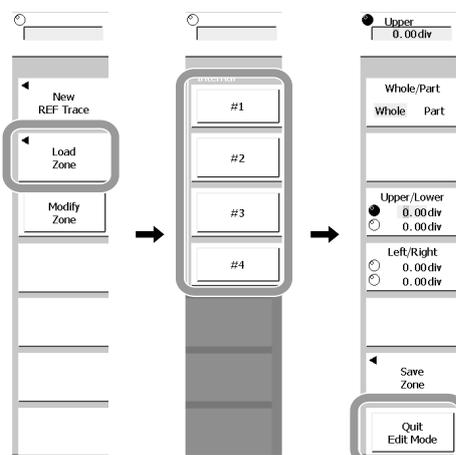
11

Displaying and Searching History Waveforms

Setting the Search Range

37. Press the **T-Range** soft key.

38. Use the **rotary knob** to set the search range.

```
●  Range1
   - 5.00 div

◄   Select
      1

◄   Mode
     WAVE

◄   Window
     Main

◄   Trace
     CH1

◄
     Edit

    T-Range
 ●  - 5.00 div  ────── Search start point
 ○    5.00 div  ────── Search end point
    Condition
   IN  OUT  X
```
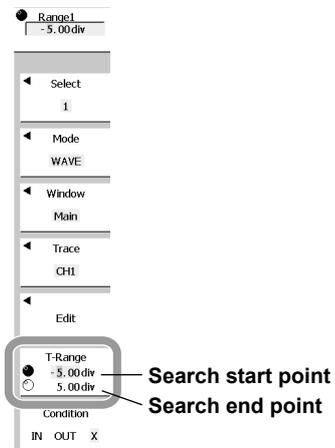
Selecting the Search Criteria

39. Press the **Condition** soft key to select IN, OUT or X.

40. Press **ESC** to return to the history search menu.
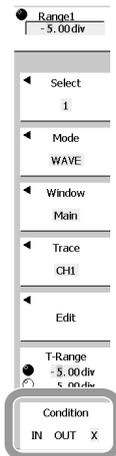
```
●  Range1
   - 5.00 div

◄   Select
      1

◄   Mode
     WAVE

◄   Window
     Main

◄   Trace
     CH1

◄
     Edit

    T-Range
 ●  - 5.00 div
 ○    5.00 div
    Condition
   IN  OUT  X
```

Perform the above operations for search condition numbers 1 to 4 as needed.

Executing and Ending a Search

41. Press the **Search Exec** soft key. The search starts.

    The **Search Exec** soft key changes to the **Search Abort** soft key.

42. Press the **Search Abort** soft key. This ends the search.
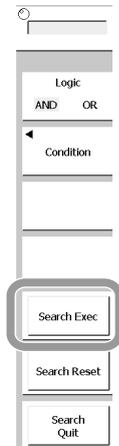
Resetting the Search

43. Press the **Search Reset** soft key. All search conditions are reset.
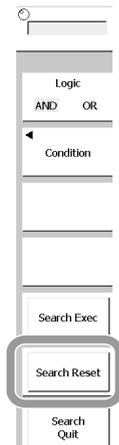
Explanation

A zone is created based on the reference waveform, and the waveform is searched based on whether the waveform is outside the zone or within the zone. The search zone is the same as the zone for a Go/NO-GO search. (See section 7.10.)

Search Condition Numbers: Select

Select the search condition number for setting the search conditions. Four search conditions (1 to 4) can be set. The search is conducted using the logical conditions of the four search conditions.

Selecting the Search Target Trace: Trace

Select the search target trace. You can select from among CH1 to CH4, or M1 to M4. A trace that is not displayed cannot be selected.

Setting the Search Conditions: Edit

- **Creating a Search Zone**
  Up to four search zones can be set. The setting range is as follows:
  - Selectable range in the up and down directions: ±8 div from the center base waveform
  - Settable range in the left and right direction: ±5 div from the center of the screen
  The target waveform to be searched in the search zone registered in search condition numbers 1 through 4 can be selected from among the input signal waveforms (CH1 to CH4) or the computed waveforms (M1 to M4).

- **Selecting the Target Waveform: Trace**
  You can select the waveform from among CH1 to CH4, or M1 to M4.

- **Setting the Search Conditions: Save Zone**
  Set the search condition number. Each of the four search conditions can be set.

Setting the Search Range: T-Range

In the initial settings, the search range is ±5 div on the time axis of the display frame, but this can be limited to the desired range. The concept behind the search range is the same as that of the setting range for the cursor display position in cursor measurement.

Setting the Search Criteria: Condition

IN: Search the history waveforms for target waveforms lying inside the search zone.
OUT: Search the history waveforms for target waveforms going outside the search zone.
X: No search is performed.

Setting the Search Logic: Logic

AND: Search for history waveforms for which all search condition numbers 1 to 4 are true
OR: Search for history waveforms for which at least one of the condition numbers 1 to 4 is true

11.3 Searching the History Waveforms Using Rectangular Zones (RECT History Search)

1. Press **HISTORY**.

Selecting the Search Logic

2. Press the **Search** soft key.
3. Press the **Logic** soft key to select AND or OR.

Selecting the Search Condition Number

4. Press the **Condition** soft key.
5. Press the **Select** soft key.
6. Select the condition number for setting the search condition and then press the corresponding soft key.

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Displaying and Searching History Waveforms

Switching the Search Mode

7. Press the **Mode** soft key.
8. Press the **Rect** soft key.

Selecting the Search Target Window

9. Press the **Window** soft key.
10. Select from among **Main**, **Zoom1**, **Zoom2**, **XY1** or **XY2** and press the corresponding soft key.

Setting the Search Channel

11. Press the **Trace** soft key.
12. Select the trace to be searched for from among CH1 to CH4 and M1 to M4 and press the corresponding soft key. To select M1 to M4, first switch to **M1-M4** by pressing the corresponding soft key.

Setting the Search Zone

The search zone is displayed when Condition is set to IN or OUT in step 19.

13.   Press the **Left/Right** soft key to select the direction in which to set the zone.

14.   Use the **rotary knob** to set the left edge and right edge of the zone.

15.   Repeat steps 13 and 14 to edit the zone.

16.   Press the **Upper/Lower** soft key to select the direction in which to set the zone.

17.   Use the **rotary knob** to set the top edge and bottom edge of the zone.

18.   Repeat steps 16 and 17 to edit the zone.
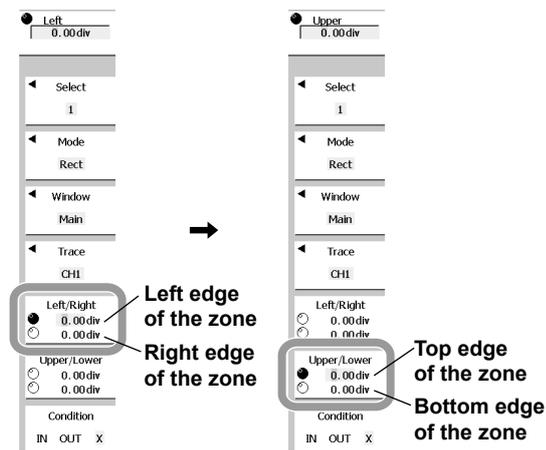
Selecting the Search Criteria

19.   Press the **Condition** soft key to select IN, OUT or X.

20.   Press **ESC** to return to the history search menu.

Perform the above operations for search condition numbers 1 to 4 as needed.

Executing and Ending a Search

21. Press the **Search Exec** soft key. The search starts.

    The **Search Exec** soft key changes to the **Search Abort** soft key.

22. Press the **Search Abort** soft key. This ends the search.
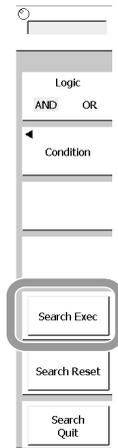
Resetting the Search

23. Press the **Search Reset** soft key. All search conditions are reset.
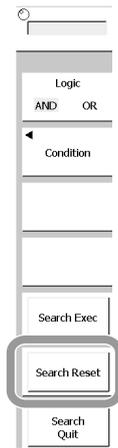
Explanation

Create a rectangle by setting the top and bottom and left and right limit values on the screen, and then search the waveforms according to whether the trace passes through that range or not. For details on the rectangular zone see section 7.11.

Search Condition Numbers: Select

Select the search condition number for setting the search conditions. Four search conditions (1 to 4) can be set. The search is conducted using the logical conditions of the four search conditions.

Setting the Search Conditions

* **Setting the Search Zone: Left/Right, Upper/Lower**
  Set the range for searching the search conditions. One search zone can be set. The setting range is as follows:
  Selectable range in the up and down directions: ±5 div (±4 div for an XY waveform) setting resolution from the base waveform: 0.01 divisions
  Settable range in the left and right direction: ±4 div setting resolution from the center of the screen: 0.01 divisions

* **Selecting the Search Target Window: Window**
  Main: Sets a normal waveform as the target.
  Zoom1:   Sets the waveform in zoom box 1 as the target.
  Zoom2:   Sets the waveform in zoom box 2 as the target.
  XY1:   Sets the waveform in XY window 1 as the target.
  XY2:   Sets the waveform in XY window 2 as the target.
  For details on Zoom 1 and Zoom 2 see section 8.7.

* **Selecting the Target Waveform: Trace**
  You can select the waveform from among CH1 to CH4, or M1 to M4.

* **Selecting the Search Criteria: Condition**
  IN: The history waveforms are searched according to whether or not the target waveform is in the search zone.
  OUT: The history waveforms are searched according to whether or not the target waveform is outside the search zone.
  X: No search is performed.

Selecting the Search Logic: Logic

AND: Search for history waveforms for which all condition numbers 1 to 4 are true
OR: Search for history waveforms for which at least one of condition numbers 1 to 4 is true

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Displaying and Searching History Waveforms

11.4 Searching History Waveforms Using Automatic Measurements of Waveform Parameters (MEASURE History Search)

1. Press **HISTORY**.

Selecting the Search Logic

2. Press the **Search** soft key.
3. Press the **Logic** soft key to select AND or OR.

Selecting the Search Condition Number

4. Press the **Condition** soft key.
5. Press the **Select** soft key.
6. Select the condition number for setting the search condition and then press the corresponding soft key.

Switching the Search Mode

7.   Press the **Mode** soft key.

8.   Press the **Parameter** soft key.

9.   Press the **Category** soft key.

10.   Press the **Measure** soft key.
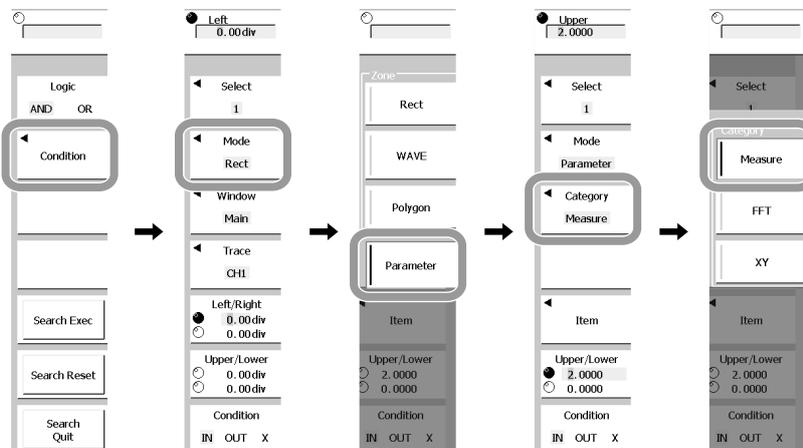
Setting the Measurement Items

11.   Press the **Item** soft key.
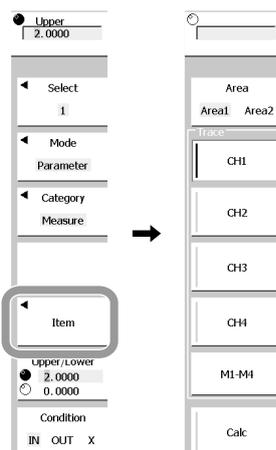
Selecting the Measurement Target Area

12.   Press the **Area** soft key to select Area1 or Area2.

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Displaying and Searching History Waveforms

Setting the Measurement Target Channel

13. Select the waveform parameter target trace from among CH1 to CH4 and M1 to M4 and press the corresponding soft key. To select M1 to M4, first switch to **M1-M4** by pressing the corresponding soft key.
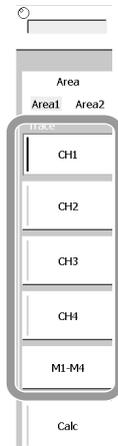
Setting the Measurement Items

14. Use the **rotary knob** to select the item to be set and then press **SET**. The selected item is checked.
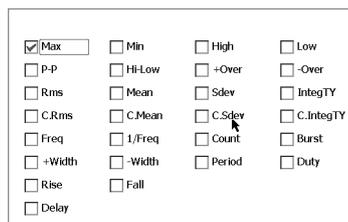
Setting the Calculation

15. Press the **Calc** soft key.

16. Use the **rotary knob** to select the equation to be set and then press **SET**. The selected calculation is checked.

17. Press **ESC**.

Setting the Search Zone

18. Press the **Upper/Lower** soft key to select the item for which the range is to be set.
19. Use the **rotary knob** to set the top edge and bottom edge of the range.

Selecting the Search Criteria

20. Press the **Condition** soft key to select IN, OUT or X.
21. Press **ESC** to return to the history search menu.

Perform the above operations for search condition numbers 1 to 4 as needed.

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Displaying and Searching History Waveforms

Executing and Ending a Search

22. Press the **Search Exec** soft key. The search starts.

The **Search Exec** soft key changes to the **Search Abort** soft key.

23. Press the **Search Abort** soft key. This ends the search.

Resetting the Search

24. Press the **Search Reset** soft key. All search conditions are reset.

Explanation

Searches waveforms according to whether automatically measured waveform parameters based on automatically measured values fall within the specified range or not. For details on waveform parameters see section 10.2.

Search Condition Numbers: Select

Select the search condition number for setting the search conditions. Four search conditions (1 to 4) can be set. The search is conducted using the logical conditions of the four search conditions.

Measurement area: Area

Select Area 1 or Area 2 as the measurement area.

Measurement Parameters: Item

You can select from among the following 27 items. For details see section 10.2.

- **Measurement Parameters on the Voltage-Axis**
  - Max: Maximum voltage value [V]
  - Min: Minimum voltage value [V]
  - High: High voltage value [V]
  - Low: Low voltage value [V]
  - P-P: P-P value (Max – min) [V]
  - Hi-Low: High voltage value – Low voltage value [V]
  - +Over: Overshoot amount [%] (Max – High)/(High – Low) × 100
  - –Over: Undershoot amount [%] (Low – Min)/(High – Low) × 100
  - Rms: Actual voltage [V] $(1/\sqrt{n})(\Sigma(xl^2))^{1/2}$
  - Mean: Mean voltage [V] $(1/n)\Sigma xl$
  - Sdev: Standard deviation [V] $(1/n(\Sigma(xl^2/n)))^{1/2}$
  - IntegTY: Total area for both positive and negative amplitude [Vs]

- **Other Measurement Parameters**
  - C.Rms: Effective value over integer multiple of time during cycle within set range [V]
  - C.Mean: Average voltage over integer multiple of time during cycle within set range [V]
  - C.Sdev: Standard deviation over integer multiple of time during cycle within set range [V]
  - C.IntegTY: Total area for both positive and negative amplitude of each period for the specified range [Vs]
  - Freq: Average frequency [Hz]
  - 1/Freq: Average cycle [s]
  - Count: Edge count [no unit]
  - Burst: Burst width [s]
  - +Width: Time from first point when value is equal to or greater than Upper, until first point when value is equal to or less than Lower when searching from the measurement start point [s]
  - –Width: Time from first point when value is equal to or less than Lower, until first point when value is equal to or greater than Upper when searching from the measurement start point [s]
  - Period: Cycle [s] (+Width) + (–Width)
  - Duty: Duty ratio [%]
  - Rise: Rise time [s]
  - Fall: Fall time [s]
  - Delay: Delay [s]

Upper limit/lower limit: Upper/Lower
This value can be set in the following range.
Upper: –1.0E+31 to 1.0E+31
Lower: –1.0E+31 to 1.0E+31

Search Criteria: Condition
- IN: Searches for a history waveform with the specified waveform parameter value within the set range.
- OUT: Searches for a history waveform with the specified waveform parameter outside the set range.
- X: No search is performed.

Selecting the Search Logic: Logic
- AND: Search for history waveforms for which all condition numbers 1 to 4 are true
- OR: Search for history waveforms for which at least one condition number 1 to 4 is true

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Displaying and Searching History Waveforms

11.5 Searching the History Waveforms Using Polygon Waveforms (POLYGON History Search)
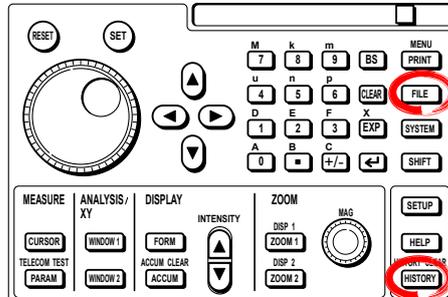
Loading Polygon Graphics

1. Press **FILE**.
2. Specify the directory in a PC card or USB memory where the polygon graphics file is stored and then select the file.
3. Press the **OPEN** soft key.
4. Select the target file and then press **SET**.
5. Press the **LOAD** soft key. A menu used to load the file appears.
6. Press the **Type** soft key. A menu appears for selecting a polygon or mask pattern.
7. Press the **Zone Polygon** soft key.
8. Press the soft key for the zone number to be loaded.
9. Press the **Load EXEC** soft key. This loads the selected file.
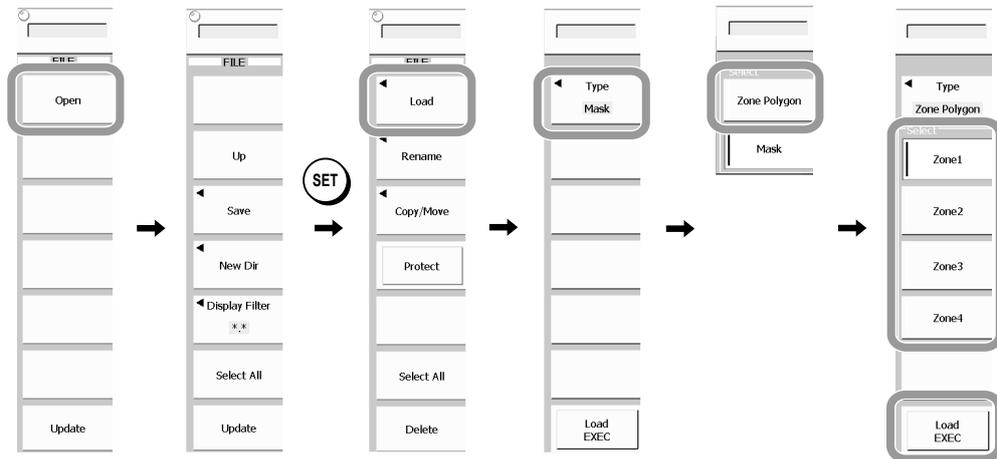
10. Press **HISTORY**.

Selecting the Search Logic

11. Press the **Search** soft key.

12. Press the **Logic** soft key to select AND or OR.
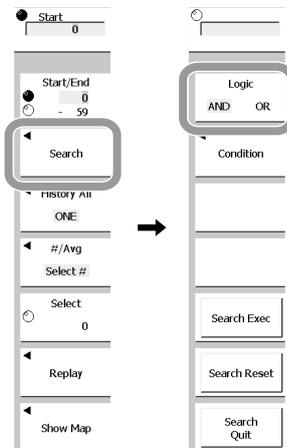
Selecting the Search Condition Number

13. Press the **Condition** soft key.

14. Press the **Select** soft key.

15. Select the condition number for setting the search condition and then press the corresponding soft key.
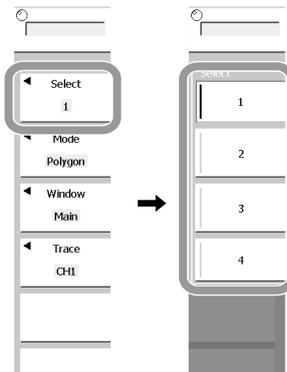
Switching the Search Mode

16. Press the **Mode** soft key.

17. Press the **Polygon** soft key.

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Displaying and Searching History Waveforms

Selecting the Search Window

18.   Press the **Window** soft key.

19.   Select from among **Main**, **Zoom1**, **Zoom2**, **XY1** or **XY2** and press the corresponding soft key.
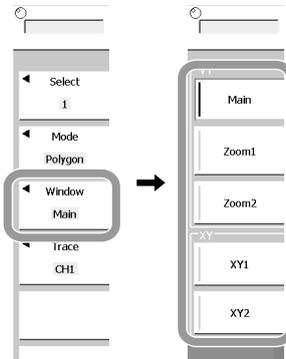
Setting the Search Channel

20.   Press the **Trace** soft key.

21.   Select the trace to be searched for from among CH1 to CH4 and M1 to M4 and press the corresponding soft key. To select M1 to M4, first switch to **M1-M4** by pressing the corresponding soft key.
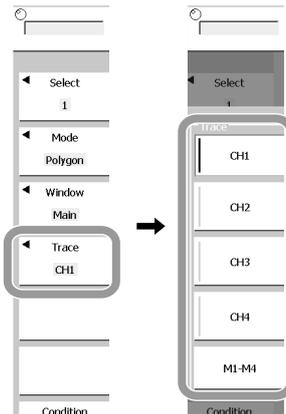
Selecting the Search Criteria

22.   Press the **Condition** soft key to select IN, OUT or X.

23.   Press **ESC** to return to the history search menu.

Perform the above operations for search condition numbers 1 to 4 as needed.

Executing and Ending a Search

24.   Press the **Search Exec** soft key. The search starts.

The **Search Exec** soft key changes to the **Search Abort** soft key.

25.   Press the **Search Abort** soft key. This ends the search.
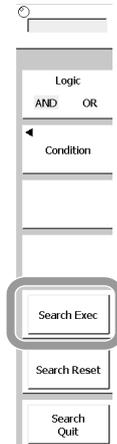
Resetting the Search

26.   Press the **Search Reset** soft key. All search conditions are reset.

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Displaying and Searching History Waveforms
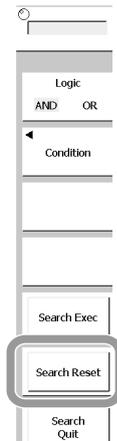
Explanation

The history waveform is searched for according to whether it is inside or outside the range of the polygon graphic that was created on a PC.

Search Condition Numbers: Select

Select the search condition number for setting the search conditions. Four search conditions (1 to 4) can be set. The search is conducted using the logical conditions of the four search conditions.

Setting the Search Conditions

· **Setting the Search Conditions: Select**
Set the search condition number for setting the search conditions.
Each of the four search conditions can be set.

· **Applicable Channels: Trace**
You can select the target trace from among CH1 to CH4, or M1 to M4.

· **Search Window: Window**
Select the window to be searched
from among Main, Zoom1, Zoom2, XY1 or XY2.

· **Search Criteria: Condition**
IN: The history waveforms are searched according to whether or not the target waveform is in the search zone.
OUT: The history waveforms are searched according to whether or not the target waveform is outside the search zone.
X: No search is performed.

Selecting the Search Logic: Logic
AND: Search for history waveforms for which all condition numbers 1 to 4 are true
OR: Search for history waveforms for which at least one condition number 1 to 4 is true

11.6 Searching the History Waveforms Using the FFT Parameter (FFT History Search)

1. Press **HISTORY**.

Selecting the Search Logic
2. Press the **Search** soft key.
3. Press the **Logic** soft key to select AND or OR.

Selecting the Search Condition Number
4. Press the **Condition** soft key.
5. Press the **Select** soft key.
6. Select the condition number for setting the search condition and then press the corresponding soft key.

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Displaying and Searching History Waveforms

Switching the Search Mode

7. Press the **Mode** soft key.
8. Press the **Parameter** soft key.
9. Press the **Category** soft key.
10. Press the **FFT** soft key.
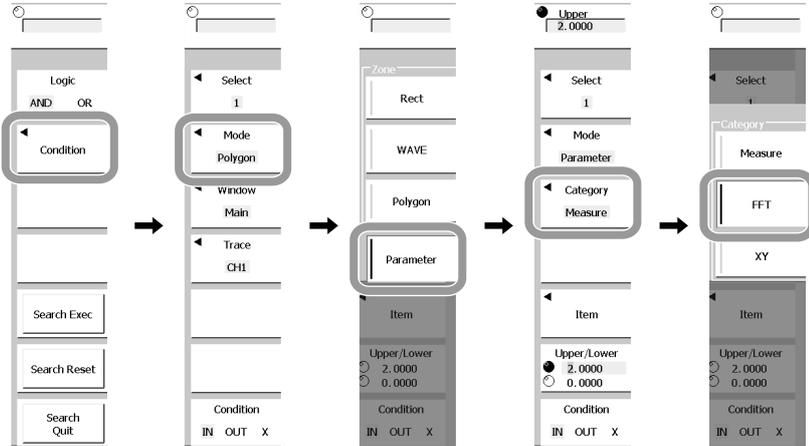
Selecting the Search Window

11. Press the **Window** soft key to select FFT1 or FFT2.
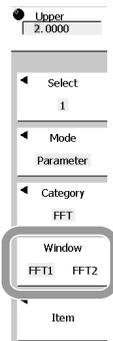
Setting the Measurement Items

12. Press the **Item** soft key.
13. Press the **Basic** soft key.
14. Select the item from the dialog box that appears. Use the **rotary knob** to select the item and then press SET to begin checking.

Setting the Calculation

15. When selecting a calculated value using an FFT value for the item, press the **Calc** soft key.

16. Select the Calc to be used and then begin the check.
Use the **rotary knob** to select the item and then press SET to begin checking.
Select from the formulas set for the FFT analysis function.

17. Press **ESC**.
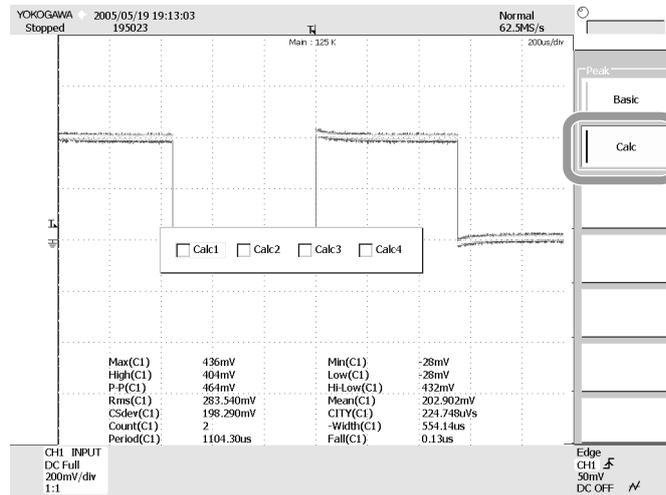
Setting the Search Range

18. Press the **Upper/Lower** soft key to select the item for which the range is to be set.

19. Use the **rotary knob** to set either Upper or Lower.

Selecting the Search Criteria

20. Press the **Condition** soft key to select IN, OUT or X.
21. Press **ESC** to return to the history search menu.

Perform the above operations for search condition numbers 1 to 4 as needed.

Executing and Ending a Search

22. Press the **Search Exec** soft key. The search starts.
    The **Search Exec** soft key changes to the **Search Abort** soft key.
23. Press the **Search Abort** soft key. This ends the search.

Resetting the Search

24. Press the **Search Reset** soft key. All search conditions are reset.

Logic
AND   OR

◄
Condition

Search Exec

Search Reset

Search
Quit

Explanation

The waveform is searched for according to whether it is inside or outside the range set by the measured values of the FFT waveform.

Search Condition Numbers: Select
Select the search condition number for setting the search conditions. Four search conditions (1 to 4) can be set. The search is conducted using the logical conditions of the four search conditions.

Search Window: Window
Select the window to be searched from among either FFT1 or FFT2.

Search Range: Upper/Lower
Set the upper limit and the lower limit for the value of the specified search item.

Search Criteria: Condition
IN: Searches for a history waveform within the range set by the specified FFT values.
OUT: Searches for a history waveform outside the range set by the specified FFT values.
X: No search is performed.

Selecting the Search Logic: Logic
AND: Search for history waveforms for which all condition numbers 1 to 4 are true
OR: Search for history waveforms for which at least one condition number 1 to 4 is true

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Displaying and Searching History Waveforms

11.7 Searching History Waveform by XY Waveform Parameter (XY History Search)
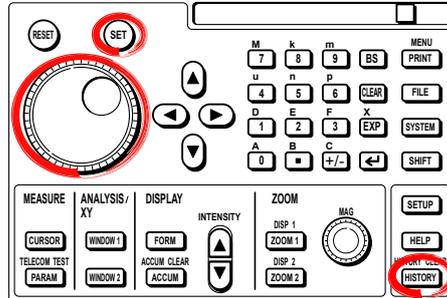
1. Press **HISTORY**.

Selecting the Search Logic

2. Press the **Search** soft key.
3. Press the **Logic** soft key, to select AND or OR.
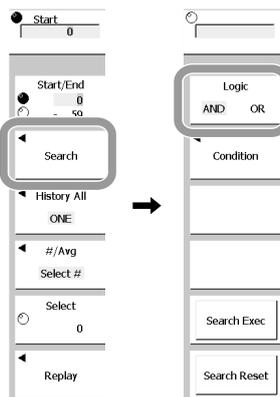
Selecting the Search Condition Number

4. Press the **Condition** soft key.
5. Press the **Select** soft key.
6. Select the condition number for setting the search condition, and press the corresponding soft key.

Changing the Search Mode
7. Press the **Mode** soft key.
8. Press the **Parameter** soft key.
9. Press the **Category** soft key.
10. Press the **XY** soft key.
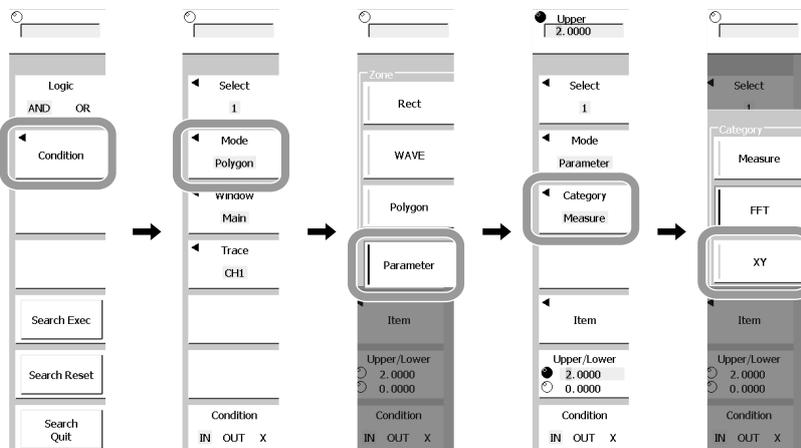
Selecting the Search Window
11. Press the **Window** soft key, to select XY1 (XY in Window1) or XY2 (XY in Window2).
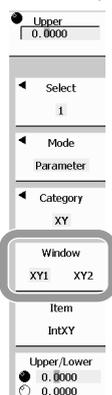
Setting the Search Range
12. Press the **Upper/Lower** soft key, to select the item for setting the range.
13. With the **rotary knob**, set Upper or Lower.

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Displaying and Searching History Waveforms

Selecting the Search Condition

14. Press the **Condition** soft key, to select IN, OUT, or X.

15. Press **ESC**, to return to the history search menu.

```
● Upper
  0.0000

◄  Select
      1

◄  Mode
   Parameter

◄  Category
      XY

   Window
  XY1    XY2

    Item
   IntXY

Upper/Lower
●  0.0000
◐  0.0000

  Condition
 IN  OUT  X
```
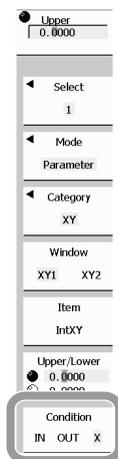
Carry out the above steps as required for search condition numbers 1 to 4.

Executing and Ending a Search

16. Press the **Search Exec** soft key. This starts the search.

The **Search Exec** soft key changes to the **Search Abort** soft key.

17. Press the **Search Abort** soft key. This ends the search.

```
◐

   Logic
 AND    OR

◄
 Condition




 Search Exec

 Search Reset
```
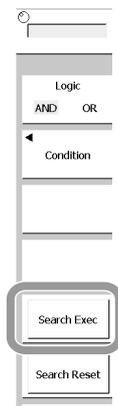
Search Reset

18 Press the **Search Reset** soft key. This resets all search conditions.

```
◐

   Logic
 AND    OR

◄
 Condition




 Search Exec

 Search Reset
```
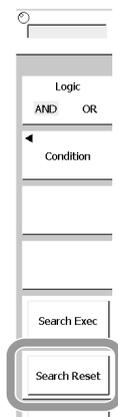
Explanation

Using an XY waveform area calculation value, you can search for waveforms inside or outside the specified range.

Determination condition

- **Setting the Search Condition: Select**
  Select the search condition number for setting the search condition. You can set each of the four search conditions.

- **Selecting the Search Target Window: Window**
  XY1:   Use the XY Window1 waveform of the analysis window as target.
  XY2:   Use the XY Window2 waveform of the analysis window as target.

- **Setting the Search Range: Upper/Lower**
  Set the upper and lower limits for the XY waveform area.

- **Selecting the Determination Condition: Condition**
  IN: Search the history waveforms for the XY waveform area within the upper and lower limits.
  OUT: Search the history waveforms for the XY waveform area outside the upper and lower limits.
  X: No history waveform search is performed.

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Displaying and Searching History Waveforms

11.8 Searching the Serial Pattern

This function can be used on products with firmware version 1.60 or higher.
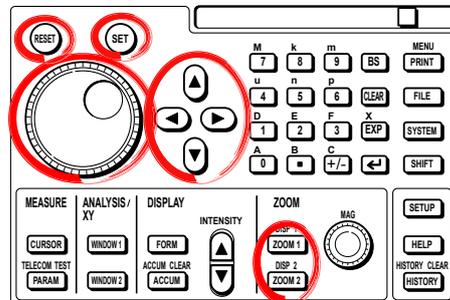
1. Press **ZOOM1** or **ZOOM2** to display the ZOOM menu.

This section explains the ZOOM1 menu as an example.

Selecting the Serial Pattern Search Function

2. Press the **Setup** soft key.
3. Press the **Search Type** soft key to display the Search Type menu.
4. Press the **Serial** soft key to display the Serial Type menu.
5. Press the **Serial** soft key.

   On models with the /F5 option, I2C and SPI are displayed as selectable items.
   For details on these functions and operations, see the *Serial Bus Signal Analysis Function User's Manual IM701310-51E*.
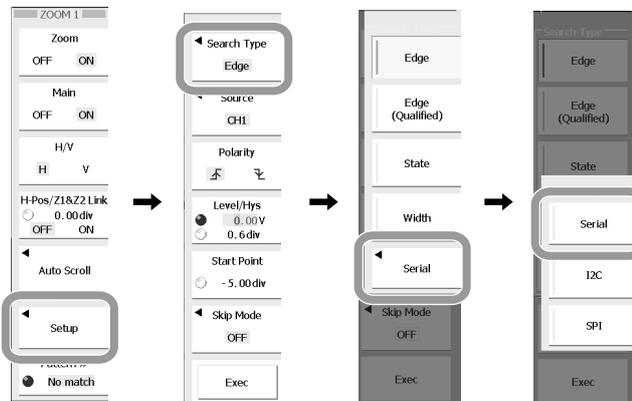
Setting the Serial Pattern

6.   Press the **Setup** soft key.

7.   Press the **Clock** soft key to select ON or OFF.
      - ON: Proceed to step 9. You must set the CS signal, clock source, and latch
               source (see page 11-40 and 11-41).
      - OFF: Proceed to step 8.

8.   Turn the **rotary knob** to set the bit rate.

9.   Press the **Set Pattern** soft key to display the data setup dialog box.
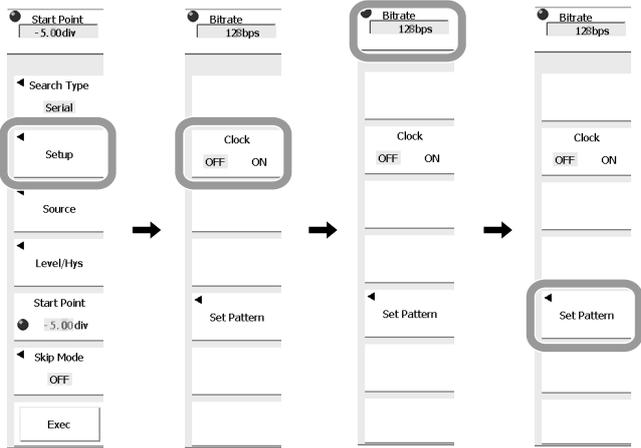
10.   Set the search pattern according to the procedural explanation in the figure
      below.

Pattern data area (Up to 128 bits of data can be
entered. Data exceeding 128 bits is discarded.)

The cursor position is the entry position.

When entering
in hexadecimal
notation

When entering
in binary
notation

For the procedure to select Bin or Hex, move the cursor, and delete or insert data, see
the section describing the trigger conditions of the serial pattern (page 6-68). The soft
keys can also be used to select Bin or Hex, move the cursor, and delete or insert data.

11.   Press **ESC** twice to go back two menus.

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Displaying and Searching History Waveforms

Setting the Data Source

12. Press the **Source** soft key to display the Data Source menu.
13. Press any of the **CH1** to **CH4** and **M1-M4** soft keys to select the data source.
    Pressing the M1-M4 soft key opens the M1, M2, M3, and M4 soft keys.
14. Turn the **rotary knob** to set the level for determining the data source high and low.
15. Press **ESC** to return to the previous screen.
16. Press the **Active** soft key to select H or L.
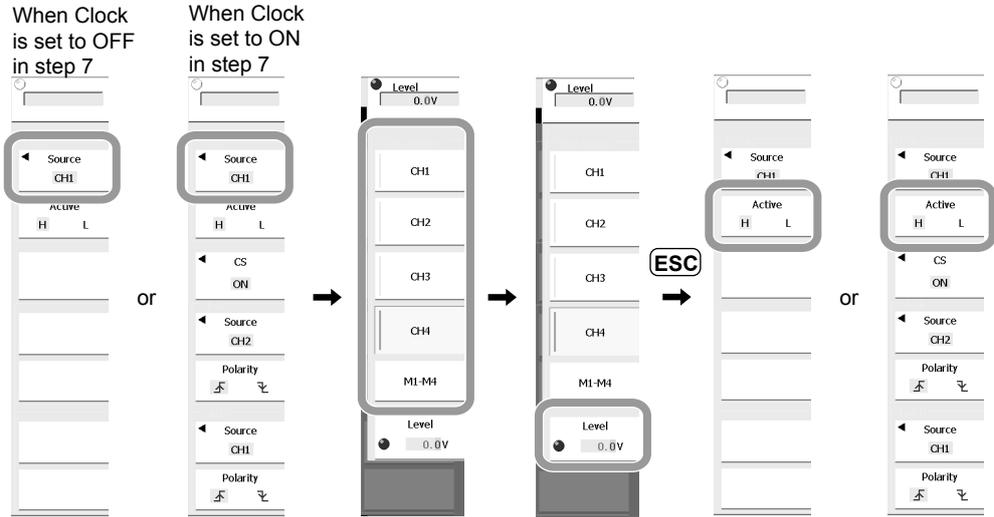
Carry out steps 17 to 31 below if you set the Clock to ON in step 7 on page 11-39.

Setting the CS Signal

17. Press the **CS** soft key to display the CS menu.
18. Press the **CS** soft key to select ON or OFF.
    • ON: Proceed to step 19.
    • OFF: Proceed to step 21.
19. Press each channel soft key to select H, L, or X.
    Pressing the M1-M4 soft key opens the M1, M2, M3, and M4 soft keys.
20. Press the **Logic** soft key to select AND or OR.
    • AND: Determines that the CS is detected when the conditions of all channels are met.
    • OR: Determines that the CS is detected when any of channel conditions is met.
21. Press **ESC** to return to the previous screen.
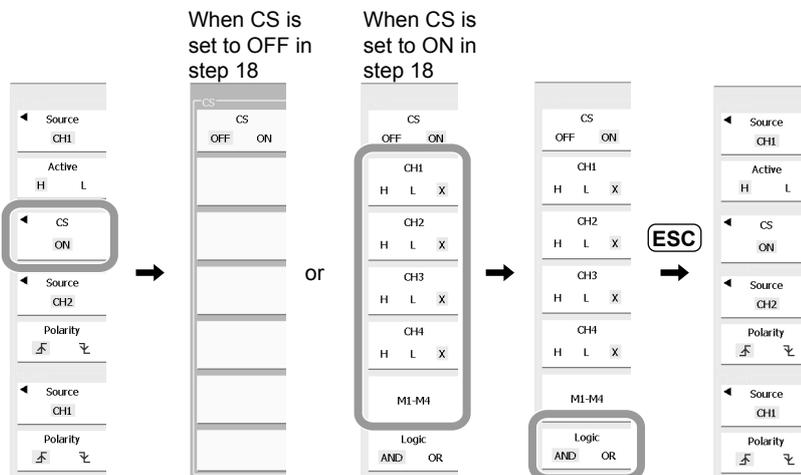
Setting the Clock Source

22. Press the **Source** soft key to display the Clock Source menu.
23. Press any of the **CH1** to **CH4** and **M1-M4** soft keys to select the clock source.
     Pressing the M1-M4 soft key opens the M1, M2, M3, and M4 soft keys.
24. Turn the **rotary knob** to set the detection level of the clock source.
25. Press **ESC** to return to the previous screen.
26. Press the **Polarity** soft key to select ⌐ or ⌐.
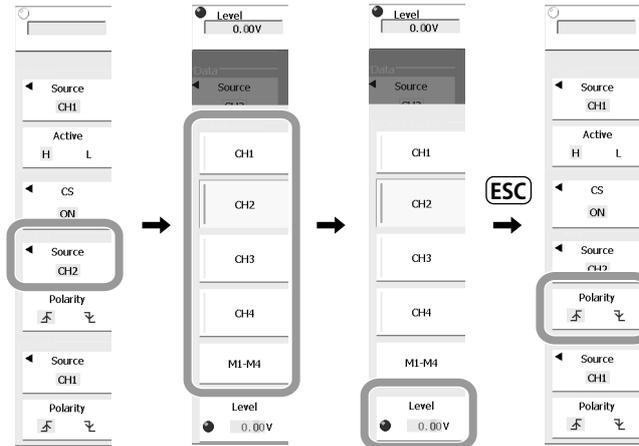
Setting the Latch Source

27. Press the **Source** soft key to display the Latch Source menu.
28. Press any of the **CH1** to **CH4**, **M1-M4**, and **X** soft keys to select the latch source.
     Pressing the M1-M4 soft key opens the M1, M2, M3, and M4 soft keys.
29. Turn the **rotary knob** to set the detection level of the latch source.
30. Press **ESC** to return to the previous screen.
31. Press the **Polarity** soft key to select ⌐ or ⌐.
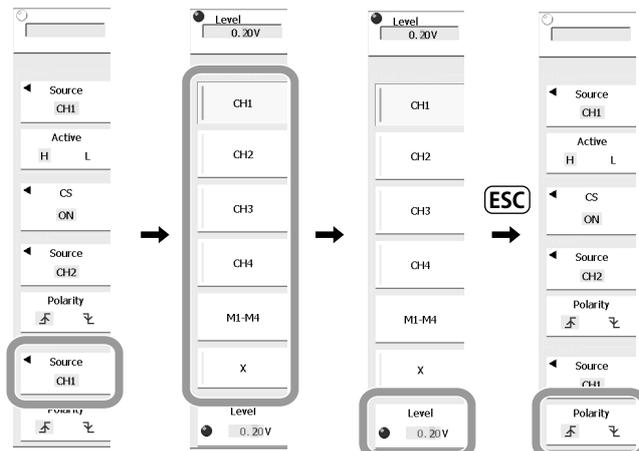
32. Press **ESC** to return to the previous screen.

11

Displaying and Searching History Waveforms

Setting the Status Determination Level and Hysteresis, the Search Start Point, and the Skip Mode

33. Press the **Level/Hys** soft key.

34. Turn the **rotary knob** to set the determination level and hysteresis for each channel.

    Pressing the M1-M4 soft key opens the M1, M2, M3, and M4 soft keys.

35. Press **ESC** to return to the previous screen.

36. Turn the **rotary knob** to set the search start point.

37. Press the **Skip Mode** soft key to display the Skip Mode menu.

38. Press any of the **OFF**, **Hold Off**, and **Decimation** soft keys to select the skip mode.

39. Turn the **rotary knob** to set the hold off time (time to skip) and decimation time (number of times to skip the search) according to the selected skip mode.
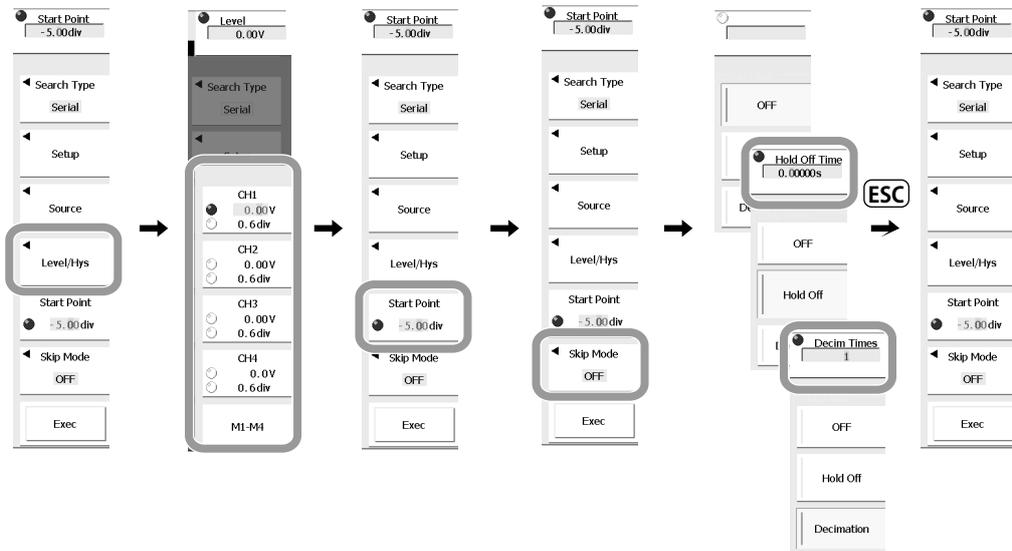
Executing the Search

40. Press the **Exec** soft key to execute the search. The Exec soft key changes to Abort. To abort the search, press this soft key.
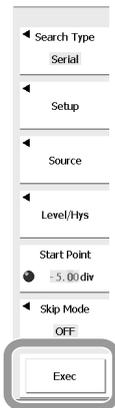
Displaying the Search Result

Numbers are assigned to the locations where the specified conditions are met. The numbers are assigned in order as follows: 0 for the first match, 1 for the second match, and so on. The maximum search number is 4999. The waveform at the location corresponding to the selected search number is shown in the zoom waveform display window.

41. Turn the **rotary knob** to select the search number. The waveform at the search number location is shown in the zoom waveform display window.
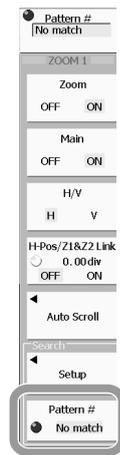
Explanation

This function searches serial status patterns. Search is made on a preset status pattern. This function can be used on products with firmware version 1.60 or higher.

Selecting the Serial Pattern Search Function

This section explains the serial pattern search function that comes standard on products with firmware version 1.60 or higher. On models with the /F5 option, I2C and SPI are displayed as selectable items. For details on these functions and operations, see the *Serial Bus Signal Analysis Function User's Manual IM701310-51E*.

Setting the Clock Source

This function searches the serial data pattern in sync with the selected clock signal. You can select whether to synchronize to the rising or falling edge of the clock.

ON: Select the clock source from CH1 to CH4 and M1 to M4.

OFF: Set the bit rate in the range of 1 k to 1 Gbps instead of selecting the clock source from the channels.

Setting the Serial Data Pattern

You can specify a serial data pattern as a search condition. Up to 128 bits can be specified. When Pattern Format is set to Hex (hexadecimal), you can enter X, 0 to 9, or A to F in units of 4 bits. When Pattern Format is set to Bin (binary), you can enter X, 0, or 1 for each bit. Enter X when not using the value as a condition.

Setting the Data Source

Select the data source for searching the serial data pattern from CH1 to CH4 and M1 to M4. You can also select high active or low active.

Setting the CS Signal

You can control the period over which the data source is detected with the CS signal when the clock source is turned ON.

ON: Select the CS signal from CH1 to CH4 and M1 to M4. You can also select the signal level state (H, L, or X) when the data source is to be detected. Select X when not using the value as a condition. You can also specify AND or OR logic to the conditions of multiple channels.

OFF: Detects the data source at all times.

Setting the Latch Source

You can select the timing when the acquired serial data pattern is compared against the pattern specified as a search condition when the clock source is turned ON. Select the latch source from CH1 to CH4, M1 to M4, and X. If X is selected, comparison is made every clock. You can select whether to synchronize to the rising or falling edge for making the comparison.

Setting the Status Determination Level and Hysteresis, the Search Start Point, and the Skip Mode

- **Determination Level of the Status**
  You can set the signal level used to determine whether the data pattern is high or low.

