DL6000/DLM6000 Series
Digital Oscilloscope/ Mixed Signal Oscilloscope

USER'S MANUAL

YOKOGAWA
Yokogawa Meters & Instruments Corporation

IM DLM6054-01EN
1st Edition

Product Registration

Thank you for purchasing YOKOGAWA products.

YOKOGAWA provides registered users with a variety of information and services.
Please allow us to serve you best by completing the product registration form accessible from our homepage.

http://tmi.yokogawa.com/

Thank you for purchasing a DL6000 Series Digital Oscilloscope or a DLM6000 Series Mixed Signal Oscilloscope (hereinafter, the DL6054, DL6104, DL6154, DLM6054, and DLM6104 will all be referred to as “the DL6000/DLM6000”). This user’s manual explains the features, operating procedures, and handling precautions of the DL6000/DLM6000. To ensure correct use, please read this manual thoroughly before beginning operation.
Keep this manual in a safe place for quick reference in the event a question arises. The following manuals, including this one, are provided as manuals for the DL6000/DLM6000. Please read all the manuals.

List of Manuals

The following four manuals, including this one, are provided as manuals for the DL6000/DLM6000. Read them along with this manual.

Manual Title	Manual No.	Description
DL6000/DLM6000 Series Digital Oscilloscope/Mixed Signal Oscilloscope User’s Manual	IM DLM6054-01EN	This manual. Explains all DL6000/DLM6000 series features, except for the communication features, and how to use them.
DL6000/DLM6000 Series Digital Oscilloscope/Mixed Signal Oscilloscope Communication Interface User’s Manual (included in CD)	IM DLM6054-17EN	Explains the DL6000/DLM6000 series communication interface features and how to use them.
DL6000/DLM6000 Series Digital Oscilloscope/Mixed Signal Oscilloscope Serial Bus Signal Triggering and Analysis Function User’s Manual	IM DLM6054-51EN	Explains the optional I2C bus signal, CAN bus signal, LIN bus signal, SPI bus signal, and UART bus signal triggering and analysis features and how to use them.
DL6000/DLM6000 Series Digital Oscilloscope/Mixed Signal Oscilloscope Power Supply Analysis Function User’s Manual	IM DLM6054-61EN	Explains the optional power supply analysis features and how to use them.

Notes

- You can check the firmware version of the instrument in the overview screen. For instructions on how to display the overview screen, see section 17.4 in this manual. For information about different firmware versions and updates, see the following webpage.
  http://tmi.yokogawa.com/
- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument’s performance and functionality. The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
- Copying or reproducing all or any part of the content of this manual without the permission of YOKOGAWA is strictly prohibited.

1st Edition: October 2009 (YK)

Trademark Acknowledgements

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Revisions

- 1st Edition: October 2009

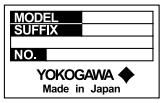
Checking the Package Contents

After receiving the product and opening the package, check the items described below. If the wrong items have been delivered, if items are missing, or if there is a problem with the appearance of the items, contact your nearest YOKOGAWA dealer.

DL6000/DLM6000

Check that the product that you received is what you ordered by referring to the model name and suffix code given on the name plate on the rear panel.

Name Plate



MODEL	Suffix Code		Description
DL6054			DL6054 Digital Oscilloscope, 4 ch, 5 GS/s, 500 MHz, max 6.25 Mpoints/CH
DL6104			DL6104 Digital Oscilloscope, 4 ch, 5 GS/s, 1 GHz, max 6.25 Mpoints/CH
DL6154			DL6154 Digital Oscilloscope, 4 ch, 10 GS/s, 1.5 GHz, max 6.25 Mpoints/CH
DLM6054			DLM6054 Mixed Signal Digital Oscilloscope, 4 ch + 16 or 32 bits, 5 GS/s, 500 MHz, max 6.25 Mpoints/CH
DLM6104			DLM6104 Mixed Signal Digital Oscilloscope, 4 ch + 16 or 32 bits, 5 GS/s, 1 GHz, max 6.25 Mpoints/CH
Power cord	-D		UL/CSA Standard power cord (Part No.: A1006WD) [Maximum rated voltage: 125 V]
	-F		VDE Standard Power Cord (Part No.: A1009WD) [Maximum rated voltage: 250 V]
	-Q		BS Standard Power Cord (Part No.: A1054WD) [Maximum rated voltage: 250 V]
	-R		AS Standard Power Cord (Part No.: A1024WD) [Maximum rated voltage: 250 V]
	-H		GB Standard Power Cord (Part No.: A1064WD) [Maximum rated voltage: 250 V]
Logic input	-L16[1]		16-bit logic input
	-L32[1]		32-bit logic input
Language (Menu and Pannel)		-HE	English
		-HJ	Japanese + English
		-HC	Chinese + English
		-HK	Korean + English
		-HG	German + English
		-HF	French + English
		-HL	Italian + English
		-HS	Spanish + English
Options		/B5	Built-in printer
		/P2[2]	2 probe power terminals
		/P4[2]	4 probe power terminals
		/C9[3]	Internal storage + LXI-compatible Ethernet interface (LXI option)
		/C12[3]	LXI-compatible Ethernet interface (LXI option)
		/G2[4]	User-defined computation
		/G4[4]	Power supply analysis feature (includes user-defined computation)
		/F3[5]	UART + I^2C + SPI Triggering and Analysis Features
		/F4[5]	UART + CAN + LIN Triggering and Analysis Features

1 Suffix codes -L16 and -L32 are not available for the DL6054, DL6104, or DL6154.
2 /P2 is an option for the DL6054, DL6104, and DL6154, while /P4 is for the DLM6054 and DLM6104.
3 Options /C9 and /C12 cannot both be installed on the same instrument.
4 Options /G2 and /G4 cannot both be installed on the same instrument. Option /G4 includes option /G2.
5 Options /F3 and /F4 cannot both be installed on the same instrument.

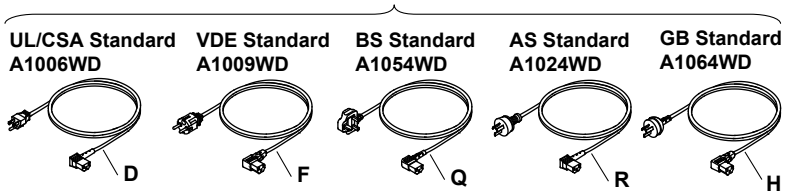
No. (Instrument number)

When contacting the dealer from which you purchased the instrument, please tell them the instrument number.

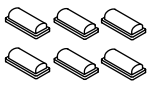
Accessories

The instrument is shipped with the following accessories. Make sure that all accessories are present and undamaged.

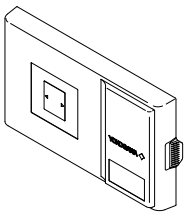
Power Cord (one of the following power cords is supplied according to the instrument's suffix codes)



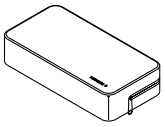
Rubber stoppers (DL6000)
B8080FR (6 stoppers)



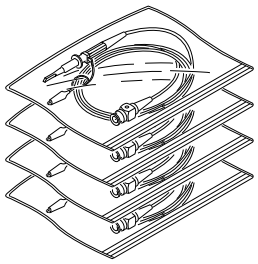
Front-panel protective cover
B8081FD



Soft case[4]
B8059GG



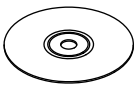
500 MHz passive probes
701939 (4 probes)



Rubber stoppers (DLM6000)
A9088ZM × 2 (4 stoppers)

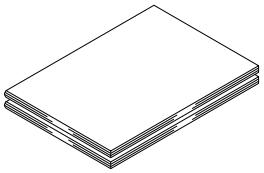
Printer roll paper (1 roll)[1]
B9988AE (for the DL6000 series)
B9850NX (for the DLM6000 series)

Communication Interface User's Manual[2]
B8081RH (CD)



Manuals

- **This manual**
- **Serial Bus Signal Analysis Manual (1) or Power Supply Analysis Manual (1)[3]**
- **Miscellaneous**



1 Included with models that have the /B5 option installed.
2 You can purchase the printed IM DLM6054-17EN manual separately. Contact your nearest YOKOGAWA dealer to purchase a copy.
3 Included with models that have the /F3, /F4, or /G4 option installed.
4 You can attach the soft case to the front-panel protective cover.

How to Use the CD-ROM (User's Manuals)

The CD-ROM contains PDF file of the following manual.

- DL6000/DLM6000 Series Digital Oscilloscope/Mixed Signal Oscilloscope Communication Interface User's Manual (IM DLM6054-17EN)

To view the above manual, you need Adobe Reader 5.0 or later.

WARNING

Never play this CD-ROM on an audio CD player. Doing so may cause loss of hearing or speaker damage due to the large sounds that may be produced.

Optional Accessories (Sold separately)

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

Product Name		Model	Notes
Probes with YOKOGAWA probe interfaces			
Active probes	PBA1000	701912	DC to 1 GHz bandwidth, 100 kΩ, 0.9 pF
	PBA2500	701913	DC to 2.5 GHz bandwidth, 100 kΩ, 0.9 pF
	PBA1500	701914	DC to 1.5 GHz bandwidth, 100 kΩ, 0.9 pF
	PBA1000	701912	DC to 1 GHz bandwidth, 100 kΩ, 0.9 pF
Differential probes	PBD2000	701923	DC to 2 GHz bandwidth, 50 kΩ, 1.1 pF
	PBDH1000	701924	DC to 1 GHz bandwidth, 1 MΩ, ±35 V max.
Current probes	PBC100	701928	DC to 100 MHz bandwidth, 30 Arms
	PBC050	701929	DC to 50 MHz bandwidth, 30 Arms
Passive probe	PB500	701939	DC to 500 MHz bandwidth, 10 MΩ
50 Ω passive probes			
Resistance probe	PBL5000	701974	DC to 5 GHz bandwidth, 500 Ω or 1 kΩ, 0.25 or 0.4 pF, SMA-BNC conversion adapter included
DC block		701975	For 50 Ω input, SMA, 30 MHz to 6 GHz
High-voltage passive probes			
100:1 probes		701944	DC to 400 MHz bandwidth, 1000 Vrms, 1.2 m in length
		701945	DC to 250 MHz bandwidth, 1000 Vrms, 3 m in length
Logic probes		701980	1 MΩ, 100 MHz toggle frequency, 8 bits
		701981	10 kΩ, 250 MHz toggle frequency, 8 bits
		701988	1 MΩ, 100 MHz toggle frequency, 8 bits
		701989	100 kΩ, 250 MHz toggle frequency, 8 bits
FET probe		700939	900 MHz bandwidth, 2.5 MΩ, 1.8 pF
Differential probes		700924	DC to 100 MHz bandwidth, ±1400 V max
		700925	DC to 15 MHz bandwidth, ±500 V max
		701920	DC to 500 MHz bandwidth, ±30 V maximum (common-mode input)
		701921	DC to 100 MHz bandwidth, ±700 V maximum
		701922	DC to 200 MHz bandwidth, ±60 V maximum (common-mode input)
		701926	DC to 50 MHz bandwidth, ±5000 V maximum (common-mode input)
Current probes		701932	DC to 100 MHz bandwidth, 30 Arms
		701933	DC to 50 MHz bandwidth, 30 Arms
Deskew signal source		701935	Approx. 0 to 5 V, approx. –100 to 0 mA, approx. 15 kHz
GO/NO-GO cable		366973	—
Rack mount kit		701983-01	For EIA
		701983-02	For JIS

Consumables (Sold Separately)

The following consumables are available for purchase separately. For information about ordering consumables, contact your nearest YOKOGAWA dealer.

Product Name	Part No.	Min. Q'ty	Notes
Printer Roll Paper	B9988AE	10	111 mm × 10 m heat sensitive paper for the DL6000 series
Printer Roll Paper	B9850NX	5	111 mm × 30 m heat sensitive paper for the DLM6000 series

Safety Precautions

This instrument is an IEC safety class I instrument (provided with a 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 assumes no liability for the customer's failure to comply with these requirements.

The following symbols are used on this instrument.


Handle with care. To protect the instrument and its users, refer to the explanation in the User's Manual or Service Manual.


Protective earth ground or protective earth ground terminal


Ground or the functional ground terminal (do not use as the protective earth ground terminal)


Alternating current


Direct current

Power on


Power off


Power-on state


Power-off state

Failure to comply with the precautions below could lead to injury or death.

WARNING

Power Supply
Make sure that the power supply voltage matches the instrument's rated supply voltage and that it does not exceed the maximum voltage range specified for the power cord.

Use the Correct Power Cord and Plug
To prevent fire and electric shock, use only a power cord supplied by YOKOGAWA. The main power plug must be plugged into an outlet with a protective earth terminal. The earth protection will be nullified if you use an ungrounded extension cord.

Connect to a Protective Earth Terminal
To prevent electric shock, be sure to connect to a protective earth terminal before turning on the power. The power cord that comes with the instrument is a three-prong cord. Connect the power cord to a properly grounded three-prong outlet.

Do Not Impair the Protective Grounding
Never cut off the internal or external protective earth wire or disconnect the wiring to the protective earth terminal. Doing so may result in electric shock or damage to the instrument.

Do Not Operate with Defective Protective Grounding or Fuses
Do not operate the instrument if its protective grounding or one of its fuses might be defective. Check the grounding and the fuses before operating the instrument.

Do Not Operate in an Explosive Atmosphere
Do not operate the instrument in the presence of flammable gasses or vapors. Doing so is extremely dangerous.

Do Not Remove Covers
Only qualified YOKOGAWA personnel should remove the instrument's covers. The inside of the instrument is dangerous because parts of it have high voltages.

Ground the Instrument before Making External Connections
Securely connect the protective grounding before connecting to the item under measurement or to an external control unit. Before touching a circuit, turn off its power and check that it has no voltage.
To prevent accidents and electric shock, connect the grounds of probes and input connectors to the earth potential (ground) of the device under measurement.

Operating Environment Limitations

CAUTION

This is a class A instrument designed for an industrial environment. Operation of this equipment in a residential area can cause radio interference, in which case users will be required to correct the interference.

Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC
(This directive is only valid in the EU.)
This product complies with the WEEE Directive (2002/96/EC) marking requirement. This marking indicates that you must not discard this electrical/ electronic product in domestic household waste.

Product Category
With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.

Do not dispose in domestic household waste. When disposing products in the EU, contact your local Yokogawa Europe B. V. office.

Conventions Used in This Manual

About Logic Inputs

This manual does not always indicate that features relating to logic input are only available on the DLM6000.
If you are using the DL6000, please be aware that you will not be able to use features relating to logic input.

Notes

The notes and cautions in this manual are categorized using the following symbols.

Improper handling or use can lead to injury to the user or damage to the instrument. This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."

WARNING Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

CAUTION Calls attention to actions or conditions that could cause light injury to the user or cause damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

Note Calls attention to information that is important for proper operation of the instrument.

Symbols and Conventions Used in Procedural Explanations

The contents of the procedural explanations in chapters 3 to 17 are indicated using the following symbols.

Procedure Areas marked with this symbol contain general procedural explanations that use images of the instrument's screen.

Explanation Areas marked with this symbol contain explanations of limitations and settings related to the procedures. The features themselves are not usually explained in detail. For information about the features themselves, see chapter 2.

Character Notations

- Bold characters in procedural explanations are used to indicate panel keys and soft keys that are used in the procedure and menu items that appear on the screen.
- When *SHIFT+panel key* appears in a procedural explanation, it means to press the SHIFT key so that its indicator illuminates, and then to press the indicated panel key. A menu for the item written in purple below the key that you pressed appears on the screen.