- **Setting the Hysteresis**
  Sets a width to the detection level so that edges are not detected by small changes.
  Selectable range: 0.0 divisions to 4.0 divisions
  Resolution: 0.1 division

- **Search Start Point**
  You can set the search start point.
  Selectable range: –5.00 divisions to 5.00 divisions
  Resolution: 0.01 division

- **Selecting the Skip Mode**
  You can select the method of skipping the source data during the search.
  OFF: Does not skip.
  Hold Off: Skips for the specified time.
                Selectable range: 0.1 ns to 1.00000 s (six significant digits)
                Resolution: 0.1 ns
  Decim Time: Skips for the specified search count.
                Selectable range: 1 to 9999

Displaying the Search Result

- Numbers are assigned to the locations where the specified conditions are met. The numbers are assigned in order as follows: 0 for the first match, 1 for the second match, and so on.
- The maximum search number is 4999.
- The waveform at the location of the selected search number can be displayed in the zoom waveform display frame.

12.1 Installing the Roll Paper into the Built-in Printer (Optional)

Printer Roll Paper

The DL9000 uses a dedicated roll paper provided by YOKOGAWA. Do not use other types of roll paper. When you are using the printer for the first time, use the roll paper that came with the package. Order extra rolls from your nearest YOKOGAWA dealer.

Part No.:   B9988AE
Specifications: Thermalsensible paper, 10 m
Minimum Quantity: 10 rolls

Handling the Roll Paper

The paper is a thermalsensible paper that changes color with the application of heat. Take note of the following points.

Storage Precautions

The paper starts changing color at around 70°C. It is affected by heat, humidity, light, and chemicals regardless of whether the paper has been used.
- Store the paper rolls in a cool, dry, and dark place.
- After opening the package, use it quickly.
- If the paper is left in contact with plastic film (such as a vinyl chloride film or Scotch tape) containing plasticizers for an extended time, the paper will lose some of its ability to reproduce color. If you are going to store the paper in a folder, for example, use a folder made of polypropylene or wood fiber.
- When using glue on the paper, do not use glue containing organic solvents such as alcohol or ether, as they will change the color of the paper.
- For prolonged storage, we suggest you make copies of the results printed on the roll paper. Due to the characteristics of the thermalsensible paper, it may lose color over time.

Handling Precautions

- Be sure to use only genuine paper rolls provided by YOKOGAWA.
- Touching the paper with sweaty hands can leave finger print marks or blur the printing.
- Rubbing the surface with a hard object can cause the paper to change color due to the heat caused by friction.
- If chemicals, oil, or other liquids come in contact with the paper, the paper may change color or the printing may fade.

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Printing Screen Images

Installing the Roll Paper

Procedure
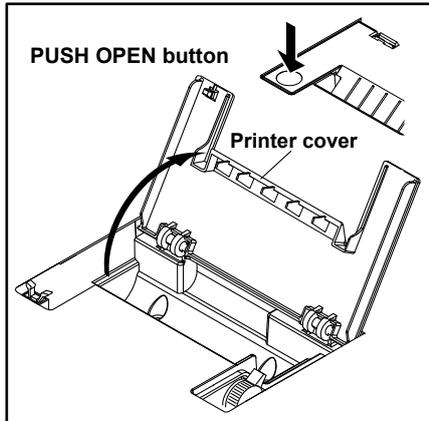
1. Press the PUSH OPEN button to unlock the printer cover. To open the printer cover, lift the handle on the right side of the printer cover.

PUSH OPEN button

Printer cover
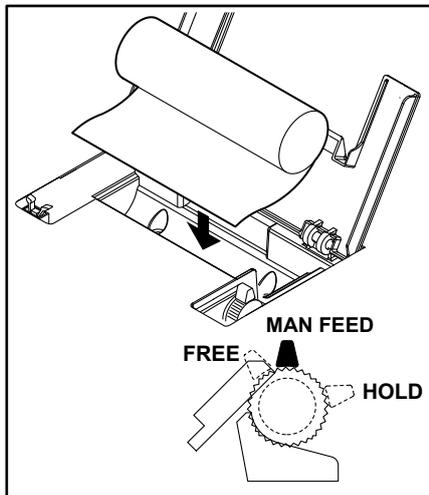
2. Move the release arm located on the right near the front to the MAN FEED position.
   Hold the roll paper so that the inner side of the roll paper (the side that is not glossy) is facing up and then insert the roll paper in the tray.

MAN FEED

FREE

HOLD
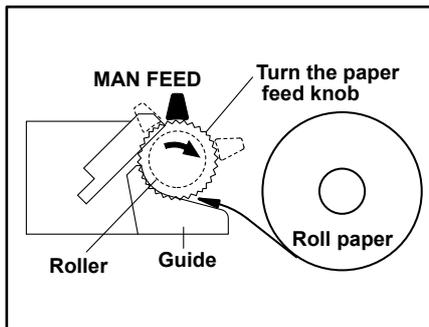
3. Insert the edge of the roll paper evenly in the space between the roller and the black guide, then rotate the paper feed knob towards the roll paper until about 10 cm of the paper extends beyond the top of the roller.

MAN FEED

Turn the paper feed knob

Roll paper

Roller **Guide**
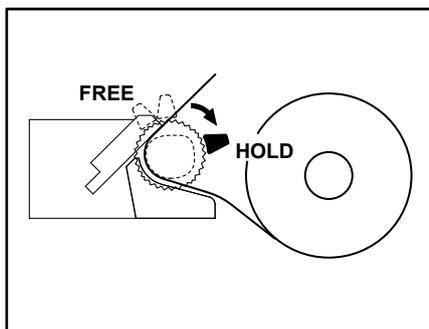
4. Move the release arm to the FREE position and straighten out the paper. Then, move the release arm to the HOLD position.
   The printing will fail with an error message if the release arm is in the FREE or MAN FEED position during operation.

FREE
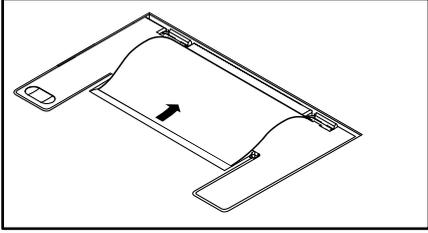
HOLD

5. Pull the printer cover back to its original position and close the cover.
    Push the printer cover down firmly until it clicks into place.

Note

Make sure to move the release arm to the HOLD position when closing the printer cover.

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Printing Screen Images

12.2 Printing Using the Built-in Printer (Optional)
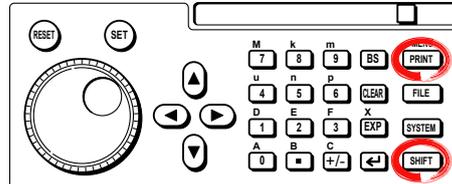
1. Press the **SHIFT** + **PRINT** key.

Selecting a Printer
2. Press the **Copy to (copy destination)** soft key. The printer selection menu appears.
3. Press the **Built-in (built-in printer)** soft key.
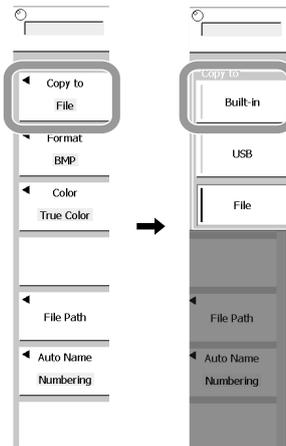
Setting Output Type
4. Press the **High Reso (high resolution)** soft key to select ON or OFF.

Printing
5. Press **PRINT**. The screen image is printed on the built-in printer.
   To abort printing, press PRINT while printing is in progress.
   While the data is being printed, the is displayed at the lower left corner of the screen.

Explanation

Output format: High Reso
The High Reso setting allows the following pixel sizes to be printed.
OFF: 1024 × 768 (XGA size) monochrome printing
ON: 2048 × 768 monochrome printing
Switching High Reso on or off does not affect the printing dimensions, and therefore when ON, the horizontal resolution is twice normal.

12.3 Printing Using a USB Printer
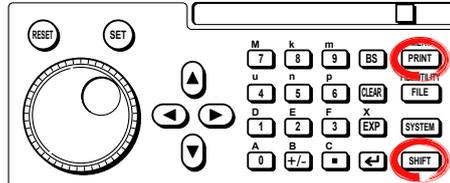
1. Connect the DL9000 and a USB printer using a USB cable. For details, see the explanation in this section.

Selecting a Printer

2. Press the **SHIFT** + **PRINT** key.
3. Press the **Copy to (copy destination)** soft key. The printer selection menu appears.
4. Press the **USB (USB printer)** soft key.
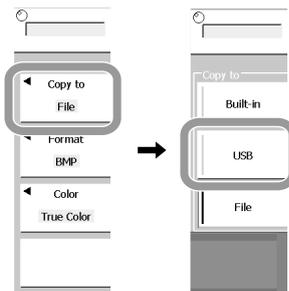
Checking the Connected Printer

5. Press the **Printer (printer)** soft key. The type of printers supported by the DL9000 is displayed.
6. Press the soft key corresponding to the connected printer.

Setting the Color

7. Press the **Color (color)** soft key to select ON or OFF.

Printing

8. Press **PRINT**. The screen image is printed on the USB printer.
   To abort printing, press PRINT while printing is in progress.
   While the data is being printed, the ⊞ is displayed at the lower left corner of the screen.

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Printing Screen Images

Explanation

You can print the screen image to a USB printer with the USB interface.

USB Peripheral Connectors

To connect a USB printer to the DL9000, connect a USB cable to the USB Peripheral connector. There are two USB peripheral connectors (ports).

Port 1 **Port 2**

1 2 3 4
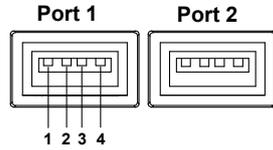
Pin No.	Signal Name	
1	VBUS:	+ 5 V
2	D –:	– Data
3	D +:	+ Data
4	GND:	Ground

Printers That Can Be Used

USB printers conforming to USB Printer Class Version 1.1 that support the following print formats can be used.

> ***Note***
> * Connect only the printers that are allowed.
> * For details on USB printers that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

Connection Procedure

When connecting a USB printer, directly connect the printer to the DL9000 using a USB cable as shown below. You can connect the USB cable regardless of whether the power to the DL9000 is ON or OFF (supports hot-plugging). Connect the type A connector of the USB cable to the DL9000; connect the type B connector to the printer. When the power switch is ON, the printer is detected and enabled after it is connected.

USB printer

DL9000

USB connection
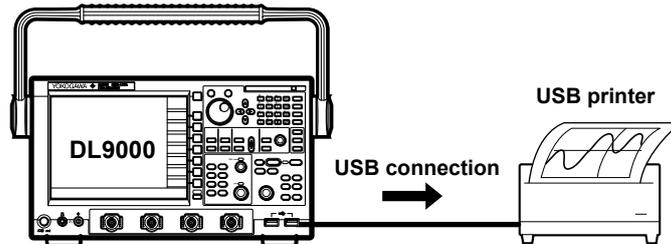
> ***Note***
> * Connect the printer directly without going through a hub.
> * Do not connect USB peripheral devices other than the compatible USB keyboard, USB mouse, USB printer, or USB storage devices to the USB peripheral device interface connector.
> * Do not connect multiple printers to the USB Peripheral connector.
> * Never turn OFF the printer or remove the USB cable while the printer is printing.
> * Do not connect or disconnect the USB cable after the power is turned ON until key operation is ready (approximately 20 to 30 s).

Color

Select one from the following.

ON: Prints the image using same colors as the screen (no background color and grid printed in black).

OFF: Prints the image using the same colors as the image printed using the built-in printer.

Precautions When Printing with a USB Printer

*   Images may not print properly on some printers. Use USB printers that have been tested for compatibility.
*   You can print with a USB printer connected to a computer. In Section 13.8, "Saving Screen Image Data," save the screen image data to a storage medium, read the data into a computer, and then print.

Note

The DL9000 may not be able to detect "out of paper" and printer errors on the USB printer. If an error occurs, press PRINT again to stop the printing.

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Printing Screen Images

13.1 Flash ATA Memory Card

PC Cards That Can Be Used

The DL9000 supports flash ATA cards (PC card TYPE II) and compact flash (using the PC card TYPE II adapter). In addition, some of the Flash ATA HDD cards can be used. For details, contact your nearest YOKOGAWA dealer.

Note

Make sure that the PC (personal computer) card that you use is compatible with the PC that you are using. The PC cards mentioned above may not work properly with all PCs. Check it beforehand.

Inserting the PC Card

With the front side of the PC card facing up, insert the PC card into the drive.
There is a PC card drive is located on the front panel and the rear panel of the DL9000.

Ejecting the PC Card

Check that the PC card is not being accessed, and press the PC card eject button to the right of the drive.

Eject button

Top face
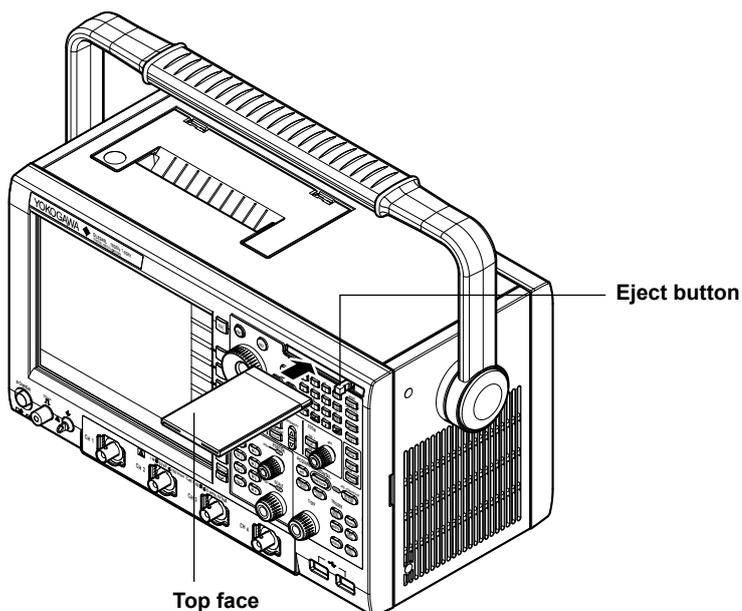
CAUTION

● The DL9000 may malfunction if the PC card is inserted and ejected within a 1-second time period.
● Removing the PC card while it is being accessed may destroy the data on the PC card.

General Handling Precautions of PC Cards

For the general handling precautions of the PC card, read the instruction manual that came with the PC card.

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Saving and Loading Data

13.2 Connecting a USB Storage Medium to the USB Port

When connecting a USB MO drive or hard disk, directly connect the device to the DL9000 using a USB cable as described below. You can connect/disconnect the USB cable at any time, regardless of the power ON/OFF state of the DL9000 (supports hot-plugging). Connect the type A connector of the USB cable to the DL9000; connect the type B connector to the USB storage. When the power switch is ON, the USB storage is detected and enabled.
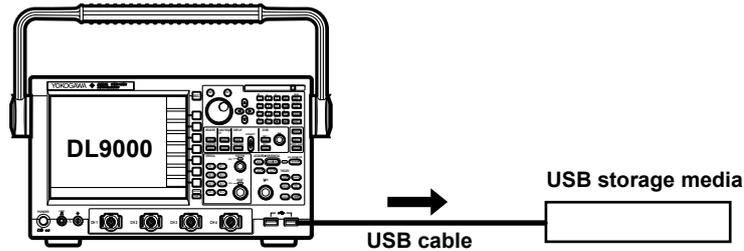
Note

- Connect the MO disk drive or hard disk directly without going through a USB hub.
- Do not connect USB peripheral devices other than the compatible USB keyboard, USB mouse, USB printer, or USB storage devices to the USB peripheral device interface connector.
- Do not connect and disconnect multiple USB devices in succession. Wait at least 10 seconds between devices.
- Do not connect or disconnect the USB cable after the power is turned ON until key operation is ready (approximately 20 to 30 s).
- USB storage that is compliant with USB Mass Storage Class Ver 1.1 can be used.
- The total number of PC cards and USB storage media that the DL9000 can handle is up to four. If the storage media is partitioned, the total number includes each partition. This is because each partition is handled as a separate storage medium.

Checking the Connected MO Disk Drive or Hard Disk

Press **FILE**. The available media are displayed.

13.3 Connecting to a Network Drive

You can connect the DL9000 to a network drive for storing and loading data such as setup data, waveform data, analysis data, and screen image data.
For details on connecting the DL9000 to a network drive, see section 15.3, "Saving and Loading Waveform/Setup/Image Data on a Network Drive."

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Saving and Loading Data

13.4 Saving/Loading the Setup Data

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure
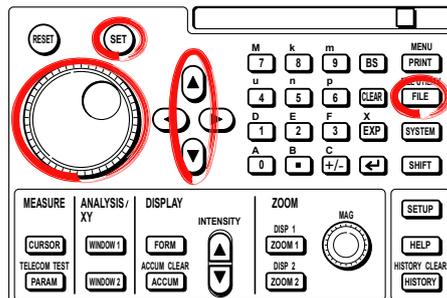
Saving the Setup Data

1. Press **FILE**.

Selecting the Save Destination Storage Medium/Directory

2. Using the **rotary knob**, select the save destination storage medium.
3. Press the **Open** soft key to confirm the storage medium.
   When saving to a directory in the storage medium, select the directory in the same manner as described above, and then press the **Open** soft key to confirm the directory.
   The selected medium/directory is displayed in "Path=......" located in the upper-left of the File List window.
   Press the Up soft key to move to the parent directory.

Setting the Data Type

4. Press the **Save** soft key. The file name setup menu appears.
5. Press the **Data Type** soft key. A menu used to select the data type appears.
6. Press the **Setup** soft key.
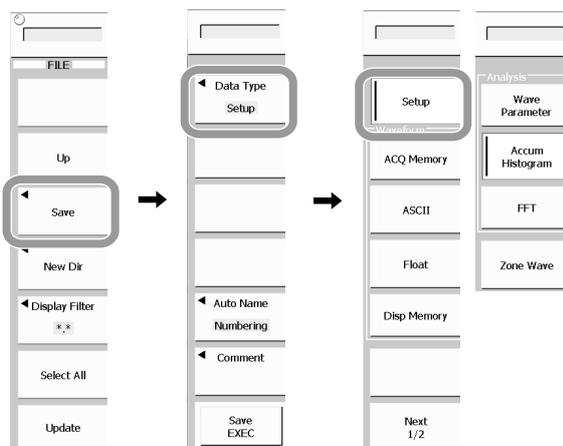
Setting the File Name

7. Press the **Auto Name** soft key. A menu used to select the file name setting method appears.
8. Select either **OFF**, **Numbering** or **Date** and then press the corresponding soft key.
    If you select Date, the date on which the file is saved becomes the file name. If you select Numbering, a sequential number is automatically added after the file name that was specified.
    If you select Date, proceed to step 12.
9. Press the **File Name** soft key.
10. Enter the file name as described in section 4.2.
11. Press **Enter**. Confirm the file name that was entered.
12. Press **ESC**.

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Saving and Loading Data
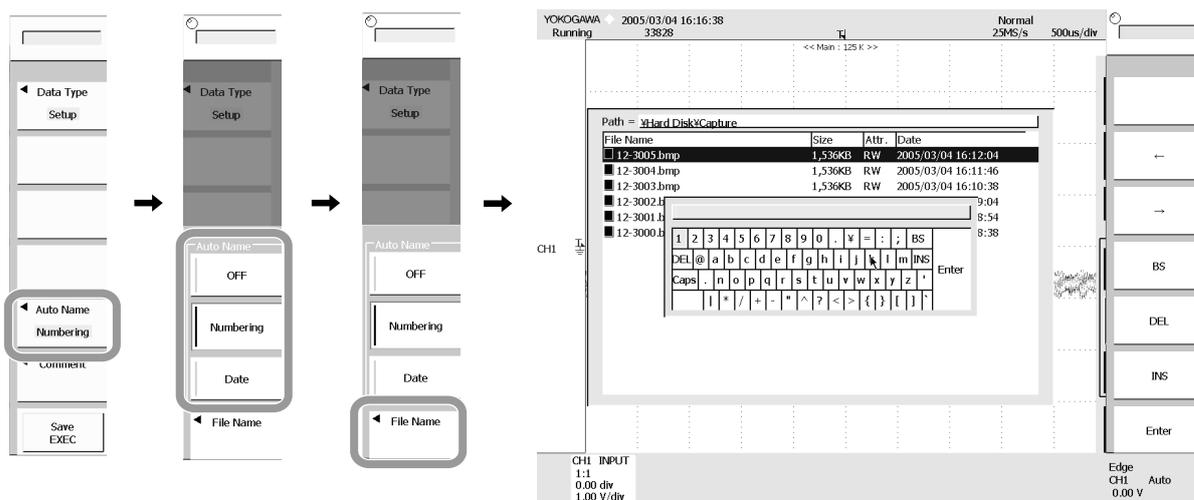
Setting a Comment

13. Press the **Comment** soft key.

14. Enter a comment up to 160 characters long as described in section 4.2, and then press Enter.

15. Press **ESC**. Doing so returns you to the previous menu.
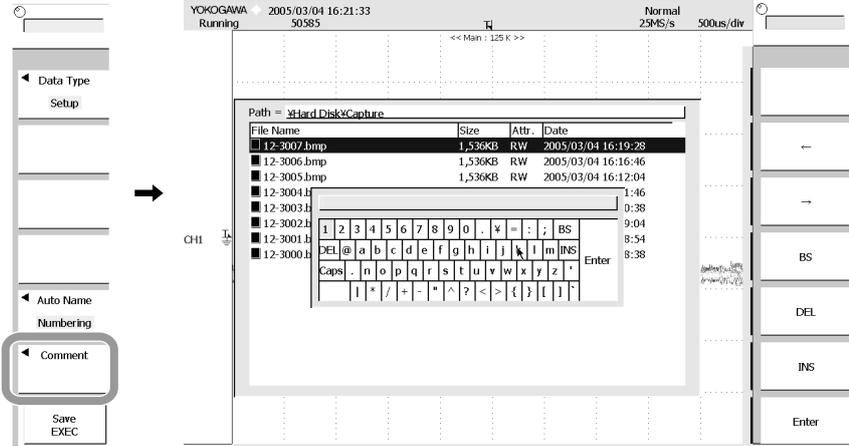
Executing the Save

16. Press the **Save Exec** soft key. The data is saved to the directory indicated by Path=...... At the same time, the Save Exec soft key changes to the Abort soft key. While the data is being saved, the media access icon is displayed at the upper left corner of the screen.

Aborting a Save

17. Press the **Abort** soft key. The save operation is aborted. At the same time, the Abort soft key changes to the Save EXEC soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

You can specify the format of files to be displayed in the file list. Set it as necessary.

18. On a screen that displays the File List dialog box, press the **Display Filter** soft key.

19. Select the extension of the file type that you want to display and then press the corresponding soft key.
To specify a user-defined file type, press the **User Def** soft key.

20. Press the **Filter** soft key.

21. Enter the file type as described in section 4.2, and then press Enter.
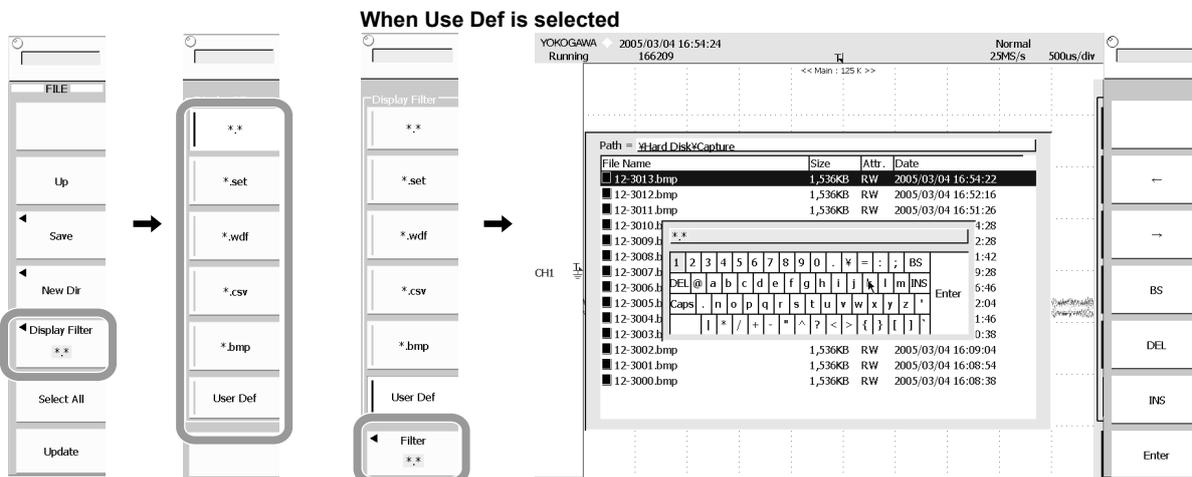
When Use Def is selected

Loading the Setup Data

1. Press **FILE**.
2. Using the **Up** and **Open** soft keys and the **rotary knob**, select the file to be loaded.
3. Press **SET**. A menu of file operations appears.
4. Press the **Load** soft key.

Executing the Load

5. Press the **Load EXEC** soft key. The selected file is read from the directory indicated in Path=...... At the same time, the Load EXEC soft key changes to the Abort soft key.

Aborting a Load

6. Press the **Abort** soft key. The load operation is aborted. At the same time, the Abort soft key changes to the Load EXEC soft key.

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Saving and Loading Data
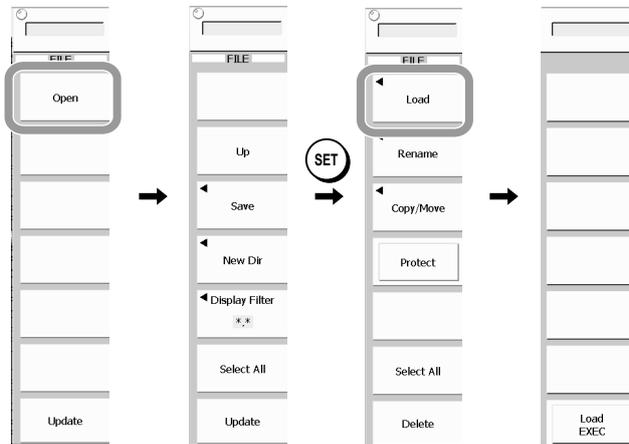
Explanation

Setup Data That Are Saved
The current setup data can be saved. However, setup data such as the date/time and communications settings are not saved.

Number of Bytes Required for a Save
Approx. 64 KB

Selecting the Storage Medium and Directory: File
Storage media in which saving and loading are possible are displayed on the File List window.

Display Examples of Storage Media
[Flash Mem]:   Internal Memory
[Storage Card]: PC card
[HD]:   Built-in Hard Disk (Optional)
[NetWork]:   Network drive (when the Ethernet interface option is installed)
[USB Storage]: USB Storage

Setting the File Name: File Name
The number of characters that can be used for a file or directory name is up to 64 characters from the beginning of the entered characters. However, the following conditions apply.
- The types of characters that can be used are 0 to 9, A to Z (uppercase even if you enter lowercase), _, -, =, (,), {, }, [,], #, $, %, &, ~, !, ', and @ on the keyboard that appears on screen.
- The following character strings cannot be used due to the limitation of MS-DOS. AUX, CON, PRN, NUL, CLOCK, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, and COM9.
- Make sure that the full path name (absolute path name from the root directory) is within 260 characters. If 260 characters is exceeded, an error occurs when you execute a file operation (save, copy, rename, create directory, etc.).
  Full path name: If you are operating a directory, specify up to the directory name.
                       If you are operating a file, specify up to the file name.
- The length of the character string displayed in the entry box of the keyboard that is shown on the screen is 36.

If you use the auto naming function of file names, the following conditions are added.
- If you set auto naming to Numbering, eight-character file names are used consisting of the first five characters entered as the file name and a three-digit serial number.
- If auto naming is set to Date (date/time), the characters entered as the file name are not used. The file name will only consists of the date information.

Auto Naming Function: Auto Name

Select one of the following three:

OFF: The name specified in File Name is assigned to the file.

Numbering: The file is saved with a three-digit number from 000 to 999 that is assigned automatically. You can specify a common name (up to five characters, specified through File Name) that is placed before the number.

Date: An 8-character file name based on the date and time is assigned using the numbers 0 to 9 and the letters A to Z as shown below. (Any file name specified for File Name is ignored.)

yr.	mo.	d.	hr.	min.		

100 ms units of time
0 ms = 00, 100 ms = 01, … , 1000 ms = 0A, 59900 ms = GN
0 min. = 00, … , 9 min. = 09, 10 min. = 0A, … , 36 min. = 0Z,
37 min. = 10, … , 46 min. = 1A, 59 min. = 1N
00:00 = 0, 09:00 = 9, 10:00 = A, … , 23:00 = N
1st = 1, … , 10th = A, … , 31st = V
Jan. = 1, … , Oct. = A, Nov. = B, Dec. = C
2000 = 0, … , 2010 = A, … , 2035 = Z
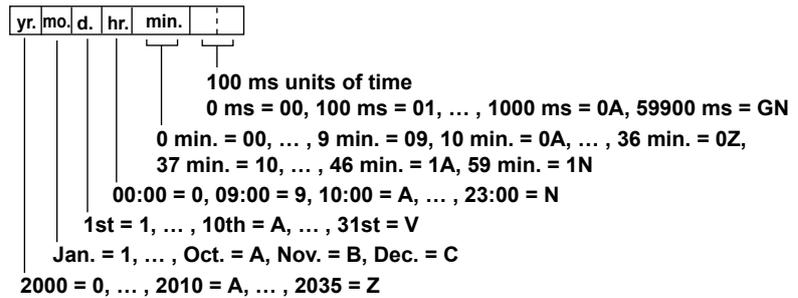
Setting a Comment: Comment

A comment of up to 160 characters can be added and saved. Comments are optional. All characters (including spaces) can be used.

Caution When Saving Data

A total of 2500 directories and files can be displayed in the file list. If there are more than 2500 directories and files in a single directory, a total of 2500 files and directories will be displayed, but it is not possible to specify which directories and files are displayed.

Extension for Setup Data

The .SET extension is automatically added to the file name.

Specifying the Files to Be Displayed in the File List Dialog Box: Display Filter

Specify the type of files to be displayed.

*.set: Displays only setup data files.

*.wdf: Displays only waveform files (ACQ Memory).

*.csv: Displays only csv files.

*.bmp: Displays only bitmap files.

User Def: Displays files with user-defined content.
"*" and "?" can be used as wildcard characters.

.: Displays all the files in the storage medium/directory.

Note

- An error occurs if a key other than the Abort key is pressed while saving or loading a file.
- Saving and Loading is not possible while data acquisition is in progress.
- If you change the extension of the file (using a PC, for example), the file can no longer be loaded.
- Up to 36 characters can be displayed in the path.
- If the setup data that is saved to a file is loaded, the settings of the keys are changed to the loaded information and cannot be undone. It is recommended that you first save the current setup data and then load the setup data from a file.
- Setup data concerning the date and time, communications, menu language, message language and USB keyboard language is not saved Therefore, loading setup data from a file will not change these settings.

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Saving and Loading Data

13.5 Saving/Loading the Measurement Data

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure
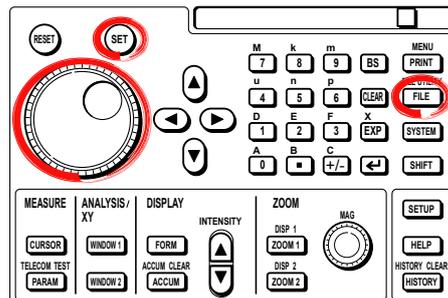
Saving the Measurement Data

1. Press **FILE**.

Selecting the Save Destination Storage Media/Directory

2. Use the **rotary knob** to select the save destination storage medium.

3. Press the **Open** soft key to confirm the storage medium.

   When saving to a directory in the storage medium, select the directory in the same manner as described above, and then press the **Open** soft key to confirm the directory.

   The selected medium/directory is displayed in "Path=......" located in the upper-left of the File List window.

   Press the Up soft key to move to the parent directory.

Setting the Data Type

4. Press the **Save** soft key. The file name setup menu appears.

5. Press the **Data Type** soft key. A menu used to select the data type appears.

6. Press the **ACQ Memory**, **ASCII** and **Float** soft keys.

Note

*   ACQ Memory data can be saved and loaded, ASCII data and floating point data can only be saved.
*   The data type is linked to the data type when Save to File was selected as an action of GO/ NO-GO determination (see sections 7.9 through 7.14) or action-on-trigger (see section 7.8).
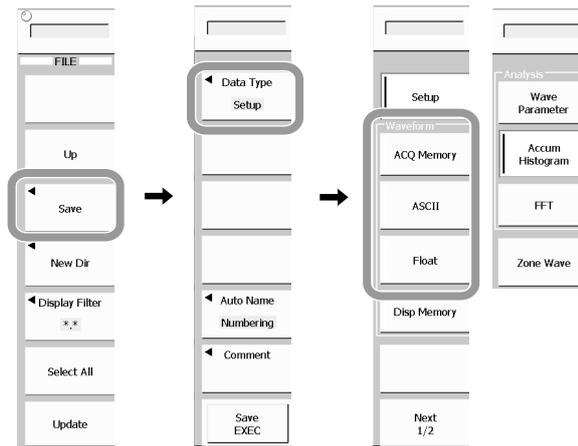
Selecting a Waveform to be Saved

7. Press the **Source** soft key. The waveform selection menu appears.

8. Press the soft key corresponding to the channel to be saved to select the waveform to be saved. To specify M1 to M4, first switch to **M1-M4** by pressing the corresponding soft key.

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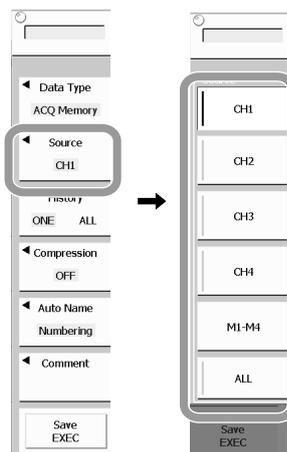
Saving and Loading Data

Selecting the Range of Waveform To Be Saved

9. Press the **History** soft key to select whether to save all the data in the history memory (ALL) or save only the displayed waveform (ONE).
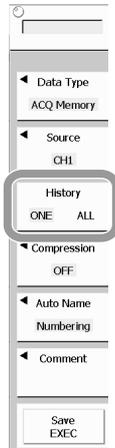
Saving with Compression/Saving with Decimation

10. Press the **Compression** soft key.
11. To compress and save the data, press the **P-P** soft key. To decimate and save the data, press the **Decim** soft key.
12. Using the **rotary knob**, set the record length after compression or decimation. The data is compressed or decimated in accordance with the record length that was set and is then saved.

Data length after compression or decimation
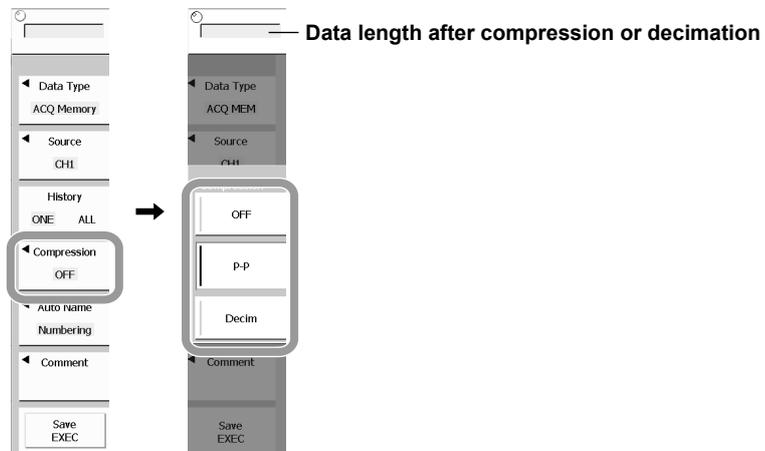
Setting the File Name

13. Press the **Auto Name** soft key. A menu used to select the file name setting method appears.

14. Select either **OFF**, **Numbering** or **Date** and then press the corresponding soft key.

    If you select Date, the date on which the file is saved becomes the file name. If you select Numbering, a sequential number is automatically added after the file name that was specified.

    If you select Date, proceed to step 18.

15. Press the **File Name** soft key.

16. Enter the file name as described in section 4.2.

17. Press **Enter**. Confirm the file name that was entered.

18. Press **ESC**.
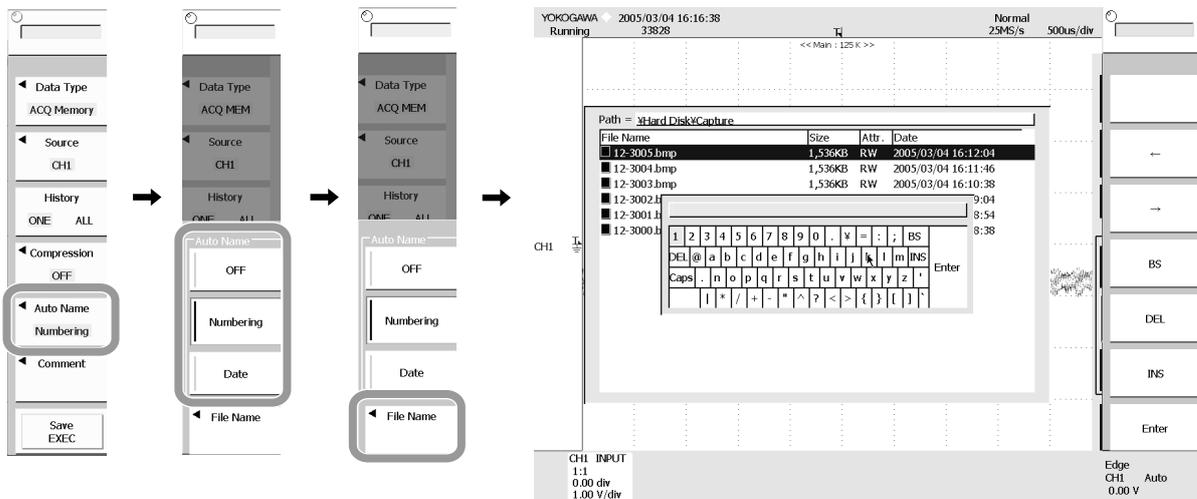
Setting a Comment

19. Press the **Comment** soft key.

20. Enter a comment up to 160 characters long as described in section 4.2, and then press Enter.

21. Press **ESC**. Doing so returns you to the previous menu.

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Saving and Loading Data

Executing the Save

22. Press the **Save Exec** soft key. The data is saved to the directory indicated by Path=...... At the same time, the Save Exec soft key changes to the Abort soft key.
    While the data is being saved, the file access icon is displayed at the upper left corner of the screen.

Aborting a Save

23. Press the **Abort** soft key. The save operation is aborted. At the same time, the Abort soft key changes to the Save EXEC soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

You can specify the format of files to be displayed in the file list. Set it as necessary.

24. On a screen that displays the File List dialog box, press the **Display Filter** soft key.
25. Select the extension of the file type that you want to display and then press the corresponding soft key.
    To specify a user-defined file type, press the **User Def** soft key.
26. Press the **Filter** soft key.
27. Enter the file type as described in section 4.2, and then press Enter.

When Use Def is selected

Loading the Waveform Data

1. Press **FILE**.
2. Using the **Up** and **Open** soft keys and the rotary knob, select the file to be loaded.
3. Press **SET**. A menu of file operations appears.
4. Select the load destination.
   Select ACQ Memory when loading data that was saved with All CH.
5. Press the **Load** soft key.
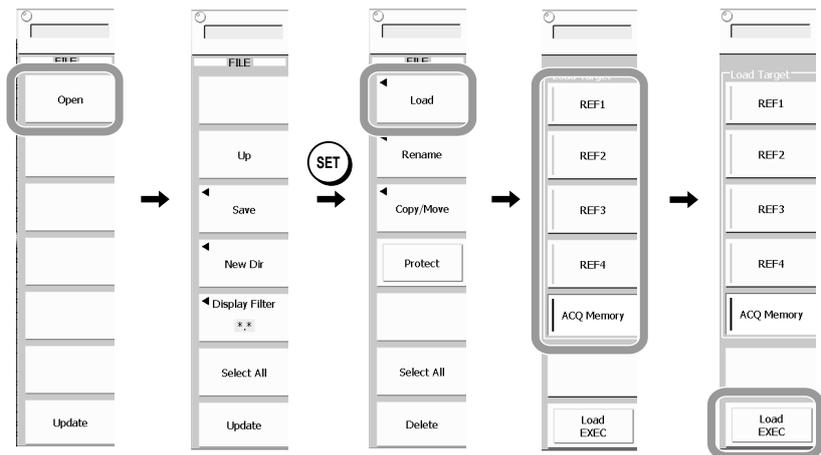
Selecting the Load Destination

5. Select the acquisition memory (ACQ Memory) or a reference waveform number for the waveform data to be loaded. When a reference waveform number is selected, the waveform data is loaded as a reference waveform. Data saved with All can only be loaded into the acquisition memory.

Executing the Load

6. Press the **Load EXEC** soft key. The selected file is read from the directory indicated in Path=...... At the same time, the Load EXEC soft key changes to the Abort soft key.

Aborting a Load

7. Press the **Abort** soft key. The load operation is aborted. At the same time, the Abort soft key changes to the Load EXEC soft key.

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Saving and Loading Data

Selecting the Data Type: Data Type

- **ASCII**
  - The units of the sampled data in the acquisition memory are converted per the specified range and saved in ASCII format. The data can be used to analyze the waveform on a PC.
  - The file cannot be loaded into the DL9000.
  - The extension is .CSV.

- **Float**
  - The units of the sampled data in the acquisition memory are converted per the specified range and saved in 32-bit floating format. The data can be used to analyze the waveform on a PC.
  - The order of the data is little-endian (Intel format).
  - The file cannot be loaded into the DL9000.
  - The extension is .FLD.

Data Size

The following table shows the data size when the record length is set to 125 kW, waveform data of CH1 to CH4 are saved, and using history waveform 1 condition.

Data Type	Extension	Data Size (Bytes)
ACQ Memory	.WDF	Approx. 1 M ((125 kW + 12) × 4 channels × the number of history waveforms × 2 + 60 K)
ASCII	.CSV	9 to 10 M bytes
Float	.FLD	Approx. 2 M (((125 kW + 12) × 4) × the number of history waveforms × 4)

Waveforms to Be Saved: Source

- Any of CH1 to CH4 and M1 to M4 can be selected for saving for all waveforms.
- The setup data including vertical axis, horizontal axis, and trigger of the waveform to be saved is also saved.
- For waveforms that are loaded using the history memory function, you can select whether to save all of the history data, or save just the current displayed waveform on the screen. You can also save only the results obtained by searching the history memory data. For details on searching history memory data, see Chapter 11.

Compressing and Saving Data: P-P

You can select whether to P-P compress the waveform data before saving.
Power spectrum computation data cannot use P-P compression.

Decimating and Saving Data: Decim

Decimates and saves data.

Selecting the Compressed Size: P-P

You can select the compressed size from among the following.
2.5 k, 6.25 k, 12.5 k, 62.5 k, 125 k, 250 k, 625 k, 1.25 M, 2.5 M, 6.25 M
If the record length and the compressed size are the same, the data is saved without compression.

Selecting the Storage Medium and Directory

Storage media in which saving and loading are possible are displayed on the File List window.

Display Examples of Storage Media

Same as the explanation given in "Display Examples of Storage Media" of section 13.4.

Setting the File Name: File Name

Same as the explanation given in "Setting the File Name" in section 13.4.

Setting a Comment: Comment

Same as the explanation given in "Setting a Comment" in section 13.4.

Specifying the Files to Be Displayed in the File List Dialog Box: Display Filter

Specify the type of files to be displayed.

Same as the explanation given in "Specifying the Files to Be Displayed in the File List Dialog Box" in section 13.4.

Note

- An error occurs if a key other than the Abort key is pressed while saving or loading a file. When waveform data is loaded, the accumulation setting is always OFF.
- If you change the extension of the saved data (using a PC, for example), the file can no longer be loaded.
- A total of 2500 directories and files can be displayed in the file list. If there are more than 2500 directories and files in a single directory, a total of 2500 files and directories will be displayed, but it is not possible to specify which directories and files are displayed.

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Saving and Loading Data

Data Format When Storing Multiple Records

When multiple records are stored (history memory, for example), the following data format is used.

ASCII Format: CR+LF is inserted between records.

<Header>
Measured data 1-1 of CH1, Measured data 1-1 of CH2, Measured data 1-1 of CH3, ... , [CR+LF]
Measured data 1-2 of CH1, Measured data 1-2 of CH2, Measured data 1-2 of CH3, ... , [CR+LF]
     ⋮
Measured data 1-m of CH1, Measured data 1-m of CH2, Measured data 1-m of CH3, ... , [CR+LF]
[CR+LF]   } Record 1
Measured data 2-1 of CH1, Measured data 2-1 of CH2, Measured data 2-1 of CH3, ... , [CR+LF]
Measured data 2-2 of CH1, Measured data 2-2 of CH2, Measured data 2-2 of CH3, ... , [CR+LF]
     ⋮
Measured data 2-n of CH1, Measured data 2-n of CH2, Measured data 2-n of CH3, … , [CR+LF]   } Record 2
[CR+LF]
     ⋮

Float Format: Stored in blocks of channels.

Measured data of record 1 of CH1
Measured data of record 2 of CH1
⋮
Measured data of record N of CH1
Measured data of record 1 of CH2
Measured data of record 2 of CH2
⋮
Measured data of record N of CH2
⋮

Loading Measurement Data

Measurement data saved on a storage media or in internal memory can be loaded and displayed. Reference waveforms or the acquisition memory can be used as the load destination. Data that was saved with the Source set to All cannot be loaded as a reference waveform. Also, data that has been compressed for storage cannot be loaded into the acquisition memory.

When waveform acquisition is started, any data loaded into the acquisition memory will be overwritten.

13.6 Saving/Loading the Accumulated Waveforms

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure
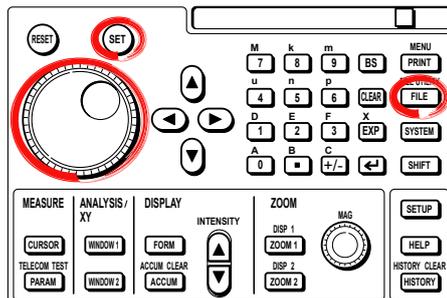
Saving Accumulated Waveforms

1. Press **FILE**.

Selecting the Save Destination Storage Media/Directory

2. Use the **rotary knob** to select the save destination storage medium.
3. Press the **Open** soft key to confirm the storage medium.

    When saving to a directory in the storage medium, select the directory in the same manner as described above, and then press the **Open** soft key to confirm the directory.

    The selected medium/directory is displayed in "Path=......" located in the upper-left of the File List window.

    Press the Up soft key to move to the parent directory.

Setting the Data Type

4. Press the **Save** soft key. The file name setup menu appears.
5. Press the **Data Type** soft key. A menu used to select the data type appears.
6. Press the **Disp Memory** soft key.
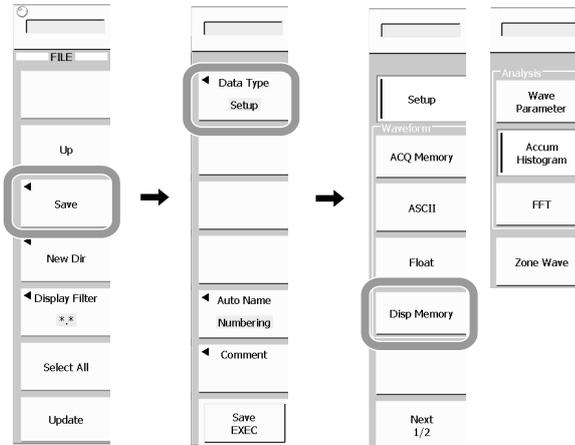
Selecting a Waveform to be Saved

7. Press the **Source** soft key. The waveform selection menu appears.
8. Press the soft key corresponding to the channel to be saved to select the waveform to be saved. To specify M1 to M4, first switch to **M1-M4** by pressing the corresponding soft key.

    To save the XY display of an accumulated waveform, first switch to XY1 to XY2 by pressing the **XY1-XY2** soft key and then specify the soft key corresponding to the desired storage location.
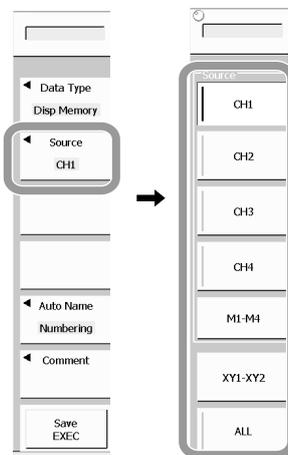
Setting the File Name

9. Press the **Auto Name** soft key. A menu used to select the file name setting method appears.

10. Select either **OFF**, **Numbering** or **Date** and then press the corresponding soft key.

    If you select Date, the date on which the file is saved becomes the file name. If you select Numbering, a sequential number is automatically added after the file name that was specified.

    If you select Date, proceed to step 14.

11. Press the **File Name** soft key.

12. Enter the file name as described in section 4.2.

13. Press **Enter**. Confirm the file name that was entered.

14. Press **ESC**.
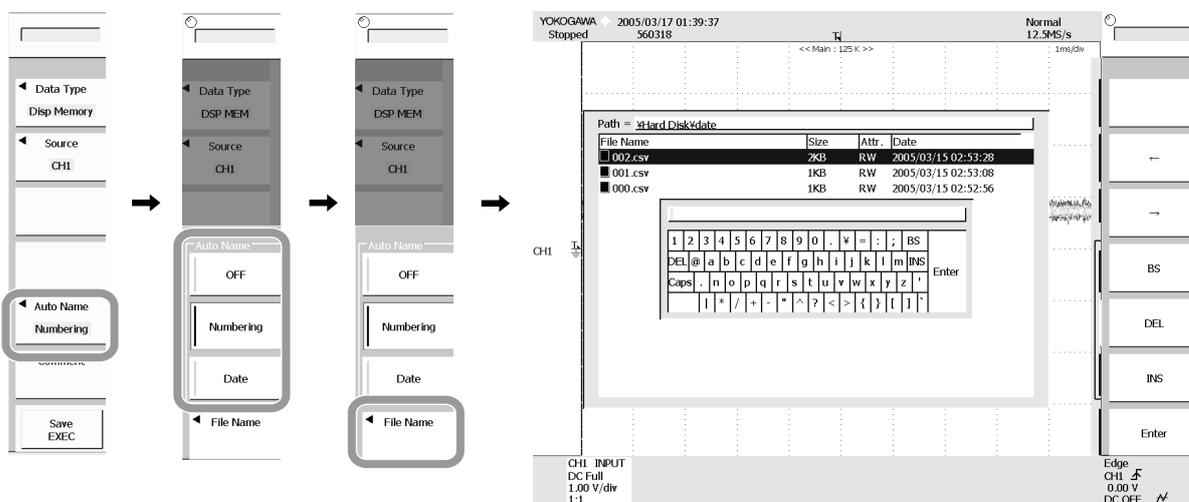
Setting a Comment

15. Press the **Comment** soft key.

16. Enter a comment up to 160 characters long as described in section 4.2, and then press Enter.

17. Press **ESC**. Doing so returns you to the previous menu.
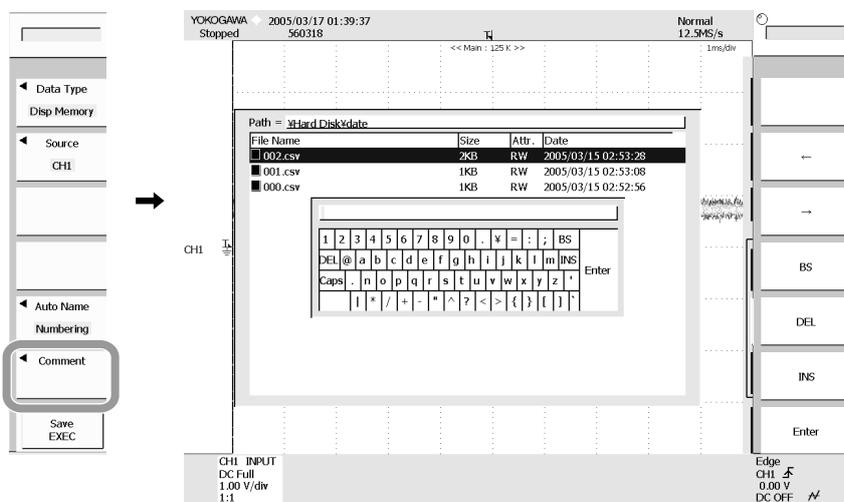
Executing the Save

18.   Press the **Save Exec** soft key. The data is saved to the directory indicated by Path=...... At the same time, the Save Exec soft key changes to the Abort soft key.

      While the data is being saved, the file access icon is displayed at the upper left corner of the screen.

Aborting a Save

19.   Press the **Abort** soft key. The save operation is aborted. At the same time, the Abort soft key changes to the Save EXEC soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

You can specify the format of files to be displayed in the file list. Set it as necessary.

20.   Set the extension for the file displayed in the File List dialog box according to the procedure described on pages 13-6.

Loading the Accumulated Waveform

1. Press **FILE**.
2. Using the **Up** and **Open** soft keys and the rotary knob, select the file to be loaded.
3. Press **SET**. A menu of file operations appears.
4. Press the **Load** soft key.

Executing the Load

5. Press the **Load EXEC** soft key. The selected file is read from the directory indicated in Path=...... At the same time, the Load EXEC soft key changes to the Abort soft key.

Aborting a Load

6. Press the **Abort** soft key. The load operation is aborted. At the same time, the Abort soft key changes to the Load EXEC soft key.

Explanation

Selecting the Storage Medium and Directory

Storage media in which saving and loading are possible are displayed on the File List window.

Display Examples of Storage Media

Same as the explanation given in "Display Examples of Storage Media" of section 13.4.

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Saving and Loading Data

Setting the File Name: File Name
Same as the explanation given in "Setting the File Name" in section 13.4.

Setting a Comment: Comment
Same as the explanation given in "Setting a Comment" in section 13.4.

Specifying the Files to Be Displayed in the File List Dialog Box: Display Filter
Specify the type of files to be displayed.
Same as the explanation given in "Specifying the Files to Be Displayed in the File List Dialog Box" in section 13.4.

Note _____

- An error occurs if a key other than the Abort key is pressed while saving or loading a file.
- When waveform data is loaded, the accumulate setting is always OFF.
- If you change the extension of the saved data (using a PC, for example), the file can no longer be loaded.
- A total of 2500 directories and files can be displayed in the file list. If there are more than 2500 directories and files in a single directory, a total of 2500 files and directories will be displayed, but it is not possible to specify which directories and files are displayed.

13.7 Saving/Loading Waveform Zones, Polygon Zones, and Mask Patterns

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CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure

Saving a Zone

1. Press **FILE**.

Selecting the Save Destination Storage Media/Directory

2. Use the **rotary knob** to select the save destination storage medium.
3. Press the **Open** soft key to confirm the storage medium.
   When saving to a directory in the storage medium, select the directory in the same manner as described above, and then press the **Open** soft key to confirm the directory.
   The selected medium/directory is displayed in "Path=......" located in the upper-left of the File List window.
   Press the Up soft key to move to the parent directory.

Setting the Data Type

4. Press the **Save** soft key. The file name setup menu appears.
5. Press the **Data Type** soft key. A menu used to select the data type appears.
6. Press the **Next 1/2** soft key.
7. Press the **Zone Wave** soft key.
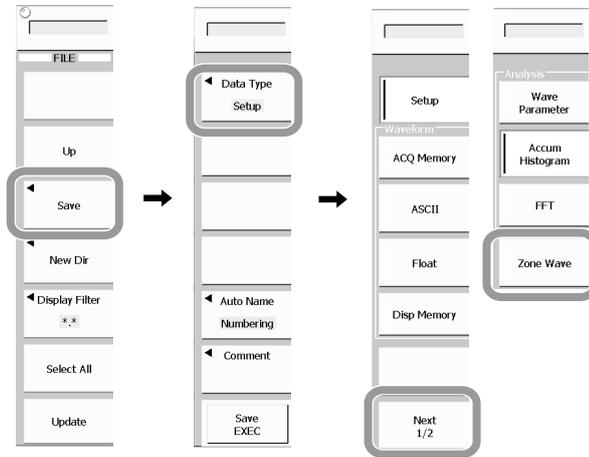
Selecting a Zone To Be Saved

8. Press the **Zone** soft key. A menu for selecting the zone appears.
9. Select the zone to be saved by pressing the soft key that corresponds to the zone number that is set for that zone.
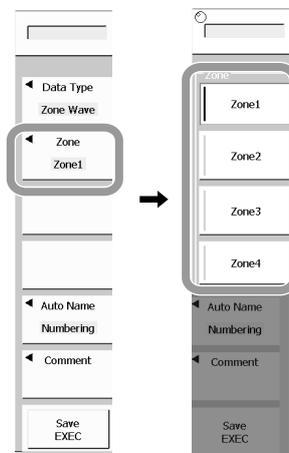
Setting the File Name

10. Press the **Auto Name** soft key. A menu used to select the file name setting method appears.

11. Select either **OFF**, **Numbering** or **Date** and then press the corresponding soft key.
    If you select Date, the date on which the file is saved becomes the file name. If you select Numbering, a sequential number is automatically added after the file name that was specified.
    If you select Date, proceed to step 15.

12. Press the **File Name** soft key.

13. Enter the file name as described in section 4.2.

14. Press **Enter**. Confirm the file name that was entered.

15. Press **ESC**.
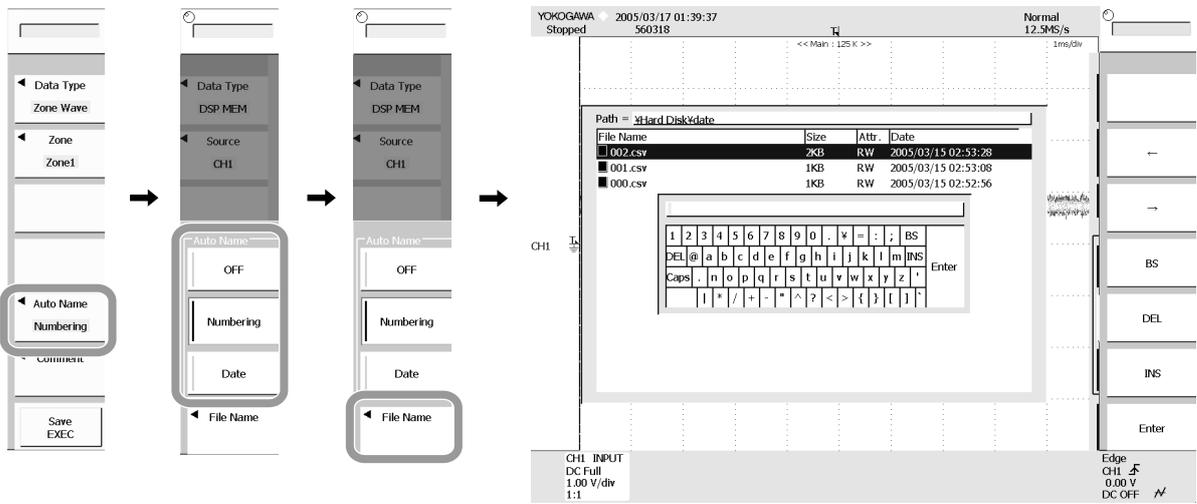
Setting a Comment

16. Press the **Comment** soft key.

17. Enter a comment up to 160 characters long as described in section 4.2, and then press Enter.

18. Press **ESC**. Doing so returns you to the previous menu.

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Saving and Loading Data
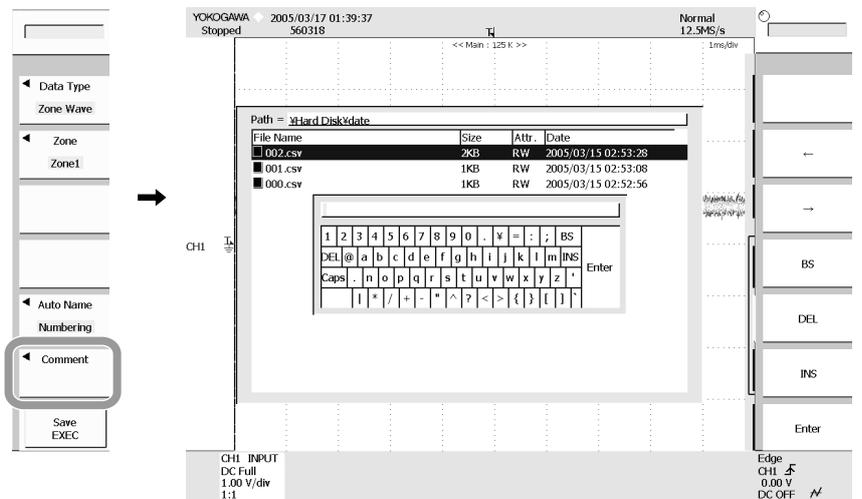
Executing the Save

19. Press the **Save Exec** soft key. The data is saved to the directory indicated by Path=...... At the same time, the Save Exec soft key changes to the Abort soft key.
    While the data is being saved, the file access icon is displayed at the upper left corner of the screen.

Aborting a Save

20. Press the **Abort** soft key. The save operation is aborted. At the same time, the Abort soft key changes to the Save EXEC soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

You can specify the format of files to be displayed in the file list. Set it as necessary.

21. Set the extension for the file displayed in the File List dialog box according to the procedure described on pages 13-6.

Loading the Waveform Zone

1. Press **FILE**.
2. Using the **Up** and **Open** soft keys and the rotary knob, select the file to be loaded.
3. Press **SET**. A menu of file operations appears.
4. Press the **Load** soft key.
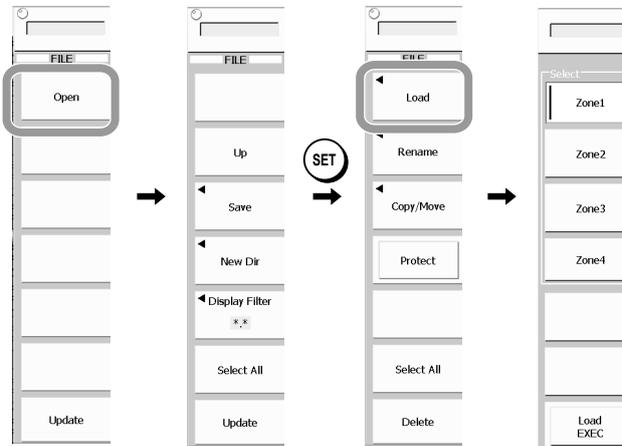
Selecting the Load Destination

5. Select the number for the zone to be loaded.

Executing the Load

6. Press the **Load EXEC** soft key. The selected file is read from the directory indicated in Path=...... At the same time, the Load EXEC soft key changes to the Abort soft key.

Aborting a Load

7. Press the **Abort** soft key. The load operation is aborted. At the same time, the Abort soft key changes to the Load EXEC soft key.

Loading the Polygon Zone or Mask Pattern

1. Select the file to be loaded in the same manner as for Loading the Waveform Zone above.
2. Press **SET**. A menu of file operations appears.
3. Press the **Load** soft key.

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Saving and Loading Data
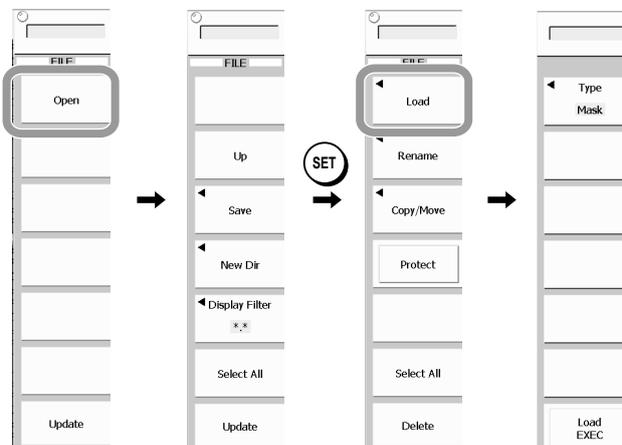
Selecting the Data Type

4. Press the Type soft key. A menu used to select the data type appears.
5. Select either Zone Polygon or Mask.
6. If Zone Polygon was selected in step 5, select the number of the zone to be loaded.

When Zone Polygon is selected

When Mask is selected

◄ Type Mask	Select Zone Polygon Mask	◄ Type Zone Polygon	◄ Type Mask
		Zone1	
		Zone2	
		Zone3	
		Zone4	
Load EXEC		Load EXEC	Load EXEC
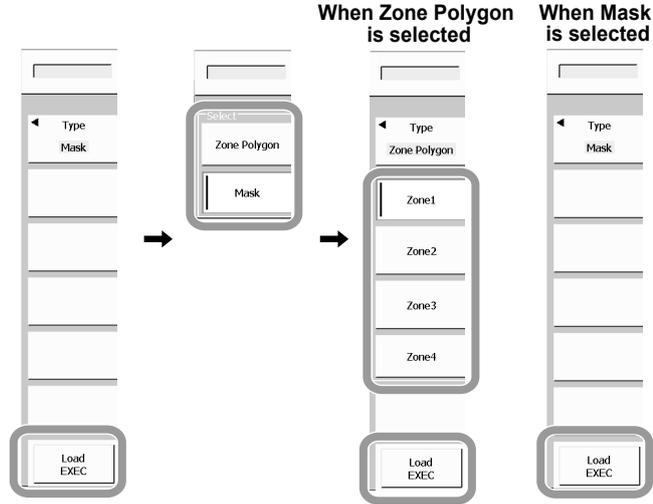
Executing the Load

7. Press the **Load EXEC** soft key. The selected file is read from the directory indicated in Path=...... At the same time, the Load EXEC soft key changes to the Abort soft key.

Aborting a Load

8. Press the **Abort** soft key. The load operation is aborted. At the same time, the Abort soft key changes to the Load EXEC soft key.

Explanation

You can search for GO/NO-GO determination and history waveform, and save and load waveform zones that are used for zoom and search. The waveform zone can be saved in Zone 1 through Zone 4.

Savable waveform zones
Waveform zones

Loadable zones and pattern
Waveform zones, polygon zones, and mask patterns

Data Extension
Waveform zones: .ZWF
Mask patterns; polygon zones: .MSK

Note
Pressing a key other than the Abort key while the save is in progress will cause an error.

13.8 Saving Screen Image Data
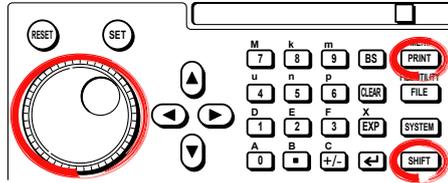
1. Press the **SHIFT + PRINT** key. The file menu appears.
2. Press the **Copy to** soft key.
3. Press the **File** soft key.
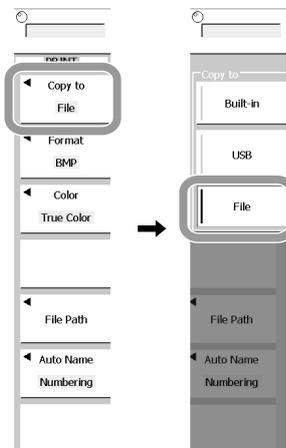
Selecting the Data Format
4. Press the **Format** soft key.
5. Select either **BMP**, **PNG, or JPEG** and then press the corresponding soft key.

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Saving and Loading Data
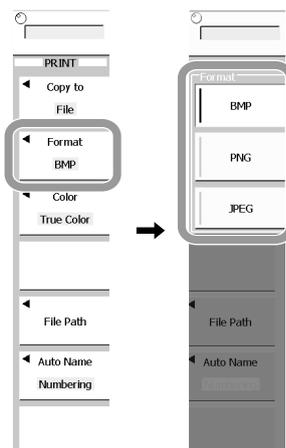
Selecting the Color Mode

6. Press the **Color** soft key.
7. Press the soft key that corresponds to the desired color mode selection.
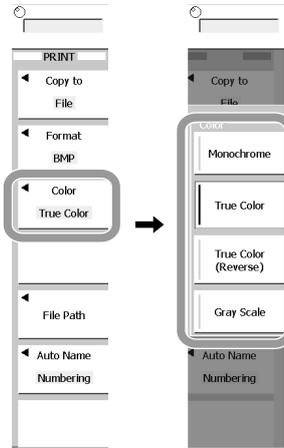
Selecting the Save Destination

8. Press the **File Path** soft key.
9. Use the **rotary knob** to select the storage medium and directory where the data is to be saved and then press the **OPEN** soft key.
   You can move to the parent directory by pressing the **Up** soft key.
10. Press **ESC**.
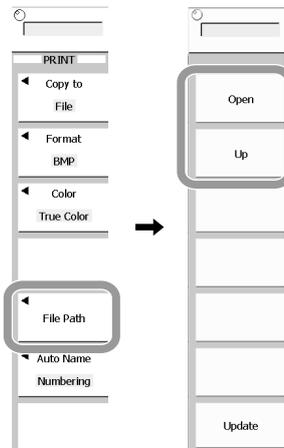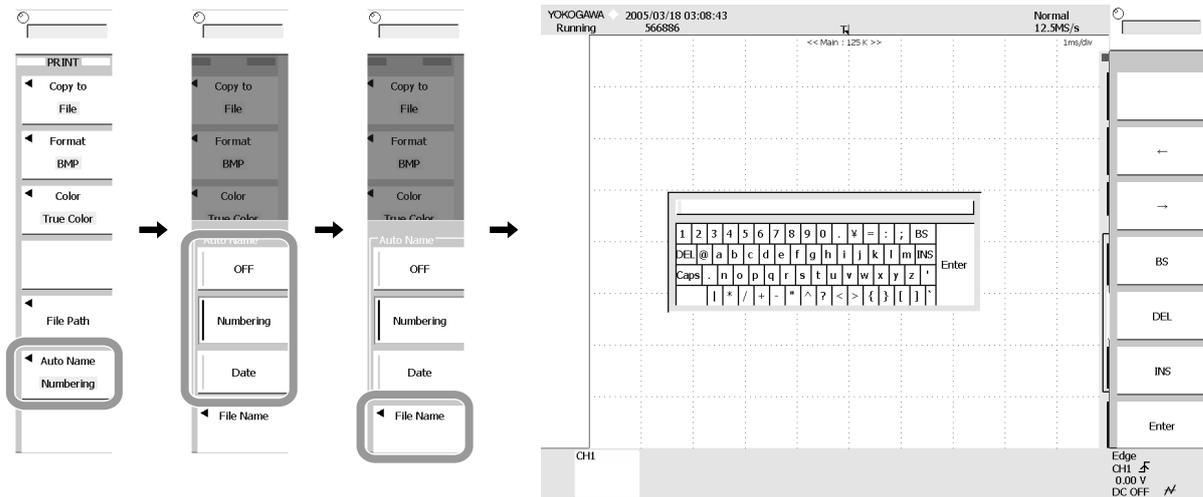
Explanation

The screen image data can be stored in a specified storage medium.

A PC card, external USB device, internal hard drive (optional), or network drive (when the optional Ethernet interface is installed) can be selected as the storage medium. For details on saving data to the network drive see section 15.3.

Data Format and Extension

Data in the following formats can be saved to a specified storage medium. The extension that is automatically attached and the data size (reference value) are indicated below.

Data Format	Extension	Data Size[1]
BMP	.BMP	Approximately 100 KB (approximately 1.6 MB)[2]
PNG	.PNG	Approximately 11 KB (approximately 52 KB)[2]
JPG	.JPG	Approximately 255 KB[3]

1 For monochrome data
2 The file size indicated in parentheses is the size for True Color data.
3 When saved in JPG format, all data are about the same size.

Color Mode

You can select the color mode.

True Color	Output using 65536 colors.
True Color(Reverse)	Do not output the background of the screen in color.
Gray Scale	Output the data using a tint of 32 gray levels.
Monochrome	Output in black and white. This mode cannot be selected with JPG format.

Save Destination

The available storage medium is displayed in the File List window.

Display Examples of Storage Media

Same as the explanation given in "Display Examples of Storage Media" of section 13.4.

Setting the File Name:File Name

Same as the explanation given in "Setting the File Name" in section 13.4.

Note

A total of 2500 directories and files can be displayed in the file list. If there are more than 2500 directories and files in a single directory, a total of 2500 files and directories will be displayed, but it is not possible to specify which directories and files are displayed.

13.9 Saving Analysis Results

1. Press **FILE**.

Selecting the Save Destination Storage Media/Directory

2. Use the **rotary knob** to select the save destination storage medium.
3. Press the **Open** soft key to confirm the storage medium.
    When saving to a directory in the storage medium, select the directory in the same manner as described above, and then press the **Open** soft key to confirm the directory.
    The selected medium/directory is displayed in "Path=......" located in the upper-left of the File List window.
    Press the Up soft key to move to the parent directory.

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Saving and Loading Data

Setting the Data Type

4. Press the **Save** soft key. The file name setup menu appears.
5. Press the **Data Type** soft key. A menu used to select the data type appears.
6. Press the **Next 1/2** soft key.
7. Press either the **Wave Parameter**, **Accum Histogram** or **FFT** soft key.
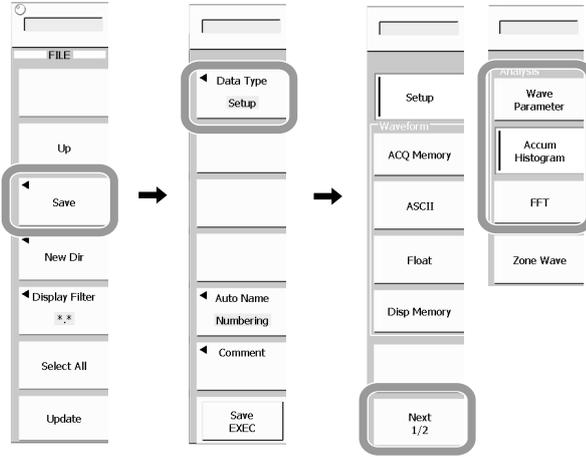
Setting the File Name

8. Press the **Auto Name** soft key. A menu used to select the file name setting method appears.
9. Select either **OFF**, **Numbering** or **Date** and then press the corresponding soft key.
   If you select Date, the date on which the file is saved becomes the file name. If you select Numbering, a sequential number is automatically added after the file name that was specified.
   If you select Date, proceed to step 13.
10. Press the **File Name** soft key.
11. Enter the file name as described in section 4.2.
12. Press **Enter**. Confirm the file name that was entered.
13. Press **ESC**.
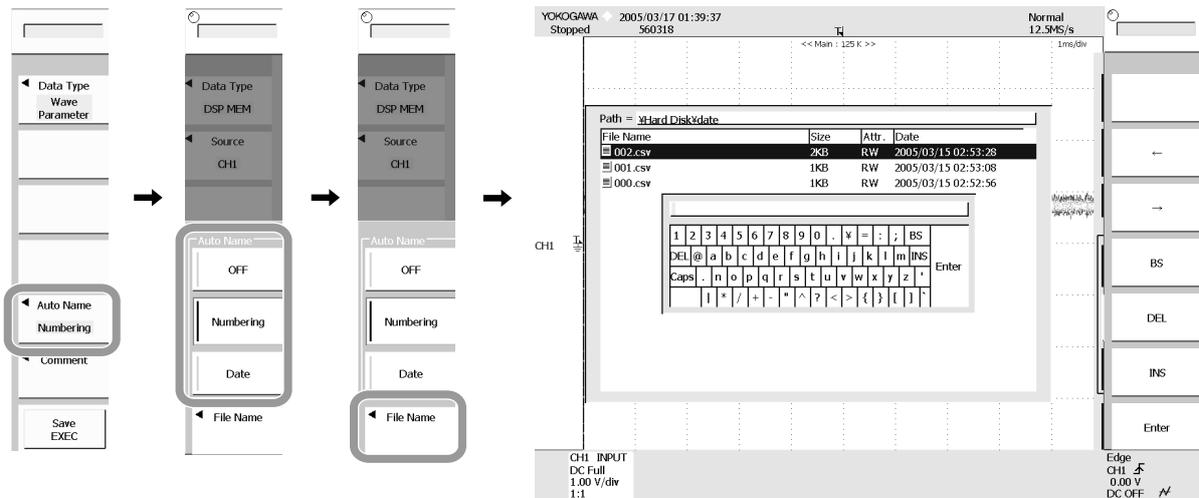
Setting a Comment

14. Press the **Comment** soft key.

15. Enter a comment up to 160 characters long as described in section 4.2, and then press Enter.

16. Press **ESC**. Doing so returns you to the previous menu.
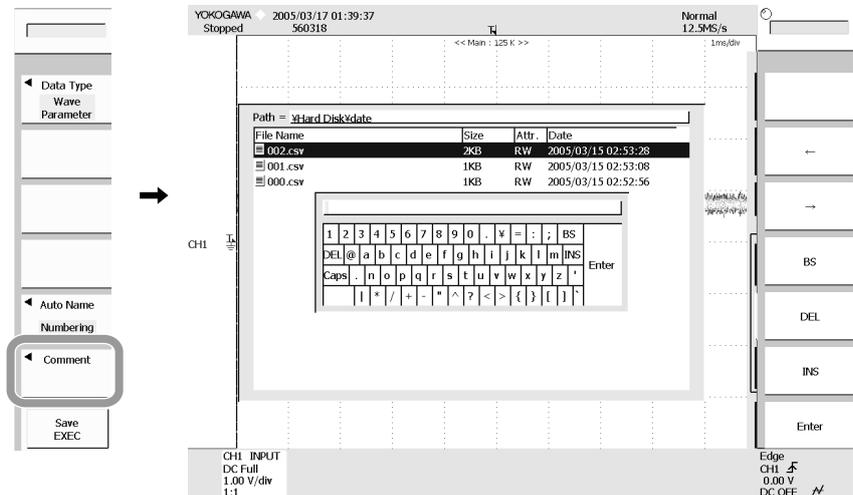
Executing the Save

17. Press the **Save Exec** soft key. The data is saved to the directory indicated by Path=...... At the same time, the Save Exec soft key changes to the Abort soft key.

    While the data is being saved, the file access icon is displayed at the upper left corner of the screen.

Aborting a Save

18. Press the **Abort** soft key. The save operation is aborted. At the same time, the Abort soft key changes to the Save EXEC soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

You can specify the format of files to be displayed in the file list. Set it as necessary.

19. Set the extension for the file displayed in the File List dialog box according to the procedure described on pages 13-6.

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Saving and Loading Data

Explanation

The analysis results are stored in CSV format in the specified storage medium. The extension is .CSV. A CSV-format data file is a comma-delimited, text-based file. It is one common data format that is used for sharing data among different spreadsheet and database applications.

A PC card, external USB device, or network drive (when the optional Ethernet interface is installed) can be selected as the storage medium.

Data Type: Data Type

Select one of the following three data types.

Wave Parameter: Saves the measured results for items specified for automatic measurement of waveform parameters. (See section 10.2 and section 10.3.)

Accum Histogram: Saves a histogram of the distribution frequency of the specified region. (See section 10.8.)

FFT: Saves the results of the FFT operation. (See section 10.6.)

Wave Parameter

Saves the maximum number of data items (either 100,000/(the number of items set to ON)) back from the point at which the save was executed.

- **Data Size**

  Data size (bytes) = the number of measurement parameters × 15 × the number of history waveforms

- **Output example**

Analysis Type	WaveParameter							
Model Name	DL9000							
Model Version	*.**							
	Rms(C1)	Mean(C1)	Sdev(C1)	ITY(C1)	CRms(C1)	CMean(C1)	CSdev(C1)	Dly(C1)	Calc1(A2)
	V	V	V	Vs	V	V	V	s	
:Max	7.12E-01	5.05E-03	7.12E-01	5.05E-05	7.12E-01	5.33E-03	7.12E-01	1.13E-03	1.13E+00
:Min	7.10E-01	-4.44E-03	7.10E-01	-4.44E-05	7.10E-01	-4.46E-03	7.10E-01	-8.99E-04	1.08E+00
:Mean	7.11E-01	1.07E-03	7.11E-01	1.07E-05	7.11E-01	1.05E-03	7.11E-01	3.44E-04	1.10E+00
:Sigma	2.47E-04	2.04E-03	2.48E-04	2.04E-05	3.42E-04	2.11E-03	3.42E-04	9.68E-04	8.23E-03
:Cnt	134	134	134	134	134	134	134	134	134
7021	7.11E-01	2.29E-03	7.11E-01	2.29E-05	7.12E-01	2.33E-03	7.12E-01	1.11E-03	1.10E+00
7031	7.11E-01	1.43E-03	7.11E-01	1.43E-05	7.11E-01	1.41E-03	7.11E-01	1.11E-03	1.11E+00
7040	7.11E-01	3.51E-03	7.11E-01	3.51E-05	7.11E-01	3.01E-03	7.11E-01	1.11E-03	1.10E+00
7050	7.11E-01	1.73E-03	7.11E-01	1.73E-05	7.12E-01	1.86E-03	7.12E-01	1.11E-03	1.11E+00
7059	7.11E-01	1.80E-03	7.11E-01	1.80E-05	7.11E-01	1.99E-03	7.11E-01	-8.86E-04	1.11E+00
7069	7.11E-01	1.15E-03	7.11E-01	1.15E-05	7.11E-01	1.13E-03	7.11E-01	1.11E-03	1.10E+00
7078	7.11E-01	1.45E-04	7.11E-01	1.45E-06	7.11E-01	-1.77E-04	7.11E-01	-8.82E-04	1.12E+00
7088	7.11E-01	2.98E-03	7.11E-01	2.98E-05	7.11E-01	3.18E-03	7.11E-01	1.11E-03	1.10E+00
7098	7.11E-01	3.27E-03	7.11E-01	3.27E-05	7.10E-01	3.69E-03	7.10E-01	-8.92E-04	1.09E+00
7107	7.11E-01	3.12E-03	7.11E-01	3.12E-05	7.11E-01	2.92E-03	7.11E-01	-8.83E-04	1.12E+00

Accum Histogram

A maximum of 640 data items are saved in Horizontal mode, and a maximum of 800 data items are saved in Vertical mode.

- **Data Size**

  Data size (bytes) = Number of analyses × 15

- **Output example**

Analysis Type	AccumHistogram
Model Name	DL9000
Model Version	9.99
8	
150	
9	
154	
6	
154	
8	
156	
9	
153	

FFT

Saves data for a maximum of 250 K points.

- **Data Size**

  Data size (bytes) = Number of data points × 15

- **Output exampl**

Analysis Type	FFT
Model Name	DL9000
Model Version	*.**
-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	

Target of Save: Source

Select either Ana1 or Ana2.

Setting the File Name:File Name

Same as the explanation given in "Setting the File Name" in section 13.4.

Setting a Comment:Comment

Same as the explanation given in "Setting a Comment" in section 13.4.

13

Saving and Loading Data

13.10 Changing the File Attributes and Deleting Files

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure
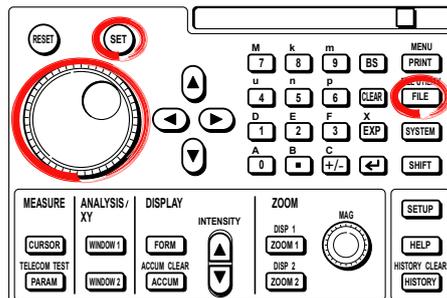
1. Press **FILE**. The File List window appears.

Selecting the File

2. Select the storage medium or directory as described in steps 2 and 3 of section 13.5, "Saving/Loading the Measurement Data."

3. Using the **rotary knob**, select the file. To select all files, press the Select All soft key. To remove the selection, press **RESET**.
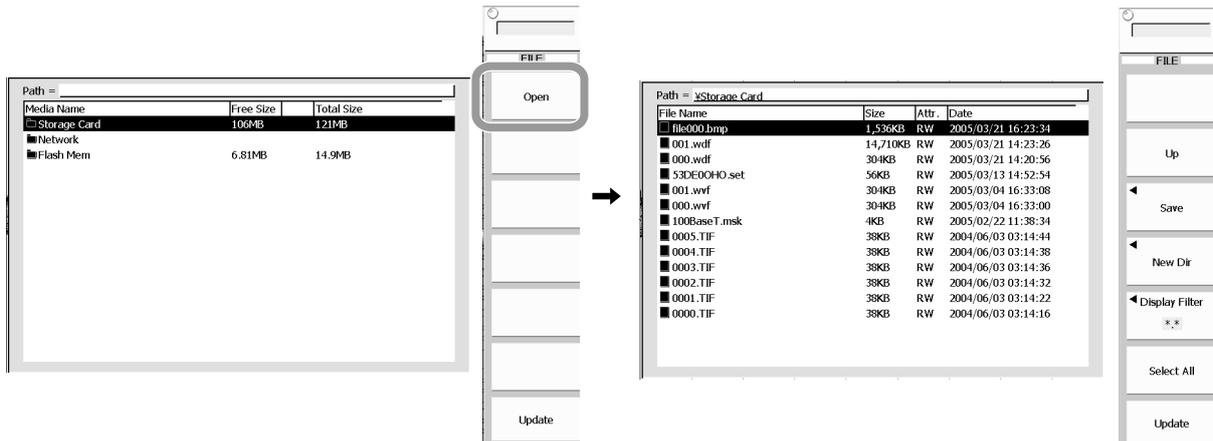
4. Press **SET**. A menu of file operations appears.

Changing the File Attributes

5.   Press the **Protect** soft key.
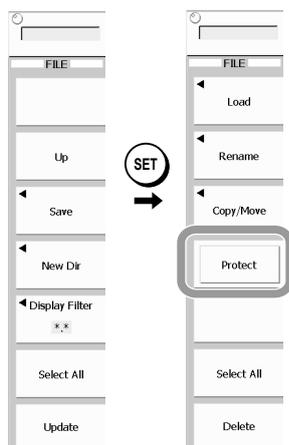
Changes the Attr parameter of the list to RW (readable/writeable) or RA (not writeable).
The Protect soft key changes to the Abort soft key.

Aborting Attribute Changes

6.   Press the **Abort** soft key. The attribute changes are aborted. At the same time, the Abort soft key changes to the Protect soft key.

Deleting Files

7.   Press the **Delete** soft key. A confirmation message appears.
8.   Use the **rotary knob** to select either OK or Cancel and then press SET. If OK was selected, the file is deleted.
The Delete soft key changes to the Abort soft key.
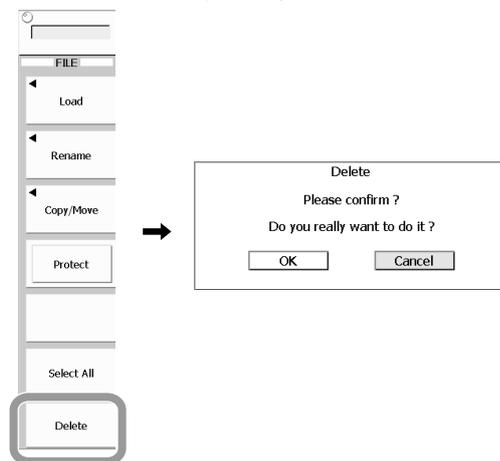
Aborting File Deletion

9.   Press the **Abort** soft key. File deletion is aborted. At the same time, the Abort soft key changes to the Delete soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

You can specify the format of files to be displayed in the file list. Set it as necessary.

10.   Set the extension for the file displayed in the File List dialog box according to the procedure described on pages 13-6.

13

Saving and Loading Data

Explanation

Selecting the Storage Medium and Directory: File
Storage media in which saving and loading are possible are displayed in the File List dialog box.

Display Examples of Storage Media
Same as the explanation given in "Display Examples of Storage Media" of section 13.4.

Changing the File Attribute: Attr (Except for Net Drive)
Select the file attribute of each file from the following.
- **RW**
  Read and write possible.
- **RA**
  Read only. Cannot be written. Cannot be erased.

Selecting the Files to Be Deleted
All highlighted files can be deleted. There are two methods in selecting the files to be deleted.
- **Selecting the files one at a time: Set**
  Press the Set soft key to select files one at a time.
- **Selecting all files at once: Select All**
  Press the Select All soft key to select all files.
  Selecting a file or directory and pressing the Select All soft key selects every file and directory in the directory containing the selected file or directory.

Specifying the Files to Be Displayed in the File List Dialog Box: Display Filter
Specify the type of files to be displayed.
Same as the explanation given in "Specifying the Files to Be Displayed in the File List Dialog Box" in section 13.4.

Note
- Data that is deleted cannot be recovered. Be sure you erase the correct files.
- If an error occurs while deleting multiple files, the files after the error occurrence are not deleted.
- You cannot change a directory attribute.

13.11 Copying/Moving Files

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure
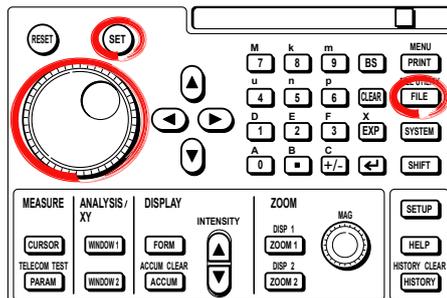
1.   Press **FILE**. The File List window appears.

Selecting the File

2.   Select the storage medium or directory as described in steps 2 and 3 of section 13.5, "Saving/Loading the Measurement Data."

3.   Using the **rotary knob**, select the file. To select all files, press the Select All soft key.
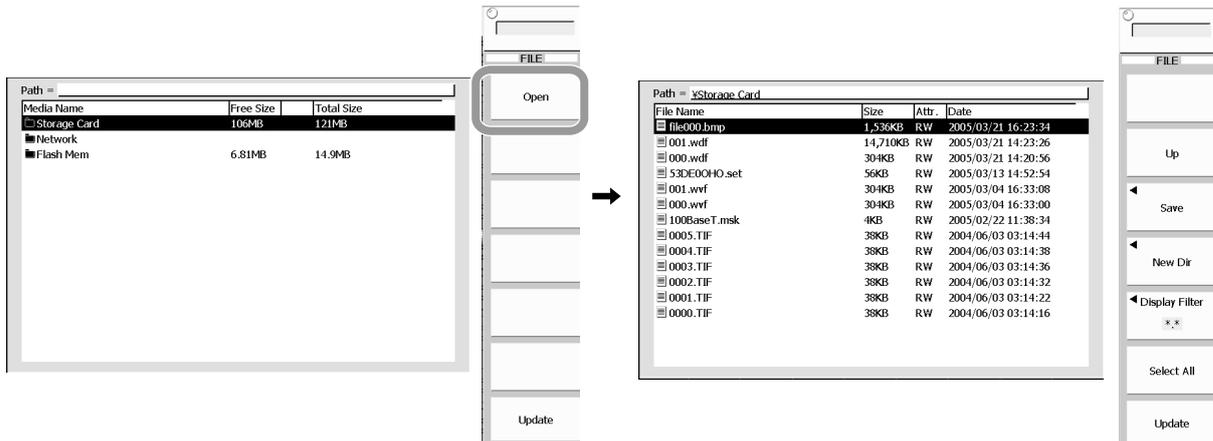
4. Press **SET**. A menu of file operations appears.
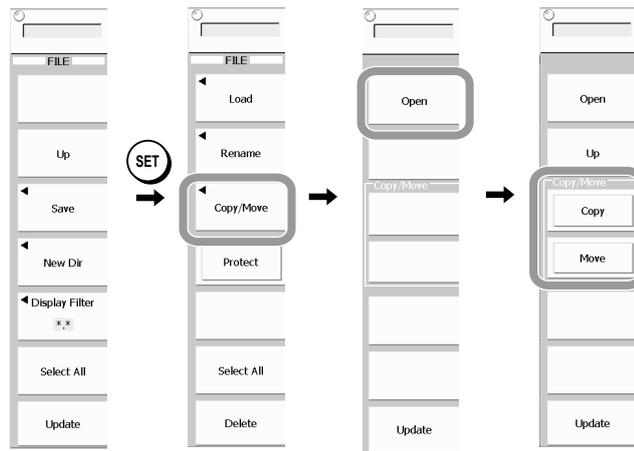
Setting the File Copy/Move Destination

5. Press the **Copy/Move** soft key.
6. Select the storage medium/directory in the same manner as described in step 2.
    To update the file list with the most recent data, press the **Update** soft key.

Copying/Moving Files

7. Press the **Copy** or **Move** soft key. The file that was selected in step 3 is moved or copied.
    The Copy or Move soft key changes to the Abort soft key.

Aborting File Copying/Moving

8. Press the **Abort** soft key. File copying or moving is aborted. At the same time, the Abort soft key changes to the Copy or Move soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

You can specify the format of files to be displayed in the file list. Set it as necessary.

9. Set the extension for the file displayed in the File List dialog box according to the procedure described on pages 13-6.

Explanation

Selecting the Files To Be Moved/Copied

Highlighted files can be copied or moved. There are two ways to select the files to be copied or moved.

- **Selecting the files one at a time: Set**
  Press the Set soft key to select files one at a time.
- **Selecting all files at once: Select All**
  Press the Select All soft key to select all files.
  Selecting a file or directory and pressing the Select All soft key selects every file and directory in the directory containing the selected file or directory.

Specifying the Files to Be Displayed in the File List Dialog Box: Display Filter

Specify the type of files to be displayed.

Same as the explanation given in "Specifying the Files to Be Displayed in the File List Dialog Box" in section 13.4.

Note

- If an error occurs while copying/moving multiple files, the files after the error occurrence are not copied/moved.
- You cannot copy/move files if files with the same file name exist at the copy/move destination.
- You cannot copy/move the same files to another directory after copying/moving the files. Select the files to be copied again and then copy them.
- A total of 2500 directories and files can be displayed in the file list. If there are more than 2500 directories and files in a single directory, a total of 2500 files and directories will be displayed, but it is not possible to specify which directories and files are displayed.

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Saving and Loading Data

13.12 Changing the Directory Name or File Name of the Storage Medium/Creating Directories

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CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure
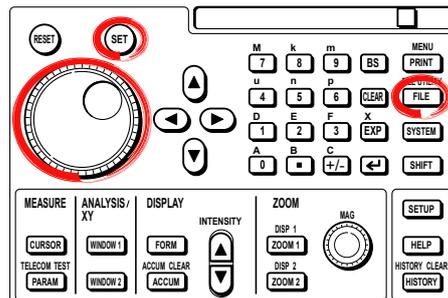
Renaming a Storage Medium Directory or File

1. Press **FILE**. The File List window appears.

Selecting the Storage Medium/Directory

2. Select the storage medium, directory, or target file as described in steps 2 and 3 of section 13.5, "Saving/Loading the Measurement Data."

Renaming the Storage Medium Directory/File (Except Net Drive)

3. Using the **rotary knob**, select the directory name/file name.
4. Press **SET**. A menu of file operations appears.
5. Press the **Rename** soft key. The keyboard is displayed, and the name of the selected directory or file is displayed in the entry box of the keyboard.
6. Enter the directory name/file name as described in section 4.2.
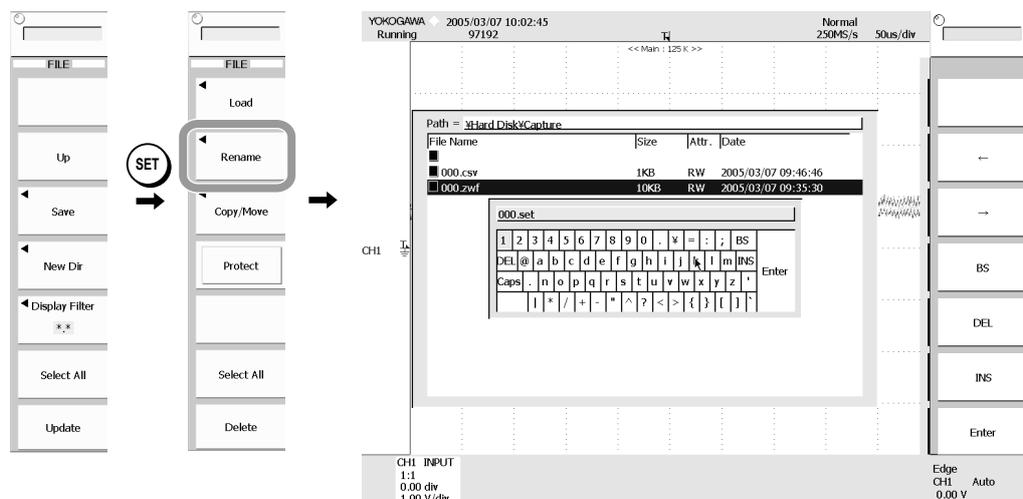
Specifying the Files to Be Displayed in the File List Dialog Box
You can specify the format of files to be displayed in the file list. Set it as necessary.
7. Set the extension for the file displayed in the File List dialog box according to the procedure described on pages 13-6.

Creating a Directory

1. Press **FILE**. The File List window appears.

Selecting the Storage Medium/Directory
2. Select the storage medium or directory as described in steps 2 and 3 of section 13.5, "Saving/Loading the Measurement Data."

Creating a Directory
3. Press the **Open** soft key. A directory is created in the storage medium/directory that is currently open.
4. Press the **New Dir** soft key. A keyboard appears.
5. Enter the directory name/file name as described in section 4.2.
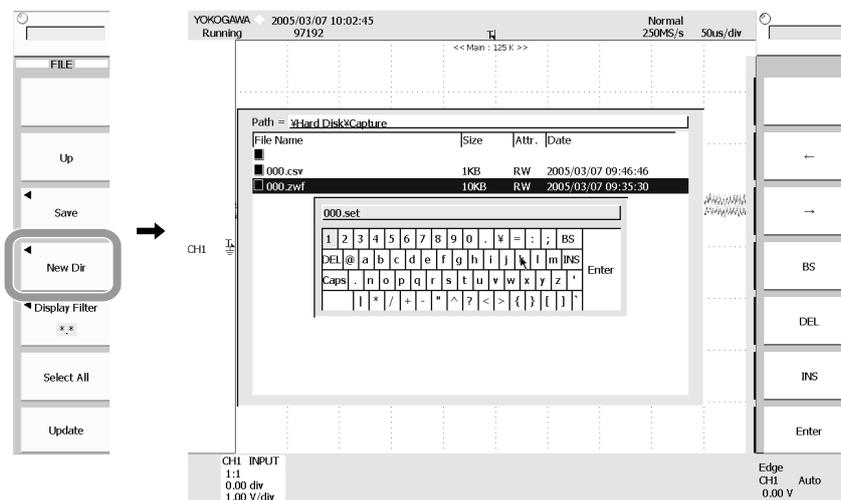
Specifying the Files to Be Displayed in the File List Dialog Box
You can specify the format of files to be displayed in the file list. Set it as necessary.
6. Set the extension for the file displayed in the File List dialog box according to the procedure described on pages 13-6.

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Saving and Loading Data

Explanation

Selecting the Storage Medium and Directory: File
Storage media in which saving and loading are possible are displayed in the File List dialog box.

Display Examples of Storage Media
Same as the explanation given in "Display Examples of Storage Media" of section 13.4.