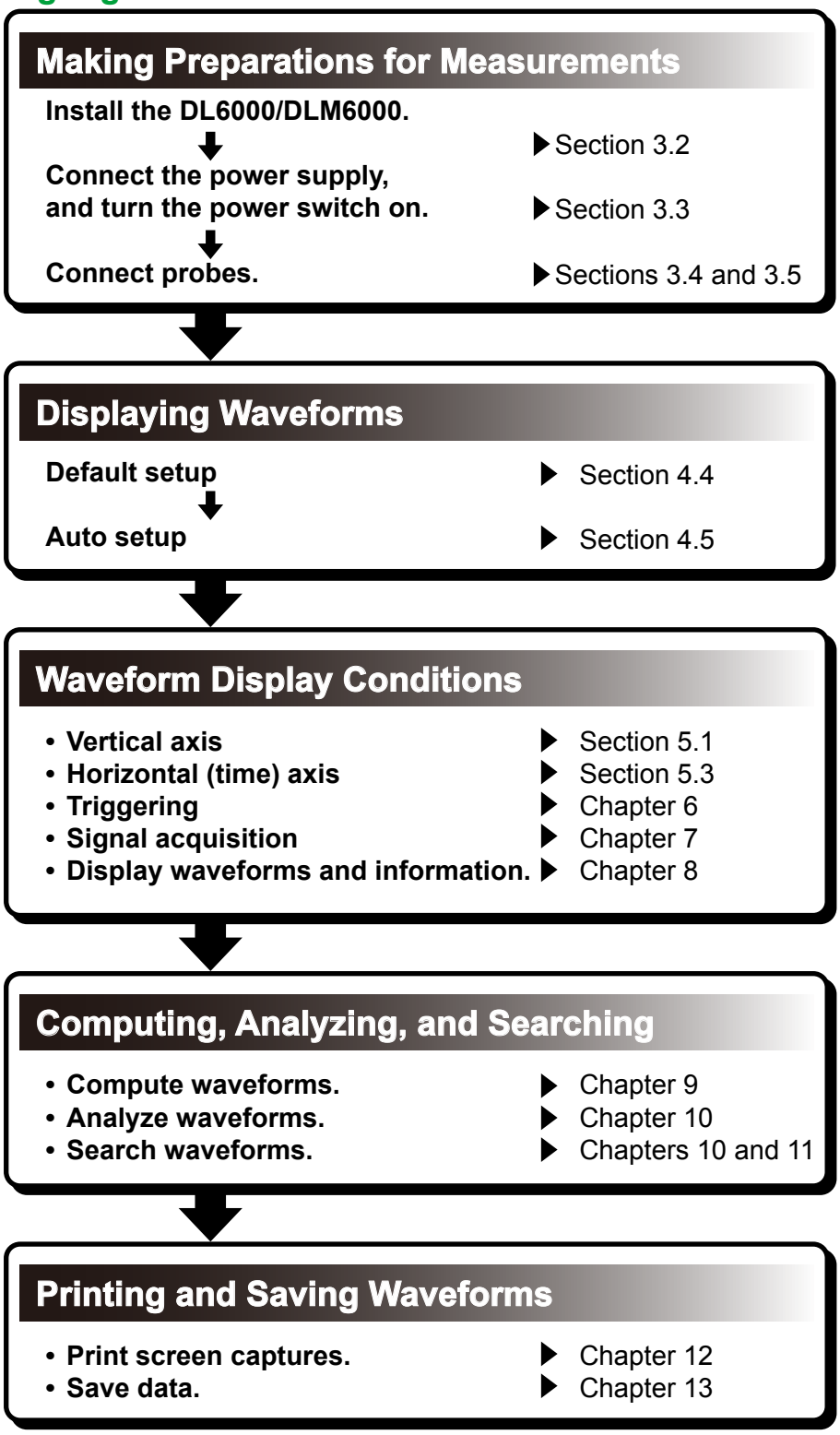
Unit

k means "1000." Example: 100 kS/s (sample rate)
K means "1024." Example: 720 KB (file size)

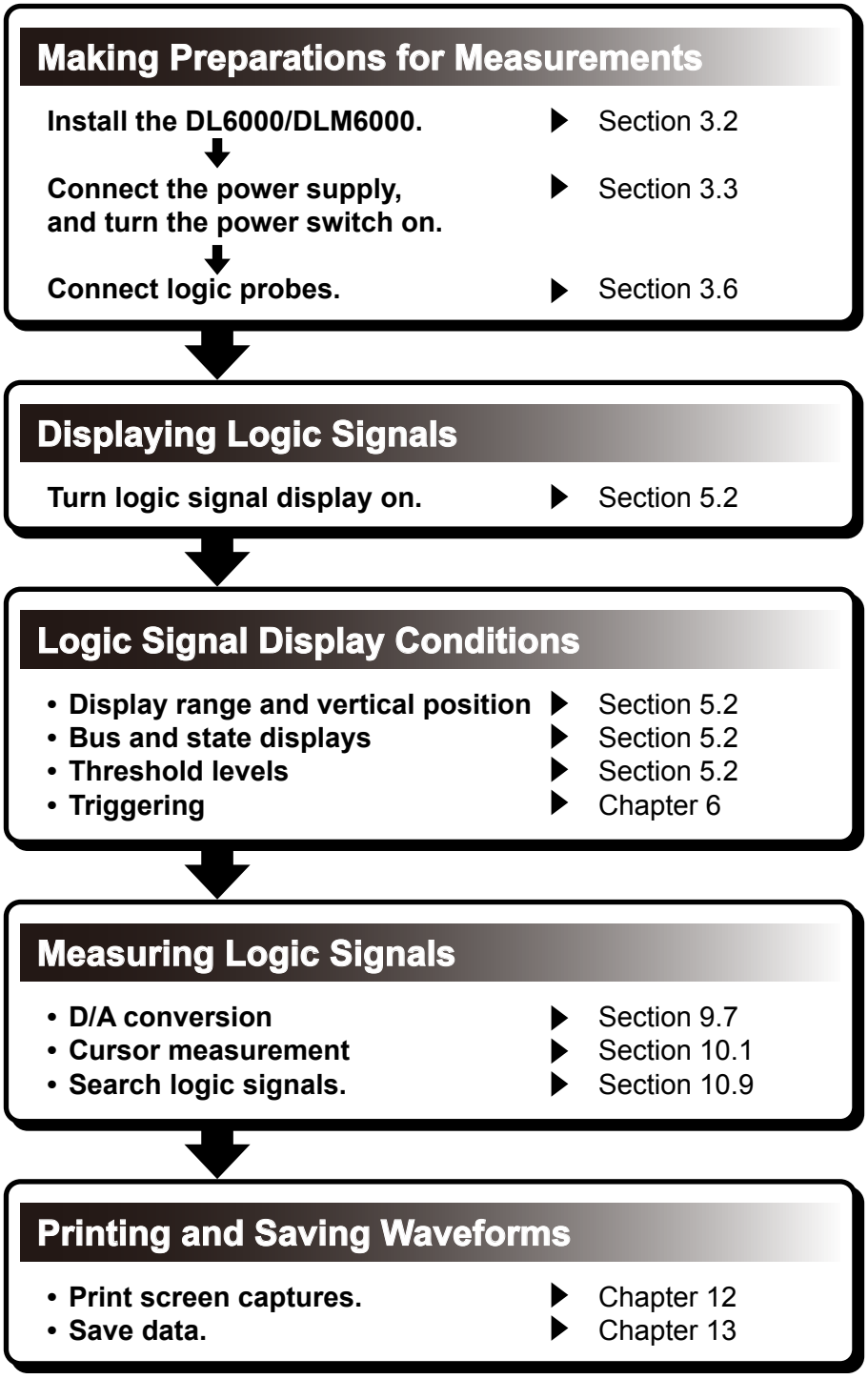
Workflow

The figure below is provided to familiarize the first-time user with the overall workflow of DL6000/DLM6000 operation. For a description of an item, see the relevant section or chapter.