Renaming a Storage Medium Directory or File: RENAME
The number of characters that can be used for a file or directory name is up to 64 characters from the beginning of the entered characters. However, the following conditions apply.
- The types of characters that can be used are 0 to 9, A to Z (uppercase even if you enter lowercase), _, -, =, (,), {, }, [,], #, $, %, &, ~, !, ', and @ on the keyboard that appears on screen.
- The following character strings cannot be used due to the limitation of MS-DOS. AUX, CON, PRN, NUL, CLOCK, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, and COM9
- Make sure that the full path name (absolute path name from the root directory) is within 260 characters. If 260 characters is exceeded, an error occurs when you execute a file operation (save, copy, rename, create directory, etc.).
  Full path name: If you are operating a directory, specify up to the directory name.
                        If you are operating a file, specify up to the file name.
- The length of the character string displayed in the entry box of the keyboard that is shown on the screen is 36.

Creating a Directory: New Dir
You can create a new directory on the storage medium. See above for the assignment of the directory name when creating a new directory.

Specifying the Files to Be Displayed in the File List Dialog Box: Display Filter
Specify the type of files to be displayed.
Same as the explanation given in "Specifying the Files to Be Displayed in the File List Dialog Box" in section 13.4.

Note
- You cannot change a directory attribute.
- If a file with the same name already exists in the same directory, the file cannot be renamed.
- If a directory with the same name already exists in the same directory, the directory cannot be created.
- This unit can recognize a maximum of 26 media.

13.13 Connecting to a PC Using the USB Port
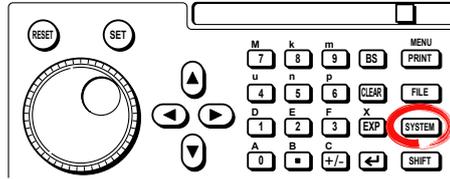
1. Press the **SYSTEM** soft key to display the SYSTEM menu.
2. Press the **Next 1/2** soft key to display the Back 2/2 menu.
3. Press the **USB Function** soft key to display the USB Function menu.
4. Press the **TMC & Mass Storage**, **TMC**, or **Mass Storage** soft key to select the communication function.
5. Restart the DL9000 to activate the settings.
    Wait at least 10 seconds after you turn the power switch OFF, and then turn the switch back ON.
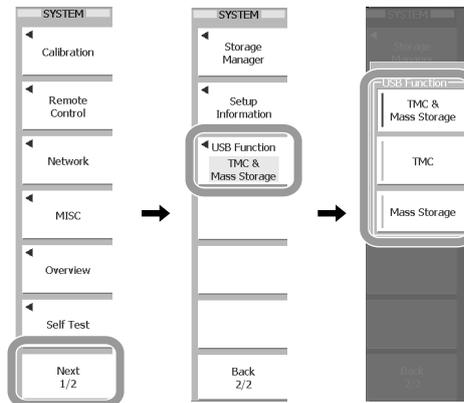
Explanation

You can connect the DL9000 to a PC through the USB port, and control the DL9000 from the PC.

Selecting the USB Communication Function
*   TMC
    *   Allows communication with the PC using the USB TMC (Test and Measurement Class).
    *   You must install YOKOGAWA's USB TMC driver in the PC to use the USB TMC function.
    *   Only use the USB TMC driver (or software) provided by YOKOGAWA.
*   Mass Storage
    *   The DL9000 functions as a USB mass storage device as viewed from the PC.
    *   There is no need to install the USB TMC driver into your PC.
*   TMC & Mass Storage
    *   Allows communication with the PC using both USB TMC and USB Mass Storage.
    *   You must install Yokogawa's USB TMC driver into your PC to use the USB TMC function in the same manner as when TMC is selected above.
    *   Only use the USB TMC driver (or software) provided by YOKOGAWA.

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Saving and Loading Data

Note

- To obtain YOKOGAWA's USB TMC driver, contact your nearest YOKOGAWA dealer or access the following USB driver page at our Web site and download it.
  http://www.yokogawa.com/tm/tm-softdownload.htm
- You must restart the DL9000 to activate the TMC, Mass Storage, or TMC & Mass Storage setting. Wait at least 10 seconds after you turn the power switch OFF, and then turn the switch back ON.
- To use the USB port as a remote control port (control using communication commands), activate the TMC or TMC & Mass Storage setting. For the procedure to select the remote control port, see the *Communication Interface User's Manual IM701310-17E*.
- File operation using the DL9000 keys is not possible, if the Mass Storage or TMC & Mass Storage is activated and the DL9000 is connected to a PC. File operation is also not possible using communication commands. Disconnect the PC or activate the TMC setting and connect the DL9000 to the PC.

14.1   Turning ON/OFF the Reference Waveform Display

Procedure
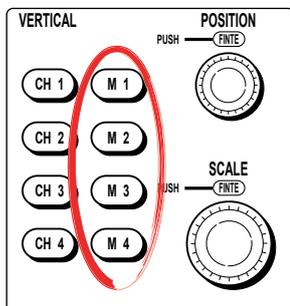
1.   Press the key from **M1** to **M4** to select the waveform to be set.
      The key lights, and the waveform appears.
2.   Press the **Select** soft key to set to REF.
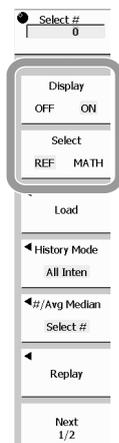
Switching the Display OFF
1.   Press the key to be turned off, from **M1** to **M4**.
2.   Press the **Display** soft key, and select OFF.

Explanation

A history waveform of input channels, a computed waveform and a waveform saved in the internal memory can be displayed as reference waveforms of 1 to 4.
The DL9000 also allows you to perform computation with data of displayed reference waveform.
When the reference waveform is set to ON, a computed waveform corresponding to the reference number cannot be displayed.

14.2 Displaying Stored Data as Reference Waveform
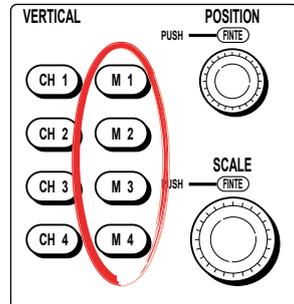
1. Press the key from **M1** to **M4** to select the waveform to be set.
2. Press the **Load** soft key. The menu appears, allowing you to select a waveform to be loaded.
3. Press the soft key corresponding to the waveform to be loaded.
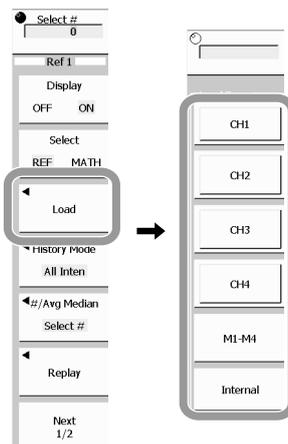
4. Press **ESC**.

Selecting History Mode

5. Press the **History Mode** soft key. A menu appears, allowing you to select the history mode.
6. Press one of the following soft keys.
   ONE: Displays only highlight waveforms selected in the following procedure
   All Halftone: Displays waveforms other than highlight waveforms in neutral color
   All Intensity: Displays the frequency of data appearance at intensity
   All Color: Displays the frequency of data appearance in color
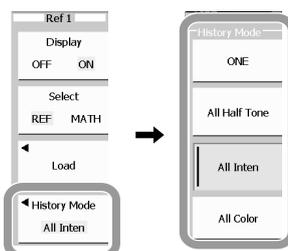
Selecting Highlight Waveform

7. When you select ONE or All Halftone in Step 6, select highlight waveforms. Select the #/Average soft key to select either the history number (#) or the average value (Avg).

8. When you select a highlight waveform with history numbers (#), select the number with the rotary knob.
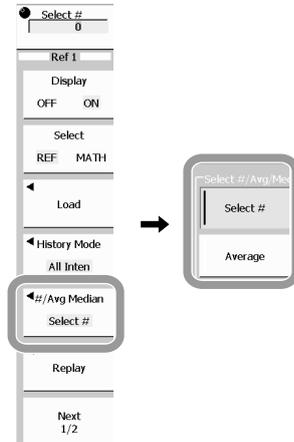
14.3 Displaying Waveforms Inverted
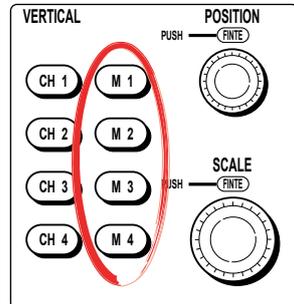
1. Press the key from **M1** to **M4** to display reference waveforms.
2. Press the **Next 1/2** soft key.
3. Press the **Invert** soft key.

14.4 Saving Data
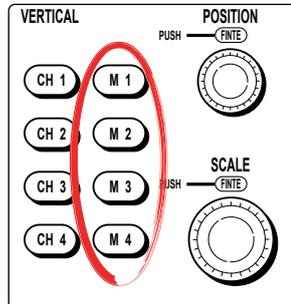
1. Press the key from **M1** to **M4** to display reference waveforms.
2. Press the **Next 1/2** soft key.
3. Press the **Save** soft key. A menu appears, allowing you to select the save destination.
4. Press one of the soft keys of the internal memory 1 - 4.
   The reference waveform is stored in the selected internal memory.
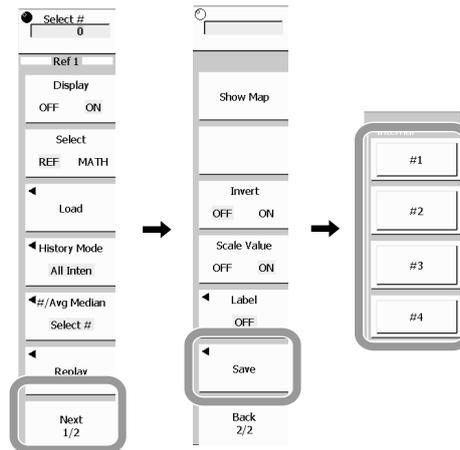
Note

A waveform exceeding 1.25 MW is saved with P-P compression to 1.25 MW.

14.5 Displaying Scale Values and Labels
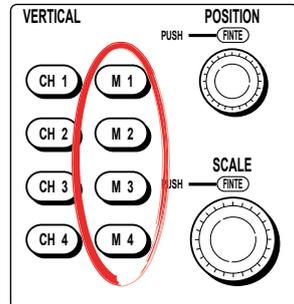
1. Press the key from **M1** to **M4** to display reference waveforms.
2. Press the **Next 1/2** soft key.

Displaying the Scale Value

3. Press the **Scale Value** soft key to select ON or OFF.
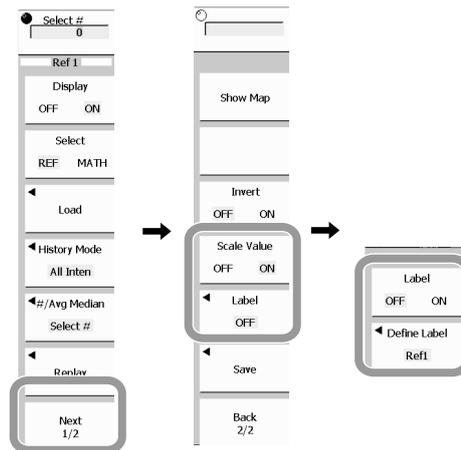
Displaying the Label

4. Press the **Label** soft key. The label setup menu appears.
5. Press the **Label** soft key to select ON or OFF.
6. Press the **Define Label** soft key. A keyboard appears.
7. Enter the contents of label as described in section 4.2.

14.6 Displaying History Waveforms Automatically
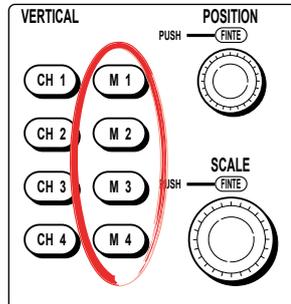
1. Press the key from **M1** to **M4** to select the waveform to be set.
2. Press the **Replay** soft key. A menu appears, allowing you to display history waveforms automatically.
3. Press the **<Play** or **Play>** soft key to display history waveforms automatically.

Menu on products with firmware version 1.80 or higher

- Down — **Slow down switching of waveforms**
- Up — **Speed up switching of waveforms**
- < — **Go to oldest waveform**
- < Play — **Play in the direction of older waveforms**
- Play > — **Play in the direction of newer waveforms**
- > — **Go to newest waveform**
- Stop — **Stop playback**
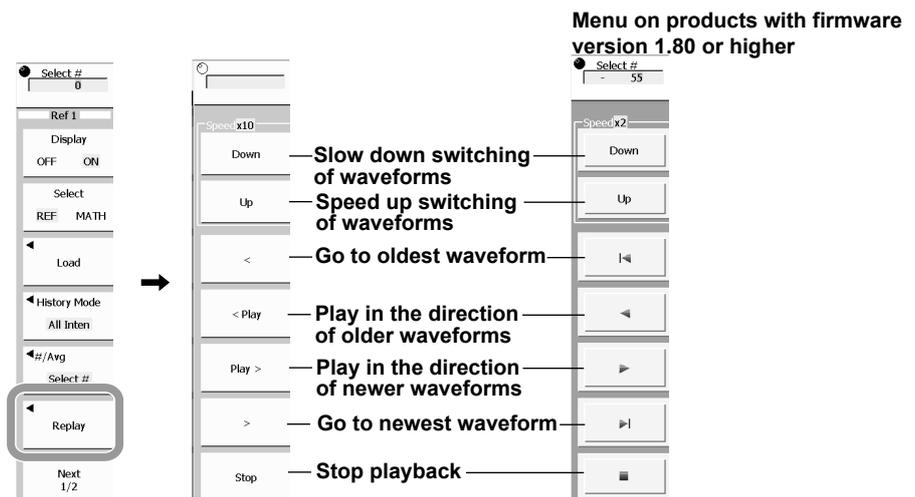
Explanation

History waveforms are displayed individually in sequence.

14.7 Displaying the Acquisition Time of a Loaded Waveform
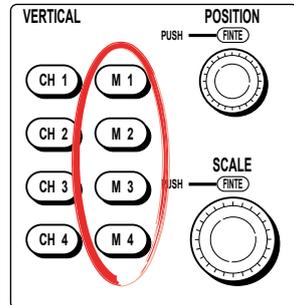
1. Press one of **M1** to **M4** to display the reference waveform.
2. Press the **Next 1/2** soft key.
3. Press the **Show Map** soft key.

Record No. Time (hour : minute : second)
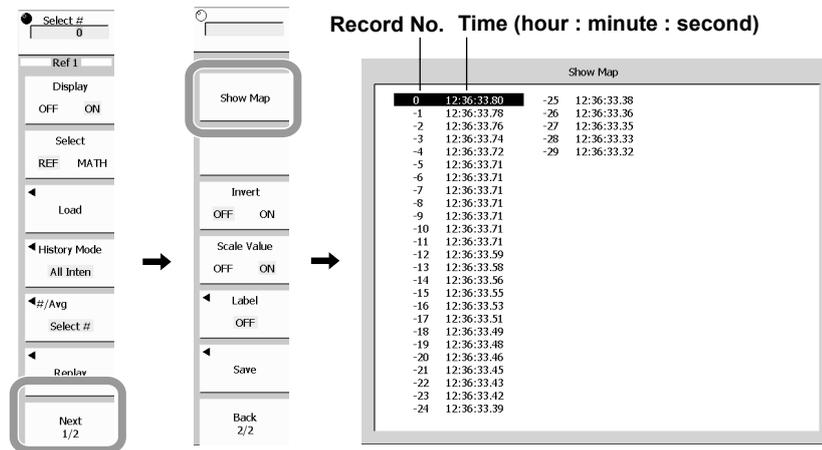
15.1   Connecting the DL9000 to the Network

Ethernet Interface Specifications

A 100BASE-TX port is provided on the rear panel of the DL9000.

Item	Specifications
Number of communication ports	1
Electrical and mechanical specifications	Conforms to IEEE802.3
Transmission system	Ethernet (100BASE-TX/10BASE-T)
Transmission rate	100 Mbps max.
Communication protocol	TCP/IP
Supported service	DHCP, DNS, MicroSoft network file shared client/server
Connector type	RJ-45 connector
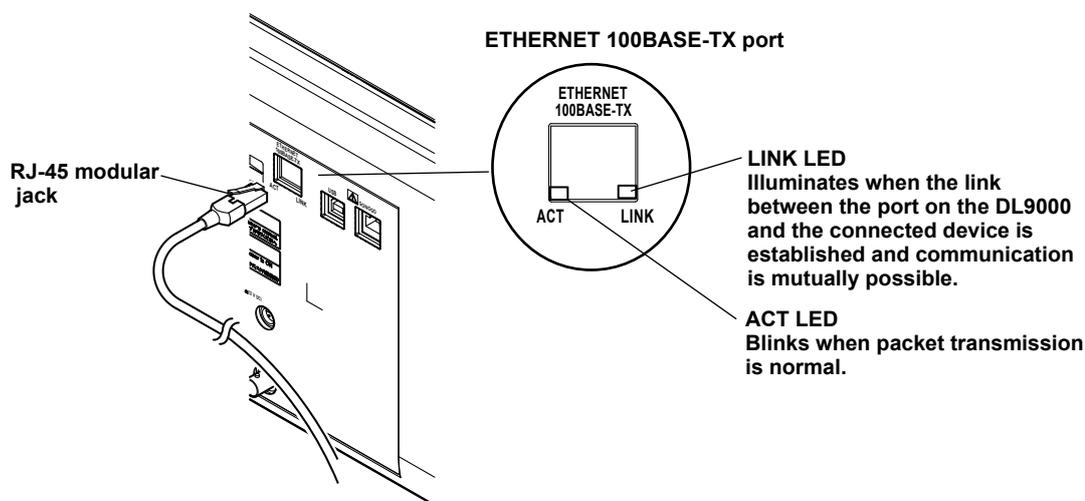
Items Necessary for Connection

Cable

Be sure to use one of the following cables for connection.
- UTP (Unshielded Twisted-Pair) cable (category 5 or better)
- STP (Shielded Twisted-Pair) cable (category 5 or better)

15

Ethernet Communications (Optional)

Connection Procedure

When Connecting to a PC on the Network

1. Turn OFF the DL9000.
2. Connect one end of the UTP (or STP) cable to the ETHERNET 100BASE-TX terminal on the rear panel.
3. Connect the other end of the UTP (or STP) cable to a hub or router.
4. Turn ON the DL9000.

Hub or router that supports 100BASE-TX

PC

DL9000

UTP cable or STP cable
(Straight cable)
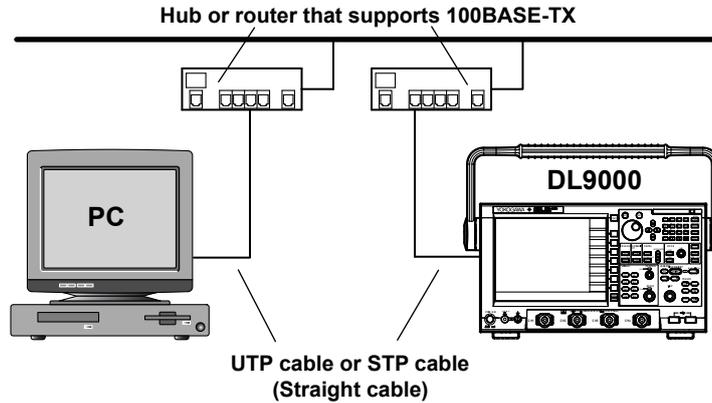
When Establishing a One-to-One Connection to a PC

1. Turn OFF the DL9000 and the PC.
2. Connect one end of the UTP (or STP) cable to the ETHERNET 100BASE-TX terminal on the rear panel.
3. Connect the other end of the UTP (or STP) cable to a hub or router.
4. Likewise, connect the PC to a hub or router.
5. Turn ON the DL9000.

Hub or router that supports 100BASE-TX

PC

DL9000

UTP cable or STP cable
(Straight cable)
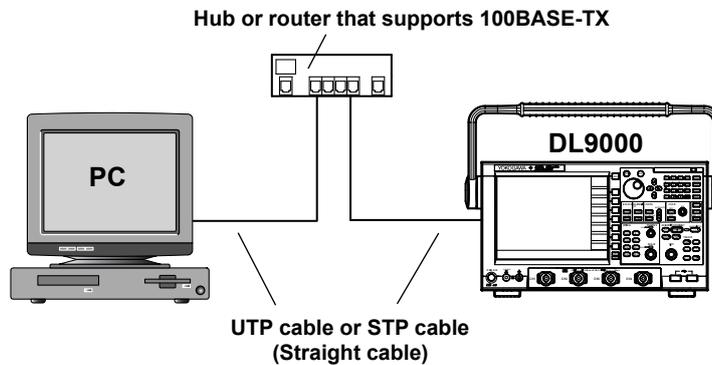
Note

• When connecting the PC one-to-one, a NIC (a 10BASE-T/100BASE-TX autoswitching card) is required for the PC.
• When using a UTP cable or STP cable (both are straight cables), be sure to use a category 5 or better cable.
• Avoid connecting the PC directly to the DL9000 without going through the hub or router. Operations are not guaranteed for communications using direct connection.

15.2 Setting Up the TCP/IP
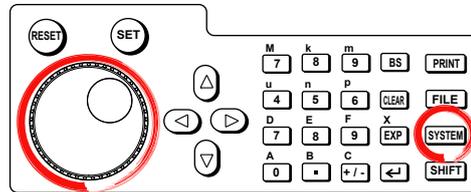
1. Press **SYSTEM**.
2. Press the **Network** soft key.
3. Press the **TCP/IP Setup** soft key. The TCP/IP setup menu appears.
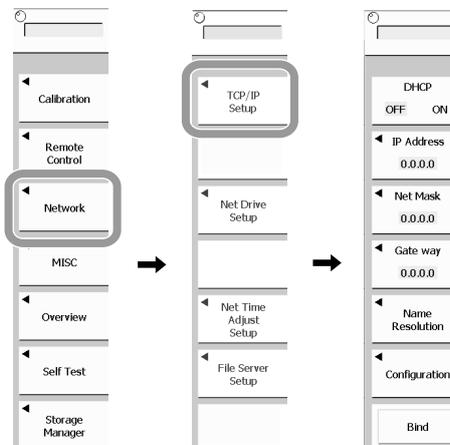
DHCP ON/OFF

4. Press the **DHCP** soft key to select either ON or OFF.
   If you set the DHCP to OFF, proceed to step 5.
   If you set the DHCP to ON, you do not have to set the IP address, subnet mask and default gateway.
   • To set the DNS, proceed to step 11.
   • If you do not wish to set up the DNS, check the network cable connection and restart the DL9000. The IP address, subnet mask, and default gateway are automatically configured.

Setting up IP Address

If DHCP was set to OFF, set the IP address.

5.	Press the **IP Address** soft key. A screen appears, allowing you to set up the IP address.

6.	Enter a value in the range of 0 to 255 as described in section 4.2.

Setting up Subnet Mask

If DHCP was set to OFF, set the subnet mask.

7.	Press the **Net Mask** soft key. A screen appears, allowing you to set up the subnet mask.

8.	Enter a value in the range of 0 to 255 as described in section 4.2.

Setting up Default Gateway

If DHCP was set to OFF, set the default gateway.

9.	Press the **Gate way** soft key. A screen appears, allowing you to set up the default gateway.

10.	Enter a value in the range of 0 to 255 as described in section 4.2.
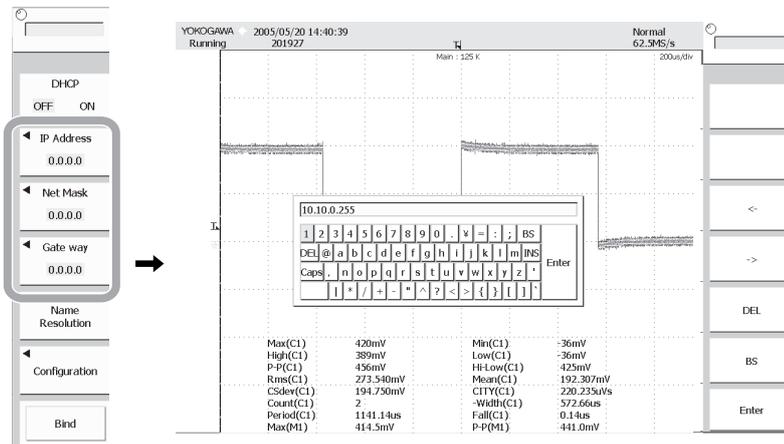
Setting up DNS and WINS

11.	Press the **Name Resolution** soft key. The DNS/WINS setup menu appears.

12.	Press the **Host Name** soft key. A screen appears, allowing you to set up the host name of the DL 9000.

13.	Set up the host name of the instrument as described in section 4.2.
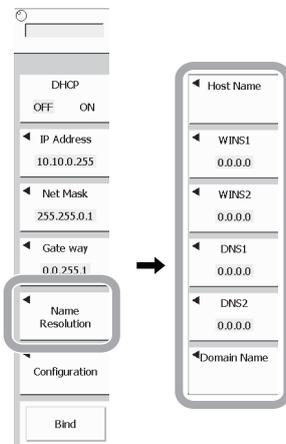
- **When Using WINS**
  14. Press the **WINS1** soft key. A screen appears, allowing you to set up the WINS address.
  15. Set up the primary address of WINS as described in section 4.2.
  16. Likewise, set up the secondary address of WINS.

- **When Using DNS**
  17. Press the **DNS1** soft key. A screen appears, allowing you to set up the DNS address.
  18. Set up the primary address of DNS as described in section 4.2.
  19. Likewise, set up the secondary address of DNS.
  20. Press the **Domain Name** soft key. A screen appears, allowing you to set up the domain name.
  21. Set up the domain name as described in section 4.2.

Note

For the operating procedure of keyboard (soft keyboard), see section 4.2, "Entering Values and Strings."

Checking Setup Items
  22. Press the **Configuration** soft key. Setup data appears.
  To clear the setup data, press **ESC**.
  MAC address is a value that appears on the right side of Physical Address.

```
--- Network Information ---
- DHCP              : OFF
- Host Name         : DL9000
- IP Address        : 192.168.0.10
- Net Mask          : 255.255.255.0
- Gateway           : 192.168.0.1
- WINS1             : 192.168.0.2
- WINS2             : 192.168.0.3
- DNS1              : 192.168.0.4
- DNS2              : 192.168.0.5
- Domain            : yokogawa.co.jp
- Physical Address  :
```

Excuting the Bind
  23. Press the **Bind** soft key to enable setup data.

Explanation

The following TCP/IP settings must be entered to use the Ethernet communications functions on the DL9000.
*   IP address
*   Subnet mask
*   Default gateway

IP Address (Internet Protocol Address)
You can assign an IP address to the DL9000. The default setting is 0.0.0.0.
The IP address is an ID that is assigned to each device on an IP network such as the internet or an intranet. The address is a 32-bit value expressed using four octets (each 0 to 255), each separated by a period as in 192.168.111.24.
Obtain an IP address from your network administrator.   The setting is automatically configured in environments using DHCP.

Subnet mask: Net Mask
You can set the mask value used when determining the subnet network address from the IP address.   The default setting is 0.0.0.0.
Huge TCP/IP networks such as the Internet are often divided up into smaller networks called sub networks.   The subnet mask is a 32 bit value that specifies the number of bits of the IP address used to identify the network address. The portion other than the network address is the host address that identifies individual computers on the network.
Consult your network administrator for the subnet mask value. The setting is automatically configured in environments using DHCP.

Default gateway: Gate Way
You can set the IP address of the gateway (default gateway) used to communicate with other networks. The default setting is 0.0.0.0.
The default gateway has a function to enable the smooth transfer of data when communicating with multiple networks.
Consult your network administrator for the default gateway value. The setting is automatically configured in environments using DHCP.

DHCP (Dynamic Host Configuration Protocol): DHCP
DCHP is a protocol that allocates setup information that is needed temporarily to PCs connecting to the network. When DHCP is turned ON, the following settings are automatically assigned.
*   IP address
*   Subnet mask
*   Default gateway
*   DNS
*   WINS
*   Domain name

To use DHCP, the network must have a DHCP server. Consult your network administrator to see if DHCP can be used.
If DHCP is set to ON, when the power is turned on for example, each time a Bind operation is executed different values may be assigned. To connect a PC to the DL9000, you need to check the configuration such as the IP address of the instrument on the PC every time the device is turned on or every time a Bind operation.

DNS (Domain Name System)

DNS is a system used to associate names used on the Internet called host names and domain names with IP addresses. Given AAA.BBBBB.com, AAA is the host name and BBBBB.com is the domain name.

Instead of using the IP address, which is a sequence of numbers, the host name and domain name can be used to access the network.

The DL9000 allows you to specify the host by name, instead of by IP address.

You set the domain name, and the DNS server address (0.0.0.0 by default). For details, consult your network administrator.

·   **DNS Server: DNS1/DNS2**

Up to two DNS server addresses can be specified (primary and secondary). If query processing fails with the primary DNS server, the secondary DNS server is automatically looked up for the mapping of the host name/domain name and IP address.

·   **Domain name: DomainName**

Domain name is a piece of information to be added to a host name on query to the DNS server.

WINS(Windows Internet Name Service)

WINS is a service that associates a NetBIOS name with an IP address of computer on the Windows network. WINS allows you to connect the DL9000 to the network in the various segments.

Note

· Execute the Bind operation when you change the configuration on Ethernet.

· **Configuring the TCP/IP Settings of the PC**

Communication parameters such as the IP address must be specified also on the PC side. Communication parameters are specified for each Ethernet NIC that is installed in the PC. Here, the settings of the NIC for connecting your PC and the DL9000 are explained. When using the DHCP server, and automatically allocating an IP address, in [TCP/IP Properties]-[IP Address Setting], select [Automatically Assign IP Address]. For example, if you are connecting a PC and the DL9000 to an Ethernet network on a one-to-one basis, you can specify parameters as indicated in the next table. For details on the parameters, consult your system or network administrator.

Parameter	Value	Remarks
IP address	(Ex) 192.168.0.128	IP address for the PC
Subnet mask	(Ex) 255.255.255.0	Set the same value as the subnet mask that was specified for the DL9000.
Gateway	0.0.0.0 (Default)	
DNS	Disable	
WINS	Disable	

The following procedure describes the steps for Windows 2000. For other OS including Windows XP, carry out equivalent steps accordingly.

1. Choose Settings > Control Panel from the Start menu to open the Control Panel folder.
2. Double-click the Network and Dial-up icon.
3. Right-click the Local Area Connection to select the Properties.
4. After selecting Internet Protocol (TCP/IP), click the Properties button to display the TCP/IP Properties dialog box.

15

Ethernet Communications (Optional)
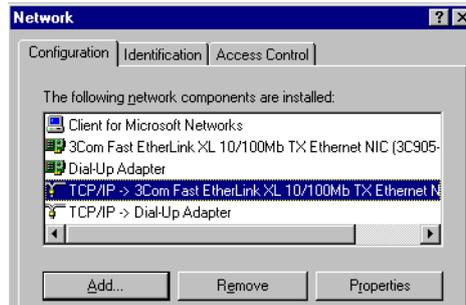
5. Set the parameters such as the IP address according to the table on the previous page and click OK.
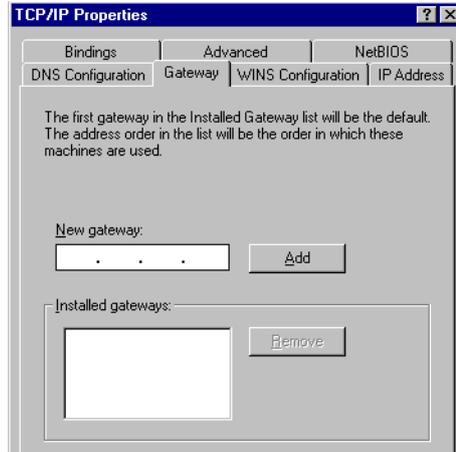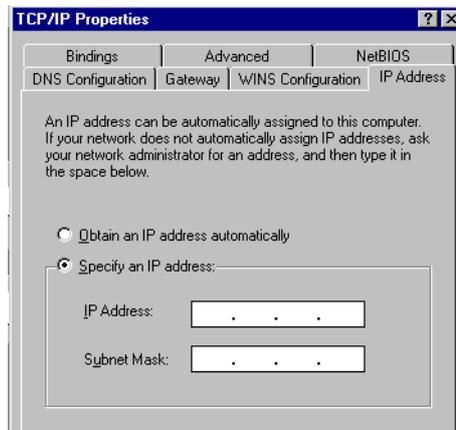
MAC Address

MAC address is a unique (single) address that is pre-assigned to each Ethernet device.
The address is necessary to physically identify the Ethernet devices on the network.
Data can be transferred between nodes based on the MAC address.

15.3 Saving and Loading Waveform/Setup/Image Data on a Network Drive
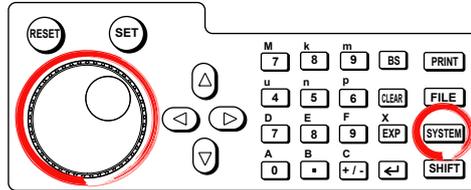
1. Press **SYSTEM**.
2. Press the **Network** soft key.
3. Press the **Net Drive Setup** soft key. The Net Drive setup menu for that key appears.
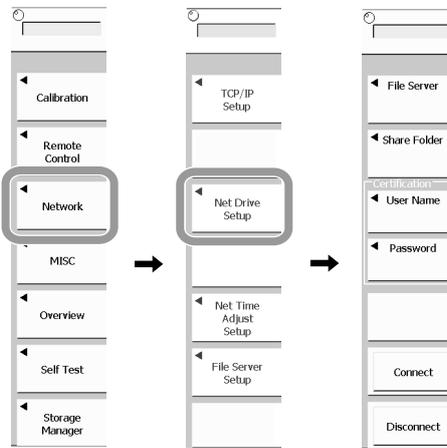
Setting a Network Drive to Be Connected

4. Press the **File Server** soft key. A screen appears, allowing you to set up server name for the file server. The IP address cannot be used to set up the file server.
5. Enter the server name for the file server as described in section 4.2.
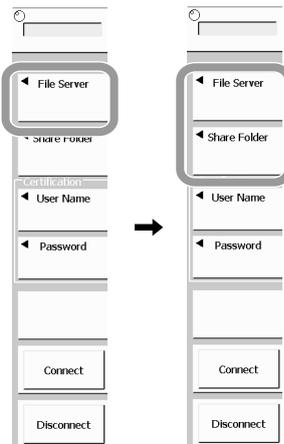
6. Press the **Share Folder** soft key. A screen appears, allowing you to set up the shared folder name.
7. Set up the folder name as described in section 4.2.

Setting User Name/Password

8. Press the **User Name** soft key. A screen appears, allowing you to set up a user name.

9. Enter a user name using up to 30 characters.

10. Press the **Password** soft key. A screen appears, allowing you to set up a password.

11. Enter a password using up to 30 characters for the user name as described in section 4.2.

Note

For the operating procedure of keyboard (soft keyboard), see section 4.2, "Entering Values and Strings."

Connecting to/Disconnecting from the Network Drive

12. Press the **Connect** soft key. The DL9000 is now connected to the network drive.
    When pressing the **Disconnect** soft key, the DL9000 is disconnected.
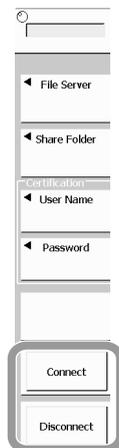
Saving Screen Images and Saving/Loading Waveform/Setup Data

- **Saving the Screen Image Data**
  13. Press the **SHIFT** + **PRINT** key.
  14. The procedure is similar to that in section 13.8, "Saving Screen Image Data." Select the network drive in the File Path setup

- **Saving/Loading Waveform Data/Setup Data**
  13. Press **FILE.**
  14. Select a network drive with the **rotary knob**.
    The procedure afterward is similar to those in section 13.4, "Saving/Loading the Setup Data" and section 13.5, "Saving/Loading the Measurement Data."

Explanation

As with the PC card drive, you can save screen image data, waveform data or setup data to a network drive via the Ethernet network.

File Server

Enter the host name of file server (the PC running the file server) on the network to which waveform/setup data will be saved. The IP address cannot be used to set up the file server.

User Name

Enter a user name using up to 30 characters.
The characters that can be used are all the ASCII characters on the keyboard.

Password

Enter the password corresponding to the user name using up to 30 characters.
The characters that can be used are all the ASCII characters on the keyboard.

Note
- A shared service should be run on a personal computer to which the DL 9000 is connected.
- To use this function, you must configure TCP/IP according to the procedure given in section 15.2.
- When the power is turned to ON, the connection to the file server is restored.

15

Ethernet Communications (Optional)

15.4 Using SNTP to Set the Date and Time
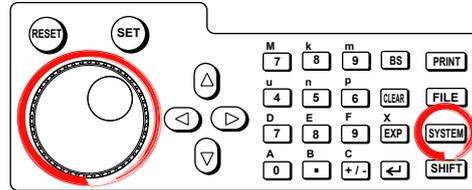
1. Press **SYSTEM**.
2. Press the **Network** soft key.
3. Press the **Net Time Adjust Setup** soft key. A menu appears for adjusting the time using SNTP.
4. Press the **Time Server** soft key. A window appears for setting the NTP/SNTP server IP address or host name.
5. Enter the IP address or host name of the NTP/SNTP server.
6. Press the **Power on Exec** soft key, to select ON or OFF.
7. With the **rotary knob**, set Time out in the range 1 to 60 (s).
8. To set the date and time, Press the **Exec** soft key. The necessary information is obtained from the NTP/SNTP server to set the date and time on this unit.
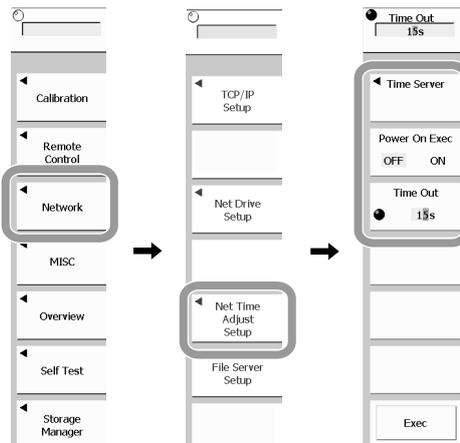
Explanation

Time data is obtained over the network from an NTP/SNTP server, and used to set the date and time on this unit.

If Power On Exec is set to ON, the date and time information is obtained from the NTP/SNTP server connected to the network each time the unit is powered on.

Note

The time difference from universal time (GMT) must be correctly set.

15.5 Accessing the DL9000 from a PC
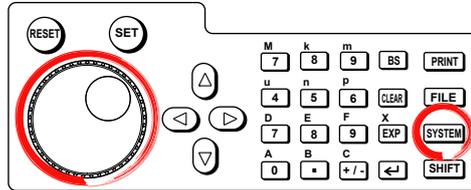
1. Press **SYSTEM**.
2. Press the **Network** soft key.
3. Press the **File Server Setup** soft key.

Selecting the File Server Function and Enabling/Disabling the Authentication Function
(Applicable to products with firmware version 1.80 or higher.)
4. Press the **Type** soft key to display the Type menu.
5. Press the **Microsoft Network** or **FTP** soft key to select the file server function.
6. Press the Mode soft key to select ON or OFF.

Setting the User Name and Password for Connecting to the DL9000 (When the Mode Is ON)
7. Press the **User Name** soft key to display a screen for entering the user name.
8. Enter the user name using up to 30 characters.
9. Press the **Password** soft key to display a screen for entering the password.
10. Enter the password corresponding to the user name using up to 15 characters.

If FTP is selected step 5, proceed to step 11.
If Microsoft Network is selected step 5, proceed to step 12.

Allowing/Prohibiting Anonymous Login (FTP Server Only)
(Applicable to products with firmware version 1.80 or higher.)
11. Press the **Allow Anonymous** soft key to select ON or OFF.

Activating the Settings
12. Press the **Entry** soft key to enable the settings.
   The specified settings are activated only when you press Entry.

Checking the Shared Folder
13. Press the **Shared Info** soft key. A list of shared storage media and folder names is displayed.
14. Press ESC to close the list.

15

Ethernet Communications (Optional)

Menu on products with firmware version 1.80 or higher

Check the shared folder

--- Shared Information ---

- Shared Name   : FlashMem
- Shared Folder : ¥Flash Mem¥SharedFolder
- Shared Name   : HD
- Shared Folder : ¥HD¥SharedFolder
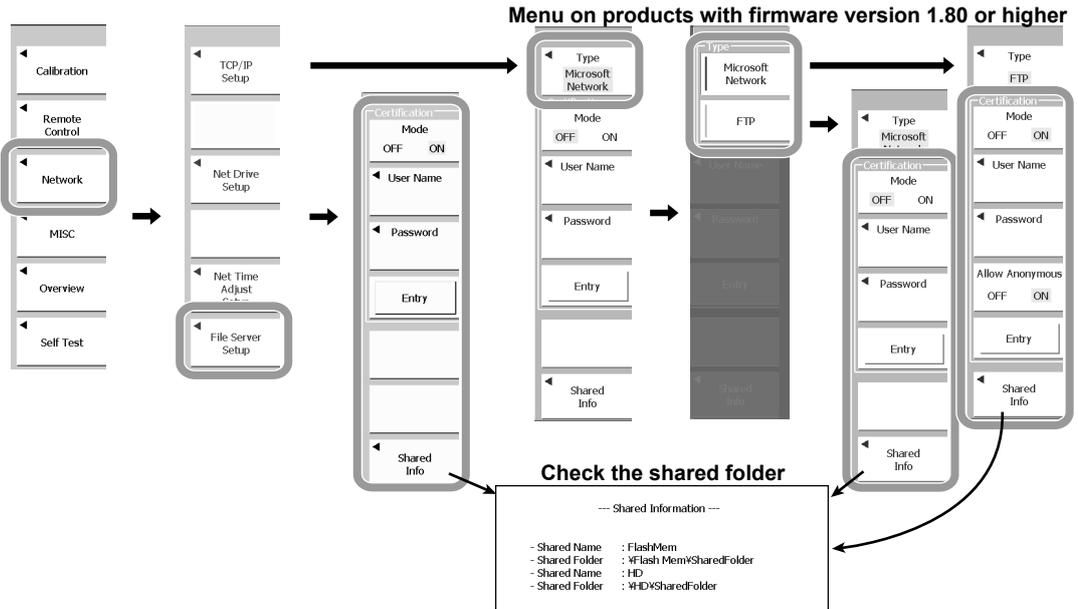
Note

For the operating procedure of the keyboard (software keyboard), see section 4.2.

Explanation

The internal memory and internal hard disk (option) of the DL9000 can be accessed from a PC via the Ethernet network.

File Server Function (Type)

(Applicable to products with firmware version 1.80 or higher. Microsoft Network is only supported on products with firmware version before 1.80.)

Select from the following:.

• Microsoft Network: Access the internal memory or internal hard disk (option) of the DL9000 from a PC using the Microsoft Network function available on the PC.

• FTP: Access the internal memory or internal hard disk (option) of the DL9000 from a PC using an FTP client.

Enabling/Disabling Authentication (Mode)

Set whether to authenticate the access from the PC to the DL9000. If set to OFF, the DL9000 can be accessed without entering the user name and password.

User Name

Enter the user name that is required when accessing the DL9000 from a PC using up to 30 characters. The characters that can be used are all the ASCII characters on the keyboard.

Password

Enter the password that is required when accessing the DL9000 from a PC using up to 15 characters. The characters that can be used are all the ASCII characters on the keyboard.

Allow Anonymous

(Applicable to products with firmware version 1.80 or higher.)

This function is configured only when the FTP server function is set to FTP. Set whether to allow anonymous users to log into the DL9000.

• ON: Allows anonymous logins. The only file operation allowed is reading.

• OFF: Prohibits anonymous logins.

The table below shows the relationship between file server settings and the login access.

Setting				
File server function	Microsoft Network		FTP	
Authentication enable/disable	Disable	Enable	Disable	Enable
User name and password	Not required	Required	Not required	Required
Anonymous login allow/prohibit	—	—	Prohibit Allow	Prohibit Allow
Login access				
User login access	Yes	Yes	Yes Yes	Yes Yes
Anonymous login access	Yes	No	No Yes	No Yes
Login access only for anonymous (all other user names not allowed)	No	No	No No	No Yes*

*   Anonymous login is possible only when both user name and password are not set.

Activating the Settings (Entry)

The specified settings are activated only when you press Entry.

Shared Folder

The same shared folder is provided for both the Microsoft Network and FTP file server functions.

> **Note**
> • The PC must be running Microsoft Windows XP Home Edition or Professional to access the DL9000 using the Microsoft Network server function.
>   If the following security update program (MS05-011) installed, problems may occur such as the file list display taking a long time or the DL9000 files not being able to copied to the PC.
>   Patch: Windows XP security update program (KB885250), Date published: February 7, 2005, Version: 885250
>   To work around this problem, contact Microsoft Customer Information Center, and install the following correction program in your PC.
>   Correction program
>   Article ID: 895900, Last Review: June 1, 2005, Revision: 2.0
>   The information above does not pertain to the FTP server function.
> • The FTP server function on the DL9000 supports two authentication methods: plain authentication and encrypted authentication. The encrypted authentication uses OTP* (One Time Password). FFFTP is a free FTP client that supports encrypted authentication.
>   *   OTP uses the MD5 algorithm (RSA Data Security, Inc. MD5 Message Digest Algorithm).
> • Up to three clients can simultaneously use the Microsoft Network server function of the DL9000. Likewise, up to three clients can simultaneously use the FTP server function.

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Ethernet Communications (Optional)

15.6 Checking the Presence of the Ethernet Interface
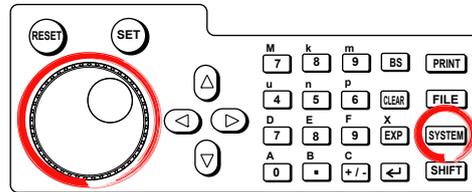
1. Press **SYSTEM**.
2. Press the **Overview** soft key. The Overview screen appears.
3. When Ether (/C10) or HDD+Ether (/C8) appears for the Option item in the Overview screen, this indicates that the Ethernet interface is installed.


```
--- System Overview ---

- Model              : 701312
  Record Length      : 2.5MW
  Sample Rate        : 10GS/s
  Serial No          : 27E00PP08

- Options
  Printer( /B5 )
  HDD+Ether( /C8     Mac      : XXXXX_XXX_XXX )
  I2C+SPI( /F5 )
  Probe Power( /P2 )

- Default Language    : ENG( -HE )

- Software
  Version            : 1.50
  Linkage Date       : 2005/9/2 21:13:15
```
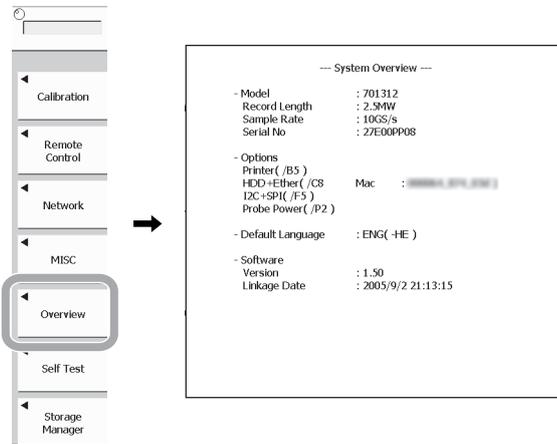
Explanation

This function allows you to check the Presence of the Ethernet Interface.

Presence of Ethernet Interface
Ether (/C10) or HDD+Ether (/C8) appears in the Overview screen.

15.7 Configuring a Firewall
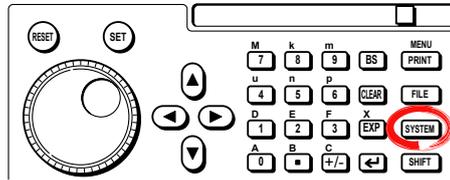
1. Press the **SYSTEM** soft key to display the SYSTEM menu.
2. Press the **Network** soft key.
3. Press the **Firewall Setup** soft key.

Enabling/Disabling the Firewall
4. Press the **Mode** soft key to select ON or OFF.

Allowing/Blocking Various Functions
5. Press the **Microsoft Network** soft key to select Allow or Block.
6. Press the **FTP** soft key to select Allow or Block.
7. Press the **Control** soft key to select Allow or Block.
8. Press the **Net Drive** soft key to select Allow or Block.
9. Press the **Net Time Adjust** soft key to select Allow or Block.

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Ethernet Communications (Optional)
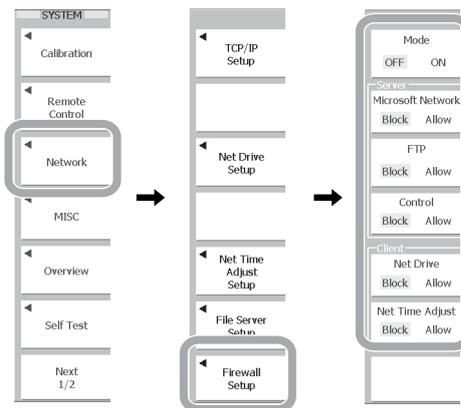
Explanation

You can block access from other devices on the network to the DL9000 or access from the DL9000 to other devices. This function can be used on products with firmware version 1.80 or higher.

Enabling/Disabling the Firewall
- ON

  Applies a firewall to the individual functions set to Block and prohibits access. (See the next subheading "Allowing/Blocking Various Functions" for the individual functions.) In addition ping an ICMP messages are blocked.
- OFF

  Allows access regardless of the settings explained in the next subheading. Open ports are as follows:

Port	Service
21/tcp	ftp
445/tcp	microsoft-ds
10001/tcp	control
137/udp	netbios-ns
138/udp	netbios-dgm

Allowing/Blocking Various Functions
A firewall can be set up for each function used in the Ethernet communication.
- Microsoft Network

  Allow or block access to the DL9000 using the Microsoft Network client function.
- FTP

  Allow or block access to the DL9000 using the FTP client function.
- Control

  Allow or block access to the DL9000 using the remote control client function.
- Net Drive

  Allow or block access the Microsoft Network server from the DL9000 network drive.
- Net Time Adjust

  Allow or block the DL9000 from accessing the NTP or SNTP server.

Note

- Limitation when Allow is selected for the Microsoft Network, FTP, and control functions

  Clients can only access the DL9000 by directly specifying the IP address or by DNS name resolution. Clients cannot access the DL9000 by WINS or broadcast name resolution.
- Limitation when Allow is selected for the FTP function

  Clients cannot access the DL9000 using passive mode.
- Limitation when Allow is selected for Net Time Adjust function

  The DL9000 can only access the server by directly specifying the IP address. Servers cannot be accessed through DNS, WINS, or broadcast name resolution.

16.1 External Trigger Input (TRIG IN)

CAUTION

Do not input any signal not meeting the specification below. An excessive voltage, for example, may damage the DL9000.

External Trigger Input Connector

This connector is used when an external signal is used as a trigger source (see Section 6.7).

⚠ TRIG IN

Item	Specifications
Connector type	BNC
Maximum input voltage	±40 V (DC + ACpeak) or 28 Vrms when the frequency is 10 kHz or less
nput frequency bandwidth	DC to 100 MHz
Input impedance	Approx. 1 MΩ, approx. 18 pF
Trigger sensitivity	0.1 Vp-p
Trigger level	±2 V (setting resolution 5 mV)

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Rear Panel Input and Output

16.2 Trigger Output (TRIG OUT)

CAUTION

Do not apply an external voltage to TRIG OUT output connector. Doing so can cause damage to the DL9000.

External Trigger Output Connector

A TTL level signal is output when a trigger is activated. The signal level is normally high and goes low when a trigger is activated.

⚠ TRIG OUT

Item	Specifications
Connector type	BNC
Output levels	5 V TTL
Logic	Goes low when trigger is activated, goes high when acquisition is completed
Output delay time	50 ns or less
Output hold time	Low level: 50 ns Minimum, High level: 50 ns Minimum

Trigger Output Circuit Diagram/Timing Chart
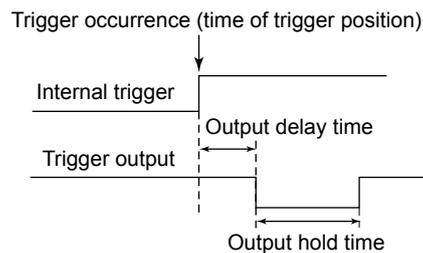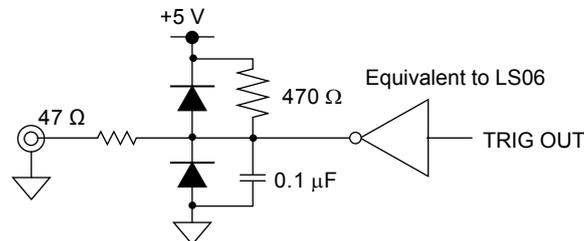
Low Level and High Level Hold Times
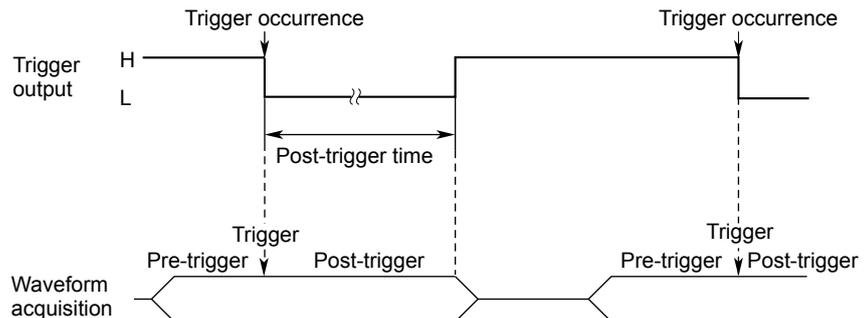
16.3 RGB Video Signal Output (RGB VIDEO OUT)

⚠️ **CAUTION**

- Power off the DL9000 and monitor before making the connection.
- Do not short the VIDEO OUT connector, or apply an external voltage. Doing so can cause damage to the DL9000.

Video Signal Output Connector

With the video signal output, the DL9000 screen display can be shown on a monitor. Any multisync monitor supporting XGA display can be connected.

⚠️ VIDEO OUT
(XGA)

Item	Specifications
Connector type	D-sub 15-pin
Output format	Analog RGB output
Output resolution	1024 × 768 pixels, approx. 60 Hz Vsync
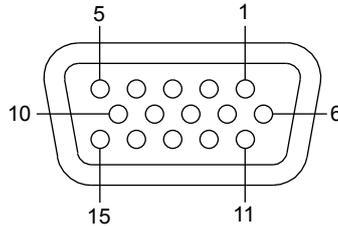
D-Sub 15-pin receptacle

Pin No.	Signal name	Specifications
1	Red	0.7 Vp-p
2	Green	0.7 Vp-p
3	Blue	0.7 Vp-p
4	—	
5	—	
6	GND	
7	GND	
8	GND	
9	—	
10	GND	
11	—	
12	—	
13	Horizontal sync signal	Approx. 36.4 kHz, TTL positive logic
14	Vertical sync signal	Approx. 60 Hz, TTL positive logic
15	—	

Connection to a Monitor

1. Power off the DL9000 and monitor.
2. Connect the DL9000 and the monitor using an analog RGB cable.
3. Power on the DL9000 and monitor.

16.4 GO/NO-GO Signal Output and External Start/Stop Signal Input

The DL9000 can output a signal indicating a GO/NO-GO determination.
An external signal can also be used for start/stop control of the DL9000.

Input/Output Connector

The GO/NO-GO output and external start/stop input use a shared connector. When the GO/NO-GO determination input/output function is not used (in the GO/NO-GO menu, Mode is set to OFF), then this functions for external start/stop input.
The connector uses a modular jack (RJ-12). A cable is available as optional accessory 366973.

Pin No.	Signal
1	NC (Not connected)
2	START IN — Starts at low edge
3	GO OUT (Negative logic) — Stops at high edge
4	NO-GO OUT (Negative logic)
5	GND
6	NC (Not connected)
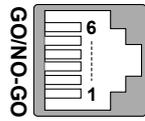
Connector on the DL9000

Input levels: TTL (0 to 5 V)

GO/NO-GO Output Signal

CAUTION

- Do not apply an external voltage to the NO-GO OUT output pin or GO OUT output pin. Doing so can cause damage to the DL9000.
- When making the external connection to the GO/NO-GO determination signal output, be careful not to connect to a different signal pin. A wrong connection could result in damage to the DL9000 or to other connected equipment.
- Do not connect a USB cable to the GO/NO-GO output connector. Doing so can cause damage to the DL9000.

For connection to an external device, use the special-purpose optional accessory GO/NO-GO cable (part no.: 366973).
Do not use the special-purpose optional accessory GO/NO-GO cable (part no.: 366973) for any purpose other than a GO/NO-GO determination from the DL9000.

Specifications of the GO/NO-GO cable (model 366973)

Approx. 1.5 m

To the GO/NO-GO output connector on the rear panel of the DL9000

RJ-12 modular jack

Wire ends are unfinished for modification as needed.
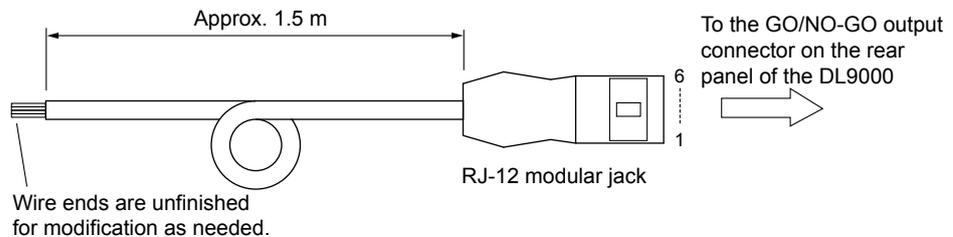
Wire color	Pin No.	Signal	Logic
Yellow	2	START IN	
White	3	GO OUT	Negative logic
Green	4	NO-GO OUT	Negative logic
Blue	5	GND	

NO-GO OUT Signal

When the determination result is "NO-GO", the output signal level (TTL levels) goes temporarily from high level to low level.

GO OUT signal

When the determination result is "GO", the output signal level (TTL levels) goes temporarily from high level to low level.

Signal Output Circuit Diagram
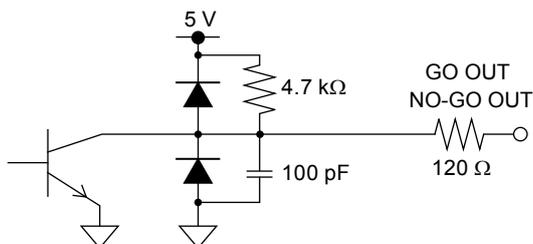
GO/NO-GO Output Timing

The signal remains low until ready to accept the next measurement. If you have specified an action to perform when conditions are true, this time is extended until that action is complete.

16
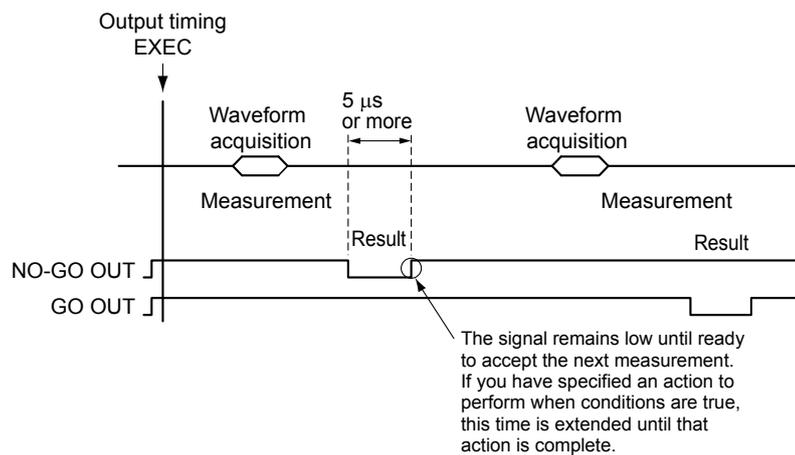
Rear Panel Input and Output

External Start/Stop Input Circuit Diagram
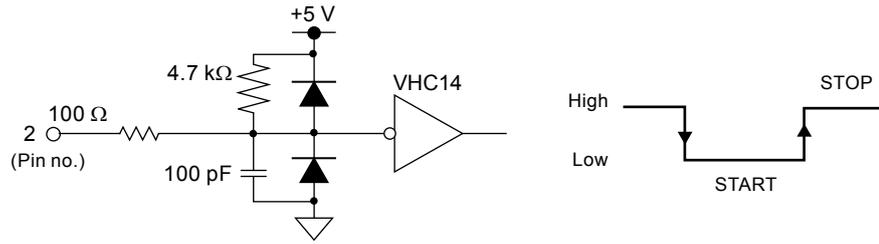
• **For input by switch**

Starts at ON
Stops at OFF
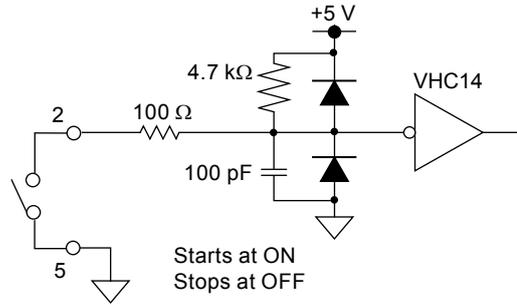
Note

• The start/stop is detected on a LOW edge or HIGT edge.
• Switch input will be supported in the near future.

16.5 Trigger Comparator Signal Output

<table>
<tr><td rowspan="5">⚠️</td><td><u>CAUTION</u></td></tr>
</table>

CAUTION

- Power off the DL9000 before making the connection.
- Do not short the TRIG COMP OUT connector, or apply an external voltage.
  Doing so can cause damage to the DL9000.

Trigger Comparator Signal Output Connector

Pin No.
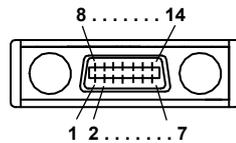
Item	Specifications
Output level	3.3 V LVPECL (difference output)
Output logic level	Negative logic
Output delay time	Max. 50 ns
Output hold time	Low level 50 ns min High level 50 ns min
Output voltage	3.3 V (max. 300 mA)

Pin No.	Signal name	Pin No.	Signal name
1	CH1 trigger comparator output (L)	8	CH3 trigger comparator output (L)
2	CH1 trigger comparator output (H)	9	CH3 trigger comparator output (H)
3	CH2 trigger comparator output (L)	10	CH4 trigger comparator output (L)
4	CH2 trigger comparator output (H)	11	CH4 trigger comparator output (H)
5	Trigger enable output (L)	12	Trigger output (L)
6	Trigger enable output (H)	13	Trigger output (H)
7	3.3 V	14	GND

The trigger output signal is output with the same timing as TRIG OUT.
The trigger enable signal is output with the timing for enabling the trigger.
The trigger comparator output signals for channels 1 to 4 are output according to the trigger condition settings for the corresponding channel.

Interface Cable
For connection, use the trigger compare output cable (701976) for the DL9000.

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Rear Panel Input and Output

17.1   Changing the Language of Messages and Switching the Click Sound On or Off

Procedure
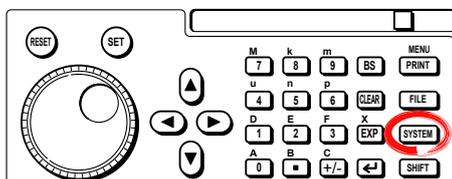
1. Press **SYSTEM**.
2. Press the **MISC** soft key.
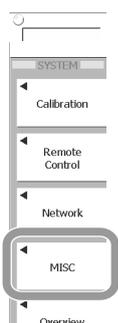
Selecting the Message Language
3. Press the **Message** soft key to display the Message menu.
4. Press the **ENG**, **JPN**, or **CHN** soft key to select the language.
   (CHN is available on products with firmware version 1.80 or higher.)
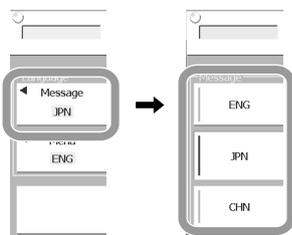
Selecting the Menu Language
(This function can be used on products with firmware version 1.80 or higher.)
3. Press the **Menu** soft key to display the Menu menu.
4. Press the **ENG** or **CHN** soft key to select the language.

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Other Operations

Turning the Click Sound ON/OFF

3. Press the **Click Sound** soft key to select ON or OFF.

```
┌─────────────┐
│ ◄           │
│   Date/Time │
├─────────────┤
│             │
╔═════════════╗
║ Click Sound ║
║ OFF    ON   ║
╚═════════════╝
├─────────────┤
│             │
└─────────────┘
```
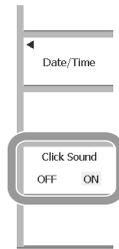
Explanation

Selecting the Message Language

A message appears when an error occurs or when you press the HELP key. You can select the message language from English (ENG), Japanese (JPN), and Chinese (CHN). Chinese is available on products with firmware version 1.80 or higher. The messages codes are common in all languages. For a description of the messages, see section 18.2.

Selecting the Menu Language

Select the menu language from English (ENG) and Chinese (CHN). This function can be used on products with firmware version 1.80 or higher.

Turning the Click Sound ON/OFF

You can enable or disable the click sound that is generated when the rotary knob is turned. The default setting is ON.

17.2 Listing the Setup Data
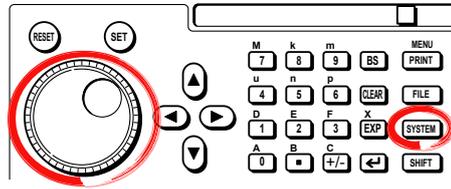
1. Press the **SYSTEM** soft key to display the SYSTEM menu.
2. Press the **Next 1/2** soft key to display the Back 2/2 menu.
3. Press the **Setup Information** soft key to display a list of setup data.
4. Turn the **rotary knob** to select the list you wish to display.
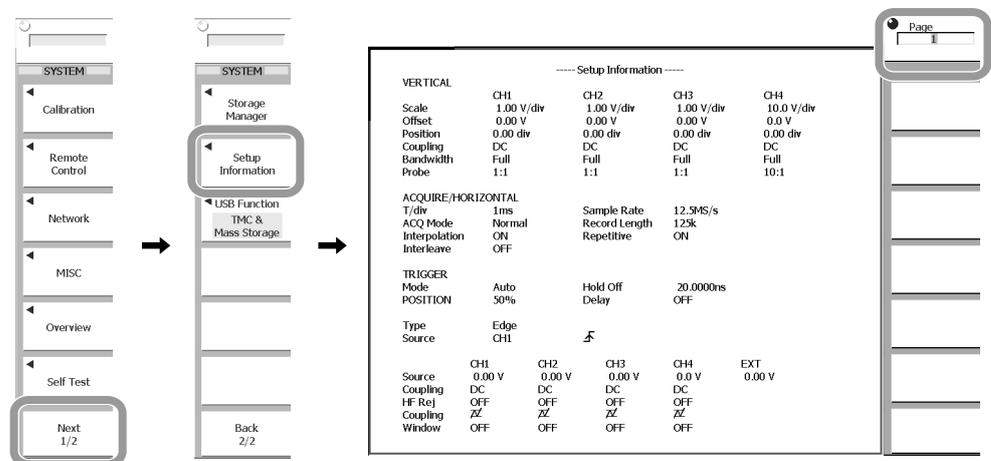
Explanation

A list of setup data can be displayed. The list is displayed across multiple pages. This function can be used on products with firmware version 1.80 or higher.

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Other Operations

18.1 If a Problem Occurs

Faults and Corrective Action

- If a message appears on the screen, read the following pages.
- If service is required, or the corrective action does not solve the problem, refer to your supplier.

Description	Probable Cause	Corrective Action	Reference Section
The power cannot be turned ON.	Using a power supply outside the ratings.	Use a correct power supply.	3.3
Nothing is displayed.	The backlight is turned OFF.	Press any key.	8.4
	The screen colors are not appropriate.	Turn the power OFF, and then turn the power ON again while pressing the **RESET** key.	4.4
The display is odd.	The system is not operating properly.	Power-cycle the DL9000.	3.3
Keys do not work.	The keys are malfunctioning.	Perform a key test. If the test fails, servicing is required.	18.3
Trigger does not activate.	The trigger settings are not appropriate.	Set the trigger conditions correctly.	Chapter 6
Measured values are not correct.	Insufficient warm-up.	Warm up the DL9000 for 30 minutes after turning on the power.	–
	Not calibrated.	Execute calibration.	4.7
	The probe's phase has not been corrected.	Perform phase correction correctly.	3.5
	The probe attenuation is not correct.	Set an appropriate value.	5.6
	An offset voltage is added.	Set the offset voltage to 0 V.	5.2
	Other causes.	Execute calibration. If the measured value is still odd, servicing is required.	4.7
Cannot output to the built-in printer.	The printer head is damaged or worn out.	Servicing required.	–
Cannot save to the specified medium.	The medium is not formatted.	Format the medium.	18.6
	No more free space on the medium.	Delete unneeded files or use another storage medium.	–
Cannot change settings or control the operation of the DL9000 via the communication interface.	The address of the DL9000 used by the program is different from the specified address.	Match the address used in the program to the address of the DL9000.	Communication Interface User's Manual (IM 701310-17)
	The interface is not used in a way that conforms to the electrical or mechanical specifications.	Use it in a way that conforms to the specifications.	

18.2 Messages and Corrective Actions

Error Messages

Messages may appear on the screen during operation, and this section explains these messages, and corrective action to take. Note that the messages can be displayed in either Japanese or English (See Section 17.1). If the corrective action requires service refer to your supplier.

In addition to the following error messages, there are also communications related error messages. These are described in the separate Communications Interface User's Manual (IM 701310-17).

Information Errors

Code	Message and corrective action	Section
51	Turned on pressing the RESET key. All the settings will be initialized.	4.4
52	Firmware is updated. All the settings are initialized.	–
53	Hardcopy is aborted.	–
54	File access is aborted.	–
55	Action-on-trigger is aborted.	7.8
56	Search aborted.	–
57	Search execution is completed, but no record was found that matched the conditions.	–
58	Search execution is completed, but no record was found that matched the pattern.	–
59	Statistical measurement is aborted.	Chapter 10
60	Analysis is aborted.	Chapter 10
61	Data not detected. Execute again after changing settings or reacquiring waveforms.	–
62	The corresponding field was not found.	–
63	Action-on-trigger is completed.	7.8

File Errors

Code	Message and corrective action	Section
500	Data size larger than remaining capacity in media. Delete unnecessary files or use other media.	Chapter 13
501	File does not exist. Check the file name.	Chapter 13
502	Assigned path does not exist or no media. Check the path name and media.	Chapter 13
503	Writing prohibited in the media. Unlock write protection of the media.	Chapter 13
504	Insufficient remaining capacity in media. Delete unnecessary files or use other media.	Chapter 13
505	File not compatible. Check the file, firmware version of the unit or model name of the unit.	–
506	Save data do not exist. Check the content to be saved.	–
507	Save data do not exist. Check the content to be saved.	–
508	Unable to open file. The may be opened by other process. Try to open file later. If the problem still exist, service may be necessary.	Chapter 15
509	Access denied.	Chapter 13
510	File system error. Service is required.	–

Code	Message and corrective action	Section
511	Media error. Service is required.	–
512	Directory can not be deleted.	Chapter 13
513	File or Directory can not be moved to other media. If the problem occurs on other media, service may be required.	Chapter 13
514	Directory entry does not exist.	–
515	Media error. Service is required.	–
516	Media error. Service is required.	–
517	End of the file.	–
518	The same file or directory name exist. Remove the file/directory or change the current path.	Chapter 13
519	Target file of Move or Copy has a read only property.	Chapter 13
520	Assigned path does not exist or no media. Check the path name and media.	Chapter 13
521	Destination folder assigned to Copy / Move is the same as the origin or sub folder. Change the destination folder.	Chapter 13
522	No file name. Type in file name.	Chapter 13
523	Auto file name failure. Change the type of auto file name or change the header of the auto name.	Chapter 13
524	Auto file name failure. Change the type of auto file name or change the header of the auto name.	Chapter 13
525	Improper file or path name. Check file/path name.	Chapter 13
526	File is disintegrated. Check the file.	–
527	File system error. Service is required.	–
528	Illegal file name. The name contains prohibited characters. Change it to a different name.	Chapter 13
529	Illegal file name. The name is reserved by the system. Change it to a different name.	Chapter 13
530	Load failure. Number of vortex exceeded the maximum. Redefine the mask data.	–
531	Unable to open file. The may be opened by other process. Try to open file later. If the problem still exist, service may be necessary.	–
532	Unable to save. Compressed record size exceeded current record size. Change the compressed record size and execute again.	–
533	Assigned path does not exist. Check the network setting and configuration.	Chapter 15
534	Assigned path does not exist. Check the network setting and configuration.	Chapter 15
535	Assigned path does not exist. Check the network setting and configuration.	Chapter 15

Troubleshooting, Maintenance, and Inspection

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Printer Errors

Code	Message and corrective action	Section
550	Printer error. Confirm the printer status.	–
551	Cannot detect printer. Turn ON the printer. Check connections.	–
552	Communication error. Check all connections and make sure all devices are on.	–
553	Paper not loaded correctly. Set the paper correctly.	12.1
554	Printer over heat. Power off immediately.	–
555	Move the release arm to the "HOLD" position.	12.1
556	No built-in printer on this model. Check the specifications to see whether or not the optional printer is provided.	Page ii

Network Errors

Code	Message and corrective action	Section
600	Invalid network parameter settings. Check the network parameters.	Chapter 15
601	Unable to connect to the server. Check the network settings and configuration.	Chapter 15
602	Invalid file server settings. Check the file server settings.	Chapter 15
603	Invalid fire wall settings. Check the fire wall settings.	Chapter 15

Execution Errors

Code	Message and corrective action	Section
650	Running. Stop and execute again.	4.6
651	Accessing file. Abort or wait until it is completed, and execute again.	–
652	Printing. Abort or wait until it is completed, and execute again.	–
653	Processing action-on-trigger. Abort or wait until it is completed, and execute again.	7.8
654	Processing zoom search. Abort or wait until it is completed, and execute again.	8.7
655	Processing auto scroll. Abort or wait until it is completed, and execute again.	–
656	Processing history search. Abort or wait until it is completed, and execute again.	Chapter 11
657	Processing history replay. Abort or wait until it is completed, and execute again.	Chapter 11
658	Processing statistical measurement. Abort or wait until it is completed, and execute again.	10.3
659	Analyzing serial bus data. Abort or wait until it is completed, and execute again.	–
660	Zone edit in process. Terminate editing.	Chapter 7
661	Processing self test. Wait until it is completed.	–
662	Acquisition in process in N Single trigger mode. Press Start/Stop key or wait until the process is completed.	Chapter 6
663	Retrievable settings does not exist. The settings is created by either Initialize or Auto Setup.	–
664	Failed to execute statistical measurement. Waveform data may not exist. In Cycle statistic mode, improper setting may result in failure to recognize the cycle.	10.3
665	Search target data does not exist. The search after analysis is completed.	–
666	Improper action setting. The saved data type is either Waveform group or Analysis group. This can be assigned from File menu.	Chapter 13
667	Retrievable data not found.	–

Troubleshooting, Maintenance, and Inspection

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Setting Error

Code	Message and corrective action	Section
800	Improper Date/Time setting.	3.6
801	Not allowed unless waveforms are shown. Display waveforms.	Chapter 5
802	Source waveforms do not exist. Display source waveforms.	Chapter 7
803	Zone waveforms do not exist.	Chapter 7
804	Illegal expression.	Chapter 9
805	Not allowed in Telecom test mode. Turn off the Telecom test mode.	10.4

System Errors

Code	Message and corrective action	Section
900	Failed to backup setup data.Initializing will be executed. Backup battery may be low. Maintenance service is required to replace the back-up battery.	18.7
901	Fan stopped. Power off immediately. Maintenance service is required.	18.7
902	Backup battery is low. Maintenance service is required to replace the back-up battery.	18.7
903	Calibration failure. Disconnect the input and execute again. If it fails again, service is necessary.	–

18.3 Carrying Out a Self-Test
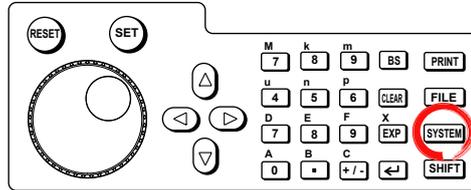
Displaying the Self-Test Menu
1. Press **SYSTEM**.
2. Press the **Self Test** soft key.
3. Press the **Test Item** soft key. The test item selection menu appears. With the soft keys, select the self-test item.
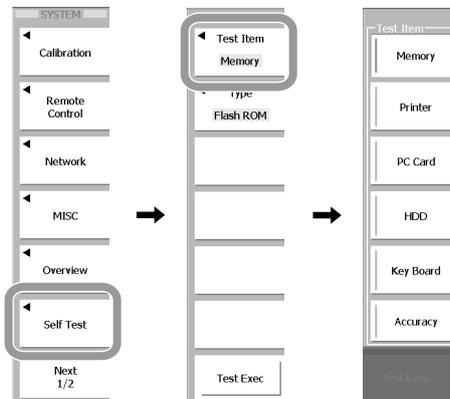
Memory Test Execution
4. In step 3, select Memory.
5. Press the **Type** soft key. A menu for selecting the memory to be tested appears.
6. With the soft keys, select memory.
7. Press the **Test Exec** soft key. This executes the memory test.

Menu on products with firmware version 1.40 or higher

Printer/PC Card/Internal HDD/Accuracy Test Execution

8. In step 3, select one of Printer, PC Card, HDD, and Accuracy.

9   Press the **Test Exec** soft key. This executes the respective test.

Note _____

Before carrying out the PC card drive test, insert a PC card.

Panel Key Test

10. In step 3, select Key Board.

11. Press the **Test Exec** soft key. The panel key test screen appears.

12. Pressing an operating key shows the corresponding key on the screen in reverse video.

13. Press all of the keys, or press **ESC** twice in succession. This ends the key test.

Soft Key Test

14. In step 3, select Key Board.

15. Press the **Soft Key** soft key. The soft keyboard appears.

16. Using the **rotary knob** and **SET**, check that characters are correctly entered from the keyboard.
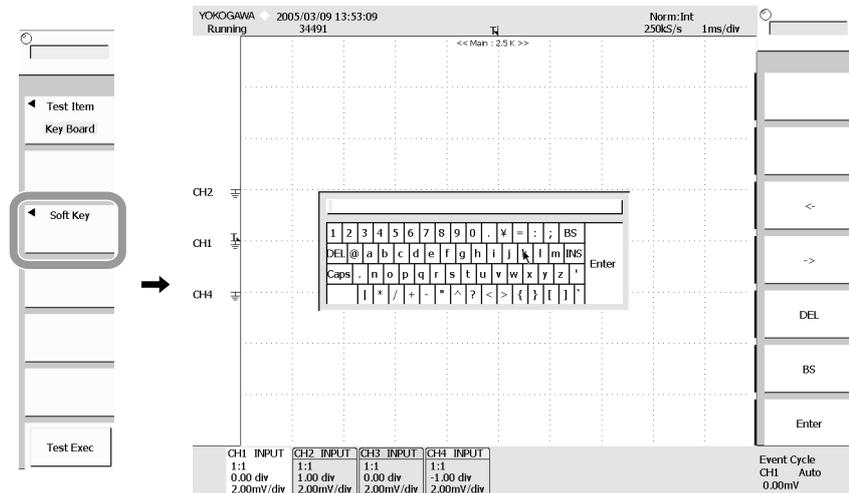
Note _____

The Accuracy test item is a test item for servicing.

Explanation

Memory test: Memory
This tests whether the RAM/ROM on the internal CPU board is operating correctly. A "Success" indication means that the result is normal.
If there is an error, "Fail" appears.

Printer test: Printer
Tests whether the optional built-in printer is operating correctly. If the test pattern is printed correctly, then the printer is normal. If there is an error, the test pattern will not print correctly.

PC card: PC Card
Tests whether the PC card slot is functioning correctly. If there is an error, after test execution, "Fail" appears.

Built-in hard disk drive (option /C8): HDD
Tests whether the built-in hard disk drive is functioning correctly. If there is an error, after test execution, "Fail" appears.

Key test: Key Board
Tests whether the front panel operating keys are functioning correctly. If the name of a pressed key appears in reverse video, it is normal.

Soft key test: Key Board
Tests whether the soft keyboard is providing normal input. If the selected characters appear, then input is normal.

Accuracy test: Accuracy
This appears as a result of system autocalibration. If there is an error, "Fail" appears.

If an error occurs in the self-test
If the error persists after trying the following, refer to your supplier.
- Try running the self-test a number of times.
- Check that the media being tested is in place.
- Check that paper is correctly loaded in the built-in printer, and that there is no paper jam (Section 12.1).

Troubleshooting, Maintenance, and Inspection

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18.4 System Overview
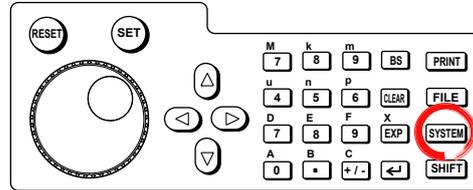
1. Press **SYSTEM**.
2. Press the **Overview** soft key. This switches to the overview screen.
   Press any key to exit the overview screen.
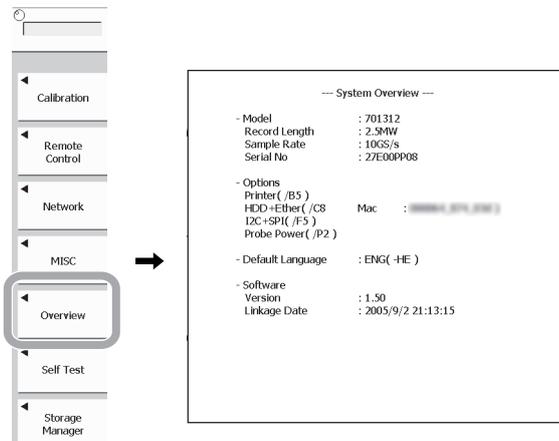
Explanation

The screen appears as above, with the following information.

Model	Model
Record Length	Record length
Sample Rate	Maximum sample rate
Serial No.	Serial No.
Options	Installed options
Default Language	Default language
Software Version	Software version number
Linkage Date	Software version date

18.5 Erasing Data from Internal Memory and Built-in Hard Disk
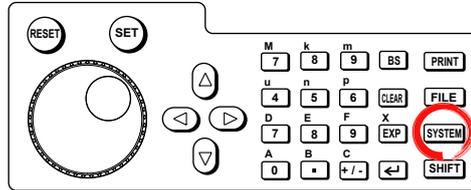
1. Press **SYSTEM**.
2. Press the **Storage Manager** soft key. The internal memory/built-in hard disk menu appears.
3. Press the **Sure Delete Exec** soft key. A message to confirm erasing the data appears.
4. With the **rotary knob** and **SET**, select OK or Cancel.
   If you select OK, all data in the internal memory and built-in hard disk is erased.
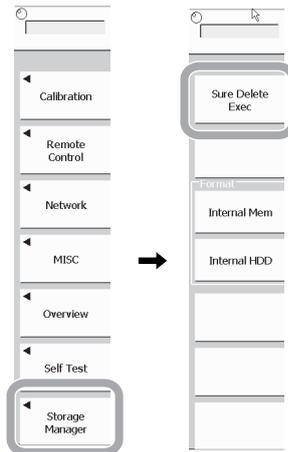
At the same time, the Sure Delete Exec soft key changes to the Abort soft key.

Aborting Data Deletion
5. Press the **Abort** soft key. Data deletion is aborted. At the same time, the Abort soft key changes to the Sure Delete Exec soft key.

Explanation

This function erases all data from the internal memory and built-in hard disk. Save required data on a PC card or other media.

Note

To erase all data from the built-in hard disk takes approximately 2 hours 40 minutes.

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18.6 Formatting Internal Memory and Built-in Hard Disk
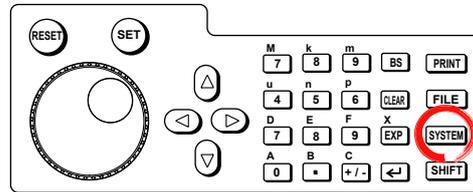
1. Press **SYSTEM**.
2. Press the **Storage Manager** soft key. The internal memory/built-in hard disk menu appears.
3. Press the **Internal Mem** or **Internal HDD** soft key. A message to confirm formatting appears.
4. With the **rotary knob** and **SET**, select OK or Cancel.
   If you select OK, the internal memory or built-in hard disk is formatted.
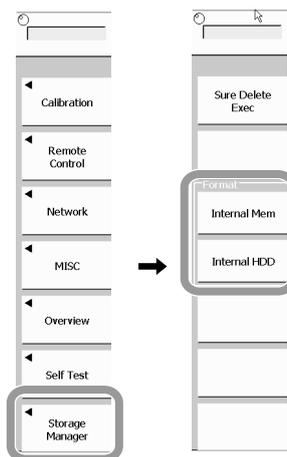
Explanation

This formats the internal memory or built-in hard disk. Save required data on a PC card or other media.

18.7 Recommended Replacement Parts

Yokogawa guarantees the DL9000 for the period and under the conditions of the product warranty.
Under the conditions of the guarantee, the following expendable components are excluded from the three-year warranty. For replacements, refer to your supplier.

Part name	Lifetime
Built-in printer	Under normal conditions of use, equivalent of 360 rolls of printer paper (part number: B9988AE)
LCD backlight	Under normal conditions of use, approx. 25,000 hours

Part name	Guarantee period
Built-in hard disk	One year from date of purchase (warranty does not cover loss of data).

The following parts are consumables. We recommend replacing them at the following intervals. For replacement parts, refer to your supplier.

Part name	Recommended replacement interval
Cooling fan	3 years
Backup battery (lithium battery)	5 years

19.1 Models

Item	Specifications		
Model name	Max. sample rate	Frequency bandwidth	Max. record length
DL9040 (701307)	5 GS/s	500 MHz	2.5 MW
DL9040L (701308)	5 GS/s	500 MHz	6.25 MW
DL9140 (701310)	5 GS/s	1 GHz	2.5 MW
DL9140L (701311)	5 GS/s	1 GHz	6.25 MW
DL9240 (701312)	10 GS/s	1.5 GHz	2.5 MW
DL9240L (701313)	10 GS/s	1.5 GHz	6.25 MW

19.2 Input Section

Item	Specifications		
Input channels	4 (CH1 to CH4)		
Input coupling setting	AC, DC, GND, DC50 Ω		
Input connector	BNC connector		
Input impedance	1 MΩ ±1.0% approx. 20 pF (10 MΩ ±2.0% approx. 14 pF when using PB500 passive probe) 50 Ω ±1.5%		
Voltage axis sensitivity setting range	For 1 MΩ input: 2 mV/div to 5 V/div (1-2-5 steps) For 50 Ω input: 2 mV/div to 500 mV/div (1-2-5 steps)		
Maximum input voltage	For 1 MΩ input (at a frequency of 1 kHz or less): 150 Vrms CAT I For 50 Ω input: 5 Vrms and 10 Vpeak (Not to exceed either of these values.)		

DC offset max. setting range (With probe attenuation factor set to 1:1)	For 1 MΩ input
	  2 mV/div to 50 mV/div: ±1 V
	  100 mV/div to 500 mV/div: ±10 V
	  1 V/div to 5 V/div: ±100 V
	For 50 Ω input
	  2 mV/div to 50 mV/div: ±1 V
	  100 mV/div to 500 mV/div: ±5 V		

Vertical axis (voltage axis) accuracy
  DC accuracy[1]
 	
  Offset voltage axis accuracy[1]
	For 1 MΩ input: ±(1.5% of 8 div + offset voltage accuracy)
	For 50 Ω input: ±(1.5% of 8 div + offset voltage accuracy)
	2 mV/div to 50 mV/div: ±(1% of setting value +0.2 mV)
	100 mV/div to 500 mV/div: ±(1% of setting value +2 mV)
	1 V/div to 5 V/div: ±(1% of setting value +20 mV)		

Voltage standing wave ratio (VSWR)	1.5 or less within frequency bandwidth (Typical value[4])		

Frequency characteristics[1,2] (–3 dB attenuation point when sine wave with amplitude ±2 div equivalent is input)	For 50 Ω input DL9040/DL9040L DL9140/DL9140L DL9240/DL9240L
	  0.5 V/div to 10 mV/div: DC to 500 MHz DC to 1 GHz DC to 1.5 GHz
	  5 mV/div: DC to 400 MHz DC to 750 MHz DC to 1 GHz
	  2 mV/div: DC to 400 MHz DC to 600MHz DC to 750MHz
	For 1 MΩ input (using PB500, measured from probe tip)
	  5 V/div to 10 mV/div: DC to 500 MHz DC to 500 MHz DC to 500 MHz
	  5 mV/div to 2 mV/div: DC to 400 MHz DC to 400 MHz DC to 400 MHz		

-3 dB low band attenuation point for AC coupling	10 Hz or below (1Hz or below using the supplied 10:1 probe)		
Skew between channels (with same setting conditions)	1 ns or below		
Residual noise level[3]	Larger of 0.4 mVrms or 0.05 div rms (Typical value[4])		
Isolation between channels (at same voltage axis sensitivity)	500 MHz model: –34 dB at 500 MHz (Typical value[4]) 1 GHz model: –30 dB at 1 GHz (Typical value[4]) 1.5 GHz model: –30 dB at 1.5 GHz (Typical value[4])		
A/D conversion resolution	8 bits (25 LSB/div) Max. 13 bits (in high resolution mode)		
Probe attenuation factor settings	1 : 1, 10 : 1, 100 : 1, 1000 : 1, 10A : 1V, 100A : 1V		
Bandwidth limit	For each channel, selectable from: FULL, 200 MHz, 20 MHz, 8 MHz, 4 MHz, 2 MHz, 1 MHz, 500 kHz, 250 kHz, 125 kHz, 62.5 kHz, 32 kHz, 16 kHz, and 8 kHz Provided by combination of analog filter (200 MHz, 20 MHz) and digital filter (IIR+FIR)		

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Item	Specifications		
Maximum sample rate		DL9040/DL9040L/DL9140/DL9140L	DL9240/DL9240L
	Realtime sampling mode		
	With interleave mode on:	5 GS/s	10 GS/s
	With interleave mode off:	2.5 GS/s	5 GS/s
	Repetitive sampling mode:	2.5 TS/s	2.5 TS/s
Maximum record length	DL9040/DL9140/DL9240	DL9040L/DL9140L/DL9240L	
	2.5 MW	6.25 MW	
Maximum acquisition rate	1.25 MW	60 waveforms/s/channel	
	12.5 kW	9,000 waveforms/s/channel	
	2.5 kW	25,000 waveforms/s/channel	
Dead time for N single[5]	400 ns or less (for each channel, 2,500,000 waveforms/second equivalent)		

1 Values in reference operating state (see page 19-11), after 30-minute warm-up period has elapsed, and calibration carried out, measured with timebase on internal clock.
2 For repeating phenomena
   The single burst frequency bandwidth is the lesser of DC to the sampling frequency/2.5 and the frequency bandwidth of the repeating phenomena.
3 With input section shorted, acquisition mode normal, interleave mode off, accumulate off, and probe attenuation factor set to 1:1
4 Typical values are typical or mean values. They are not strictly guaranteed.
5 No change in the acquisition rate with an increase or decrease in the number of channels

19.3 Trigger Section

Item	Specifications			
Trigger modes	Auto, Auto Level, Normal, Single, N-Single			
Trigger sources	CH1 to CH4:	Input signal to each input connector[1]		
	LINE:	Connected commercial power signal (can only be used for Edge trigger)		
	EXT:	Signal input to TRIG IN connector		
Trigger coupling	CH1 to CH4:	DC/AC (But for I^2C trigger: DC, for TV trigger: TV)		
	EXT:	DC		
HF rejection	Select the bandwidth limit with respect to the trigger source (OFF/15 kHz (DC to approx. 15 kHz)/20 MHz (DC to approx. 20 MHz)) (CH1 to CH4)			
Trigger hysteresis	Select trigger level hysteresis width for each channel (CH1 to CH4) Cannot be set for channel using TV trigger			
	High:	Apply hysteresis of approx. 1.0 div centered on trigger level		
	Low:	Apply hysteresis of approx. 0.3 div centered on trigger level		
Trigger level setting range	CH1 to CH4:	±4 div from screen center		
	EXT:	±2 V (using 1:1 probe) ±20 V (using 10:1 probe)		
Trigger level setting resolution	CH1 to CH4:	0.01 div		
	EXT:	5 mV (using 1:1 probe) 50 mV (using 10:1 probe)		
Trigger level accuracy	CH1 to CH4[1]:	±(0.2 div + 10% of trigger level)		
	EXT[2]:	±(50 mV + 10% of trigger level)		
Window comparator	Can be set for each channel, CH1 to CH4			
	Center:	±4 div from screen center		
	Width:	±4 div centered on Center setting		
External trigger probe attenuation factor setting	1:1/10: 1			
Trigger sensitivity		DL9040/DL9040L	DL9140/DL9140L	DL9240/DL9240L
	CH1 to CH4[1]: 1 div$_{P-P}$	For DC to 500 MHz	For DC to 1 GHz	For DC to 1 GHz
	EXT[2]: 100 mV$_{P-P}$	For DC to 100 MHz	For DC to 100 MHz	For DC to 100 MHz
	Except: Edge OR[1]: 1 div$_{P-P}$	For DC to 50 MHz	For DC to 50 MHz	For DC to 50 MHz
Trigger position	With display record length as 100%, can be set to 0.1% resolution			
Trigger delay	Time:	Delay from trigger activation for set time		
		0 to 10 s Minimum resolution 5 ps (depending on sampling rate)		
	First edge after time:	Delay from trigger activation to first specified edge after setting time		
		0 to 10 s 2 ns steps		
	Edge:	Delay from trigger activation until specified edge count		
		1 to 10E9 steps of 1		

Item	Specifications	
Hold-off time setting range	20 ns to 10 s resolution 5 ns	
Trigger slope (direction)	Rising or falling	
Trigger type	Edge/State	
	Edge:	Trigger on the edge of a single trigger source.
	Edge(Qualified):	Activate the trigger on the edge of a single trigger source when the Qualification condition holds.
	Edge OR:	Trigger on the logical OR of multiple trigger source edge conditions (Max 50 MHz).
	State:	Trigger on ENTER/EXIT when state condition holds.
	Width	
	Pulse:	Trigger on the width of a single trigger source.
	Pulse(Qualified):	Trigger on the width of a single trigger source when the Qualification condition holds.
	Pulse State:	Trigger on the width when the state condition holds.
	Time width setting mode	
		More than: Trigger when condition changes when time for which condition holds is longer than T1.
		Less than: Trigger when condition changes when time for which condition holds is shorter than T1.
		Between: Trigger when condition changes when time for which condition holds is longer than T1 and shorter than T2.
		Out of Range: Trigger when condition changes when time for which condition holds is shorter than T1 and longer than T2.
		Time out: Trigger when time for which condition holds exceeds T1.
		Setting time (T1/T2): 1 ns to 10 s, 500 ps resolution
		Time accuracy: ±(0.2% of setting value + 1 ns)
	Event Interval	
	Event Cycle:	Trigger when event period is within the set time range.
	Event Delay:	Trigger when the interval between event 1 occurring and the first subsequent occurrence of event 2 is within the set time range.
	Event Sequence:	Trigger at the first occurrence of event 2 within the set time range from event 1 occurring.
	Time width setting mode:	This function is the same as the "Time width setting mode" for Width.
		Setting time (T1/T2): 1.5 ns to 10 s, 500 ps resolution
		Time accuracy: ±(0.2% of setting value + 1 ns)
	Event:	Edge/Edge Qualify/State/Pulse/Pulse(Qualified)/Pulse State/I^2C/SPI/Serial Pattern (Event can be selected as anything other than TV or Edge OR)
	Enhanced	
	TV:	Trigger on video signal in various TV systems
		Mode: NTSC/PAL/HDTV/USER
		Input CH: CH1 to CH4
		Sync Guard: 60-90% of Hsync, in steps of 1%
		Line: 5-1054(NTSC) 2-1251(PAL) 2-1251(HDTV) 2-2048(USER)
		Field: 1/2/X
		Frame Skip: 1/2/4/8
	I^2C:	Trigger on I^2C bus signal
		Mode: NON ACK, Every Start, General Cll, Start byte/HS Mode, ADR&DATA
	SPI:	Trigger on SPI (Serial Peripheral Interface) bus signal
		Mode: 3-wire, 4-wire
	Serial Pattern:	Trigger on general-purpose serial communications signal
		Maximum bit rate: 50 Mbps
		Maximum bit length: 128 bits

1   In reference operating state (see page 19-11), after warm-up time has elapsed, immediately after calibration
2   In reference operating state (see page 19-11), after warm-up time has elapsed
3   Typical values are typical or mean values. They are not strictly guaranteed.

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19.4 Time Axis

Item	Specifications
Time axis setting range	500 ps/div to 50 s/div (1-2-5 steps)
Timebase accuracy[1]	±(0.001%)
Time axis measurement accuracy[1]	±(0.001% + 10 ps + time for 1 sample)

1 In reference operating state (see page 19-11), after warm-up time has elapsed

19.5 Display Section

Item	Specifications
Display	8.4-inch (21.3 cm) color TFT liquid crystal display
Display screen size	170.5 mm (wide) × 127.9 mm (high)
Total display pixels	1024 × 768 (XGA)
Waveform display pixels	800 × 640

19.6 Functions

Waveform Acquisition and Display

Item	Specifications
Acquisition mode	Selectable from normal, average, and envelope acquisition modes
High resolution mode	Vertical axis resolution increased to maximum 13 bits
Interleave mode	One input signal is sampled with two (or four) A/D converters, doubling (or quadrupling) the maximum sample rate.
Sampling mode	For some time axis settings, can be switched between realtime sampling and repetitive sampling.
Interpolate function	Actual sampled data can be interpolated by a maximum factor of 1000 (2000 in high resolution mode), increasing the time resolution (max. 2.5 TS/s).

Record length	DL9040/DL9140/DL9240
	  2.5 kW/6.25 kW/12.5 kW/25 kW/62.5 kW/125 kW/250 kW/625 kW/1.25 MW/2.5 MW
	DL9040L/DL9140L/DL9240L
	  2.5 kW/6.25 kW/12.5 kW/25 kW/62.5 kW/125 kW/250 kW/625 kW/1.25 MW/2.5 MW/6.25 MW

Zoom	Waveforms can be zoomed in the time axis direction or voltage axis direction (with up to two independent zoom sections)
Display format	Analog waveform divided into 1, 2, or 4 displays
Display interpolation	Can be selected from dot display of sample points, sine interpolation display, linear interpolation display, and pulse interpolation display.
Graticule	Can be selected from three types
Auxiliary display ON/OFF	Display of scale values, waveform labels, and trigger marks can be switched on or off.
Accumulate	Provides waveform superimposition. Can be selected from count mode and time mode.
Snapshot	Currently displayed waveform can be left on the screen Snapshot waveforms can be saved and reloaded (bitmap format)
Clear trace	Displayed waveforms can be erased.