Analog Signal Waveform Observation



Logic Signal Observation



Contents

Checking the Package Contents iii
Safety Precautions vi
Conventions Used in This Manual ix
Workflow x

Chapter 1 Component Names and Functions

1.1 Top Panel, Front Panel, and Rear Panel 1-1
1.2 Keys and Knobs 1-4
1.3 Screen Display 1-8

Chapter 2 Features

2.1 System Configuration 2-1
2.2 Vertical (Analog Signal) and Horizontal Axes 2-2
2.3 Triggering 2-6
2.4 Displaying and Triggering on Logic Signals 2-14
2.5 Acquisition Conditions 2-15
2.6 Display 2-21
2.7 Computed and Reference Waveforms 2-24
2.8 Analysis and Searching 2-27
2.9 Communication 2-33
2.10 Other Useful Features 2-34

Chapter 3 Making Preparations for Measurements

⚠ 3.1 Handling Precautions 3-1
⚠ 3.2 Installing the Instrument 3-3
⚠ 3.3 Connecting the Power 3-6
⚠ 3.4 Connecting the Probe 3-9
⚠ 3.5 Compensating the Probe (Phase Correction) 3-12
⚠ 3.6 Connecting Logic Probes 3-14
3.7 Setting the Date and Time 3-16

Chapter 4 Basic Operations

4.1 Key and Dialog Box Operations 4-1
4.2 Entering Values and Strings 4-5
4.3 Using USB Keyboards and Mouse Devices 4-7
4.4 Returning to the Default Settings 4-11
4.5 Performing Auto Setup 4-12
4.6 Storing and Recalling Setup Information 4-15
4.7 Calibrating the DL6000/DLM6000 4-17

Chapter 5 Vertical and Horizontal Control

⚠ 5.1 Vertical Axis Settings for Analog Input Signals 5-1
5.2 Vertical Axis Settings for Logic Input Signals 5-8
5.3 Horizontal (Time) Axis Settings 5-13

Chapter 6 Triggering

6.1 Setting the Trigger Mode and Hold-off Time 6-1
6.2 Setting the Trigger Position and Trigger Delay 6-3
6.3 Triggering on an Edge Trigger 6-5

6.4 Triggering on an Edge Condition 6-10
6.5 Triggering on the OR of Multiple Edge Triggers 6-14
6.6 Triggering on State Conditions 6-15
6.7 Triggering on a Pulse Width Condition 6-20
6.8 Triggering on a Pulse Width Condition under Specified Qualifications 6-25
6.9 Triggering on a State Width Condition 6-28
6.10 Triggering on a TV Trigger 6-33
6.11 Triggering on Period, Delay, and Sequence Events 6-39
6.12 Triggering on Combination Triggers (B TRIG) 6-44
6.13 Triggering on a Serial Pattern Signal 6-47
6.14 Setting the Action-On-Trigger 6-52
6.15 Performing GO/NO-GO Determination with Zones 6-56
6.16 Performing GO/NO-GO Determination with Parameters 6-65
6.17 Performing GO/NO-GO Determination with Mask Tests and Eye Patterns 6-70

Chapter 7 Waveform Acquisition and Display

7.1 Setting Conditions for Waveform Acquisition 7-1
7.2 Acquiring Waveforms 7-5

Chapter 8 Display

8.1 Setting Display Conditions 8-1
8.2 Displaying Accumulated Waveforms 8-5
8.3 Taking Snapshots and Clearing Traces 8-7
8.4 Zooming in on Waveforms 8-8
8.5 Vertically Zooming in on Waveforms 8-11

Chapter 9 Computed and Reference Waveforms

9.1 Setting the Computation Mode 9-1
9.2 Performing Addition, Subtraction, and Multiplication 9-2
9.3 Performing Filter Computations 9-3
9.4 Performing Integration 9-5
9.5 Counting Edges 9-6
9.6 Performing Rotary Counting 9-8
9.7 Performing D/A Conversion on Logic Signals 9-10
9.8 Loading Reference Waveforms 9-12
9.9 Setting Labels and Units 9-14
9.10 Performing User-Defined Computations (Optional) 9-15

Chapter 10 Analysis and Searching

10.1 Using Cursors to Make Measurements 10-1
10.2 Automatically Measuring Waveform Parameters 10-10
10.3 Performing Statistical Processing on Measured Waveform Parameter Values 10-17
10.4 Viewing the Phase between Measured Waveforms on the XY Display 10-20
10.5 Performing FFT Analysis 10-22
10.6 Displaying Histograms, Trends, and Lists of Automated Measurements of Waveform Parameters 10-28
10.7 Displaying the Frequency Distribution of a Specified Area (Accum Histogram) 10-31
10.8 Performing a Mask Test 10-34
10.9 Searching Waveforms 10-38

Chapter 11 Displaying and Searching History Waveforms

11.1 Displaying History Waveforms....11-1
11.2 Searching for History Waveforms by Zone....11-5
11.3 Searching for History Waveforms Using Parameters....11-10

Chapter 12 Printing Screen Captures

12.1 Loading Roll Paper into the Built-In Printer (Optional)....12-1
12.2 Printing Using the Built-in Printer (Optional)....12-6
12.3 Printing Using a USB Printer....12-7
12.4 Printing on a Network Printer (Optional)....12-9

Chapter 13 Saving and Loading Data

13.1 About ATA Flash Memory Cards....13-1
13.2 Connecting a USB Storage Device to a USB Port....13-2
13.3 Connecting to a Network Drive....13-3
13.4 Saving Measured Data....13-4
13.5 Saving Setup Data....13-9
13.6 Saving Other Types of Data....13-11
13.7 Loading Measured Data....13-14
13.8 Loading Setup Data....13-15
13.9 Loading Other Types of Data....13-16
13.10 File Operations....13-17
13.11 Saving Screen Capture Data....13-21
13.12 Connecting to a PC through a USB Port....13-23

Chapter 14 Ethernet Interface (Optional)

14.1 Connecting the DL6000/DLM6000 to a Network....14-1
14.2 Configuring TCP/IP Settings....14-3
14.3 Saving and Loading Measurement, Setup, and Image Data on a Network Drive....14-6
14.4 Configuring E-mail Transmission (SMTP client function)....14-8
14.5 Using SNTP to Set the Date and Time....14-11
14.6 Accessing the DL6000/DLM6000 from a PC (File Server)....14-12
14.7 Using a PC to Monitor the DL6000/DLM6000 and Change Its Settings (Web Server) 14-14
14.8 Configuring a Network Printer....14-19
14.9 Checking Whether or Not the DL6000/DLM6000 Has an Ethernet Interface....14-21
14.10 Configuring the Firewall....14-22
14.11 Initializing All Ethernet Interface Settings....14-24

Chapter 15 Rear Panel Input and Output

⚠ 15.1 External Trigger Input (TRIG IN)....15-1
⚠ 15.2 Trigger Output (TRIG OUT)....15-2
⚠ 15.3 RGB Video Signal Output (RGB VIDEO OUT)....15-3
⚠ 15.4 GO/NO-GO Signal Output....15-4

Chapter 16 Other Operations

16.1 Changing the Message Language, Menu Language, and USB Keyboard Language, and Turning the Click Sound On and Off....16-1
16.2 Viewing Setup Information....16-2
16.3 Enabling Translucent Display and Changing the Font Size....16-3
16.4 Adjusting the Backlight....16-4

Chapter 17 Troubleshooting, Maintenance, and Inspection

17.1 If a Problem Occurs 17-1
17.2 Messages and Corrective Actions 17-2
17.3 Carrying Out Self-Tests (Self Test) 17-6
17.4 Viewing System Information (Overview) 17-8
17.5 Deleting All Data in the Internal and Flash Memory 17-9
17.6 Formatting Flash Memory 17-10
17.7 Recommended Replacement Parts 17-11

Chapter 18 Specifications

18.1 Signal Input Section 18-1
18.2 Triggering Section 18-3
18.3 Time Axis 18-7
18.4 Display 18-7
18.5 Features 18-8
18.6 Built-in Printer (/B5 Option) 18-15
18.7 Storage 18-15
18.8 USB for Peripherals 18-15
18.9 Auxiliary I/O Section 18-16
18.10 Computer Interface 18-17
18.11 General Specifications 18-18
18.12 External Dimensions 18-21

Appendix

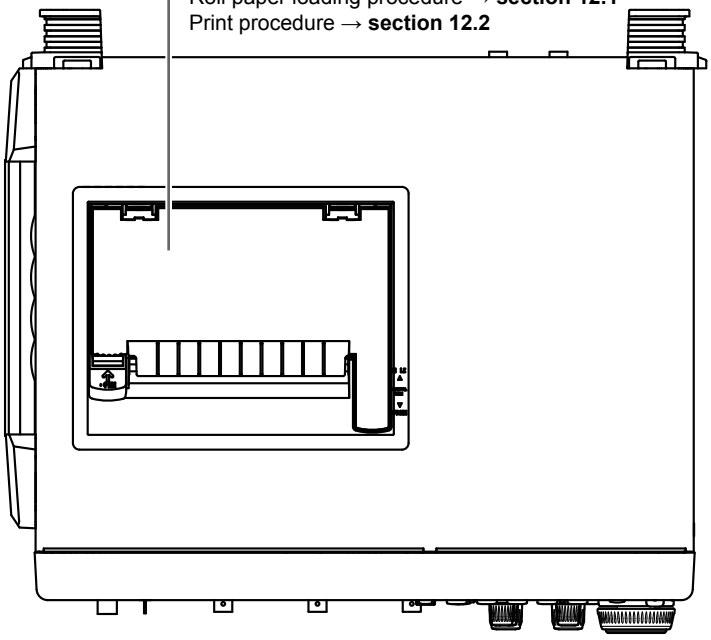
Appendix 1 How Waveform Areas Are Calculated App-1
Appendix 2 104 USB Keyboard Key Assignments App-2
Appendix 3 Integration and Differentiation of Waveform Parameters App-4
Appendix 4 ASCII Data File Format App-5

Index

1.1 Top Panel, Front Panel, and Rear Panel

Top Panel (DLM6000)

Built-in printer
You can print the display.
Roll paper loading procedure → **section 12.1**
Print procedure → **section 12.2**



Front Panel (DL6000/DLM6000)

Soft keys
Use to select items on the soft key menus that appear during configuration.

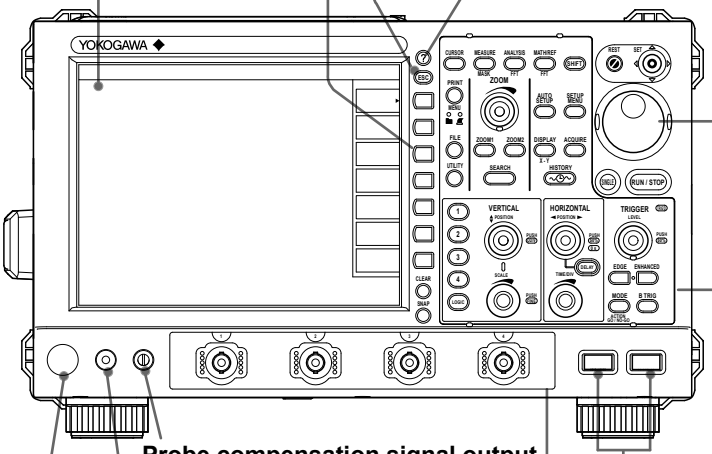
LCD
Explanation of the screen display → **chapter 8.**

ESC key
Use to clear soft key menus and pop-up menus.

Help (?) Key
Turns on and off the help window, which explains various features.

Jog shuttle
Use to change values and move cursors.

Keys and knobs
Explanation → **page 1-3**



Power switch
→ **section 3.3**

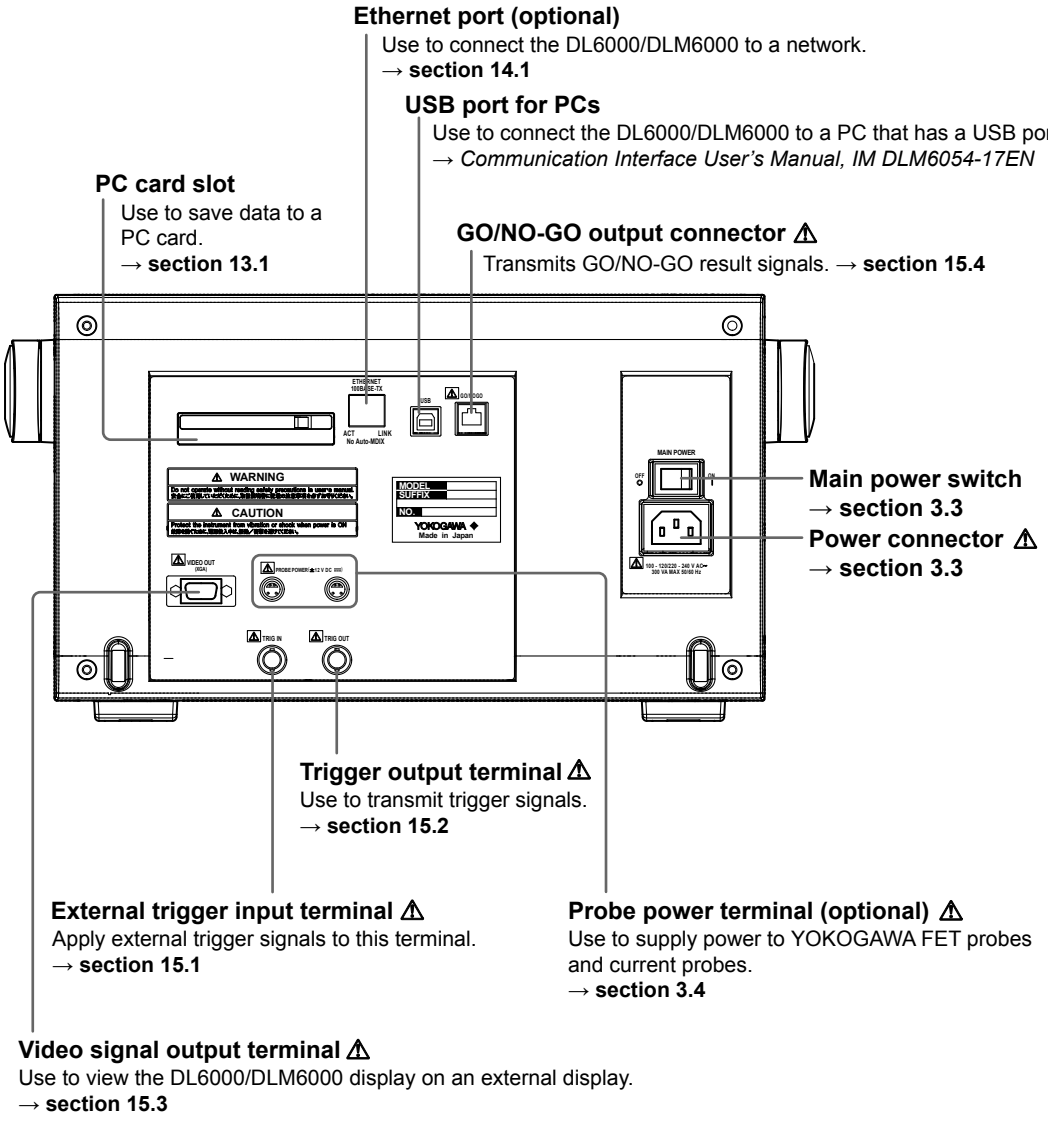
Probe compensation signal output terminal (1 kHz/1 Vp-p) ⚠
Transmits phase correction signals for probes. Phase correction procedure → **section 3.5**

Functional ground terminal
Connect a ground wire to this terminal when performing probe phase correction.

USB ports for peripherals ⚠
You can connect a USB printer, keyboard, mouse, or storage device to each of these ports.
→ **sections 4.3 and 12.3**

Signal input terminals and probe interface terminal ⚠
Connect probes to these terminals to observe analog signals. → **section 3.4**

Rear Panel (DL6000)

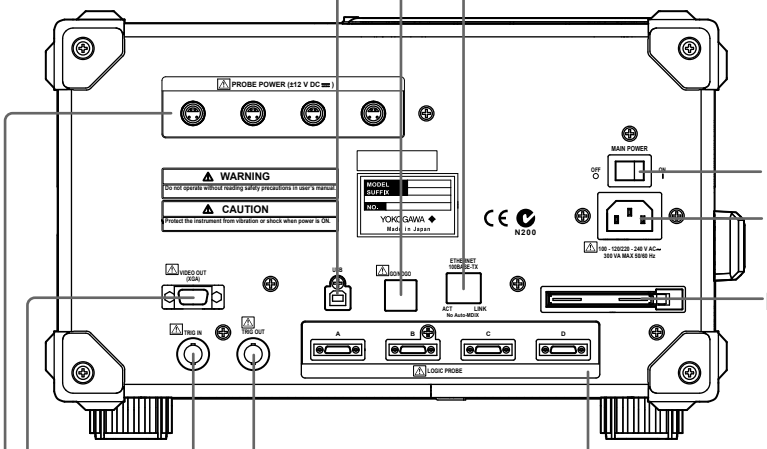


Rear Panel (DLM6000)