Vertical Axis and Horizontal Axis Settings

Item	Specifications
Channel ON/OFF	CH1 to CH4 can be independently switched ON/OFF
Input filter	Independent bandwidth limits possible for CH1 to CH4
Vertical position setting	Waveform can be moved vertically by ±4 div from the center of the waveform display window
Roll mode	When trigger mode is Auto, Auto Level, or Single, roll mode display is used in following time axis range. 100 ms/div to 50 s/div

Analysis

Item	Specifications		
Search and zoom	Part of a displayed waveform can be found and enlarged. Voltage axis direction magnification: 1-10 times Time axis direction magnification: From normal size to 1 data value/div Auto Scroll function: Automatically scrolls the zoom screen in the time axis direction. Search function: Find specified part of currently displayed waveform from a specified time, and display in zoom window. Search Type: Edge/Edge Qualified/State/Pulse/Pulse(Qualified)/Pulse State/ I²C(Option)/SPI(Option)/Serial Pattern		
History memory	Max. images:	DL9040/DL9140/DL9240	1000 (2.5 kW) using history 800 (2.5 kW) using N single
		DL9040L/DL9140L/DL9240L	2000 (2.5 kW) using history 1600 (2.5 kW) using N single
	The number of history images does not change when interleave mode is enabled.		
	History search:	Searches for waveforms in the history memory meeting a specified condition, and displays.	
	Search type:	RECT/WAVE/POLYGON/PARAMETER(MEASURE/FFT/XY)	
	Replay:	Automatically replay history waveforms.	
Cursor measurement	Can be selected from 5 different cursor types Vertical/Horizontal/VT/H&V/Marker/Serial		

Automated measurement of waveform parameters	Following waveform parameters can be measured automatically.
	Items applicable to all setting range data, regardless of period:
	  MAX/MIN/HIGH/LOW/P-P/HIGH-LOW/+OVER/-OVER/RMS/MEAN/Sdev/IntegTY
	Items applicable to all setting range data, related to period:
	  C.rms/C.mean/C.Sdev/C.IntegTY/(1/FREQ)/FREQ/COUNT/BURST
	Items applicable to first data found in setting range:
	  +Width/-Width/PERIOD/DUTY/RISE/FALL/DELAY		

ANALYSIS	XY, FFT, Wave Parameter, Accum Histogram, Serial Bus		
XY	Selecting the specified trace on each of the horizontal axis (X-axis) and vertical axis (Y-axis), provides a view of the voltage phase relationship between the two trace signals.		
FFT	FFT (fast Fourier transform) (max. 250k points).		
Wave Parameter	Display one waveform parameter in Histogram, Trend, or List format.		
Accum Histogram	For accumulated waveforms, the frequency distribution in a specified range is shown as a histogram.		
Serial Bus	Analysis and display of I²C, SPI, and other serial bus signal data.		
Telecom test	Mask Test or Eye Pattern measurement is carried out.		

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Item	Specifications
Computation Standard	Computation is possible for a maximum of 8 traces (CH1 to CH4, and M1 to M4) +/–/*/INTEG/COUNT(EDGE)/COUNT(ROTARY)/Through/Delay/Moving Avg/LowPass/High Pass
Reference function	Maximum of 4 traces (M1 to M4) of saved waveform data can be displayed, and analyzed (computation, cursor). Waveforms with history can be loaded and replay.
Action on trigger	Carry out the selected action in automated measurement of waveform parameters or a waveform zone determination, when each condition holds.

Mode: OFF/All Condition/(GO/NOGO Zone/Param)/(GO/NOGO Telecom Test)
Action: Buzzer/Print/Save
All Condition: Carry out specified action for each acquisition.

GO/NOGO Zone:		Determine whether acquired waveform passes specified zone or not.
	Zone type:	RECT/Polygon/WAVE
GO/NOGO Parameter:		Determine whether the specified parameter of the acquired waveform is in the specified range or not.
	Parameter type:	Measure/FFT/XY
GO/NOGO Telecom Test:		Make the determination using the condition set in "Telecom Test".
	Category:	Mask Test/Eye Pattern

Screen Image Data Output

Item	Specifications
Built-in printer (option)	Screen hard copy can be output.
External printer	Output screen image to external printer through USB/Ethernet. Supports EPSON/CANON/HP(PCL) inkjet printers etc.
PC card /built-in media/ Internal HDD[1]/USB HDD/ Network drive[2]	Output data format: PNG, BMP, JPEG

1 Internal HDD/USB HOST is an option.
2 When Ethernet Interface option is installed.

Saving Data

Item	Specifications
History memory PC card /built-in media / Internal HDD[1]/USB HDD/ Network drive[2]	Max. 2000 waveform images automatically saved (for record length 2.5 KW) Waveform data, setting data, and other data can be saved.

1 Internal HDD is an option.
2 When Ethernet Interface option is installed.

Miscellaneous

Item	Specifications	
Setup	Initialize:	Automatically return settings to their factory defaults.
	Auto setup:	Automatically set to the optimal settings for the input signal.
	CH auto scale:	Automatically set the voltage axis only for the trace to the optimal setting for the input signal.
	User:	Up to three sets of user-defined settings can be saved in memory and recalled.
	Store/recall:	Up to four sets of settings can be stored and recalled
Calibration	Automatic calibration and manual calibration possible.	
Environmental settings	Screen color, date and time, message language, and click sound on/off can be set.	
Overview	Provides a system specification overview.	
Self-test	Allows memory test, key test, printer and other tests.	
Numeric keypad	Allows input of numeric values.	
Cursor keys	Move the cursor in all four directions.	
Probe compensation signal output	Outputs signal (approx. 1 Vp-p, approx. 1 kHz square wave) from front panel probe compensation signal output connector.	
Help function	Displays information about settings.	

19.7 Built-in Printer (/B5 option)

Item	Specifications
Printing method	Thermal line dot printer
Thermal element resolution	8 dots/mm
Paper width	112 mm

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19.8 Auxiliary Inputs and Outputs

External Trigger Input (TRIG IN)

Item	Specifications
Connector type	BNC
Input bandwidth[1]	DC-100 MHz
Input impedance	Approx. 1 MΩ, approx. 18pF
Maximum input voltage	±40 V (DC + AC peak) or 28 Vrms, frequency 10 kHz or below
Trigger level	±2 V (measurement resolution 5 mV)

1 In standard operating state, after warm-up time has elapsed

External Trigger Output (TRIG OUT)

Item	Specifications
Connector type	BNC
Output level	5V TTL
Output logic format	Negative logic
Output delay time	50 ns max
Output hold time	Low level 50 ns min, High level 50 ns min

Comparator Outputs (COMP OUT)

Item	Specifications
Connector type	12214-8210-00TA (manufacturer 3M)
Output connectors	14 (CH1-4 trigger comparator output, trigger out output, trigger enable output, 3.3 V, GND)
Output level	3.3 V LVPECL (difference output)
Output delay time	50 ns max
Output hold time	Low level 50 ns min, High level 50 ns min

Probe Interface Connectors

Item	Specifications
Output connectors	4
Output voltage	±12 V (up to total 1.2 A together with probe power connector), ±5 V (up to total 800 mA)
Suitable probes	Active probe (701913), Differential probe (701923)

Probe Power Connector (/P2 option)

Item	Specifications
Output connectors	2
Output voltage	±12 V (up to total 1.2 A together with probe interface connector)
Suitable probes	FET probe (700939), current probe (701932, 701933), differential probe (701920, 701921)

GO/NOGO input/output

Item	Specifications
Connector type	RJ-12 modular jack
Signal types	START-IN, GO-OUT, NOGO-OUT
Input/output levels	START-IN input: TTL (0-5 V) switch input also possible GO-OUT, NOGO_OUT output: TTL (0-5 V)
Suitable cable	Four-core modular cable (366973)

Video signal output (VIDEO OUT)

Item	Specifications
Connector type	D-Sub 15-pin receptacle
Output format	Analog RGB output
Output resolution	Sub-XGA output 1024 × 768 pixels, approx. 60 Hz Vsync (pixel clock frequency 62.5 MHz)

19.9 Storage

Built-in Memory Media

Item	Specifications
Media type	Compact Flash
Capacity	32 MB

Built-in Hard Disk (/C8 option)

Item	Specifications
Number of drives	1
Size	2.5-inch
Usable HDD capacity	30 GB FAT32
File names	Long file names (up to 256 ASCII characters) supported

USB Peripheral Interface Connector

Item	Specifications
Connector type	USB type A connector (receptacle)
Electrical and mechanical specifications	USB Rev. 2.0 compliant
Supported transfer standards	LS (Low Speed) mode (1.5 Mbps), FS (Full Speed) mode (12 Mbps)
Supported devices	HID Class Ver. 1.1 USB HID Class Ver1.1 compliant mouse and 109-key keyboard (Japanese), 104-key keyboard (US) USB Printer Class Ver. 1.0 compliant, EPSON/HP (PCL) inkjet printers supported USB Mass Storage Class Ver. 1.1 compliant mass-storage devices USB HUB Device (one only) Maximum four devices can be connected. * Check with the Yokogawa marketing department for a list of peripherals whose operation has been confirmed.
Ports	2
Power supply	5 V, 500 mA (each port)

Specifications

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19.10 Computer Interfaces

PC card interface

Item	Specifications
Ports	2 (front panel × 1, rear panel × 1)
Supported cards	GP-IB card (option support) National Instruments NI PCMCIA-GPIB cards supported Storage cards Flash ATA memory cards (PC card TYPE II), CF card + adapter card, HDD-type PC cards

Check with your supplier for a list of products whose operation has been confirmed.

USB-PC Connection

Item	Specifications
Connector type	USB type B connector (receptacle)
Electrical and mechanical Specifications	USB Rev.2.0 compliant
Supported transfer standards	HS (High Speed) mode (480 Mbps), FS (Full Speed) mode (12 Mbps)
Ports	1
Supported protocol	Acts as a composite device simultaneously supporting the following two protocols. USBTMC-USB488 (USB Test and Measurement Class Ver. 1.0)[1] USB bus can be used with GPIB commands. Mass Storage Class Ver. 1.1 Access from a computer to this unit's built-in storage media, HDD, PC card[2], USB mass-storage device is possible (reading and writing). However, formatting is not possible.
Supported system environment	Computer running Windows XP/2000 Japanese/English version, equipped with USB port.

1 Separate driver is not required.
2 Driver is not required.

Ethernet (/C8, /C10 options)

Item	Specifications
Connector type	RJ-45 connector
Communications port	1
Electrical and mechanical Specifications	IEEE802.3 compliant
Transmission method	Ethernet (100BASE-TX/10BASE-T)
Communications protocol	TCP/IP
Supported services	DHCP, DNS, Microsoft network file sharing server and client, SNTP client, firewall
LED indicators	Two: Link (Yellow: lit when link is established), Activity (Green: lit while packets being transferred)

19.11 General Specifications

Item	Specifications
Standard operating conditions	Ambient temperature: 23 ±5˚C Ambient humidity: 55 ±10%RH Power supply voltage and frequency tolerance: Within 1% of rated value
Warm-up time	At least 30 minutes
Storage conditions	Temperature: –20 to 60˚C Humidity: 20 to 80%RH (no condensation)
Operating conditions	Temperature: 5 to 40˚C Humidity: 20 to 80%RH (not using printer) (no condensation) 35 to 80%RH (using printer) (no condensation)
Recommended calibration period	1 year
Storage altitude	3000 m or less
Operating altitude	2000 m or less
Rated supply voltage	100 to 120 VAC or 220 to 240 VAC (switched automatically)
Power supply voltage fluctuation tolerance	90 to 132 VAC or 180 to 264 VAC
Rated supply frequency	50/60 Hz
Power supply frequency fluctuation tolerance	48 to 63 Hz
Power supply fuse	Internal (not replaceable)
Maximum power consumption	300 VA
Withstand voltage (between power supply and case)	1.5 kVAC, 1 minute
Insulation resistance (between power supply and case)	500 VDC, at least 10 MΩ
External dimensions	350(W) × 200(H) × 178(D) mm (with printer cover packed away, excluding handle and other projections)
Weight (including printer)	Approx. 6.5 kg
Cooling method	Forced air cooling, side ventilation
Installation orientation	Horizontal (stand may be used) or vertical; must not be stacked
Battery backup	Setup data and clock are backed up with the internal lithium battery Battery lifetime: Approx. 5 years (at ambient temperature 25˚C)

Specifications

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Item	Specifications	
Safety Standards	Complying standards	EN61010-1 • Overvoltage category II[1] • Pollution degree 2[2]
Emission	Complying standards	• EN61326 Class A, C-Tick AS/NZS CISPR11 (applies to 701307, 701308, 701310, 401311, 701312, 101313, 701913, 701923, 701943, and 701974 with 701975) • EN61000-3-2 • EN61000-3-3 • This product is a Class A (for commercial environment) product. Operation of this product in a residential area may cause radio interference in which case the user is required to correct the interference. Cable condition • External trigger input terminal(TRIG IN) Use a BNC cable[3] and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (DL9000 end). • Trigger output terminall(TRIG OUT) Same as the external trigger input terminal above. • Trigger comparator output terminal(TRIG IN) Use a Trigger comparator output cable(YOKOGAWA model 701976, sold separately). and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (DL9000 end). • Video signal output (VIDEO OUT) terminal Use a 15-pin D-Sub VGA shielded cable[3] and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN)(TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (DL9000 end). • USB PERIPHERAL connector Attach a ferrite core (TDK: ZCAT1325-0530A, YOKOGAWA: A1181MN) on one end (DL7400 end) of the USB cable[3]. • USB interface connector Attach a ferrite core (TDK: ZCAT1325-0530A, YOKOGAWA: A1181MN) on one end (DL7400 end) of the USB cable[3]. • GO/NO-GO output terminal Use a GO/NOGO cable (YOKOGAWA model 366973, sold separately)and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) twice around the ferrite core (see figure below) on one end (DL9000 end). • Ethernet interface connector Use a Ethernet interface cable[3] and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) twice around the ferrite core (see figure below) on one end (DL9000 end).

Item	Specifications		
Immunity	Complying standards	• EN61326 commercial environment (applies to 701307, 701308, 701310, 701311, 101312, 701313,701913, 701923, 701943, and 701974 with 701975) Influence in the immunity environment (performance criterion A) • Noise increase: within ±200 mV (when using 701943) within ±200 mV (when using 701974 with 701975) within ±2 V (when using 701913)	
	Test conditions	When 5 GS/s, envelope mode, 20 MHz BWL (10:1 probe attenuation setting), and 50-Ω termination at the probe tip. Cable condition: Same as the cable condition for emission above.	
	Test Item	1. Electrostatic discharge	EN61000-4-2 Air discharge: ±8 kV, contact discharge: ±4 kV, criteria B
		2. Radiated immunity	EN61000-4-3 80 MHz to 1 GHz, 1.4 GHz to 2 GHz, 10 V/m Criteria A
		3. Conducted immunity	EN61000-4-6 3 V, criteria A
		4. Electrical fast transient/burst	EN61000-4-4 Power line: ±2 kV, signal line: ±1 kV, criteria B
		5. Power frequency magnetic field	EN61000-4-8 30 A/m, 50 Hz, criteria A
		6. Surge immunity	EN61000-4-5 Between lines: ±1 kV, common: ±2 kV criteria B
		7. Voltage dip and interruption	EN61000-4-11 0.5 cycle, both polarities, 100%, criteria A
	Definitions of criteria	• Criteria A Aforementioned "Influence in the immunity environment" is A and B met during the test. • Criteria B This apparatus continues to operate without hang-up or falling into uncontrollable conditions during the test. No change of actual operating state or stored data is allowed.	

1   The instrument's expected transient overvoltage is 1500 V. Do not use the instrument for overvoltage category II, III, or IV measurements.
2   Pollution Degree applies to the degree of adhesion of a solid, liquid, or gas which deteriorates withstand voltage or surface resistivity. Pollution Degree 2 applies to normal indoor atmospheres (with only non-conductive pollution).
3   Use cables of length 3 m or less.

Specifications

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19.12 External Dimensions

Main unit

Units: mm

Unless otherwise specified, tolerances are ±3% (±0.3 mm for dimensions less than 10 mm).

Rear View

11.1

178

15.5

92

200

10

25

350

25
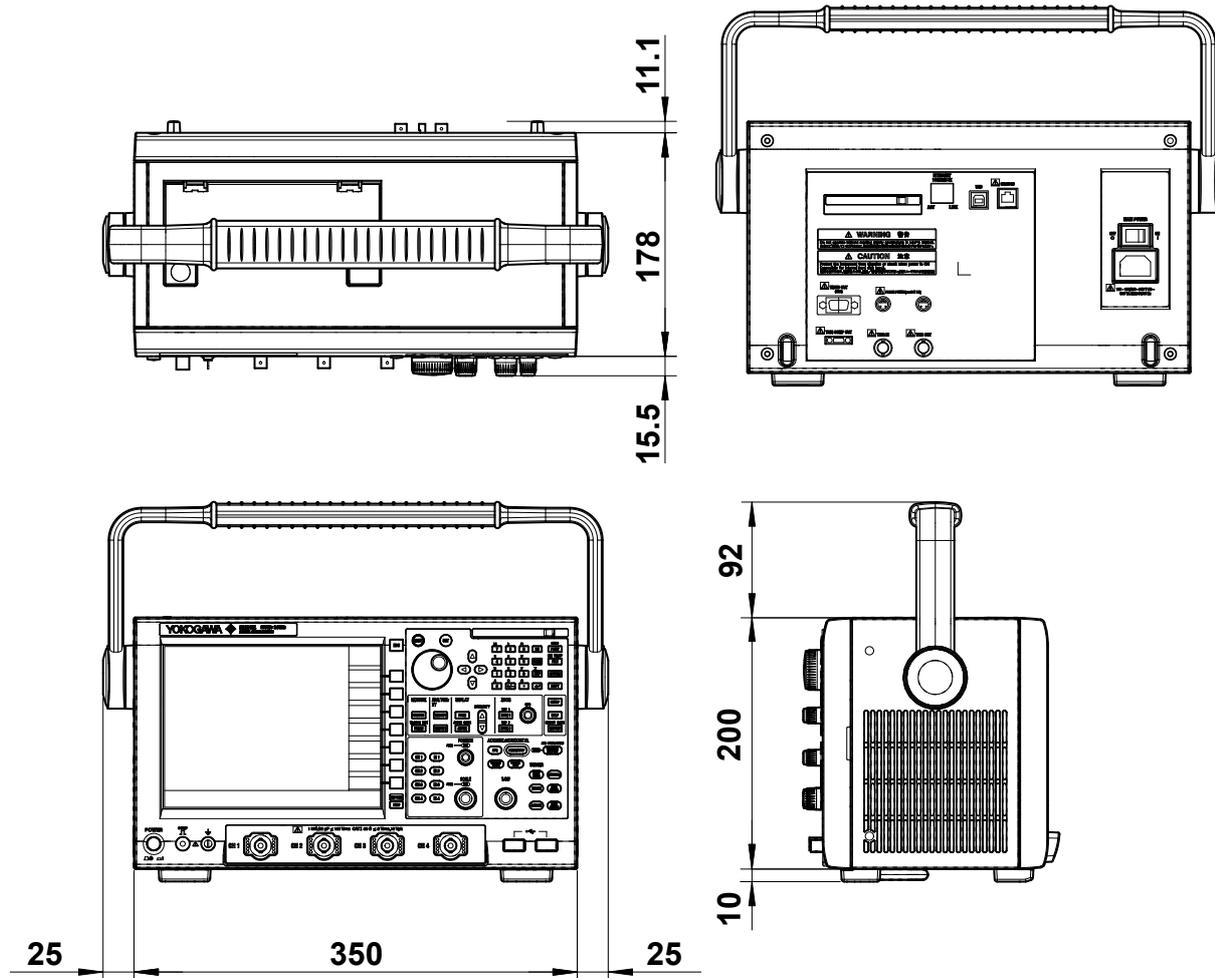
Appendix 1 Relationship between the Time Axis Setting, Sample Rate and Record Length

Overview

The sample rate and record length depend on the time axis setting, and whether repetitive sampling mode, interleave mode, data interpolation, and high resolution mode are on or off.
The DL9000 uses repetitive sampling and data interpolation to increase the effective sample rate above the maximum sampling rate. When the maximum sample rate is exceeded, the following processing is carried out.

When data interpolation is on
- When the repetitive sampling mode is off, the data is interpolated to increase the sampling rate.
- When the repetitive sampling mode is on, if the time axis setting is 50 ns/div or below, and the sample rate is 500 G/s or more, then repetitive sampling is carried out, and otherwise data interpolation is carried out.
- If the sampling rate exceeds 2500 GS/s, 25000 GS/s is maintained, and the record length is reduced.

When data interpolation is off
- When the repetitive sampling mode is off, the record length is reduced to increase the sample rate. If the record length is less than 100 words, repetitive sampling is carried out.
- When the repetitive sampling mode is on, repetitive sampling is carried out with the record length 1.25 Mwords or below.
- When the settings are such that the sample rate exceeds 2500 GS/s, 25000 GS/s is maintained, and the record length is reduced.

Regardless of whether data interpolation is on or off, the minimum sample rate is 50 S/s.

The following pages show examples of the relationship between the time axis setting, sample rate, and record length.

Appendix 1 Relationship between the Time Axis Setting, Sample Rate and Record Length

Interpolation ON (Max: 1.25GS/s)

DL9040/DL9040L/DL9140/DL9140L: Interleave mode OFF, High resolution mode ON

T/div (s/div)	2.5k S/s	2.5k pts	6.25k S/s	6.25k pts	12.5k S/s	12.5k pts	25k S/s	25k pts	62.5k S/s	62.5k pts	125k S/s	125k pts	250k S/s	250k pts	625k S/s	625k pts	1.25M S/s	1.25M pts	2.5M *1 S/s	2.5M *1 pts	6.25M *1 S/s	6.25M *1 pts
500ps	500GS/s	2.5k	1250GS/s	6.25k	2500GS/s	12.5k	2500GS/s	12.5k	2500GS/s	12.5k	2500GS/s	12.5k	2500GS/s	12.5k	2500GS/s	12.5k	2500GS/s	12.5k	2500GS/s	12.5k		
1ns	250GS/s	2.5k	625GS/s	6.25k	1250GS/s	12.5k	2500GS/s	25k	2500GS/s	25k	2500GS/s	25k	2500GS/s	25k	2500GS/s	25k	2500GS/s	25k	2500GS/s	25k		
2ns	125GS/s	2.5k	312.5GS/s	6.25k	625GS/s	12.5k	1250GS/s	25k	2500GS/s	50k	2500GS/s	50k	2500GS/s	50k	2500GS/s	50k	2500GS/s	50k	2500GS/s	50k		
5ns	50GS/s	2.5k	125GS/s	6.25k	250GS/s	12.5k	500GS/s	25k	1250GS/s	62.5k	2500GS/s	125k	2500GS/s	125k	2500GS/s	125k	2500GS/s	125k	2500GS/s	125k		
10ns	25GS/s	2.5k	62.5GS/s	6.25k	125GS/s	12.5k	250GS/s	25k	625GS/s	62.5k	1250GS/s	125k	2500GS/s	250k	2500GS/s	250k	2500GS/s	250k	2500GS/s	250k		
20ns	12.5GS/s	2.5k	31.25GS/s	6.25k	62.5GS/s	12.5k	125GS/s	25k	312.5GS/s	62.5k	625GS/s	125k	1250GS/s	250k	2500GS/s	500k	2500GS/s	500k	2500GS/s	500k		
50ns	5GS/s	2.5k	12.5GS/s	6.25k	25GS/s	12.5k	50GS/s	25k	125GS/s	62.5k	250GS/s	125k	500GS/s	250k	1250GS/s	625k	2500GS/s	1.25M	2500GS/s	1.25M		
100ns	2.5GS/s	2.5k	6.25GS/s	6.25k	12.5GS/s	12.5k	25GS/s	25k	62.5GS/s	62.5k	125GS/s	125k	250GS/s	250k	625GS/s	625k	1250GS/s	1.25M	2500GS/s	2.5M		
200ns	1.25GS/s	2.5k	3.125GS/s	6.25k	6.25GS/s	12.5k	12.5GS/s	25k	31.25GS/s	62.5k	62.5GS/s	125k	125GS/s	250k	312.5GS/s	625k	625GS/s	1.25M	1250GS/s	2.5M		
500ns	500MS/s	2.5k	1.25GS/s	6.25k	2.5GS/s	12.5k	5GS/s	25k	12.5GS/s	62.5k	25GS/s	125k	50GS/s	250k	125GS/s	625k	250GS/s	1.25M	500GS/s	2.5M		
1us	250MS/s	2.5k	625MS/s	6.25k	1.25GS/s	12.5k	2.5GS/s	25k	6.25GS/s	62.5k	12.5GS/s	125k	25GS/s	250k	62.5GS/s	625k	125GS/s	1.25M	250GS/s	2.5M		
2us	125MS/s	2.5k	312.5MS/s	6.25k	625MS/s	12.5k	1.25GS/s	25k	3.125GS/s	62.5k	6.25GS/s	125k	12.5GS/s	250k	31.25GS/s	625k	62.5GS/s	1.25M	125GS/s	2.5M		
5us	50MS/s	2.5k	125MS/s	6.25k	250MS/s	12.5k	500MS/s	25k	1.25GS/s	62.5k	2.5GS/s	125k	5GS/s	250k	12.5GS/s	625k	25GS/s	1.25M	50GS/s	2.5M		
10us	25MS/s	2.5k	62.5MS/s	6.25k	125MS/s	12.5k	250MS/s	25k	625MS/s	62.5k	1.25GS/s	125k	2.5GS/s	250k	6.25GS/s	625k	12.5GS/s	1.25M	25GS/s	2.5M		
20us	12.5MS/s	2.5k	31.25MS/s	6.25k	62.5MS/s	12.5k	125MS/s	25k	312.5MS/s	62.5k	625MS/s	125k	1.25GS/s	250k	3.125GS/s	625k	6.25GS/s	1.25M	12.5GS/s	2.5M		
50us	5MS/s	2.5k	12.5MS/s	6.25k	25MS/s	12.5k	50MS/s	25k	125MS/s	62.5k	250MS/s	125k	500MS/s	250k	1.25GS/s	625k	2.5GS/s	1.25M	5GS/s	2.5M		
100us	2.5MS/s	2.5k	6.25MS/s	6.25k	12.5MS/s	12.5k	25MS/s	25k	62.5MS/s	62.5k	125MS/s	125k	250MS/s	250k	625MS/s	625k	1.25GS/s	1.25M	2.5GS/s	2.5M		
200us	1.25MS/s	2.5k	3.125MS/s	6.25k	6.25MS/s	12.5k	12.5MS/s	25k	31.25MS/s	62.5k	62.5MS/s	125k	125MS/s	250k	312.5MS/s	625k	625MS/s	1.25M	1.25GS/s	2.5M		
500us	500kS/s	2.5k	1.25MS/s	6.25k	2.5MS/s	12.5k	5MS/s	25k	12.5MS/s	62.5k	25MS/s	125k	50MS/s	250k	125MS/s	625k	250MS/s	1.25M	500MS/s	2.5M		
1ms	250kS/s	2.5k	625kS/s	6.25k	1.25MS/s	12.5k	2.5MS/s	25k	6.25MS/s	62.5k	12.5MS/s	125k	25MS/s	250k	62.5MS/s	625k	125MS/s	1.25M	250MS/s	2.5M		
2ms	125kS/s	2.5k	312.5kS/s	6.25k	625kS/s	12.5k	1.25MS/s	25k	3.125MS/s	62.5k	6.25MS/s	125k	12.5MS/s	250k	31.25MS/s	625k	62.5MS/s	1.25M	125MS/s	2.5M		
5ms	50kS/s	2.5k	125kS/s	6.25k	250kS/s	12.5k	500kS/s	25k	1.25MS/s	62.5k	2.5MS/s	125k	5MS/s	250k	12.5MS/s	625k	25MS/s	1.25M	50MS/s	2.5M		
10ms	25kS/s	2.5k	62.5kS/s	6.25k	125kS/s	12.5k	250kS/s	25k	625kS/s	62.5k	1.25MS/s	125k	2.5MS/s	250k	6.25MS/s	625k	12.5MS/s	1.25M	25MS/s	2.5M		
20ms	12.5kS/s	2.5k	31.25kS/s	6.25k	62.5kS/s	12.5k	125kS/s	25k	312.5kS/s	62.5k	625kS/s	125k	1.25MS/s	250k	3.125MS/s	625k	6.25MS/s	1.25M	12.5MS/s	2.5M		
50ms	5kS/s	2.5k	12.5kS/s	6.25k	25kS/s	12.5k	50kS/s	25k	125kS/s	62.5k	250kS/s	125k	500kS/s	250k	1.25MS/s	625k	2.5MS/s	1.25M	5MS/s	2.5M		
100ms	2.5kS/s	2.5k	6.25kS/s	6.25k	12.5kS/s	12.5k	25kS/s	25k	62.5kS/s	62.5k	125kS/s	125k	250kS/s	250k	625kS/s	625k	1.25MS/s	1.25M	2.5MS/s	2.5M		
200ms	1.25kS/s	2.5k	3.125kS/s	6.25k	6.25kS/s	12.5k	12.5kS/s	25k	31.25kS/s	62.5k	62.5kS/s	125k	125kS/s	250k	312.5kS/s	625k	625kS/s	1.25M	1.25MS/s	2.5M		
500ms	500S/s	2.5k	1.25kS/s	6.25k	2.5kS/s	12.5k	5kS/s	25k	12.5kS/s	62.5k	25kS/s	125k	50kS/s	250k	125kS/s	625k	250kS/s	1.25M	500kS/s	2.5M		
1s	250S/s	2.5k	625S/s	6.25k	1.25kS/s	12.5k	2.5kS/s	25k	6.25kS/s	62.5k	12.5kS/s	125k	25kS/s	250k	62.5kS/s	625k	125kS/s	1.25M	250kS/s	2.5M		
2s	125S/s	2.5k	312.5S/s	6.25k	625S/s	12.5k	1.25kS/s	25k	3.125kS/s	62.5k	6.25kS/s	125k	12.5kS/s	250k	31.25kS/s	625k	62.5kS/s	1.25M	125kS/s	2.5M		
5s	50S/s	2.5k	125S/s	6.25k	250S/s	12.5k	500S/s	25k	1.25kS/s	62.5k	2.5kS/s	125k	5kS/s	250k	12.5kS/s	625k	25kS/s	1.25M	50kS/s	2.5M		
10s	*50S/s*	*5k*	62.5S/s	6.25k	125S/s	12.5k	250S/s	25k	625S/s	62.5k	1.25kS/s	125k	2.5kS/s	250k	6.25kS/s	625k	12.5kS/s	1.25M	25kS/s	2.5M		
20s	*50S/s*	*10k*	*50S/s*	*10k*	62.5S/s	12.5k	125S/s	25k	312.5S/s	62.5k	625S/s	125k	1.25kS/s	250k	3.125kS/s	625k	6.25kS/s	1.25M	12.5kS/s	2.5M		
50s	*50S/s*	*25k*	*50S/s*	*25k*	*50S/s*	*25k*	50S/s	25k	125S/s	62.5k	250S/s	125k	500S/s	250k	1.25kS/s	625k	2.5kS/s	1.25M	5kS/s	2.5M		

Bold: Expanded interpolation or expanded repetitive sampling (variable record length)

Interpolation or repetitive sampling (when repetitive sampling mode is ON)

Interpolation

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

Envelope mode available

Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Interpolation ON (Max: 2.5GS/s)
a) DL9040/DL9040L/DL9140/DL9140L: Interleave mode OFF, High resolution mode OFF   b) DL9040/DL9040L/DL9140/DL9140L: Interleave mode ON, High resolution mode ON,
c) DL9240/DL9240L: Interleave mode OFF, High resolution mode OFF
DL9240/DL9240L: Interleave mode OFF, High resolution mode ON

Each cell shows **Sample rate / Record length**.

T/div	2.5k	6.25k	12.5k	25k	62.5k	125k	250k	625k	1.25M	2.5M *1	6.25M *1
500ps	500GS/s / 2.5k	1250GS/s / 6.25k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k
1ns	250GS/s / 2.5k	625GS/s / 6.25k	1250GS/s / 12.5k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k
2ns	125GS/s / 2.5k	312.5GS/s / 6.25k	625GS/s / 12.5k	1250GS/s / 25k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k
5ns	50GS/s / 2.5k	125GS/s / 6.25k	250GS/s / 12.5k	500GS/s / 25k	1250GS/s / 62.5k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k
10ns	25GS/s / 2.5k	62.5GS/s / 6.25k	125GS/s / 12.5k	250GS/s / 25k	625GS/s / 62.5k	1250GS/s / 125k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k
20ns	12.5GS/s / 2.5k	31.25GS/s / 6.25k	62.5GS/s / 12.5k	125GS/s / 25k	312.5GS/s / 62.5k	625GS/s / 125k	1250GS/s / 250k	2500GS/s / 500k	2500GS/s / 500k	2500GS/s / 500k	2500GS/s / 500k
50ns	5GS/s / 2.5k	12.5GS/s / 6.25k	25GS/s / 12.5k	50GS/s / 25k	125GS/s / 62.5k	250GS/s / 125k	500GS/s / 250k	1250GS/s / 625k	2500GS/s / 1.25M	2500GS/s / 1.25M	2500GS/s / 1.25M
100ns	2.5GS/s / 2.5k	6.25GS/s / 6.25k	12.5GS/s / 12.5k	25GS/s / 25k	62.5GS/s / 62.5k	125GS/s / 125k	250GS/s / 250k	625GS/s / 625k	1250GS/s / 1.25M	2500GS/s / 2.5M	2500GS/s / 2.5M
200ns	1.25GS/s / 2.5k	3.125GS/s / 6.25k	6.25GS/s / 12.5k	12.5GS/s / 25k	31.25GS/s / 62.5k	62.5GS/s / 125k	125GS/s / 250k	312.5GS/s / 625k	625GS/s / 1.25M	1250GS/s / 2.5M	2500GS/s / 5M
500ns	500MS/s / 2.5k	1.25GS/s / 6.25k	2.5GS/s / 12.5k	5GS/s / 25k	12.5GS/s / 62.5k	25GS/s / 125k	50GS/s / 250k	125GS/s / 625k	250GS/s / 1.25M	500GS/s / 2.5M	1250GS/s / 6.25M
1us	250MS/s / 2.5k	625MS/s / 6.25k	1.25GS/s / 12.5k	2.5GS/s / 25k	6.25GS/s / 62.5k	12.5GS/s / 125k	25GS/s / 250k	62.5GS/s / 625k	125GS/s / 1.25M	250GS/s / 2.5M	625GS/s / 6.25M
2us	125MS/s / 2.5k	312.5MS/s / 6.25k	625MS/s / 12.5k	1.25GS/s / 25k	3.125GS/s / 62.5k	6.25GS/s / 125k	12.5GS/s / 250k	31.25GS/s / 625k	62.5GS/s / 1.25M	125GS/s / 2.5M	312.5GS/s / 6.25M
5us	50MS/s / 2.5k	125MS/s / 6.25k	250MS/s / 12.5k	500MS/s / 25k	1.25GS/s / 62.5k	2.5GS/s / 125k	5GS/s / 250k	12.5GS/s / 625k	25GS/s / 1.25M	50GS/s / 2.5M	125GS/s / 6.25M
10us	25MS/s / 2.5k	62.5MS/s / 6.25k	125MS/s / 12.5k	250MS/s / 25k	625MS/s / 62.5k	1.25GS/s / 125k	2.5GS/s / 250k	6.25GS/s / 625k	12.5GS/s / 1.25M	25GS/s / 2.5M	62.5GS/s / 6.25M
20us	12.5MS/s / 2.5k	31.25MS/s / 6.25k	62.5MS/s / 12.5k	125MS/s / 25k	312.5MS/s / 62.5k	625MS/s / 125k	1.25GS/s / 250k	3.125GS/s / 625k	6.25GS/s / 1.25M	12.5GS/s / 2.5M	31.25GS/s / 6.25M
50us	5MS/s / 2.5k	12.5MS/s / 6.25k	25MS/s / 12.5k	50MS/s / 25k	125MS/s / 62.5k	250MS/s / 125k	500MS/s / 250k	1.25GS/s / 625k	2.5GS/s / 1.25M	5GS/s / 2.5M	12.5GS/s / 6.25M
100us	2.5MS/s / 2.5k	6.25MS/s / 6.25k	12.5MS/s / 12.5k	25MS/s / 25k	62.5MS/s / 62.5k	125MS/s / 125k	250MS/s / 250k	625MS/s / 625k	1.25GS/s / 1.25M	2.5GS/s / 2.5M	6.25GS/s / 6.25M
200us	1.25MS/s / 2.5k	3.125MS/s / 6.25k	6.25MS/s / 12.5k	12.5MS/s / 25k	31.25MS/s / 62.5k	62.5MS/s / 125k	125MS/s / 250k	312.5MS/s / 625k	625MS/s / 1.25M	1.25GS/s / 2.5M	3.125GS/s / 6.25M
500us	500kS/s / 2.5k	1.25MS/s / 6.25k	2.5MS/s / 12.5k	5MS/s / 25k	12.5MS/s / 62.5k	25MS/s / 125k	50MS/s / 250k	125MS/s / 625k	250MS/s / 1.25M	500MS/s / 2.5M	1.25GS/s / 6.25M
1ms	250kS/s / 2.5k	625kS/s / 6.25k	1.25MS/s / 12.5k	2.5MS/s / 25k	6.25MS/s / 62.5k	12.5MS/s / 125k	25MS/s / 250k	62.5MS/s / 625k	125MS/s / 1.25M	250MS/s / 2.5M	625MS/s / 6.25M
2ms	125kS/s / 2.5k	312.5kS/s / 6.25k	625kS/s / 12.5k	1.25MS/s / 25k	3.125MS/s / 62.5k	6.25MS/s / 125k	12.5MS/s / 250k	31.25MS/s / 625k	62.5MS/s / 1.25M	125MS/s / 2.5M	312.5MS/s / 6.25M
5ms	50kS/s / 2.5k	125kS/s / 6.25k	250kS/s / 12.5k	500kS/s / 25k	1.25MS/s / 62.5k	2.5MS/s / 125k	5MS/s / 250k	12.5MS/s / 625k	25MS/s / 1.25M	50MS/s / 2.5M	125MS/s / 6.25M
10ms	25kS/s / 2.5k	62.5kS/s / 6.25k	125kS/s / 12.5k	250kS/s / 25k	625kS/s / 62.5k	1.25MS/s / 125k	2.5MS/s / 250k	6.25MS/s / 625k	12.5MS/s / 1.25M	25MS/s / 2.5M	62.5MS/s / 6.25M
20ms	12.5kS/s / 2.5k	31.25kS/s / 6.25k	62.5kS/s / 12.5k	125kS/s / 25k	312.5kS/s / 62.5k	625kS/s / 125k	1.25MS/s / 250k	3.125MS/s / 625k	6.25MS/s / 1.25M	12.5MS/s / 2.5M	31.25MS/s / 6.25M
50ms	5kS/s / 2.5k	12.5kS/s / 6.25k	25kS/s / 12.5k	50kS/s / 25k	125kS/s / 62.5k	250kS/s / 125k	500kS/s / 250k	1.25MS/s / 625k	2.5MS/s / 1.25M	5MS/s / 2.5M	12.5MS/s / 6.25M
100ms	2.5kS/s / 2.5k	6.25kS/s / 6.25k	12.5kS/s / 12.5k	25kS/s / 25k	62.5kS/s / 62.5k	125kS/s / 125k	250kS/s / 250k	625kS/s / 625k	1.25MS/s / 1.25M	2.5MS/s / 2.5M	6.25MS/s / 6.25M
200ms	1.25kS/s / 2.5k	3.125kS/s / 6.25k	6.25kS/s / 12.5k	12.5kS/s / 25k	31.25kS/s / 62.5k	62.5kS/s / 125k	125kS/s / 250k	312.5kS/s / 625k	625kS/s / 1.25M	1.25MS/s / 2.5M	3.125MS/s / 6.25M
500ms	500S/s / 2.5k	1.25kS/s / 6.25k	2.5kS/s / 12.5k	5kS/s / 25k	12.5kS/s / 62.5k	25kS/s / 125k	50kS/s / 250k	125kS/s / 625k	250kS/s / 1.25M	500kS/s / 2.5M	1.25MS/s / 6.25M
1s	250S/s / 2.5k	625S/s / 6.25k	1.25kS/s / 12.5k	2.5kS/s / 25k	6.25kS/s / 62.5k	12.5kS/s / 125k	25kS/s / 250k	62.5kS/s / 625k	125kS/s / 1.25M	250kS/s / 2.5M	625kS/s / 6.25M
2s	125S/s / 2.5k	312.5S/s / 6.25k	625S/s / 12.5k	1.25kS/s / 25k	3.125kS/s / 62.5k	6.25kS/s / 125k	12.5kS/s / 250k	31.25kS/s / 625k	62.5kS/s / 1.25M	125kS/s / 2.5M	312.5kS/s / 6.25M
5s	50S/s / 2.5k	125S/s / 6.25k	250S/s / 12.5k	500S/s / 25k	1.25kS/s / 62.5k	2.5kS/s / 125k	5kS/s / 250k	12.5kS/s / 625k	25kS/s / 1.25M	50kS/s / 2.5M	125kS/s / 6.25M
10s	*50S/s / 5k*	62.5S/s / 6.25k	125S/s / 12.5k	250S/s / 25k	625S/s / 62.5k	1.25kS/s / 125k	2.5kS/s / 250k	6.25kS/s / 625k	12.5kS/s / 1.25M	25kS/s / 2.5M	62.5kS/s / 6.25M
20s	*50S/s / 10k*	*50S/s / 10k*	62.5S/s / 12.5k	125S/s / 25k	312.5S/s / 62.5k	625S/s / 125k	1.25kS/s / 250k	3.125kS/s / 625k	6.25kS/s / 1.25M	12.5kS/s / 2.5M	31.25kS/s / 6.25M
50s	*50S/s / 25k*	*50S/s / 25k*	*50S/s / 25k*	50S/s / 25k	125S/s / 62.5k	250S/s / 125k	500S/s / 250k	1.25kS/s / 625k	2.5kS/s / 1.25M	5kS/s / 2.5M	12.5kS/s / 6.25M

Bold: Expanded interpolation or expanded repetitive sampling (variable record length)

[light-blue shading] Interpolation or repetitive sampling (when repetitive sampling mode is ON)

[blue shading] Interpolation

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

[dashed box] Envelope mode available (a, b)   [solid box] Envelope mode available (c)   [dash-dot box] Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Appendix

App

Interpolation ON (Max: 5GS/s)
a) DL9040/DL9040L/DL9140/DL9140L: Interleave mode ON, High resolution mode OFF, b) DL9240/DL9240L: Interleave mode OFF, High resolution mode OFF,
c) DL9240/DL9240L: Interleave mode ON, High resolution mode ON

Each cell shows **sample rate / record length**.