USB port for PCs
Use to connect the DL6000/DLM6000 to a PC that has a USB port.
→ *Communication Interface User's Manual, IM DLM6054-17EN*

GO/NO-GO output connector ⚠
Transmits GO/NO-GO result signals. → **section 15.4**

Ethernet port (optional)
Use to connect the DL6000/DLM6000 to a network.
→ **section 14.1**



Main power switch
→ **section 3.3**

Power connector ⚠
→ **section 3.3**

PC card slot
Use to save data to a PC card.
→ **section 13.1**

Trigger output terminal ⚠
Use to transmit trigger signals.
→ **section 15.2**

Logic signal input ports ⚠
Connect logic probes to these ports to observe logic signals. → **section 3.6**
- **DLM6000 series 16-bit models**
  Comes with POD A and POD C
- **DLM6000 series 32-bit models**
  Comes with POD A, POD B, POD C, and POD D

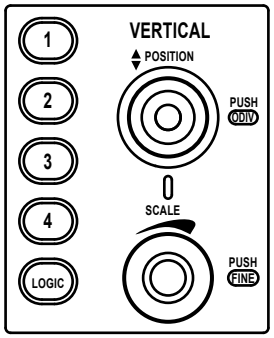
External trigger input terminal ⚠
Apply external trigger signals to this terminal. → **section 15.1**

Video signal output terminal ⚠
Use to view the DL6000/DLM6000 display on an external display. → **section 15.3**

Probe power terminal (optional) ⚠
Use to supply power to YOKOGAWA FET probes and current probes. → **section 3.4**

1.2 Keys and Knobs

Vertical Axis and Channels



CH1 to CH4 Keys ► Section 5.1

Display menus for turning analog signal input channels on and off, for expanding and reducing the vertical axis, and for setting the vertical position, coupling, probe type, offset voltage, bandwidth limit, linear scaling, and waveform labels. Also, press any of these keys to select which channel the SCALE and POSITION knobs will adjust. The channel keys illuminate when their corresponding channel displays are on.

LOGIC Keys ► Section 5.2

Displays a menu for configuring the logic signal display (grouping, order, bus display, and state display), skew adjustment, threshold levels, labels, etc. Press this key and then the POSITION knob to set the vertical display position of the logic signal. Press this key and then the SCALE knob to set the vertical display range of the logic signal.

POSITION Knob ► Sections 5.1 and 5.2

Before you turn this knob, select the channel that you want to adjust by pressing LOGIC or a key from CH1 to CH4.

When a channel from CH1 to CH4 is selected, you can use this knob to adjust the vertical display position (vertical position). When you change the vertical scale, the location of the vertical position does not change. This knob has a push switch. You can press the knob to reset the position to 0.0 divisions.

When the LOGIC channel is selected, you can adjust the vertical position of the LOGIC channel.

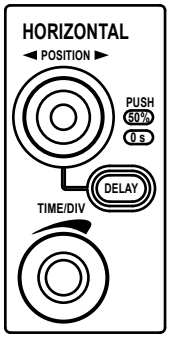
SCALE Knob ► Sections 5.1 and 5.2

Use this knob to set the vertical scale. Before you turn this knob, select the channel that you want to adjust by pressing LOGIC or a key from CH1 to CH4. If you change the scale while waveform acquisition is stopped, the waveform is expanded or reduced vertically. If you restart signal acquisition, the DL6000/DLM6000 acquires signals using the new vertical scale.

This knob has a push switch. If you are adjusting a channel from CH1 to CH4, you can press the knob to switch the resolution. Pressing the knob so that the Fine indicator illuminates enables you to make finer adjustments.

If you are adjusting the LOGIC channel, you can switch between four different vertical scales.

Horizontal Axis



POSITION Knob ► Section 6.2

You can change the horizontal display position (trigger position) of acquired waveforms. When you change the time axis scale, the location of the trigger position does not change. This knob has a push switch. You can press the knob to reset the position to the default value of 50%.

DELAY Key ► Section 6.2

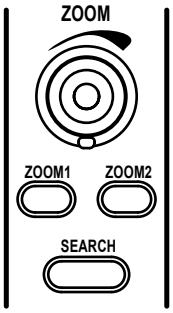
The DELAY key illuminates when you press it. While the key is illuminated, you can set the trigger delay using the POSITION knob.

You can reset the trigger delay to its default value of 0 s by pressing the POSITION knob when the DELAY key is illuminated.

TIME/DIV Knob ► Section 5.3

Use this knob to set the time scale. If you change the scale while waveform acquisition is stopped, the scale change actually takes effect when you restart waveform acquisition.

Trigger



EDGE Key ► Section 6.4

Displays a menu for configuring the edge trigger. When you press this key, the edge trigger is selected, and the key illuminates.

ENHANCED Key ► Sections 6.5 to 6.11 and section 6.13

Displays a menu for configuring enhanced triggers such as qualified edge triggers, pulse width triggers, TV triggers and serial bus triggers. When you press this key, enhanced triggering is selected, and the key illuminates.

MODE and ACTION GO/NO-GO (SHIFT+MODE) Keys ► Sections 6.1 and 6.14 to 6.17

Displays a menu for setting the trigger mode and the hold-off. Press SHIFT and then MODE to display a menu for configuring action-on-trigger and GO/NO-GO determination settings.

B TRIG Key ► Section 6.12

Displays a menu for configuring the conditions for triggering on a combination of the A (condition A set using EDGE or ENHANCED) and B triggers.

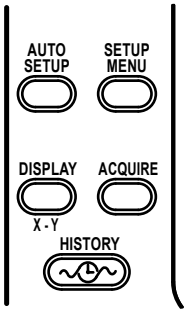
LEVEL Knob

Use this knob to set the trigger level. This knob has a push switch. You can press the knob to automatically set the trigger level to the center of the waveform (50% of the waveform amplitude).

TRIG'D LED

Illuminates when the DL6000/DLM6000 triggers.

Waveform Acquisition Conditions, History Waveforms, Screen Display, and Setup Information



AUTO SETUP Key ► Section 4.5

Automatically configures the DL6000/DLM6000 settings to values that are appropriate for the input signals.

SETUP MENU Key ► Sections 4.4 and 4.6

Displays a menu for returning all the settings to their default values, storing and recalling setup information, etc.

On models that are equipped with the /F3 or /F4 option, a serial bus signal analysis menu appears. For information about serial bus signal analysis, see the *Serial Bus Signal Triggering and Analysis Manual, IM DLM6054-51EN*.

On models with the /G4 option, a power supply analysis menu appears.

For information about power supply analysis, see the *Power Supply Analysis Manual, IM DLM6054-61EN*.

DISPLAY Key ► Sections 8.1 and 8.2

Displays a menu for configuring the display.

SHIFT+DISPLAY (XY) Key ► Section 10.4

Press SHIFT and then DISPLAY to display an XY analysis menu.

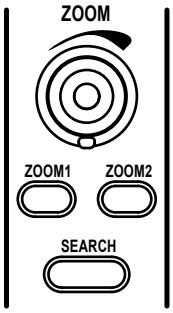
ACQUIRE Key ► Section 7.1

A menu for configuring waveform acquisition settings such as record length, repetitive sampling, interleave, and interpolation appears.

HISTORY (∿◷∿) Key ► Chapter 11

Displays a menu for displaying and searching waveforms using the history feature.

Zooming and Searching



ZOOM1 and ZOOM2 Keys ► Sections 8.4, and 8.5

Displays a waveform zoom display menu. When one of the waveform zoom displays is on, its corresponding key illuminates. When ZOOM1 and ZOOM2 are both on, the key that is under the control of the ZOOM knob illuminates more brightly.

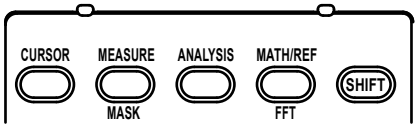
ZOOM Knob ► Section 8.4

When a zoom display is on, you can turn this knob to set the magnification of the selected vertical or horizontal axis. Before turning this knob, press ZOOM1 or ZOOM2 to select the zoom waveform whose magnification you want to control.

SEARCH Key ► Section 10.9

Displays a waveform search menu.

Analysis, Computation, and Reference Waveforms



CURSOR Key ► Section 10.1

Displays a menu for making cursor measurements.

MEASURE Key ► Sections 10.2 and 10.3

Displays a menu for automated measurements of waveform parameters and for statistical processing.

SHIFT+MEASURE (MASK) Key ► Section 10.8

Press SHIFT and then MEASURE to display a mask test menu.

ANALYSIS Key ► Sections 10.4 to 10.8

Displays a menu for configuring serial bus signal analysis, XY display, FFT analysis, waveform parameter histograms and lists, etc. The key illuminates when the menu is displayed.

MATH/REF Key ► Chapter 9

Displays a menu for configuring waveform computations and reference waveforms.

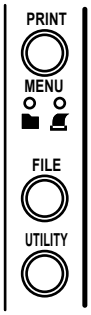
SHIFT+MATH/REF (FFT) Key ► Section 10.5

Press SHIFT and then MATH/REF to display an FFT menu.

SHIFT Key

Press this key once to access the features that are written in purple below each key. The shift key illuminates when the keys are shifted. Press the key again to clear the shifted state.

Printing Screen Captures, Saving Data, and Utilities



PRINT Key ► Sections 12.2 to 12.4 and 13.9

Prints the screen capture data.

SHIFT+PRINT (MENU) Key ► Sections 12.2 to 12.4 and 13.9

Press SHIFT and then PRINT to display a menu for printing screen captures to the built-in printer or a USB printer or display a menu for saving screen capture data to a storage medium. An indicator illuminates to show which menu is selected.

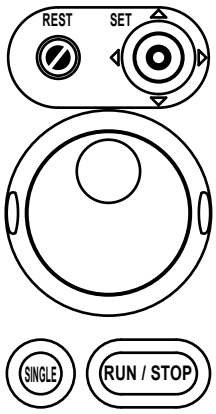
FILE Key ► Sections 13.4 to 13.8 and 13.10 to 13.13

Displays a menu for manipulating files and saving and loading data from a PC card or USB memory device.

UTILITY Key ► Chapters 14 and 16

Displays a menu for calibrating the DL6000/DLM6000, formatting storage media, executing self-tests, and for configuring the network, the connection to the PC, the date and time, the message language, and the click sound. You can also use this key to display system information (installed options and the firmware version).

Waveform Acquisition and Miscellaneous Operations



RUN/STOP Key ► Section 7.2

Starts and stops signal acquisition in accordance with the specified trigger mode. The key illuminates while the DL6000/DLM6000 is acquiring waveforms.

SINGLE Key ► Section 7.2

Causes the DL6000/DLM6000 to acquire one waveform. In Average mode, the DL6000/DLM6000 acquires one waveform that has been obtained through the linear averaging of waveforms for the specified number of times.

RESET (⊘) Key

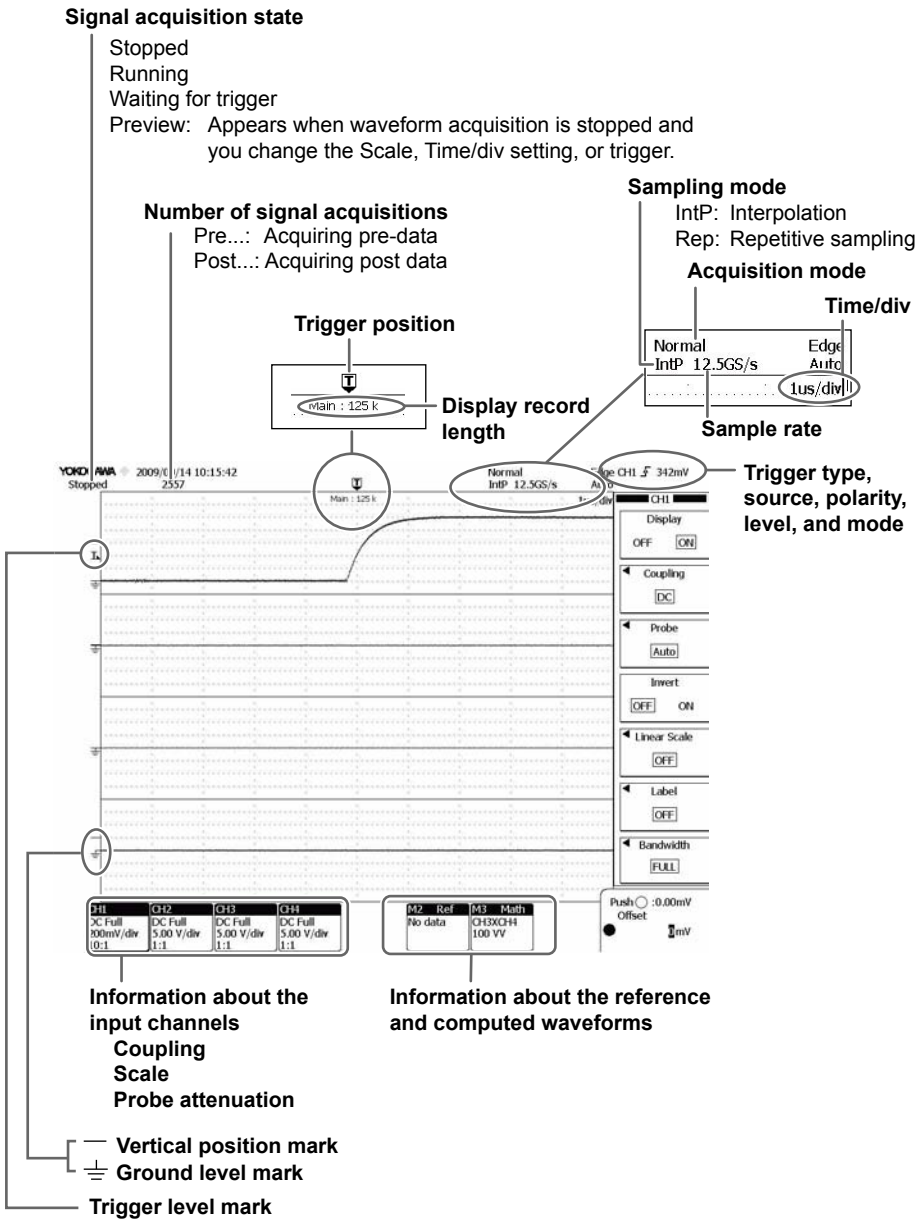
Resets a value to its default.

SET (◎) Key

Press this key to enter the menu item that you selected using the jog shuttle.
Or, if there are two items on the jog shuttle setup menu, you can press SET to change the item that the jog shuttle adjusts.
Move the SET key left and right to move the cursor between numeric digits.
Move the select key up or down to increase or decrease a value. On a dialog menu, move the select key up and down to change the setting.