T/div	2.5k	6.25k	12.5k	25k	62.5k	125k	250k	625k	1.25M	2.5M *1	6.25M *1
500ps	500GS/s / 2.5k	1250GS/s / 6.25k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k
1ns	250GS/s / 2.5k	625GS/s / 6.25k	1250GS/s / 12.5k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k
2ns	125GS/s / 2.5k	312.5GS/s / 6.25k	625GS/s / 12.5k	1250GS/s / 25k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k
5ns	50GS/s / 2.5k	125GS/s / 6.25k	250GS/s / 12.5k	500GS/s / 25k	1250GS/s / 62.5k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k
10ns	25GS/s / 2.5k	62.5GS/s / 6.25k	125GS/s / 12.5k	250GS/s / 25k	625GS/s / 62.5k	1250GS/s / 125k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k
20ns	10GS/s / 2.5k	31.25GS/s / 6.25k	62.5GS/s / 12.5k	125GS/s / 25k	312.5GS/s / 62.5k	625GS/s / 125k	1250GS/s / 250k	2500GS/s / 500k	2500GS/s / 500k	2500GS/s / 500k	2500GS/s / 500k
50ns	5GS/s / 2k	12.5GS/s / 6.25k	25GS/s / 12.5k	50GS/s / 25k	125GS/s / 62.5k	250GS/s / 125k	500GS/s / 250k	1250GS/s / 625k	2500GS/s / 1.25M	2500GS/s / 1.25M	2500GS/s / 1.25M
100ns	2.5GS/s / 2.5k	6.25GS/s / 6.25k	12.5GS/s / 12.5k	25GS/s / 25k	62.5GS/s / 62.5k	125GS/s / 125k	250GS/s / 250k	625GS/s / 625k	1250GS/s / 1.25M	2500GS/s / 2.5M	2500GS/s / 2.5M
200ns	1.25GS/s / 2.5k	3.125GS/s / 6.25k	6.25GS/s / 12.5k	12.5GS/s / 25k	31.25GS/s / 62.5k	62.5GS/s / 125k	125GS/s / 250k	312.5GS/s / 625k	625GS/s / 1.25M	1250GS/s / 2.5M	2500GS/s / 5M
500ns	500MS/s / 2.5k	1.25GS/s / 6.25k	2.5GS/s / 12.5k	5GS/s / 25k	12.5GS/s / 62.5k	25GS/s / 125k	50GS/s / 250k	125GS/s / 625k	250GS/s / 1.25M	500GS/s / 2.5M	1250GS/s / 6.25M
1us	250MS/s / 2.5k	625MS/s / 6.25k	1.25GS/s / 12.5k	2.5GS/s / 25k	6.25GS/s / 62.5k	12.5GS/s / 125k	25GS/s / 250k	62.5GS/s / 625k	125GS/s / 1.25M	250GS/s / 2.5M	625GS/s / 6.25M
2us	125MS/s / 2.5k	312.5MS/s / 6.25k	625MS/s / 12.5k	1.25GS/s / 25k	3.125GS/s / 62.5k	6.25GS/s / 125k	12.5GS/s / 250k	31.25GS/s / 625k	62.5GS/s / 1.25M	125GS/s / 2.5M	312.5GS/s / 6.25M
5us	50MS/s / 2.5k	125MS/s / 6.25k	250MS/s / 12.5k	500MS/s / 25k	1.25GS/s / 62.5k	2.5GS/s / 125k	5GS/s / 250k	12.5GS/s / 625k	25GS/s / 1.25M	50GS/s / 2.5M	125GS/s / 6.25M
10us	25MS/s / 2.5k	62.5MS/s / 6.25k	125MS/s / 12.5k	250MS/s / 25k	625MS/s / 62.5k	1.25GS/s / 125k	2.5GS/s / 250k	6.25GS/s / 625k	12.5GS/s / 1.25M	25GS/s / 2.5M	62.5GS/s / 6.25M
20us	12.5MS/s / 2.5k	31.25MS/s / 6.25k	62.5MS/s / 12.5k	125MS/s / 25k	312.5MS/s / 62.5k	625MS/s / 125k	1.25GS/s / 250k	3.125GS/s / 625k	6.25GS/s / 1.25M	12.5GS/s / 2.5M	31.25GS/s / 6.25M
50us	5MS/s / 2.5k	12.5MS/s / 6.25k	25MS/s / 12.5k	50MS/s / 25k	125MS/s / 62.5k	250MS/s / 125k	500MS/s / 250k	1.25GS/s / 625k	2.5GS/s / 1.25M	5GS/s / 2.5M	12.5GS/s / 6.25M
100us	2.5MS/s / 2.5k	6.25MS/s / 6.25k	12.5MS/s / 12.5k	25MS/s / 25k	62.5MS/s / 62.5k	125MS/s / 125k	250MS/s / 250k	625MS/s / 625k	1.25GS/s / 1.25M	2.5GS/s / 2.5M	6.25GS/s / 6.25M
200us	1.25MS/s / 2.5k	3.125MS/s / 6.25k	6.25MS/s / 12.5k	12.5MS/s / 25k	31.25MS/s / 62.5k	62.5MS/s / 125k	125MS/s / 250k	312.5MS/s / 625k	625MS/s / 1.25M	1.25GS/s / 2.5M	3.125GS/s / 6.25M
500us	500kS/s / 2.5k	1.25MS/s / 6.25k	2.5MS/s / 12.5k	5MS/s / 25k	12.5MS/s / 62.5k	25MS/s / 125k	50MS/s / 250k	125MS/s / 625k	250MS/s / 1.25M	500MS/s / 2.5M	1.25GS/s / 6.25M
1ms	250kS/s / 2.5k	625kS/s / 6.25k	1.25MS/s / 12.5k	2.5MS/s / 25k	6.25MS/s / 62.5k	12.5MS/s / 125k	25MS/s / 250k	62.5MS/s / 625k	125MS/s / 1.25M	250MS/s / 2.5M	625MS/s / 6.25M
2ms	125kS/s / 2.5k	312.5kS/s / 6.25k	625kS/s / 12.5k	1.25MS/s / 25k	3.125MS/s / 62.5k	6.25MS/s / 125k	12.5MS/s / 250k	31.25MS/s / 625k	62.5MS/s / 1.25M	125MS/s / 2.5M	312.5MS/s / 6.25M
5ms	50kS/s / 2.5k	125kS/s / 6.25k	250kS/s / 12.5k	500kS/s / 25k	1.25MS/s / 62.5k	2.5MS/s / 125k	5MS/s / 250k	12.5MS/s / 625k	25MS/s / 1.25M	50MS/s / 2.5M	125MS/s / 6.25M
10ms	25kS/s / 2.5k	62.5kS/s / 6.25k	125kS/s / 12.5k	250kS/s / 25k	625kS/s / 62.5k	1.25MS/s / 125k	2.5MS/s / 250k	6.25MS/s / 625k	12.5MS/s / 1.25M	25MS/s / 2.5M	62.5MS/s / 6.25M
20ms	12.5kS/s / 2.5k	31.25kS/s / 6.25k	62.5kS/s / 12.5k	125kS/s / 25k	312.5kS/s / 62.5k	625kS/s / 125k	1.25MS/s / 250k	3.125MS/s / 625k	6.25MS/s / 1.25M	12.5MS/s / 2.5M	31.25MS/s / 6.25M
50ms	5kS/s / 2.5k	12.5kS/s / 6.25k	25kS/s / 12.5k	50kS/s / 25k	125kS/s / 62.5k	250kS/s / 125k	500kS/s / 250k	1.25MS/s / 625k	2.5MS/s / 1.25M	5MS/s / 2.5M	12.5MS/s / 6.25M
100ms	2.5kS/s / 2.5k	6.25kS/s / 6.25k	12.5kS/s / 12.5k	25kS/s / 25k	62.5kS/s / 62.5k	125kS/s / 125k	250kS/s / 250k	625kS/s / 625k	1.25MS/s / 1.25M	2.5MS/s / 2.5M	6.25MS/s / 6.25M
200ms	1.25kS/s / 2.5k	3.125kS/s / 6.25k	6.25kS/s / 12.5k	12.5kS/s / 25k	31.25kS/s / 62.5k	62.5kS/s / 125k	125kS/s / 250k	312.5kS/s / 625k	625kS/s / 1.25M	1.25MS/s / 2.5M	3.125MS/s / 6.25M
500ms	500S/s / 2.5k	1.25kS/s / 6.25k	2.5kS/s / 12.5k	5kS/s / 25k	12.5kS/s / 62.5k	25kS/s / 125k	50kS/s / 250k	125kS/s / 625k	250kS/s / 1.25M	500kS/s / 2.5M	1.25MS/s / 6.25M
1s	250S/s / 2.5k	625S/s / 6.25k	1.25kS/s / 12.5k	2.5kS/s / 25k	6.25kS/s / 62.5k	12.5kS/s / 125k	25kS/s / 250k	62.5kS/s / 625k	125kS/s / 1.25M	250kS/s / 2.5M	625kS/s / 6.25M
2s	125S/s / 2.5k	312.5S/s / 6.25k	625S/s / 12.5k	1.25kS/s / 25k	3.125kS/s / 62.5k	6.25kS/s / 125k	12.5kS/s / 250k	31.25kS/s / 625k	62.5kS/s / 1.25M	125kS/s / 2.5M	312.5kS/s / 6.25M
5s	50S/s / 2.5k	125S/s / 6.25k	250S/s / 12.5k	500S/s / 25k	1.25kS/s / 62.5k	2.5kS/s / 125k	5kS/s / 250k	12.5kS/s / 625k	25kS/s / 1.25M	50kS/s / 2.5M	125kS/s / 6.25M
10s	*50S/s* / 5k	62.5S/s / 6.25k	125S/s / 12.5k	250S/s / 25k	625S/s / 62.5k	1.25kS/s / 125k	2.5kS/s / 250k	6.25kS/s / 625k	12.5kS/s / 1.25M	25kS/s / 2.5M	62.5kS/s / 6.25M
20s	*50S/s* / 10k	*50S/s* / 10k	62.5S/s / 12.5k	125S/s / 25k	312.5S/s / 62.5k	625S/s / 125k	1.25kS/s / 250k	3.125kS/s / 625k	6.25kS/s / 1.25M	12.5kS/s / 2.5M	31.25kS/s / 6.25M
50s	*50S/s* / 25k	*50S/s* / 25k	*50S/s* / 25k	*50S/s* / 25k	125S/s / 62.5k	250S/s / 125k	500S/s / 250k	1.25kS/s / 625k	2.5kS/s / 1.25M	5kS/s / 2.5M	12.5kS/s / 6.25M

Bold: Expanded interpolation or expanded repetitive sampling (variable record length)

[light blue] Interpolation or repetitive sampling (when repetitive sampling mode is ON)

[blue] Interpolation

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation

[dashed box] Envelope mode available (a)   [solid box] Envelope mode available (b, c)   [dash-dot box] Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Interpolation ON (Max: 10GS/s)

DL9240/DL9240L: Interleave mode ON, High resolution mode OFF

T/div(s/div)	2.5k		6.25k		12.5k		25k		62.5k		125k		250k		625k		1.25M		2.5M *1		6.25M *1	
500ps	500GS/s	2.5k	1250GS/s	6.25k	2500GS/s	12.5k	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**
1ns	250GS/s	2.5k	625GS/s	6.25k	1250GS/s	12.5k	2500GS/s	25k	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**
2ns	100GS/s	2k	250GS/s	5k	625GS/s	12.5k	1250GS/s	25k	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**
5ns	50GS/s	2.5k	100GS/s	5k	250GS/s	12.5k	500GS/s	25k	1250GS/s	62.5k	2500GS/s	125k	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**
10ns	20GS/s	2k	50GS/s	5k	100GS/s	10k	250GS/s	25k	625GS/s	62.5k	1250GS/s	125k	2500GS/s	250k	**2500GS/s**	**250k**	**2500GS/s**	**250k**	**2500GS/s**	**250k**	**2500GS/s**	**250k**
20ns	10GS/s	2k	20GS/s	4k	50GS/s	10k	100GS/s	20k	250GS/s	50k	625GS/s	125k	1250GS/s	250k	**2500GS/s**	**500k**	**2500GS/s**	**500k**	**2500GS/s**	**500k**	**2500GS/s**	**500k**
50ns	5GS/s	2.5k	10GS/s	5k	20GS/s	10k	50GS/s	25k	100GS/s	50k	250GS/s	125k	500GS/s	250k	1250GS/s	625k	2500GS/s	1.25M	**2500GS/s**	**1.25M**	**2500GS/s**	**1.25M**
100ns	2.5GS/s	2.5k	5GS/s	5k	10GS/s	10k	20GS/s	20k	50GS/s	50k	100GS/s	100k	250GS/s	250k	500GS/s	500k	1250GS/s	1.25M	2500GS/s	2.5M	2500GS/s	2.5M
200ns	1.25GS/s	2.5k	2.5GS/s	5k	5GS/s	10k	10GS/s	20k	20GS/s	40k	50GS/s	100k	100GS/s	200k	250GS/s	500k	500GS/s	1M	1250GS/s	2.5M	2500GS/s	5M
500ns	500MS/s	2.5k	1.25GS/s	6.25k	2.5GS/s	12.5k	5GS/s	25k	10GS/s	50k	20GS/s	100k	50GS/s	250k	100GS/s	500k	250GS/s	1.25M	500GS/s	2.5M	1250GS/s	6.25M
1us	250MS/s	2.5k	625MS/s	6.25k	1.25GS/s	12.5k	2.5GS/s	25k	5GS/s	50k	10GS/s	100k	20GS/s	200k	50GS/s	500k	100GS/s	1M	250GS/s	2.5M	500GS/s	5M
2us	125MS/s	2.5k	312.5MS/s	6.25k	625MS/s	12.5k	1.25GS/s	25k	2.5Gps	50k	5GS/s	100k	10GS/s	200k	20GS/s	400k	50GS/s	1M	100GS/s	2M	250GS/s	5M
5us	50MS/s	2.5k	125MS/s	6.25k	250MS/s	12.5k	500MS/s	25k	1.25GS/s	62.5k	2.5GS/s	125k	5GS/s	250k	10GS/s	500k	20GS/s	1M	50GS/s	2.5M	100GS/s	5M
10us	25MS/s	2.5k	62.5MS/s	6.25k	125MS/s	12.5k	250MS/s	25k	625MS/s	62.5k	1.25GS/s	125k	2.5GS/s	250k	5GS/s	500k	10GS/s	1M	20GS/s	2M	50GS/s	5M
20us	12.5MS/s	2.5k	31.25MS/s	6.25k	62.5MS/s	12.5k	125MS/s	25k	312.5MS/s	62.5k	625MS/s	125k	1.25GS/s	250k	2.5Gps	500k	5GS/s	1M	10GS/s	2M	20GS/s	4M
50us	5MS/s	2.5k	12.5MS/s	6.25k	25MS/s	12.5k	50MS/s	25k	125MS/s	62.5k	250MS/s	125k	500MS/s	250k	1.25GS/s	625k	2.5GS/s	1.25M	5GS/s	2.5M	10GS/s	5M
100us	2.5MS/s	2.5k	6.25MS/s	6.25k	12.5MS/s	12.5k	25MS/s	25k	62.5MS/s	62.5k	125MS/s	125k	250MS/s	250k	625MS/s	625k	1.25GS/s	1.25M	2.5GS/s	2.5M	5GS/s	5M
200us	1.25MS/s	2.5k	3.125MS/s	6.25k	6.25MS/s	12.5k	12.5MS/s	25k	31.25MS/s	62.5k	62.5MS/s	125k	125MS/s	250k	312.5MS/s	625k	625MS/s	1.25M	1.25GS/s	2.5M	2.5GS/s	5M
500us	500kS/s	2.5k	1.25MS/s	6.25k	2.5MS/s	12.5k	5MS/s	25k	12.5MS/s	62.5k	25MS/s	125k	50MS/s	250k	125MS/s	625k	250MS/s	1.25M	500MS/s	2.5M	1.25GS/s	6.25M
1ms	250kS/s	2.5k	625kS/s	6.25k	1.25MS/s	12.5k	2.5MS/s	25k	6.25MS/s	62.5k	12.5MS/s	125k	25MS/s	250k	62.5MS/s	625k	125MS/s	1.25M	250MS/s	2.5M	625M	6.25M
2ms	125kS/s	2.5k	312.5kS/s	6.25k	625kS/s	12.5k	1.25MS/s	25k	3.125MS/s	62.5k	6.25MS/s	125k	12.5MS/s	250k	31.25MS/s	625k	62.5MS/s	1.25M	125MS/s	2.5M	312.5M	6.25M
5ms	50kS/s	2.5k	125kS/s	6.25k	250kS/s	12.5k	500kS/s	25k	1.25MS/s	62.5k	2.5MS/s	125k	5MS/s	250k	12.5MS/s	625k	25MS/s	1.25M	50MS/s	2.5M	125MS/s	6.25M
10ms	25kS/s	2.5k	62.5kS/s	6.25k	125kS/s	12.5k	250kS/s	25k	625kS/s	62.5k	1.25MS/s	125k	2.5MS/s	250k	6.25MS/s	625k	12.5MS/s	1.25M	25MS/s	2.5M	62.5MS/s	6.25M
20ms	12.5kS/s	2.5k	31.25kS/s	6.25k	62.5kS/s	12.5k	125kS/s	25k	312.5kS/s	62.5k	625kS/s	125k	1.25MS/s	250k	3.125MS/s	625k	6.25MS/s	1.25M	12.5MS/s	2.5M	31.25MS/s	6.25M
50ms	5kS/s	2.5k	12.5kS/s	6.25k	25kS/s	12.5k	50kS/s	25k	125kS/s	62.5k	250kS/s	125k	500kS/s	250k	1.25MS/s	625k	2.5MS/s	1.25M	5MS/s	2.5M	12.5MS/s	6.25M
100ms	2.5kS/s	2.5k	6.25kS/s	6.25k	12.5kS/s	12.5k	25kS/s	25k	62.5kS/s	62.5k	125kS/s	125k	250kS/s	250k	625kS/s	625k	1.25MS/s	1.25M	2.5MS/s	2.5M	6.25MS/s	6.25M
200ms	1.25kS/s	2.5k	3.125kS/s	6.25k	6.25kS/s	12.5k	12.5kS/s	25k	31.25kS/s	62.5k	62.5kS/s	125k	125kS/s	250k	312.5kS/s	625k	625kS/s	1.25M	1.25MS/s	2.5M	3.125MS/s	6.25M
500ms	500S/s	2.5k	1.25k	6.25k	2.5kS/s	12.5k	5kS/s	25k	12.5kS/s	62.5k	25kS/s	125k	50kS/s	250k	125kS/s	625k	250kS/s	1.25M	500kS/s	2.5M	1.25MS/s	6.25M
1s	250S/s	2.5k	625S/s	6.25k	1.25kS/s	12.5k	2.5kS/s	25k	6.25kS/s	62.5k	12.5kS/s	125k	25kS/s	250k	62.5kS/s	625k	125kS/s	1.25M	250kS/s	2.5M	625kS/s	6.25M
2s	125S/s	2.5k	312.5S/s	6.25k	625S/s	12.5k	1.25kS/s	25k	31.25kS/s	62.5k	6.25kS/s	125k	12.5kS/s	250k	31.25kS/s	625k	62.5kS/s	1.25M	125kS/s	2.5M	312.5kS/s	6.25M
5s	50S/s	2.5k	125S/s	6.25k	250S/s	12.5k	500S/s	25k	1.25kS/s	62.5k	2.5kS/s	125k	5kS/s	250k	12.5kS/s	625k	25kS/s	1.25M	50kS/s	2.5M	125kS/s	6.25M
10s	*50S/s*	*5k*	62.5S/s	6.25k	125S/s	12.5k	250S/s	25k	625S/s	62.5k	1.25kS/s	125k	2.5kS/s	250k	6.25kS/s	625k	12.5kS/s	1.25M	25kS/s	2.5M	62.5kS/s	6.25M
20s	*50S/s*	*10k*	*50S/s*	*10k*	62.5S/s	12.5k	125S/s	25k	312.5S/s	62.5k	625S/s	125k	1.25kS/s	250k	31.25kS/s	625k	6.25kS/s	1.25M	12.5kS/s	2.5M	31.25kS/s	6.25M
50s	*50S/s*	*25k*	*50S/s*	*25k*	*50S/s*	*25k*	50S/s	25k	125kS/s	62.5k	250S/s	125k	500S/s	250k	1.25kS/s	625k	2.5kS/s	1.25M	5kS/s	2.5M	12.5kS/s	6.25M

Bold: Expanded interpolation or expanded repetitive sampling (variable record length)

▨ Interpolation or repetitive sampling (when repetitive sampling mode is ON)

■ Interpolation

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

▭ Envelope mode available ⬚ Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Interpolation OFF   Repetitive sampling OFF (Max: 1.25GS/s)
DL9040/DL9040L/DL9140/DL9140L: Interleave mode OFF, High resolution mode ON

Each cell shows **Sample Rate / Record Length**.

T/div(s/div)	2.5k	6.25k	12.5k	25k	62.5k	125k	250k	625k	1.25M	2.5M *1	6.25M *1
500ps	500GS/s / 2.5k	1250GS/s / 6.25k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	
1ns	250GS/s / 2.5k	625GS/s / 6.25k	1250GS/s / 12.5k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	
2ns	125GS/s / 2.5k	312.5GS/s / 6.25k	625GS/s / 12.5k	1250GS/s / 25k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	
5ns	50GS/s / 2.5k	125GS/s / 6.25k	250GS/s / 12.5k	500GS/s / 25k	1250GS/s / 62.5k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	
10ns	1.25GS/s / 125	1.25GS/s / 125	1.25GS/s / 125	1.25GS/s / 125	1.25GS/s / 125	1.25GS/s / 125	1.25GS/s / 125	1.25GS/s / 125	1.25GS/s / 125	1.25GS/s / 125	
20ns	1.25GS/s / 250	1.25GS/s / 250	1.25GS/s / 250	1.25GS/s / 250	1.25GS/s / 250	1.25GS/s / 250	1.25GS/s / 250	1.25GS/s / 250	1.25GS/s / 250	1.25GS/s / 250	
50ns	1.25GS/s / 625	1.25GS/s / 625	1.25GS/s / 625	1.25GS/s / 625	1.25GS/s / 625	1.25GS/s / 625	1.25GS/s / 625	1.25GS/s / 625	1.25GS/s / 625	1.25GS/s / 625	
100ns	1.25GS/s / 1.25k	1.25GS/s / 1.25k	1.25GS/s / 1.25k	1.25GS/s / 1.25k	1.25GS/s / 1.25k	1.25GS/s / 1.25k	1.25GS/s / 1.25k	1.25GS/s / 1.25k	1.25GS/s / 1.25k	1.25GS/s / 1.25k	
200ns	1.25GS/s / 2.5k	1.25GS/s / 2.5k	1.25GS/s / 2.5k	1.25GS/s / 2.5k	1.25GS/s / 2.5k	1.25GS/s / 2.5k	1.25GS/s / 2.5k	1.25GS/s / 2.5k	1.25GS/s / 2.5k	1.25GS/s / 2.5k	
500ns	500MS/s / 2.5k	1.25GS/s / 6.25k	1.25GS/s / 6.25k	1.25GS/s / 6.25k	1.25GS/s / 6.25k	1.25GS/s / 6.25k	1.25GS/s / 6.25k	1.25GS/s / 6.25k	1.25GS/s / 6.25k	1.25GS/s / 6.25k	
1us	250MS/s / 2.5k	625MS/s / 6.25k	1.25GS/s / 12.5k	1.25GS/s / 12.5k	1.25GS/s / 12.5k	1.25GS/s / 12.5k	1.25GS/s / 12.5k	1.25GS/s / 12.5k	1.25GS/s / 12.5k	1.25GS/s / 12.5k	
2us	125MS/s / 2.5k	312.5MS/s / 6.25k	625MS/s / 12.5k	1.25GS/s / 25k	1.25GS/s / 25k	1.25GS/s / 25k	1.25GS/s / 25k	1.25GS/s / 25k	1.25GS/s / 25k	1.25GS/s / 25k	
5us	50MS/s / 2.5k	125MS/s / 6.25k	250MS/s / 12.5k	500MS/s / 25k	1.25GS/s / 62.5k	1.25GS/s / 62.5k	1.25GS/s / 62.5k	1.25GS/s / 62.5k	1.25GS/s / 62.5k	1.25GS/s / 62.5k	
10us	25MS/s / 2.5k	62.5MS/s / 6.25k	125MS/s / 12.5k	250MS/s / 25k	625MS/s / 62.5k	1.25GS/s / 125k	1.25GS/s / 125k	1.25GS/s / 125k	1.25GS/s / 125k	1.25GS/s / 125k	
20us	12.5MS/s / 2.5k	31.25MS/s / 6.25k	62.5MS/s / 12.5k	125MS/s / 25k	312.5MS/s / 62.5k	625MS/s / 125k	1.25GS/s / 250k	1.25GS/s / 250k	1.25GS/s / 250k	1.25GS/s / 250k	
50us	5MS/s / 2.5k	12.5MS/s / 6.25k	25MS/s / 12.5k	50MS/s / 25k	125MS/s / 62.5k	250MS/s / 125k	500MS/s / 250k	1.25GS/s / 625k	1.25GS/s / 625k	1.25GS/s / 625k	
100us	2.5MS/s / 2.5k	6.25MS/s / 6.25k	12.5MS/s / 12.5k	25MS/s / 25k	62.5MS/s / 62.5k	125MS/s / 125k	250MS/s / 250k	625MS/s / 625k	1.25GS/s / 1.25M	1.25GS/s / 1.25M	
200us	1.25MS/s / 2.5k	3.125MS/s / 6.25k	6.25MS/s / 12.5k	12.5MS/s / 25k	31.25MS/s / 62.5k	62.5MS/s / 125k	125MS/s / 250k	312.5MS/s / 625k	625MS/s / 1.25M	1.25GS/s / 2.5M	
500us	500kS/s / 2.5k	1.25MS/s / 6.25k	2.5MS/s / 12.5k	5MS/s / 25k	12.5MS/s / 62.5k	25MS/s / 125k	50MS/s / 250k	125MS/s / 625k	250MS/s / 1.25M	500MS/s / 2.5M	
1ms	250kS/s / 2.5k	625kS/s / 6.25k	1.25MS/s / 12.5k	2.5MS/s / 25k	6.25MS/s / 62.5k	12.5MS/s / 125k	25MS/s / 250k	62.5MS/s / 625k	125MS/s / 1.25M	250MS/s / 2.5M	
2ms	125kS/s / 2.5k	312.5kS/s / 6.25k	625kS/s / 12.5k	1.25MS/s / 25k	3.125MS/s / 62.5k	6.25MS/s / 125k	12.5MS/s / 250k	31.25MS/s / 625k	62.5MS/s / 1.25M	125MS/s / 2.5M	
5ms	50kS/s / 2.5k	125kS/s / 6.25k	250kS/s / 12.5k	500kS/s / 25k	1.25MS/s / 62.5k	2.5MS/s / 125k	5MS/s / 250k	12.5MS/s / 625k	25MS/s / 1.25M	50MS/s / 2.5M	
10ms	25kS/s / 2.5k	62.5kS/s / 6.25k	125kS/s / 12.5k	250kS/s / 25k	625kS/s / 62.5k	1.25MS/s / 125k	2.5MS/s / 250k	6.25MS/s / 625k	12.5MS/s / 1.25M	25MS/s / 2.5M	
20ms	12.5kS/s / 2.5k	31.25kS/s / 6.25k	62.5kS/s / 12.5k	125kS/s / 25k	312.5kS/s / 62.5k	625kS/s / 125k	1.25MS/s / 250k	3.125MS/s / 625k	6.25MS/s / 1.25M	12.5MS/s / 2.5M	
50ms	5kS/s / 2.5k	12.5kS/s / 6.25k	25kS/s / 12.5k	50kS/s / 25k	125kS/s / 62.5k	250kS/s / 125k	500kS/s / 250k	1.25MS/s / 625k	2.5MS/s / 1.25M	5MS/s / 2.5M	
100ms	2.5kS/s / 2.5k	6.25kS/s / 6.25k	12.5kS/s / 12.5k	25kS/s / 25k	62.5kS/s / 62.5k	125kS/s / 125k	250kS/s / 250k	625kS/s / 625k	1.25MS/s / 1.25M	2.5MS/s / 2.5M	
200ms	1.25kS/s / 2.5k	3.125kS/s / 6.25k	6.25kS/s / 12.5k	12.5kS/s / 25k	31.25kS/s / 62.5k	62.5kS/s / 125k	125kS/s / 250k	312.5kS/s / 625k	625kS/s / 1.25M	1.25MS/s / 2.5M	
500ms	500S/s / 2.5k	1.25kS/s / 6.25k	2.5kS/s / 12.5k	5kS/s / 25k	12.5kS/s / 62.5k	25kS/s / 125k	50kS/s / 250k	125kS/s / 625k	250kS/s / 1.25M	500kS/s / 2.5M	
1s	250S/s / 2.5k	625S/s / 6.25k	1.25kS/s / 12.5k	2.5kS/s / 25k	6.25kS/s / 62.5k	12.5kS/s / 125k	25kS/s / 250k	62.5kS/s / 625k	125kS/s / 1.25M	250kS/s / 2.5M	
2s	125S/s / 2.5k	312.5S/s / 6.25k	625S/s / 12.5k	1.25kS/s / 25k	3.125kS/s / 62.5k	6.25kS/s / 125k	12.5kS/s / 250k	31.25kS/s / 625k	62.5kS/s / 1.25M	125kS/s / 2.5M	
5s	50S/s / 2.5k	125S/s / 6.25k	250S/s / 12.5k	500S/s / 25k	1.25kS/s / 62.5k	2.5kS/s / 125k	5kS/s / 250k	12.5kS/s / 625k	25kS/s / 1.25M	50kS/s / 2.5M	
10s	50S/s / 5k	62.5S/s / 6.25k	125S/s / 12.5k	250S/s / 25k	625S/s / 62.5k	1.25kS/s / 125k	2.5kS/s / 250k	6.25kS/s / 625k	12.5kS/s / 1.25M	25kS/s / 2.5M	
20s	50S/s / 10k	50S/s / 10k	62.5S/s / 12.5k	125S/s / 25k	312.5S/s / 62.5k	625S/s / 125k	1.25kS/s / 250k	3.125kS/s / 625k	6.25kS/s / 1.25M	12.5kS/s / 2.5M	
50s	50S/s / 25k	50S/s / 25k	50S/s / 25k	50S/s / 25k	125S/s / 62.5k	250S/s / 125k	500S/s / 250k	1.25kS/s / 625k	2.5kS/s / 1.25M	5kS/s / 2.5M	

Legend:
- [light blue] Repetitive sampling
- [medium blue] Expanded repetitive sampling (variable record length)
- Bold: Expanded normal mode (variable record length)
- Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.
- [solid box] Envelope mode available
- [dashed box] Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Appendix 1 Relationship between the Time Axis Setting, Sample Rate and Record Length

Interpolation OFF   Repetitive sampling ON (Max: 1.25GS/s)
DL9040/DL9040L/DL9140/DL9140L: Interleave mode OFF, High resolution mode ON

Each cell shows: sample rate / record length. Italic cells indicate the minimum sample rate (50 S/s) region.

T/div (s/div)	2.5k	6.25k	12.5k	25k	62.5k	125k	250k	625k	1.25M	2.5M *1	6.25M *1
500ps	500GS/s / 2.5k	1250GS/s / 6.25k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	
1ns	250GS/s / 2.5k	625GS/s / 6.25k	1250GS/s / 12.5k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	
2ns	125GS/s / 2.5k	312.5GS/s / 6.25k	625GS/s / 12.5k	1250GS/s / 25k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	
5ns	50GS/s / 2.5k	125GS/s / 6.25k	250GS/s / 12.5k	500GS/s / 25k	1250GS/s / 62.5k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	
10ns	25GS/s / 2.5k	62.5GS/s / 6.25k	125GS/s / 12.5k	250GS/s / 25k	625GS/s / 62.5k	1250GS/s / 125k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k	
20ns	12.5GS/s / 2.5k	31.25GS/s / 6.25k	62.5GS/s / 12.5k	125GS/s / 25k	312.5GS/s / 62.5k	625GS/s / 125k	1250GS/s / 250k	2500GS/s / 500k	2500GS/s / 500k	2500GS/s / 500k	
50ns	5GS/s / 2.5k	12.5GS/s / 6.25k	25GS/s / 12.5k	50GS/s / 25k	125GS/s / 62.5k	250GS/s / 125k	500GS/s / 250k	1250GS/s / 625k	2500GS/s / 1.25M	2500GS/s / 1.25M	
100ns	2.5GS/s / 2.5k	6.25GS/s / 6.25k	12.5GS/s / 12.5k	25GS/s / 25k	62.5GS/s / 62.5k	125GS/s / 125k	250GS/s / 250k	625GS/s / 625k	1250GS/s / 1.25M	2500GS/s / 2.5M	
200ns	1.25GS/s / 2.5k	3.125GS/s / 6.25k	6.25GS/s / 12.5k	12.5GS/s / 25k	31.25GS/s / 62.5k	62.5GS/s / 125k	125GS/s / 250k	312.5GS/s / 625k	625GS/s / 1.25M	1250GS/s / 2.5M	
500ns	500MS/s / 2.5k	1.25GS/s / 6.25k	2.5GS/s / 12.5k	5GS/s / 25k	12.5GS/s / 62.5k	25GS/s / 125k	50GS/s / 250k	125GS/s / 625k	250GS/s / 1.25M	500GS/s / 2.5M	
1us	250MS/s / 2.5k	625MS/s / 6.25k	1.25GS/s / 12.5k	2.5GS/s / 25k	6.25GS/s / 62.5k	12.5GS/s / 125k	25GS/s / 250k	62.5GS/s / 625k	125GS/s / 1.25M	250GS/s / 2.5M	
2us	125MS/s / 2.5k	312.5MS/s / 6.25k	625MS/s / 12.5k	1.25GS/s / 25k	3.125GS/s / 62.5k	6.25GS/s / 125k	12.5GS/s / 250k	31.25GS/s / 625k	62.5GS/s / 1.25M	125GS/s / 2.5M	
5us	50MS/s / 2.5k	125MS/s / 6.25k	250MS/s / 12.5k	500MS/s / 25k	1.25GS/s / 62.5k	2.5GS/s / 125k	5GS/s / 250k	12.5GS/s / 625k	25GS/s / 1.25M	50GS/s / 2.5M	
10us	25MS/s / 2.5k	62.5MS/s / 6.25k	125MS/s / 12.5k	250MS/s / 25k	625MS/s / 62.5k	1.25GS/s / 125k	2.5GS/s / 250k	6.25GS/s / 625k	12.5GS/s / 1.25M	25GS/s / 2.5M	
20us	12.5MS/s / 2.5k	31.25MS/s / 6.25k	62.5MS/s / 12.5k	125MS/s / 25k	312.5MS/s / 62.5k	625MS/s / 125k	1.25GS/s / 250k	3.125GS/s / 625k	6.25GS/s / 1.25M	12.5GS/s / 2.5M	
50us	5MS/s / 2.5k	12.5MS/s / 6.25k	25MS/s / 12.5k	50MS/s / 25k	125MS/s / 62.5k	250MS/s / 125k	500MS/s / 250k	1.25GS/s / 625k	2.5GS/s / 1.25M	5GS/s / 2.5M	
100us	2.5MS/s / 2.5k	6.25MS/s / 6.25k	12.5MS/s / 12.5k	25MS/s / 25k	62.5MS/s / 62.5k	125MS/s / 125k	250MS/s / 250k	625MS/s / 625k	1.25GS/s / 1.25M	2.5GS/s / 2.5M	
200us	1.25MS/s / 2.5k	3.125MS/s / 6.25k	6.25MS/s / 12.5k	12.5MS/s / 25k	31.25MS/s / 62.5k	62.5MS/s / 125k	125MS/s / 250k	312.5MS/s / 625k	625MS/s / 1.25M	1.25GS/s / 2.5M	
500us	500kS/s / 2.5k	1.25MS/s / 6.25k	2.5MS/s / 12.5k	5MS/s / 25k	12.5MS/s / 62.5k	25MS/s / 125k	50MS/s / 250k	125MS/s / 625k	250MS/s / 1.25M	500MS/s / 2.5M	
1ms	250kS/s / 2.5k	625kS/s / 6.25k	1.25MS/s / 12.5k	2.5MS/s / 25k	6.25MS/s / 62.5k	12.5MS/s / 125k	25MS/s / 250k	62.5MS/s / 625k	125MS/s / 1.25M	250MS/s / 2.5M	
2ms	125kS/s / 2.5k	312.5kS/s / 6.25k	625kS/s / 12.5k	1.25MS/s / 25k	3.125MS/s / 62.5k	6.25MS/s / 125k	12.5MS/s / 250k	31.25MS/s / 625k	62.5MS/s / 1.25M	125MS/s / 2.5M	
5ms	50kS/s / 2.5k	125kS/s / 6.25k	250kS/s / 12.5k	500kS/s / 25k	1.25MS/s / 62.5k	2.5MS/s / 125k	5MS/s / 250k	12.5MS/s / 625k	25MS/s / 1.25M	50MS/s / 2.5M	
10ms	25kS/s / 2.5k	62.5kS/s / 6.25k	125kS/s / 12.5k	250kS/s / 25k	625kS/s / 62.5k	1.25MS/s / 125k	2.5MS/s / 250k	6.25MS/s / 625k	12.5MS/s / 1.25M	25MS/s / 2.5M	
20ms	12.5kS/s / 2.5k	31.25kS/s / 6.25k	62.5kS/s / 12.5k	125kS/s / 25k	312.5kS/s / 62.5k	625kS/s / 125k	1.25MS/s / 250k	3.125MS/s / 625k	6.25MS/s / 1.25M	12.5MS/s / 2.5M	
50ms	5kS/s / 2.5k	12.5kS/s / 6.25k	25kS/s / 12.5k	50kS/s / 25k	125kS/s / 62.5k	250kS/s / 125k	500kS/s / 250k	1.25MS/s / 625k	2.5MS/s / 1.25M	5MS/s / 2.5M	
100ms	2.5kS/s / 2.5k	6.25kS/s / 6.25k	12.5kS/s / 12.5k	25kS/s / 25k	62.5kS/s / 62.5k	125kS/s / 125k	250kS/s / 250k	625kS/s / 625k	1.25MS/s / 1.25M	2.5MS/s / 2.5M	
200ms	1.25kS/s / 2.5k	3.125kS/s / 6.25k	6.25kS/s / 12.5k	12.5kS/s / 25k	31.25kS/s / 62.5k	62.5kS/s / 125k	125kS/s / 250k	312.5kS/s / 625k	625kS/s / 1.25M	1.25MS/s / 2.5M	
500ms	500S/s / 2.5k	1.25kS/s / 6.25k	2.5kS/s / 12.5k	5kS/s / 25k	12.5kS/s / 62.5k	25kS/s / 125k	50kS/s / 250k	125kS/s / 625k	250kS/s / 1.25M	500kS/s / 2.5M	
1s	250S/s / 2.5k	625S/s / 6.25k	1.25kS/s / 12.5k	2.5kS/s / 25k	6.25kS/s / 62.5k	12.5kS/s / 125k	25kS/s / 250k	62.5kS/s / 625k	125kS/s / 1.25M	250kS/s / 2.5M	
2s	125S/s / 2.5k	312.5S/s / 6.25k	625S/s / 12.5k	1.25kS/s / 25k	3.125kS/s / 62.5k	6.25kS/s / 125k	12.5kS/s / 250k	31.25kS/s / 625k	62.5kS/s / 1.25M	125kS/s / 2.5M	
5s	50S/s / 2.5k	125S/s / 6.25k	250S/s / 12.5k	500S/s / 25k	1.25kS/s / 62.5k	2.5kS/s / 125k	5kS/s / 250k	12.5kS/s / 625k	25kS/s / 1.25M	50kS/s / 2.5M	
10s	*50S/s / 5k*	62.5S/s / 6.25k	125S/s / 12.5k	250S/s / 25k	625S/s / 62.5k	1.25kS/s / 125k	2.5kS/s / 250k	6.25kS/s / 625k	12.5kS/s / 1.25M	25kS/s / 2.5M	
20s	*50S/s / 10k*	*50S/s / 10k*	62.5S/s / 12.5k	125S/s / 25k	312.5S/s / 62.5k	625S/s / 125k	1.25kS/s / 250k	3.125kS/s / 625k	6.25kS/s / 1.25M	12.5kS/s / 2.5M	
50s	*50S/s / 25k*	*50S/s / 25k*	*50S/s / 25k*	50S/s / 25k	125S/s / 62.5k	250S/s / 125k	500S/s / 250k	1.25kS/s / 625k	2.5kS/s / 1.25M	5kS/s / 2.5M	

Legend:

- (light blue) Repetitive sampling
- (cyan) Expanded repetitive sampling (variable record length)
- Bold: Expanded normal mode (variable record length)
- Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.
- (solid box outline) *1 Maximum record length
- (dashed box outline) Roll mode available
- Envelope mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Appendix

App

Interpolation OFF   Repetitive sampling OFF (Max: 2.5GS/s)

a) DL9040/DL9040L/DL9140/DL9140L: Interleave mode OFF, High resolution mode OFF, b) DL9040/DL9040L/DL9140/DL9140L: Interleave mode ON, High resolution mode ON,
c) DL9240/DL9240L: Interleave mode OFF, High resolution mode OFF, High resolution mode ON

Each cell shows: sample rate / record length.

T/div (s/div)	2.5k	6.25k	12.5k	25k	62.5k	125k	250k	625k	1.25M	2.5M *1	6.25M *1
500ps	500GS/s / 2.5k	1250GS/s / 6.25k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k
1ns	250GS/s / 2.5k	625GS/s / 6.25k	1250GS/s / 12.5k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k
2ns	125GS/s / 2.5k	312.5GS/s / 6.25k	625GS/s / 12.5k	1250GS/s / 25k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k
5ns	2.5GS/s / 125	2.5GS/s / 125	2.5GS/s / 125	2.5GS/s / 125	2.5GS/s / 125	2.5GS/s / 125	2.5GS/s / 125	2.5GS/s / 125	2.5GS/s / 125	2.5GS/s / 125	2.5GS/s / 125
10ns	2.5GS/s / 250	2.5GS/s / 250	2.5GS/s / 250	2.5GS/s / 250	2.5GS/s / 250	2.5GS/s / 250	2.5GS/s / 250	2.5GS/s / 250	2.5GS/s / 250	2.5GS/s / 250	2.5GS/s / 250
20ns	2.5GS/s / 500	2.5GS/s / 500	2.5GS/s / 500	2.5GS/s / 500	2.5GS/s / 500	2.5GS/s / 500	2.5GS/s / 500	2.5GS/s / 500	2.5GS/s / 500	2.5GS/s / 500	2.5GS/s / 500
50ns	2.5GS/s / 1.25k	2.5GS/s / 1.25k	2.5GS/s / 1.25k	2.5GS/s / 1.25k	2.5GS/s / 1.25k	2.5GS/s / 1.25k	2.5GS/s / 1.25k	2.5GS/s / 1.25k	2.5GS/s / 1.25k	2.5GS/s / 1.25k	2.5GS/s / 1.25k
100ns	2.5GS/s / 2.5k	2.5GS/s / 2.5k	2.5GS/s / 2.5k	2.5GS/s / 2.5k	2.5GS/s / 2.5k	2.5GS/s / 2.5k	2.5GS/s / 2.5k	2.5GS/s / 2.5k	2.5GS/s / 2.5k	2.5GS/s / 2.5k	2.5GS/s / 2.5k
200ns	1.25GS/s / 2.5k	2.5GS/s / 5k	2.5GS/s / 5k	2.5GS/s / 5k	2.5GS/s / 5k	2.5GS/s / 5k	2.5GS/s / 5k	2.5GS/s / 5k	2.5GS/s / 5k	2.5GS/s / 5k	2.5GS/s / 5k
500ns	500MS/s / 2.5k	1.25GS/s / 6.25k	2.5GS/s / 12.5k	2.5GS/s / 12.5k	2.5GS/s / 12.5k	2.5GS/s / 12.5k	2.5GS/s / 12.5k	2.5GS/s / 12.5k	2.5GS/s / 12.5k	2.5GS/s / 12.5k	2.5GS/s / 12.5k
1us	250MS/s / 2.5k	625MS/s / 6.25k	1.25GS/s / 12.5k	2.5GS/s / 25k	2.5GS/s / 25k	2.5GS/s / 25k	2.5GS/s / 25k	2.5GS/s / 25k	2.5GS/s / 25k	2.5GS/s / 25k	2.5GS/s / 25k
2us	125MS/s / 2.5k	312.5MS/s / 6.25k	625MS/s / 12.5k	1.25GS/s / 25k	2.5GS/s / 50k	2.5GS/s / 50k	2.5GS/s / 50k	2.5GS/s / 50k	2.5GS/s / 50k	2.5GS/s / 50k	2.5GS/s / 50k
5us	50MS/s / 2.5k	125MS/s / 6.25k	250MS/s / 12.5k	500MS/s / 25k	1.25GS/s / 62.5k	2.5GS/s / 125k	2.5GS/s / 125k	2.5GS/s / 125k	2.5GS/s / 125k	2.5GS/s / 125k	2.5GS/s / 125k
10us	25MS/s / 2.5k	62.5MS/s / 6.25k	125MS/s / 12.5k	250MS/s / 25k	625MS/s / 62.5k	1.25GS/s / 125k	2.5GS/s / 250k	2.5GS/s / 250k	2.5GS/s / 250k	2.5GS/s / 250k	2.5GS/s / 250k
20us	12.5MS/s / 2.5k	31.25MS/s / 6.25k	62.5MS/s / 12.5k	125MS/s / 25k	312.5MS/s / 62.5k	625MS/s / 125k	1.25GS/s / 250k	2.5GS/s / 500k	2.5GS/s / 500k	2.5GS/s / 500k	2.5GS/s / 500k
50us	5MS/s / 2.5k	12.5MS/s / 6.25k	25MS/s / 12.5k	50MS/s / 25k	125MS/s / 62.5k	250MS/s / 125k	500MS/s / 250k	1.25GS/s / 625k	2.5GS/s / 1.25M	2.5GS/s / 1.25M	2.5GS/s / 1.25M
100us	2.5MS/s / 2.5k	6.25MS/s / 6.25k	12.5MS/s / 12.5k	25MS/s / 25k	62.5MS/s / 62.5k	125MS/s / 125k	250MS/s / 250k	625MS/s / 625k	1.25GS/s / 1.25M	2.5GS/s / 2.5M	2.5GS/s / 2.5M
200us	1.25MS/s / 2.5k	3.125MS/s / 6.25k	6.25MS/s / 12.5k	12.5MS/s / 25k	31.25MS/s / 62.5k	62.5MS/s / 125k	125MS/s / 250k	312.5MS/s / 625k	625MS/s / 1.25M	1.25GS/s / 2.5M	2.5GS/s / 5M
500us	500kS/s / 2.5k	1.25MS/s / 6.25k	2.5MS/s / 12.5k	5MS/s / 25k	12.5MS/s / 62.5k	25MS/s / 125k	50MS/s / 250k	125MS/s / 625k	250MS/s / 1.25M	500MS/s / 2.5M	1.25GS/s / 6.25M
1ms	250kS/s / 2.5k	625kS/s / 6.25k	1.25MS/s / 12.5k	2.5MS/s / 25k	6.25MS/s / 62.5k	12.5MS/s / 125k	25MS/s / 250k	62.5MS/s / 625k	125MS/s / 1.25M	250MS/s / 2.5M	625MS/s / 6.25M
2ms	125kS/s / 2.5k	312.5kS/s / 6.25k	625kS/s / 12.5k	1.25MS/s / 25k	3.125MS/s / 62.5k	6.25MS/s / 125k	12.5MS/s / 250k	31.25MS/s / 625k	62.5MS/s / 1.25M	125MS/s / 2.5M	312.5MS/s / 6.25M
5ms	50kS/s / 2.5k	125kS/s / 6.25k	250kS/s / 12.5k	500kS/s / 25k	1.25MS/s / 62.5k	2.5MS/s / 125k	5MS/s / 250k	12.5MS/s / 625k	25MS/s / 1.25M	50MS/s / 2.5M	125MS/s / 6.25M
10ms	25kS/s / 2.5k	62.5kS/s / 6.25k	125kS/s / 12.5k	250kS/s / 25k	625kS/s / 62.5k	1.25MS/s / 125k	2.5MS/s / 250k	6.25MS/s / 625k	12.5MS/s / 1.25M	25MS/s / 2.5M	62.5MS/s / 6.25M
20ms	12.5kS/s / 2.5k	31.25kS/s / 6.25k	62.5kS/s / 12.5k	125kS/s / 25k	312.5kS/s / 62.5k	625kS/s / 125k	1.25MS/s / 250k	3.125MS/s / 625k	6.25MS/s / 1.25M	12.5MS/s / 2.5M	31.25MS/s / 6.25M
50ms	5kS/s / 2.5k	12.5kS/s / 6.25k	25kS/s / 12.5k	50kS/s / 25k	125kS/s / 62.5k	250kS/s / 125k	500kS/s / 250k	1.25MS/s / 625k	2.5MS/s / 1.25M	5MS/s / 2.5M	12.5MS/s / 6.25M
100ms	2.5kS/s / 2.5k	6.25kS/s / 6.25k	12.5kS/s / 12.5k	25kS/s / 25k	62.5kS/s / 62.5k	125kS/s / 125k	250kS/s / 250k	625kS/s / 625k	1.25MS/s / 1.25M	2.5MS/s / 2.5M	6.25MS/s / 6.25M
200ms	1.25kS/s / 2.5k	3.125kS/s / 6.25k	6.25kS/s / 12.5k	12.5kS/s / 25k	31.25kS/s / 62.5k	62.5kS/s / 125k	125kS/s / 250k	312.5kS/s / 625k	625kS/s / 1.25M	1.25MS/s / 2.5M	3.125MS/s / 6.25M
500ms	500S/s / 2.5k	1.25kS/s / 6.25k	2.5kS/s / 12.5k	5kS/s / 25k	12.5kS/s / 62.5k	25kS/s / 125k	50kS/s / 250k	125kS/s / 625k	250kS/s / 1.25M	500kS/s / 2.5M	1.25MS/s / 6.25M
1s	250S/s / 2.5k	625S/s / 6.25k	1.25kS/s / 12.5k	2.5kS/s / 25k	6.25kS/s / 62.5k	12.5kS/s / 125k	25kS/s / 250k	62.5kS/s / 625k	125kS/s / 1.25M	250kS/s / 2.5M	625kS/s / 6.25M
2s	125S/s / 2.5k	312.5S/s / 6.25k	625S/s / 12.5k	1.25kS/s / 25k	3.125kS/s / 62.5k	6.25kS/s / 125k	12.5kS/s / 250k	31.25kS/s / 625k	62.5kS/s / 1.25M	125kS/s / 2.5M	312.5kS/s / 6.25M
5s	50S/s / 2.5k	125S/s / 6.25k	250S/s / 12.5k	500S/s / 25k	1.25kS/s / 62.5k	2.5kS/s / 125k	5kS/s / 250k	12.5kS/s / 625k	25kS/s / 1.25M	50kS/s / 2.5M	125kS/s / 6.25M
10s	50S/s / 5k	62.5S/s / 6.25k	125S/s / 12.5k	250S/s / 25k	625S/s / 62.5k	1.25kS/s / 125k	2.5kS/s / 250k	6.25kS/s / 625k	12.5kS/s / 1.25M	25kS/s / 2.5M	62.5kS/s / 6.25M
20s	50S/s / 10k	50S/s / 10k	62.5S/s / 12.5k	125S/s / 25k	312.5S/s / 62.5k	625S/s / 125k	1.25kS/s / 250k	3.125kS/s / 625k	6.25kS/s / 1.25M	12.5kS/s / 2.5M	31.25kS/s / 6.25M
50s	50S/s / 25k	50S/s / 25k	50S/s / 25k	50S/s / 25k	125S/s / 62.5k	250S/s / 125k	500S/s / 250k	1.25kS/s / 625k	2.5kS/s / 1.25M	5kS/s / 2.5M	12.5kS/s / 6.25M

Legend:

Repetitive sampling

Expanded repetitive sampling (variable record length)

Bold: Expanded normal mode (variable record length)

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

Envelope mode available (c)

Envelope mode available (a, b)

Envelope mode available by reservation

Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Interpolation OFF   Repetitive sampling ON (Max: 2.5GS/s)

a) DL9040/DL9040L/DL9140/DL9140L: Interleave mode OFF, High resolution mode OFF,   b) DL9040/DL9040L/DL9140/DL9140L: Interleave mode ON, High resolution mode ON,
c) DL9240/DL9240L Interleave mode OFF, High resolution mode OFF, High resolution mode ON

T/div (s/div)	2.5k SR	2.5k RL	6.25k SR	6.25k RL	12.5k SR	12.5k RL	25k SR	25k RL	62.5k SR	62.5k RL	125k SR	125k RL	250k SR	250k RL	625k SR	625k RL	1.25M SR	1.25M RL	2.5M*1 SR	2.5M*1 RL	6.25M*1 SR	6.25M*1 RL
500ps	500GSps	2.5k	1250GSps	6.25k	2500GSps	12.5k	2500GSps	12.5k	2500GSps	12.5k	2500GSps	12.5k	2500GSps	12.5k	2500GSps	12.5k	2500GSps	12.5k	2500GSps	12.5k	2500GSps	12.5k
1ns	250GSps	2.5k	625GSps	6.25k	1250GSps	12.5k	2500GSps	25k	2500GSps	25k	2500GSps	25k	2500GSps	25k	2500GSps	25k	2500GSps	25k	2500GSps	25k	2500GSps	25k
2ns	125GSps	2.5k	312.5GSps	6.25k	625GSps	12.5k	1250GSps	25k	2500GSps	50k	2500GSps	50k	2500GSps	50k	2500GSps	50k	2500GSps	50k	2500GSps	50k	2500GSps	50k
5ns	50GSps	2.5k	125GSps	6.25k	250GSps	12.5k	500GSps	25k	1250GSps	62.5k	2500GSps	125k	2500GSps	125k	2500GSps	125k	2500GSps	125k	2500GSps	125k	2500GSps	125k
10ns	25GSps	2.5k	62.5GSps	6.25k	125GSps	12.5k	250GSps	25k	625GSps	62.5k	1250GSps	125k	2500GSps	250k	2500GSps	250k	2500GSps	250k	2500GSps	250k	2500GSps	250k
20ns	12.5GSps	2.5k	31.25GSps	6.25k	62.5GSps	12.5k	125GSps	25k	312.5GSps	62.5k	625GSps	125k	1250GSps	250k	2500GSps	500k	2500GSps	500k	2500GSps	500k	2500GSps	500k
50ns	5GSps	2.5k	12.5GSps	6.25k	25GSps	12.5k	50GSps	25k	125GSps	62.5k	250GSps	125k	500GSps	250k	1250GSps	625k	2500GSps	1.25M	2500GSps	1.25M	2500GSps	1.25M
100ns	2.5GSps	2.5k	6.25GSps	6.25k	12.5GSps	12.5k	25GSps	25k	62.5GSps	62.5k	125GSps	125k	250GSps	250k	625GSps	625k	1250GSps	1.25M	1250GSps	1.25M	1250GSps	1.25M
200ns	1.25GSps	2.5k	3.125GSps	6.25k	6.25GSps	12.5k	12.5GSps	25k	31.25GSps	62.5k	62.5GSps	125k	125GSps	250k	312.5GSps	625k	625GSps	1.25M	625GSps	1.25M	625GSps	1.25M
500ns	500MSps	2.5k	1.25GSps	6.25k	2.5GSps	12.5k	5GSps	25k	12.5GSps	62.5k	25GSps	125k	50GSps	250k	125GSps	625k	250GSps	1.25M	250GSps	1.25M	250GSps	1.25M
1us	250MSps	2.5k	625MSps	6.25k	1.25GSps	12.5k	2.5GSps	25k	6.25GSps	62.5k	12.5GSps	125k	25GSps	250k	62.5GSps	625k	125GSps	1.25M	125GSps	1.25M	125GSps	1.25M
2us	125MSps	2.5k	312.5MSps	6.25k	625MSps	12.5k	1.25GSps	25k	3.125GSps	62.5k	6.25GSps	125k	12.5GSps	250k	31.25GSps	625k	62.5GSps	1.25M	62.5GSps	1.25M	62.5GSps	1.25M
5us	50MSps	2.5k	125MSps	6.25k	250MSps	12.5k	500MSps	25k	1.25GSps	62.5k	2.5GSps	125k	5GSps	250k	12.5GSps	625k	25GSps	1.25M	25GSps	1.25M	25GSps	1.25M
10us	25MSps	2.5k	62.5MSps	6.25k	125MSps	12.5k	250MSps	25k	625MSps	62.5k	1.25GSps	125k	2.5GSps	250k	6.25GSps	625k	12.5GSps	1.25M	12.5GSps	1.25M	12.5GSps	1.25M
20us	12.5MSps	2.5k	31.25MSps	6.25k	62.5MSps	12.5k	125MSps	25k	312.5MSps	62.5k	625MSps	125k	1.25GSps	250k	3.125GSps	625k	6.25GSps	1.25M	6.25GSps	1.25M	6.25GSps	1.25M
50us	5MSps	2.5k	12.5MSps	6.25k	25MSps	12.5k	50MSps	25k	125MSps	62.5k	250MSps	125k	500MSps	250k	1.25GSps	625k	2.5GSps	1.25M	2.5GSps	1.25M	2.5GSps	1.25M
100us	2.5MSps	2.5k	6.25MSps	6.25k	12.5MSps	12.5k	25MSps	25k	62.5MSps	62.5k	125MSps	125k	250MSps	250k	625MSps	625k	1.25GSps	1.25M	2.5GSps	2.5M	2.5GSps	2.5M
200us	1.25MSps	2.5k	3.125MSps	6.25k	6.25MSps	12.5k	12.5MSps	25k	31.25MSps	62.5k	62.5MSps	125k	125MSps	250k	312.5MSps	625k	625MSps	1.25M	1.25GSps	2.5M	2.5GSps	5M
500us	500kSps	2.5k	1.25MSps	6.25k	2.5MSps	12.5k	5MSps	25k	12.5MSps	62.5k	25MSps	125k	50MSps	250k	125MSps	625k	250MSps	1.25M	500MSps	2.5M	1.25GSps	6.25M
1ms	250kSps	2.5k	625kSps	6.25k	1.25MSps	12.5k	2.5MSps	25k	6.25MSps	62.5k	12.5MSps	125k	25MSps	250k	62.5MSps	625k	125MSps	1.25M	250MSps	2.5M	625MSps	6.25M
2ms	125kSps	2.5k	312.5kSps	6.25k	625kSps	12.5k	1.25MSps	25k	3.125MSps	62.5k	6.25MSps	125k	12.5MSps	250k	31.25MSps	625k	62.5MSps	1.25M	125MSps	2.5M	312.5MSps	6.25M
5ms	50kSps	2.5k	125kSps	6.25k	250kSps	12.5k	500kSps	25k	1.25MSps	62.5k	2.5MSps	125k	5MSps	250k	12.5MSps	625k	25MSps	1.25M	50MSps	2.5M	125MSps	6.25M
10ms	25kSps	2.5k	62.5kSps	6.25k	125kSps	12.5k	250kSps	25k	625kSps	62.5k	1.25MSps	125k	2.5MSps	250k	6.25MSps	625k	12.5MSps	1.25M	25MSps	2.5M	62.5MSps	6.25M
20ms	12.5kSps	2.5k	31.25kSps	6.25k	62.5kSps	12.5k	125kSps	25k	312.5kSps	62.5k	625kSps	125k	1.25MSps	250k	3.125MSps	625k	6.25MSps	1.25M	12.5MSps	2.5M	31.25MSps	6.25M
50ms	5kSps	2.5k	12.5kSps	6.25k	25kSps	12.5k	50kSps	25k	125kSps	62.5k	250kSps	125k	500kSps	250k	1.25MSps	625k	2.5MSps	1.25M	5MSps	2.5M	12.5MSps	6.25M
100ms	2.5kSps	2.5k	6.25kSps	6.25k	12.5kSps	12.5k	25kSps	25k	62.5kSps	62.5k	125kSps	125k	250kSps	250k	625kSps	625k	1.25MSps	1.25M	2.5MSps	2.5M	6.25MSps	6.25M
200ms	1.25kSps	2.5k	3.125kSps	6.25k	6.25kSps	12.5k	12.5kSps	25k	31.25kSps	62.5k	62.5kSps	125k	125kSps	250k	312.5kSps	625k	625kSps	1.25M	1.25MSps	2.5M	3.125MSps	6.25M
500ms	500Sps	2.5k	1.25kSps	6.25k	2.5kSps	12.5k	5kSps	25k	12.5kSps	62.5k	25kSps	125k	50kSps	250k	125kSps	625k	250kSps	1.25M	500kSps	2.5M	1.25MSps	6.25M
1s	250Sps	2.5k	625Sps	6.25k	1.25kSps	12.5k	2.5kSps	25k	6.25kSps	62.5k	12.5kSps	125k	25kSps	250k	62.5kSps	625k	125kSps	1.25M	250kSps	2.5M	625kSps	6.25M
2s	125Sps	2.5k	312.5Sps	6.25k	625Sps	12.5k	1.25kSps	25k	3.125kSps	62.5k	6.25kSps	125k	12.5kSps	250k	31.25kSps	625k	62.5kSps	1.25M	125kSps	2.5M	312.5kSps	6.25M
5s	50Sps	2.5k	125Sps	6.25k	250Sps	12.5k	500Sps	25k	1.25kSps	62.5k	2.5kSps	125k	5kSps	250k	12.5kSps	625k	25kSps	1.25M	50kSps	2.5M	125kSps	6.25M
10s	50Sps	5k	62.5Sps	6.25k	125Sps	12.5k	250Sps	25k	625Sps	62.5k	1.25kSps	125k	2.5kSps	250k	6.25kSps	625k	12.5kSps	1.25M	25kSps	2.5M	62.5kSps	6.25M
20s	50Sps	10k	50Sps	10k	62.5Sps	12.5k	125Sps	25k	312.5Sps	62.5k	625Sps	125k	1.25kSps	250k	3.125kSps	625k	6.25kSps	1.25M	12.5kSps	2.5M	31.25kSps	6.25M
50s	50Sps	25k	50Sps	25k	50Sps	25k	50Sps	25k	125Sps	62.5k	250Sps	125k	500Sps	250k	1.25kSps	625k	2.5kSps	1.25M	5kSps	2.5M	12.5kSps	6.25M

Legend:

- ▉ (light blue) Repetitive sampling
- ▉ (cyan) Expanded repetitive sampling (variable record length)
- Bold: Expanded normal mode (variable record length)
- Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.
- ☐ Envelope mode available (c)
- ⌐ ┐ (dashed box) Envelope mode available (a, b)
- ┄ ┄ (dashed line) Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Appendix 1 Relationship between the Time Axis Setting, Sample Rate and Record Length

Interpolation OFF   Repetitive sampling OFF (Max: 5GS/s)   Repetitive sampling

a) DL9040/DL9040L/DL9140/DL9140L: Interleave mode ON, High resolution mode OFF,   b) DL9240/DL9240L: Interleave mode OFF, High resolution mode OFF, High resolution mode OFF, High resolution mode ON

c) DL9240/DL9240L: Interleave mode ON, High resolution mode ON

The table relates the time-axis setting (T/div) to the sample rate for each record-length setting. The two top rows (500ps, 1ns) show the expanded-repetitive sample rates (maximum 2500GS/s). In the repetitive-sampling region the sample rate is held at 5GS/s with a reduced (variable) record length; below this the sample rate decreases to maintain the full record length.

T/div (s/div)	2.5k	6.25k	12.5k	25k	62.5k	125k	250k	625k	1.25M	2.5M *1	6.25M *1
500ps	500GS/s	1250GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s
1ns	250GS/s	625GS/s	1250GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s	2500GS/s
2ns	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
5ns	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
10ns	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
20ns	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
50ns	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
100ns	2.5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
200ns	1.25GS/s	3.125GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
500ns	500MS/s	1.25GS/s	2.5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
1us	250MS/s	625MS/s	1.25GS/s	2.5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
2us	125MS/s	312.5MS/s	625MS/s	1.25GS/s	3.125GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
5us	50MS/s	125MS/s	250MS/s	500MS/s	1.25GS/s	2.5GS/s	5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
10us	25MS/s	62.5MS/s	125MS/s	250MS/s	625MS/s	1.25GS/s	2.5GS/s	5GS/s	5GS/s	5GS/s	5GS/s
20us	12.5MS/s	31.25MS/s	62.5MS/s	125MS/s	312.5MS/s	625MS/s	1.25GS/s	3.125GS/s	5GS/s	5GS/s	5GS/s
50us	5MS/s	12.5MS/s	25MS/s	50MS/s	125MS/s	250MS/s	500MS/s	1.25GS/s	2.5GS/s	5GS/s	5GS/s
100us	2.5MS/s	6.25MS/s	12.5MS/s	25MS/s	62.5MS/s	125MS/s	250MS/s	625MS/s	1.25GS/s	2.5GS/s	5GS/s
200us	1.25MS/s	3.125MS/s	6.25MS/s	12.5MS/s	31.25MS/s	62.5MS/s	125MS/s	312.5MS/s	625MS/s	1.25GS/s	3.125GS/s
500us	500kS/s	1.25MS/s	2.5MS/s	5MS/s	12.5MS/s	25MS/s	50MS/s	125MS/s	250MS/s	500MS/s	1.25GS/s
1ms	250kS/s	625kS/s	1.25MS/s	2.5MS/s	6.25MS/s	12.5MS/s	25MS/s	62.5MS/s	125MS/s	250MS/s	625MS/s
2ms	125kS/s	312.5kS/s	625kS/s	1.25MS/s	3.125MS/s	6.25MS/s	12.5MS/s	31.25MS/s	62.5MS/s	125MS/s	312.5MS/s
5ms	50kS/s	125kS/s	250kS/s	500kS/s	1.25MS/s	2.5MS/s	5MS/s	12.5MS/s	25MS/s	50MS/s	125MS/s
10ms	25kS/s	62.5kS/s	125kS/s	250kS/s	625kS/s	1.25MS/s	2.5MS/s	6.25MS/s	12.5MS/s	25MS/s	62.5MS/s
20ms	12.5kS/s	31.25kS/s	62.5kS/s	125kS/s	312.5kS/s	625kS/s	1.25MS/s	3.125MS/s	6.25MS/s	12.5MS/s	31.25MS/s
50ms	5kS/s	12.5kS/s	25kS/s	50kS/s	125kS/s	250kS/s	500kS/s	1.25MS/s	2.5MS/s	5MS/s	12.5MS/s
100ms	2.5kS/s	6.25kS/s	12.5kS/s	25kS/s	62.5kS/s	125kS/s	250kS/s	625kS/s	1.25MS/s	2.5MS/s	6.25MS/s
200ms	1.25kS/s	3.125kS/s	6.25kS/s	12.5kS/s	31.25kS/s	62.5kS/s	125kS/s	312.5kS/s	625kS/s	1.25MS/s	3.125MS/s
500ms	500S/s	1.25kS/s	2.5kS/s	5kS/s	12.5kS/s	25kS/s	50kS/s	125kS/s	250kS/s	500kS/s	1.25MS/s
1s	250S/s	625S/s	1.25kS/s	2.5kS/s	6.25kS/s	12.5kS/s	25kS/s	62.5kS/s	125kS/s	250kS/s	625kS/s
2s	125S/s	312.5S/s	625S/s	1.25kS/s	3.125kS/s	6.25kS/s	12.5kS/s	31.25kS/s	62.5kS/s	125kS/s	312.5kS/s
5s	50S/s	125S/s	250S/s	500S/s	1.25kS/s	2.5kS/s	5kS/s	12.5kS/s	25kS/s	50kS/s	125kS/s
10s	50S/s	62.5S/s	125S/s	250S/s	625S/s	1.25kS/s	2.5kS/s	6.25kS/s	12.5kS/s	25kS/s	62.5kS/s
20s	50S/s	50S/s	62.5S/s	125S/s	312.5S/s	625S/s	1.25kS/s	3.125kS/s	6.25kS/s	12.5kS/s	31.25kS/s
50s	50S/s	50S/s	50S/s	50S/s	125S/s	250S/s	500S/s	1.25kS/s	2.5kS/s	5kS/s	12.5kS/s

Legend:

- (light blue) Repetitive sampling
- (cyan) Expanded repetitive sampling (variable record length)
- **Bold**: Expanded normal mode (variable record length)
- *Italics*: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.
- [dashed box] Envelope mode available (a)
- [solid box] Envelope mode available (b, c)
- [dash-dot box] Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Interpolation OFF Repetitive sampling ON (Max: 5GS/s)

a) DL9040/DL9040L/DL9140/DL9140L: Interleave mode ON, High resolution mode OFF, b) DL9240/DL9240L: Interleave mode OFF, High resolution mode OFF,
c) DL9240/DL9240L: Interleave mode ON, High resolution mode ON

Each cell lists the sample rate over the record length ("rate / record length").

T/div(s/div)	2.5k	6.25k	12.5k	25k	62.5k	125k	250k	625k	1.25M	2.5M *1	6.25M *1
500ps	500GS/s / 2.5k	1250GS/s / 6.25k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k
1ns	250GS/s / 2.5k	625GS/s / 6.25k	1250GS/s / 12.5k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k
2ns	125GS/s / 2.5k	312.5GS/s / 6.25k	625GS/s / 12.5k	1250GS/s / 25k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k
5ns	50GS/s / 2.5k	125GS/s / 6.25k	250GS/s / 12.5k	500GS/s / 25k	1250GS/s / 62.5k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k
10ns	25GS/s / 2.5k	62.5GS/s / 6.25k	125GS/s / 12.5k	250GS/s / 25k	625GS/s / 62.5k	1250GS/s / 125k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k
20ns	12.5GS/s / 2.5k	31.25GS/s / 6.25k	62.5GS/s / 12.5k	125GS/s / 25k	312.5GS/s / 62.5k	625GS/s / 125k	1250GS/s / 250k	2500GS/s / 500k	2500GS/s / 500k	2500GS/s / 500k	2500GS/s / 500k
50ns	5GS/s / 2.5k	12.5GS/s / 6.25k	25GS/s / 12.5k	50GS/s / 25k	125GS/s / 62.5k	250GS/s / 125k	500GS/s / 250k	1250GS/s / 625k	2500GS/s / 1.25M	2500GS/s / 1.25M	2500GS/s / 1.25M
100ns	2.5GS/s / 2.5k	5GS/s / 5k	12.5GS/s / 12.5k	25GS/s / 25k	62.5GS/s / 62.5k	125GS/s / 125k	250GS/s / 250k	625GS/s / 625k	1250GS/s / 1.25M	2500GS/s / 2.5M	2500GS/s / 2.5M
200ns	1.25GS/s / 2.5k	2.5GS/s / 5k	5GS/s / 10k	12.5GS/s / 25k	31.25GS/s / 62.5k	62.5GS/s / 125k	125GS/s / 250k	312.5GS/s / 625k	625GS/s / 1.25M	1250GS/s / 2.5M	2500GS/s / 5M
500ns	500MS/s / 2.5k	1.25GS/s / 6.25k	2.5GS/s / 12.5k	5GS/s / 25k	12.5GS/s / 62.5k	25GS/s / 125k	50GS/s / 250k	125GS/s / 625k	250GS/s / 1.25M	500GS/s / 2.5M	1250GS/s / 6.25M
1us	250MS/s / 2.5k	625MS/s / 6.25k	1.25GS/s / 12.5k	2.5GS/s / 25k	5GS/s / 50k	12.5GS/s / 125k	25GS/s / 250k	62.5GS/s / 625k	125GS/s / 1.25M	250GS/s / 2.5M	625GS/s / 6.25M
2us	125MS/s / 2.5k	312.5MS/s / 6.25k	625MS/s / 12.5k	1.25GS/s / 25k	2.5GS/s / 50k	5GS/s / 100k	12.5GS/s / 250k	31.25GS/s / 625k	62.5GS/s / 1.25M	125GS/s / 2.5M	312.5GS/s / 6.25M
5us	50MS/s / 2.5k	125MS/s / 6.25k	250MS/s / 12.5k	500MS/s / 25k	1.25GS/s / 62.5k	2.5GS/s / 125k	5GS/s / 250k	12.5GS/s / 625k	25GS/s / 1.25M	50GS/s / 2.5M	125GS/s / 6.25M
10us	25MS/s / 2.5k	62.5MS/s / 6.25k	125MS/s / 12.5k	250MS/s / 25k	625MS/s / 62.5k	1.25GS/s / 125k	2.5GS/s / 250k	5GS/s / 500k	12.5GS/s / 1.25M	25GS/s / 2.5M	62.5GS/s / 6.25M
20us	12.5MS/s / 2.5k	31.25MS/s / 6.25k	62.5MS/s / 12.5k	125MS/s / 25k	312.5MS/s / 62.5k	625MS/s / 125k	1.25GS/s / 250k	2.5GS/s / 500k	5GS/s / 1M	12.5GS/s / 2.5M	31.25GS/s / 6.25M
50us	5MS/s / 2.5k	12.5MS/s / 6.25k	25MS/s / 12.5k	50MS/s / 25k	125MS/s / 62.5k	250MS/s / 125k	500MS/s / 250k	1.25GS/s / 625k	2.5GS/s / 1.25M	5GS/s / 2.5M	12.5GS/s / 6.25M
100us	2.5MS/s / 2.5k	6.25MS/s / 6.25k	12.5MS/s / 12.5k	25MS/s / 25k	62.5MS/s / 62.5k	125MS/s / 125k	250MS/s / 250k	625MS/s / 625k	1.25GS/s / 1.25M	2.5GS/s / 2.5M	5GS/s / 5M
200us	1.25MS/s / 2.5k	3.125MS/s / 6.25k	6.25MS/s / 12.5k	12.5MS/s / 25k	31.25MS/s / 62.5k	62.5MS/s / 125k	125MS/s / 250k	312.5MS/s / 625k	625MS/s / 1.25M	1.25GS/s / 2.5M	2.5GS/s / 5M
500us	500kS/s / 2.5k	1.25MS/s / 6.25k	2.5MS/s / 12.5k	5MS/s / 25k	12.5MS/s / 62.5k	25MS/s / 125k	50MS/s / 250k	125MS/s / 625k	250MS/s / 1.25M	500MS/s / 2.5M	1.25GS/s / 6.25M
1ms	250kS/s / 2.5k	625kS/s / 6.25k	1.25MS/s / 12.5k	2.5MS/s / 25k	6.25MS/s / 62.5k	12.5MS/s / 125k	25MS/s / 250k	62.5MS/s / 625k	125MS/s / 1.25M	250MS/s / 2.5M	625MS/s / 6.25M
2ms	125kS/s / 2.5k	312.5kS/s / 6.25k	625kS/s / 12.5k	1.25MS/s / 25k	3.125MS/s / 62.5k	6.25MS/s / 125k	12.5MS/s / 250k	31.25MS/s / 625k	62.5MS/s / 1.25M	125MS/s / 2.5M	312.5MS/s / 6.25M
5ms	50kS/s / 2.5k	125kS/s / 6.25k	250kS/s / 12.5k	500kS/s / 25k	1.25MS/s / 62.5k	2.5MS/s / 125k	5MS/s / 250k	12.5MS/s / 625k	25MS/s / 1.25M	50MS/s / 2.5M	125MS/s / 6.25M
10ms	25kS/s / 2.5k	62.5kS/s / 6.25k	125kS/s / 12.5k	250kS/s / 25k	625kS/s / 62.5k	1.25MS/s / 125k	2.5MS/s / 250k	6.25MS/s / 625k	12.5MS/s / 1.25M	25MS/s / 2.5M	62.5MS/s / 6.25M
20ms	12.5kS/s / 2.5k	31.25kS/s / 6.25k	62.5kS/s / 12.5k	125kS/s / 25k	312.5kS/s / 62.5k	625kS/s / 125k	1.25MS/s / 250k	3.125MS/s / 625k	6.25MS/s / 1.25M	12.5MS/s / 2.5M	31.25MS/s / 6.25M
50ms	5kS/s / 2.5k	12.5kS/s / 6.25k	25kS/s / 12.5k	50kS/s / 25k	125kS/s / 62.5k	250kS/s / 125k	500kS/s / 250k	1.25MS/s / 625k	2.5MS/s / 1.25M	5MS/s / 2.5M	12.5MS/s / 6.25M
100ms	2.5kS/s / 2.5k	6.25kS/s / 6.25k	12.5kS/s / 12.5k	25kS/s / 25k	62.5kS/s / 62.5k	125kS/s / 125k	250kS/s / 250k	625kS/s / 625k	1.25MS/s / 1.25M	2.5MS/s / 2.5M	6.25MS/s / 6.25M
200ms	1.25kS/s / 2.5k	3.125kS/s / 6.25k	6.25kS/s / 12.5k	12.5kS/s / 25k	31.25kS/s / 62.5k	62.5kS/s / 125k	125kS/s / 250k	312.5kS/s / 625k	625kS/s / 1.25M	1.25MS/s / 2.5M	3.125MS/s / 6.25M
500ms	500S/s / 2.5k	1.25kS/s / 6.25k	2.5kS/s / 12.5k	5kS/s / 25k	12.5kS/s / 62.5k	25kS/s / 125k	50kS/s / 250k	125kS/s / 625k	250kS/s / 1.25M	500kS/s / 2.5M	1.25MS/s / 6.25M
1s	250S/s / 2.5k	625S/s / 6.25k	1.25kS/s / 12.5k	2.5kS/s / 25k	6.25kS/s / 62.5k	12.5kS/s / 125k	25kS/s / 250k	62.5kS/s / 625k	125kS/s / 1.25M	250kS/s / 2.5M	625kS/s / 6.25M
2s	125S/s / 2.5k	312.5S/s / 6.25k	625S/s / 12.5k	1.25kS/s / 25k	3.125kS/s / 62.5k	6.25kS/s / 125k	12.5kS/s / 250k	31.25kS/s / 625k	62.5kS/s / 1.25M	125kS/s / 2.5M	312.5kS/s / 6.25M
5s	50S/s / 2.5k	125S/s / 6.25k	250S/s / 12.5k	500S/s / 25k	1.25kS/s / 62.5k	2.5kS/s / 125k	5kS/s / 250k	12.5kS/s / 625k	25kS/s / 1.25M	50kS/s / 2.5M	125kS/s / 6.25M
10s	50S/s / 5k	62.5S/s / 6.25k	125S/s / 12.5k	250S/s / 25k	625S/s / 62.5k	1.25kS/s / 125k	2.5kS/s / 250k	6.25kS/s / 625k	12.5kS/s / 1.25M	25kS/s / 2.5M	62.5kS/s / 6.25M
20s	50S/s / 10k	50S/s / 10k	62.5S/s / 12.5k	125S/s / 25k	312.5S/s / 62.5k	625S/s / 125k	1.25kS/s / 250k	3.125kS/s / 625k	6.25kS/s / 1.25M	12.5kS/s / 2.5M	31.25kS/s / 6.25M
50s	50S/s / 25k	50S/s / 25k	50S/s / 25k	50S/s / 25k	125S/s / 62.5k	250S/s / 125k	500S/s / 250k	1.25kS/s / 625k	2.5kS/s / 1.25M	5kS/s / 2.5M	12.5kS/s / 6.25M

Legend:

- (light blue) Repetitive sampling
- (medium blue) Expanded repetitive sampling (variable record length)
- Bold: Expanded normal mode (variable record length)
- Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.
- (solid box) Envelope mode available (c)
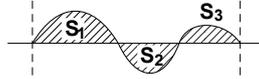- (dashed box) Envelope mode available (a, b)
- (dash-dot box) Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Appendix

App

Appendix 1 Relationship between the Time Axis Setting, Sample Rate and Record Length

Interpolation OFF   Repetitive sampling OFF (Max: 10GS/s)

DL9240/DL9240L: Interleave mode ON, High resolution mode OFF

Each record-length column gives the Sample rate / Record length. Column header shows the representative (un-capped) sample rate and the record-length setting.

T/div	2.5k (500GS/s)	6.25k (1250GS/s)	12.5k (2500GS/s)	25k (2500GS/s)	62.5k (2500GS/s)	125k (2500GS/s)	250k (2500GS/s)	625k (2500GS/s)	1.25M (2500GS/s)	2.5M *1 (2500GS/s)	6.25M *1 (2500GS/s)
500ps	10GS/s / 50	10GS/s / 50	10GS/s / 50	10GS/s / 50	10GS/s / 50	10GS/s / 50	10GS/s / 50	10GS/s / 50	10GS/s / 50	10GS/s / 50	10GS/s / 50
1ns	10GS/s / 100	10GS/s / 100	10GS/s / 100	10GS/s / 100	10GS/s / 100	10GS/s / 100	10GS/s / 100	10GS/s / 100	10GS/s / 100	10GS/s / 100	10GS/s / 100
2ns	10GS/s / 200	10GS/s / 200	10GS/s / 200	10GS/s / 200	10GS/s / 200	10GS/s / 200	10GS/s / 200	10GS/s / 200	10GS/s / 200	10GS/s / 200	10GS/s / 200
5ns	10GS/s / 500	10GS/s / 500	10GS/s / 500	10GS/s / 500	10GS/s / 500	10GS/s / 500	10GS/s / 500	10GS/s / 500	10GS/s / 500	10GS/s / 500	10GS/s / 500
10ns	10GS/s / 1k	10GS/s / 1k	10GS/s / 1k	10GS/s / 1k	10GS/s / 1k	10GS/s / 1k	10GS/s / 1k	10GS/s / 1k	10GS/s / 1k	10GS/s / 1k	10GS/s / 1k
20ns	10GS/s / 2k	10GS/s / 2k	10GS/s / 2k	10GS/s / 2k	10GS/s / 2k	10GS/s / 2k	10GS/s / 2k	10GS/s / 2k	10GS/s / 2k	10GS/s / 2k	10GS/s / 2k
50ns	5GS/s / 2.5k	10GS/s / 5k	10GS/s / 5k	10GS/s / 5k	10GS/s / 5k	10GS/s / 5k	10GS/s / 5k	10GS/s / 5k	10GS/s / 5k	10GS/s / 5k	10GS/s / 5k
100ns	2.5GS/s / 2.5k	6.25GS/s / 6.25k	10GS/s / 10k	10GS/s / 10k	10GS/s / 10k	10GS/s / 10k	10GS/s / 10k	10GS/s / 10k	10GS/s / 10k	10GS/s / 10k	10GS/s / 10k
200ns	1.25GS/s / 2.5k	3.125GS/s / 6.25k	6.25GS/s / 12.5k	10GS/s / 20k	10GS/s / 20k	10GS/s / 20k	10GS/s / 20k	10GS/s / 20k	10GS/s / 20k	10GS/s / 20k	10GS/s / 20k
500ns	500MS/s / 2.5k	1.25GS/s / 6.25k	2.5GS/s / 12.5k	5GS/s / 25k	10GS/s / 50k	10GS/s / 50k	10GS/s / 50k	10GS/s / 50k	10GS/s / 50k	10GS/s / 50k	10GS/s / 50k
1us	250MS/s / 2.5k	625MS/s / 6.25k	1.25GS/s / 12.5k	2.5GS/s / 25k	6.25GS/s / 62.5k	10GS/s / 100k	10GS/s / 100k	10GS/s / 100k	10GS/s / 100k	10GS/s / 100k	10GS/s / 100k
2us	125MS/s / 2.5k	312.5MS/s / 6.25k	625MS/s / 12.5k	1.25GS/s / 25k	3.125GS/s / 62.5k	6.25GS/s / 125k	10GS/s / 200k	10GS/s / 200k	10GS/s / 200k	10GS/s / 200k	10GS/s / 200k
5us	50MS/s / 2.5k	125MS/s / 6.25k	250MS/s / 12.5k	500MS/s / 25k	1.25GS/s / 62.5k	2.5GS/s / 125k	5GS/s / 250k	10GS/s / 500k	10GS/s / 500k	10GS/s / 500k	10GS/s / 500k
10us	25MS/s / 2.5k	62.5MS/s / 6.25k	125MS/s / 12.5k	250MS/s / 25k	625MS/s / 62.5k	1.25GS/s / 125k	2.5GS/s / 250k	6.25GS/s / 625k	10GS/s / 1M	10GS/s / 1M	10GS/s / 1M
20us	12.5MS/s / 2.5k	31.25MS/s / 6.25k	62.5MS/s / 12.5k	125MS/s / 25k	312.5MS/s / 62.5k	625MS/s / 125k	1.25GS/s / 250k	3.125GS/s / 625k	6.25GS/s / 1.25M	10GS/s / 2M	10GS/s / 2M
50us	5MS/s / 2.5k	12.5MS/s / 6.25k	25MS/s / 12.5k	50MS/s / 25k	125MS/s / 62.5k	250MS/s / 125k	500MS/s / 250k	1.25GS/s / 625k	2.5GS/s / 1.25M	5GS/s / 2.5M	10GS/s / 5M
100us	2.5MS/s / 2.5k	6.25MS/s / 6.25k	12.5MS/s / 12.5k	25MS/s / 25k	62.5MS/s / 62.5k	125MS/s / 125k	250MS/s / 250k	625MS/s / 625k	1.25GS/s / 1.25M	2.5GS/s / 2.5M	6.25GS/s / 6.25M
200us	1.25MS/s / 2.5k	3.125MS/s / 6.25k	6.25MS/s / 12.5k	12.5MS/s / 25k	31.25MS/s / 62.5k	62.5MS/s / 125k	125MS/s / 250k	312.5MS/s / 625k	625MS/s / 1.25M	1.25GS/s / 2.5M	3.125GS/s / 6.25M
500us	500kS/s / 2.5k	1.25MS/s / 6.25k	2.5MS/s / 12.5k	5MS/s / 25k	12.5MS/s / 62.5k	25MS/s / 125k	50MS/s / 250k	125MS/s / 625k	250MS/s / 1.25M	500MS/s / 2.5M	1.25GS/s / 6.25M
1ms	250kS/s / 2.5k	625kS/s / 6.25k	1.25MS/s / 12.5k	2.5MS/s / 25k	6.25MS/s / 62.5k	12.5MS/s / 125k	25MS/s / 250k	62.5MS/s / 625k	125MS/s / 1.25M	250MS/s / 2.5M	625MS/s / 6.25M
2ms	125kS/s / 2.5k	312.5kS/s / 6.25k	625kS/s / 12.5k	1.25MS/s / 25k	3.125MS/s / 62.5k	6.25MS/s / 125k	12.5MS/s / 250k	31.25MS/s / 625k	62.5MS/s / 1.25M	125MS/s / 2.5M	312.5MS/s / 6.25M
5ms	50kS/s / 2.5k	125kS/s / 6.25k	250kS/s / 12.5k	500kS/s / 25k	1.25MS/s / 62.5k	2.5MS/s / 125k	5MS/s / 250k	12.5MS/s / 625k	25MS/s / 1.25M	50MS/s / 2.5M	125MS/s / 6.25M
10ms	25kS/s / 2.5k	62.5kS/s / 6.25k	125kS/s / 12.5k	250kS/s / 25k	625kS/s / 62.5k	1.25MS/s / 125k	2.5MS/s / 250k	6.25MS/s / 625k	12.5MS/s / 1.25M	25MS/s / 2.5M	62.5MS/s / 6.25M
20ms	12.5kS/s / 2.5k	31.25kS/s / 6.25k	62.5kS/s / 12.5k	125kS/s / 25k	312.5kS/s / 62.5k	625kS/s / 125k	1.25MS/s / 250k	3.125MS/s / 625k	6.25MS/s / 1.25M	12.5MS/s / 2.5M	31.25MS/s / 6.25M
50ms	5kS/s / 2.5k	12.5kS/s / 6.25k	25kS/s / 12.5k	50kS/s / 25k	125kS/s / 62.5k	250kS/s / 125k	500kS/s / 250k	1.25MS/s / 625k	2.5MS/s / 1.25M	5MS/s / 2.5M	12.5MS/s / 6.25M
100ms	2.5kS/s / 2.5k	6.25kS/s / 6.25k	12.5kS/s / 12.5k	25kS/s / 25k	62.5kS/s / 62.5k	125kS/s / 125k	250kS/s / 250k	625kS/s / 625k	1.25MS/s / 1.25M	2.5MS/s / 2.5M	6.25MS/s / 6.25M
200ms	1.25kS/s / 2.5k	3.125kS/s / 6.25k	6.25kS/s / 12.5k	12.5kS/s / 25k	31.25kS/s / 62.5k	62.5kS/s / 125k	125kS/s / 250k	312.5kS/s / 625k	625kS/s / 1.25M	1.25MS/s / 2.5M	3.125MS/s / 6.25M
500ms	500S/s / 2.5k	1.25kS/s / 6.25k	2.5kS/s / 12.5k	5kS/s / 25k	12.5kS/s / 62.5k	25kS/s / 125k	50kS/s / 250k	125kS/s / 625k	250kS/s / 1.25M	500kS/s / 2.5M	1.25MS/s / 6.25M
1s	250S/s / 2.5k	625S/s / 6.25k	1.25kS/s / 12.5k	2.5kS/s / 25k	6.25kS/s / 62.5k	12.5kS/s / 125k	25kS/s / 250k	62.5kS/s / 625k	125kS/s / 1.25M	250kS/s / 2.5M	625kS/s / 6.25M
2s	125S/s / 2.5k	312.5S/s / 6.25k	625S/s / 12.5k	1.25kS/s / 25k	3.125kS/s / 62.5k	6.25kS/s / 125k	12.5kS/s / 250k	31.25kS/s / 625k	62.5kS/s / 1.25M	125kS/s / 2.5M	312.5kS/s / 6.25M
5s	50S/s / 2.5k	125S/s / 6.25k	250S/s / 12.5k	500S/s / 25k	1.25kS/s / 62.5k	2.5kS/s / 125k	5kS/s / 250k	12.5kS/s / 625k	25kS/s / 1.25M	50kS/s / 2.5M	125kS/s / 6.25M
10s	*50S/s / 5k*	62.5S/s / 6.25k	125S/s / 12.5k	250S/s / 25k	625S/s / 62.5k	1.25kS/s / 125k	2.5kS/s / 250k	6.25kS/s / 625k	12.5kS/s / 1.25M	25kS/s / 2.5M	62.5kS/s / 6.25M
20s	*50S/s / 10k*	*50S/s / 10k*	62.5S/s / 12.5k	125S/s / 25k	312.5S/s / 62.5k	625S/s / 125k	1.25kS/s / 250k	3.125kS/s / 625k	6.25kS/s / 1.25M	12.5kS/s / 2.5M	31.25kS/s / 6.25M
50s	*50S/s / 25k*	*50S/s / 25k*	*50S/s / 25k*	50S/s / 25k	125S/s / 62.5k	250S/s / 125k	500S/s / 250k	1.25kS/s / 625k	2.5kS/s / 1.25M	5kS/s / 2.5M	12.5kS/s / 6.25M

Legend:

- Repetitive sampling
- Expanded repetitive sampling (variable record length)
- Bold: Expanded normal mode (variable record length)
- Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.
- [ ] Envelope mode available
- [- -] Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

terpolation OFF   Repetitive sampling ON (Max: 10GS/s)
DL9240/DL9240L: Interleave mode ON, High resolution mode OFF

Values are shown as **sample rate / record length** for each record length setting.

T/div (s/div)	2.5k	6.25k	12.5k	25k	62.5k	125k	250k	625k	1.25M	2.5M *1	6.25M *1
500ps	500GS/s / 2.5k	1250GS/s / 6.25k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k	2500GS/s / 12.5k
1ns	250GS/s / 2.5k	625GS/s / 6.25k	1250GS/s / 12.5k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k	2500GS/s / 25k
2ns	125GS/s / 2.5k	312.5GS/s / 6.25k	625GS/s / 12.5k	1250GS/s / 25k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k	2500GS/s / 50k
5ns	50GS/s / 2.5k	125GS/s / 6.25k	250GS/s / 12.5k	500GS/s / 25k	1250GS/s / 62.5k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k	2500GS/s / 125k
10ns	25GS/s / 2.5k	62.5GS/s / 6.25k	125GS/s / 12.5k	250GS/s / 25k	625GS/s / 62.5k	1250GS/s / 125k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k	2500GS/s / 250k
20ns	10GS/s / 2k	31.25GS/s / 6.25k	62.5GS/s / 12.5k	125GS/s / 25k	312.5GS/s / 62.5k	625GS/s / 125k	1250GS/s / 250k	2500GS/s / 500k	2500GS/s / 500k	2500GS/s / 500k	2500GS/s / 500k
50ns	5GS/s / 2.5k	10GS/s / 5k	25GS/s / 12.5k	50GS/s / 25k	125GS/s / 62.5k	250GS/s / 125k	500GS/s / 250k	1250GS/s / 625k	2500GS/s / 1.25M	2500GS/s / 1.25M	2500GS/s / 1.25M
100ns	2.5GS/s / 2.5k	6.25GS/s / 6.25k	10GS/s / 10k	25GS/s / 25k	62.5GS/s / 62.5k	125GS/s / 125k	250GS/s / 250k	625GS/s / 625k	1250GS/s / 1.25M	1250GS/s / 1.25M	1250GS/s / 1.25M
200ns	1.25GS/s / 2.5k	3.125GS/s / 6.25k	6.25GS/s / 12.5k	10GS/s / 20k	31.25GS/s / 62.5k	62.5GS/s / 125k	125GS/s / 250k	312.5GS/s / 625k	625GS/s / 1.25M	625GS/s / 1.25M	625GS/s / 1.25M
500ns	500MS/s / 2.5k	1.25GS/s / 6.25k	2.5GS/s / 12.5k	5GS/s / 25k	10GS/s / 50k	25GS/s / 125k	50GS/s / 250k	125GS/s / 625k	250GS/s / 1.25M	250GS/s / 1.25M	250GS/s / 1.25M
1us	250MS/s / 2.5k	625MS/s / 6.25k	1.25GS/s / 12.5k	2.5GS/s / 25k	6.25GS/s / 62.5k	10GS/s / 100k	25GS/s / 250k	62.5GS/s / 625k	125GS/s / 1.25M	125GS/s / 1.25M	125GS/s / 1.25M
2us	125MS/s / 2.5k	312.5MS/s / 6.25k	625MS/s / 12.5k	1.25GS/s / 25k	3.125GS/s / 62.5k	6.25GS/s / 125k	10GS/s / 200k	31.25GS/s / 625k	62.5GS/s / 1.25M	62.5GS/s / 1.25M	62.5GS/s / 1.25M
5us	50MS/s / 2.5k	125MS/s / 6.25k	250MS/s / 12.5k	500MS/s / 25k	1.25GS/s / 62.5k	2.5GS/s / 125k	5GS/s / 250k	10GS/s / 500k	25GS/s / 1.25M	25GS/s / 1.25M	25GS/s / 1.25M
10us	25MS/s / 2.5k	62.5MS/s / 6.25k	125MS/s / 12.5k	250MS/s / 25k	625MS/s / 62.5k	1.25GS/s / 125k	2.5GS/s / 250k	6.25GS/s / 625k	12.5GS/s / 1.25M	12.5GS/s / 1.25M	12.5GS/s / 1.25M
20us	12.5MS/s / 2.5k	31.25MS/s / 6.25k	62.5MS/s / 12.5k	125MS/s / 25k	312.5MS/s / 62.5k	625MS/s / 125k	1.25GS/s / 250k	3.125GS/s / 625k	6.25GS/s / 1.25M	10GS/s / 2M	10GS/s / 2M
50us	5MS/s / 2.5k	12.5MS/s / 6.25k	25MS/s / 12.5k	50MS/s / 25k	125MS/s / 62.5k	250MS/s / 125k	500MS/s / 250k	1.25GS/s / 625k	2.5GS/s / 1.25M	5GS/s / 2.5M	10GS/s / 5M
100us	2.5MS/s / 2.5k	6.25MS/s / 6.25k	12.5MS/s / 12.5k	25MS/s / 25k	62.5MS/s / 62.5k	125MS/s / 125k	250MS/s / 250k	625MS/s / 625k	1.25GS/s / 1.25M	2.5GS/s / 2.5M	6.25GS/s / 6.25M
200us	1.25MS/s / 2.5k	3.125MS/s / 6.25k	6.25MS/s / 12.5k	12.5MS/s / 25k	31.25MS/s / 62.5k	62.5MS/s / 125k	125MS/s / 250k	312.5MS/s / 625k	625MS/s / 1.25M	1.25GS/s / 2.5M	3.125GS/s / 6.25M
500us	500kS/s / 2.5k	1.25MS/s / 6.25k	2.5MS/s / 12.5k	5MS/s / 25k	12.5MS/s / 62.5k	25MS/s / 125k	50MS/s / 250k	125MS/s / 625k	250MS/s / 1.25M	500MS/s / 2.5M	1.25GS/s / 6.25M
1ms	250kS/s / 2.5k	625kS/s / 6.25k	1.25MS/s / 12.5k	2.5MS/s / 25k	6.25MS/s / 62.5k	12.5MS/s / 125k	25MS/s / 250k	62.5MS/s / 625k	125MS/s / 1.25M	250MS/s / 2.5M	625MS/s / 6.25M
2ms	125kS/s / 2.5k	312.5kS/s / 6.25k	625kS/s / 12.5k	1.25MS/s / 25k	3.125MS/s / 62.5k	6.25MS/s / 125k	12.5MS/s / 250k	31.25MS/s / 625k	62.5MS/s / 1.25M	125MS/s / 2.5M	312.5MS/s / 6.25M
5ms	50kS/s / 2.5k	125kS/s / 6.25k	250kS/s / 12.5k	500kS/s / 25k	1.25MS/s / 62.5k	2.5MS/s / 125k	5MS/s / 250k	12.5MS/s / 625k	25MS/s / 1.25M	50MS/s / 2.5M	125MS/s / 6.25M
10ms	25kS/s / 2.5k	62.5kS/s / 6.25k	125kS/s / 12.5k	250kS/s / 25k	625kS/s / 62.5k	1.25MS/s / 125k	2.5MS/s / 250k	6.25MS/s / 625k	12.5MS/s / 1.25M	25MS/s / 2.5M	62.5MS/s / 6.25M
20ms	12.5kS/s / 2.5k	31.25kS/s / 6.25k	62.5kS/s / 12.5k	125kS/s / 25k	312.5kS/s / 62.5k	625kS/s / 125k	1.25MS/s / 250k	3.125MS/s / 625k	6.25MS/s / 1.25M	12.5MS/s / 2.5M	31.25MS/s / 6.25M
50ms	5kS/s / 2.5k	12.5kS/s / 6.25k	25kS/s / 12.5k	50kS/s / 25k	125kS/s / 62.5k	250kS/s / 125k	500kS/s / 250k	1.25MS/s / 625k	2.5MS/s / 1.25M	5MS/s / 2.5M	12.5MS/s / 6.25M
100ms	2.5kS/s / 2.5k	6.25kS/s / 6.25k	12.5kS/s / 12.5k	25kS/s / 25k	62.5kS/s / 62.5k	125kS/s / 125k	250kS/s / 250k	625kS/s / 625k	1.25MS/s / 1.25M	2.5MS/s / 2.5M	6.25MS/s / 6.25M
200ms	1.25kS/s / 2.5k	3.125kS/s / 6.25k	6.25kS/s / 12.5k	12.5kS/s / 25k	31.25kS/s / 62.5k	62.5kS/s / 125k	125kS/s / 250k	312.5kS/s / 625k	625kS/s / 1.25M	1.25MS/s / 2.5M	3.125MS/s / 6.25M
500ms	500S/s / 2.5k	1.25kS/s / 6.25k	2.5kS/s / 12.5k	5kS/s / 25k	12.5kS/s / 62.5k	25kS/s / 125k	50kS/s / 250k	125kS/s / 625k	250kS/s / 1.25M	500kS/s / 2.5M	1.25MS/s / 6.25M
1s	250S/s / 2.5k	625S/s / 6.25k	1.25kS/s / 12.5k	2.5kS/s / 25k	6.25kS/s / 62.5k	12.5kS/s / 125k	25kS/s / 250k	62.5kS/s / 625k	125kS/s / 1.25M	250kS/s / 2.5M	625kS/s / 6.25M
2s	125S/s / 2.5k	312.5S/s / 6.25k	625S/s / 12.5k	1.25kS/s / 25k	3.125kS/s / 62.5k	6.25kS/s / 125k	12.5kS/s / 250k	31.25kS/s / 625k	62.5kS/s / 1.25M	125kS/s / 2.5M	312.5kS/s / 6.25M
5s	50S/s / 2.5k	125S/s / 6.25k	250S/s / 12.5k	500S/s / 25k	1.25kS/s / 62.5k	2.5kS/s / 125k	5kS/s / 250k	12.5kS/s / 625k	25kS/s / 1.25M	50kS/s / 2.5M	125kS/s / 6.25M
10s	50S/s / 5k	62.5S/s / 6.25k	125S/s / 12.5k	250S/s / 25k	625S/s / 62.5k	1.25kS/s / 125k	2.5kS/s / 250k	6.25kS/s / 625k	12.5kS/s / 1.25M	25kS/s / 2.5M	62.5kS/s / 6.25M
20s	50S/s / 10k	50S/s / 10k	62.5S/s / 12.5k	125S/s / 25k	312.5S/s / 62.5k	625S/s / 125k	1.25kS/s / 250k	3.125kS/s / 625k	6.25kS/s / 1.25M	12.5kS/s / 2.5M	31.25kS/s / 6.25M
50s	50S/s / 25k	50S/s / 25k	50S/s / 25k	50S/s / 25k	125S/s / 62.5k	250S/s / 125k	500S/s / 250k	1.25kS/s / 625k	2.5kS/s / 1.25M	5kS/s / 2.5M	12.5kS/s / 6.25M

Legend:

- (light blue) Repetitive sampling
- (cyan) Expanded repetitive sampling (variable record length)
- **Bold**: Expanded normal mode (variable record length)
- *Italics*: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.
- (box) Envelope mode available
- (dashed box) Roll mode available

*1 Maximum record length in high resolution mode is 1.25 MW with the DL9040/DL9040L/DL9140/DL9140L and 2.5 MW with the DL9240/DL9240L.

Appendix

App

Appendix 2 How to Calculate the Area of a Waveform

IntegTY

Total Area for both Positive and Negative Sides: $S_1 + S_3 - S_2$

XY display: IntegXY

Open

(1) When Only One Y Data Corresponds to X Data

a
Start point
Stop point
Area of S = S_0
S_0
X axis (Y = 0)

b
Stop point
Start point
Area of S = $-S_0$
S_0
X axis (Y = 0)

c
X axis (Y = 0)
Area of S = $-S_0$
S_0
Start point
Stop point

d
X axis (Y = 0)
Area of S = S_0
S_0
Stop point
Start point
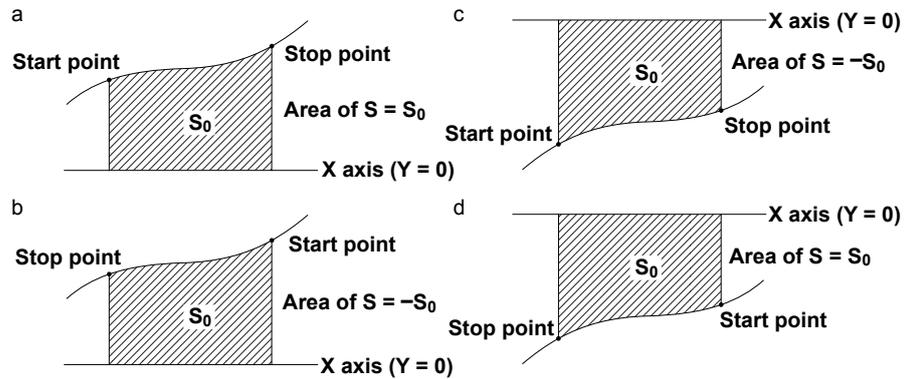
(2) When the Waveform Extends into the Negative Side

Start point
S_0
X axis (Y = 0)
S_1
Area of S = $S_0 - S_1$
Stop point
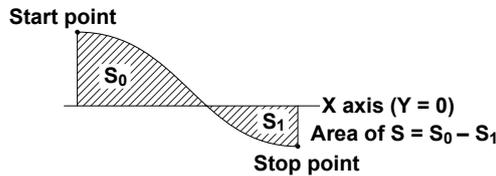
(3) When Two or more Y Data Correspond to X Data

Start point
S_0
Area of S = S_0
Stop point
X axis (Y = 0)

Start point
S_0
Stop point
S_1
Area of S = $S_0 + 2 \times S_1 + S_2$
S_2
X axis (Y = 0)

Close

(1) Multiple Loops

Area of S = $n \times S_0$
n: Number of Loops
S_0
Start, Stop point
Waveform

(2) Non-Closed Curve

Area of S = S_0
Area Enclosed by a Curve Connecting the Start and Stop Points
S_0
Start point
Stop point
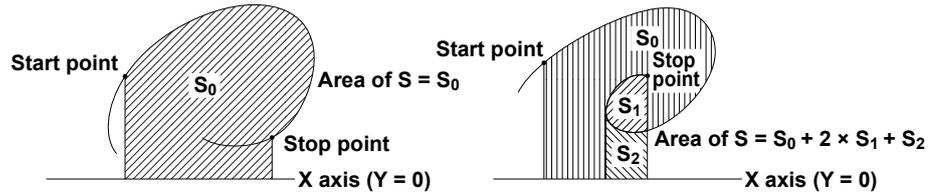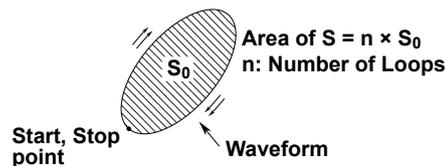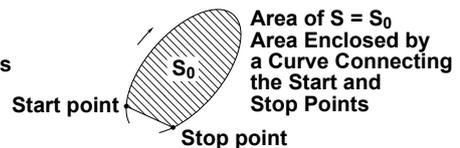
(3) Loop Tracinga Figure Eight

S_1
Area of S = $|S_0 - S_1|$
S_0
Start point
Stop point

(4) Spiral Loop

S_1
Area of S = $S_0 \times 2 + S_1$
Number of Overlaps Varies According to the Number of Loops
S_0
Start point
Stop point

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