1.3 Screen Display

Normal Analog Signal Waveform Screen



Acquisition Mode Displays

Normal

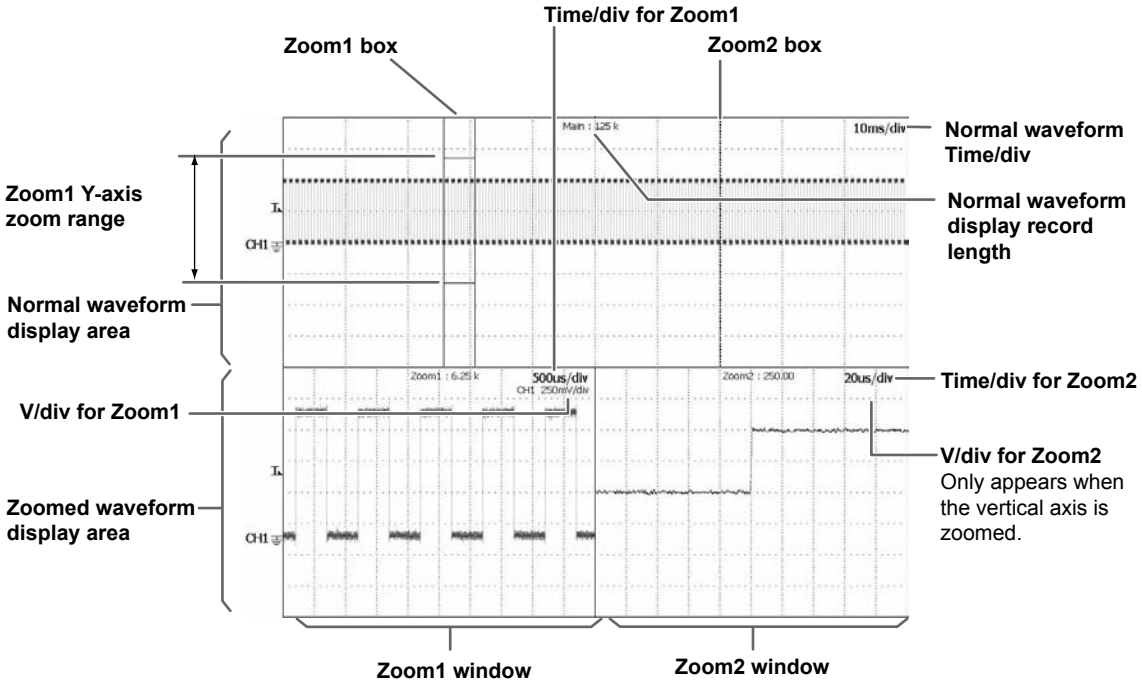
Envelope

Average

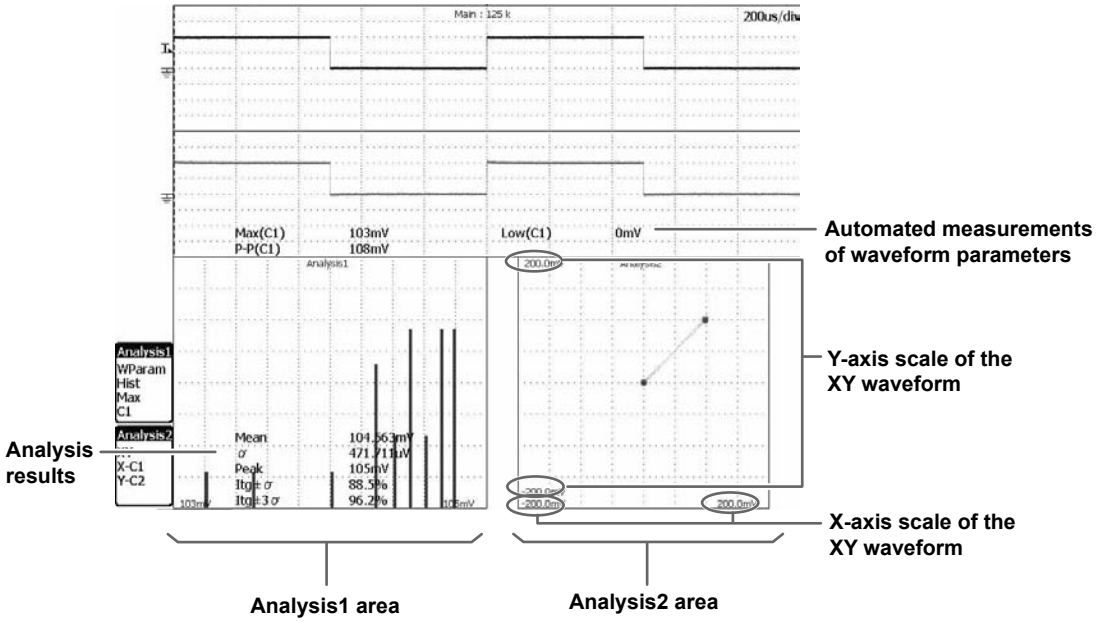
Note

The DL6000/DLM6000 LCD may include a few defective pixels.

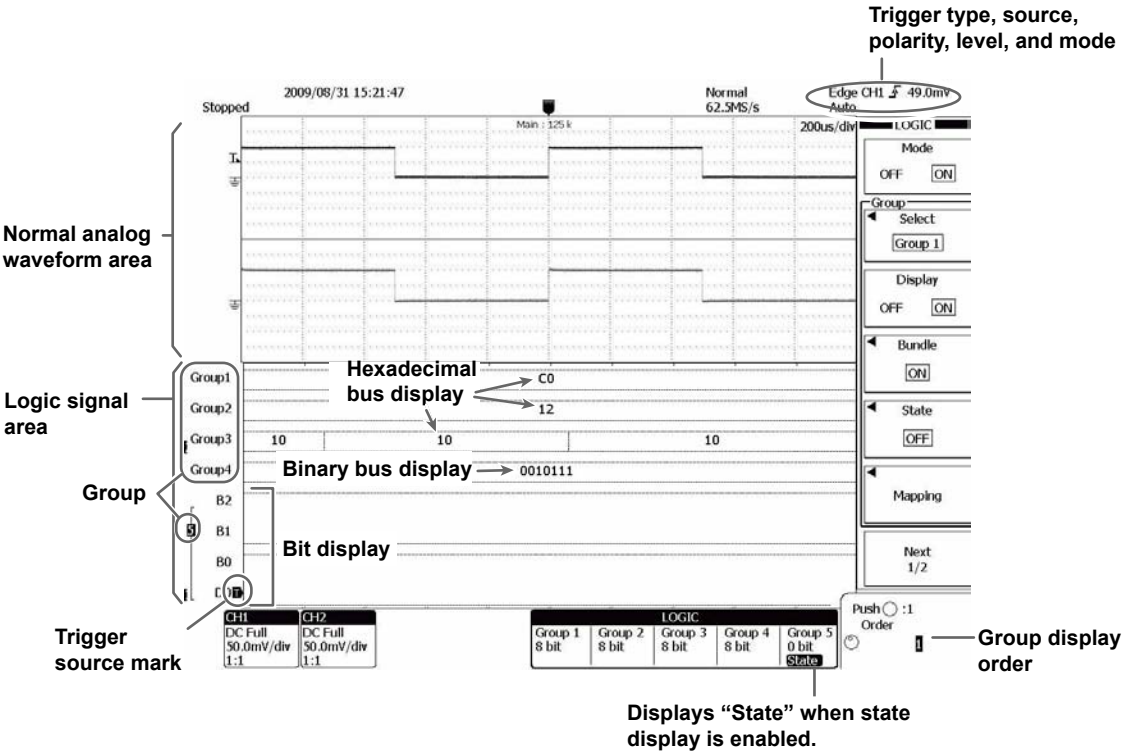
Screen Displaying Zoom Waveforms



Screen Displaying Analysis Results

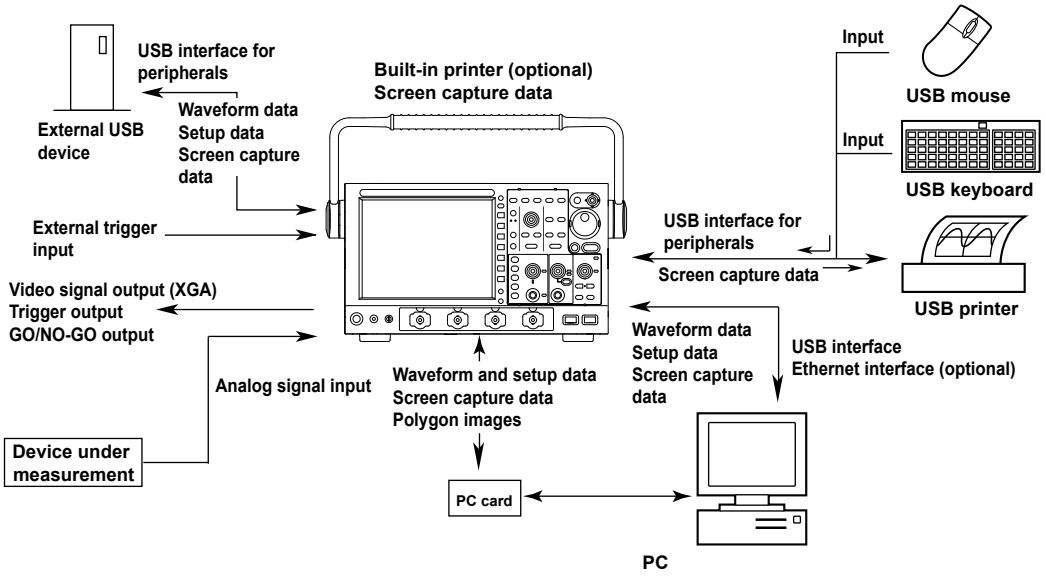


Screen Displaying Logic Signals

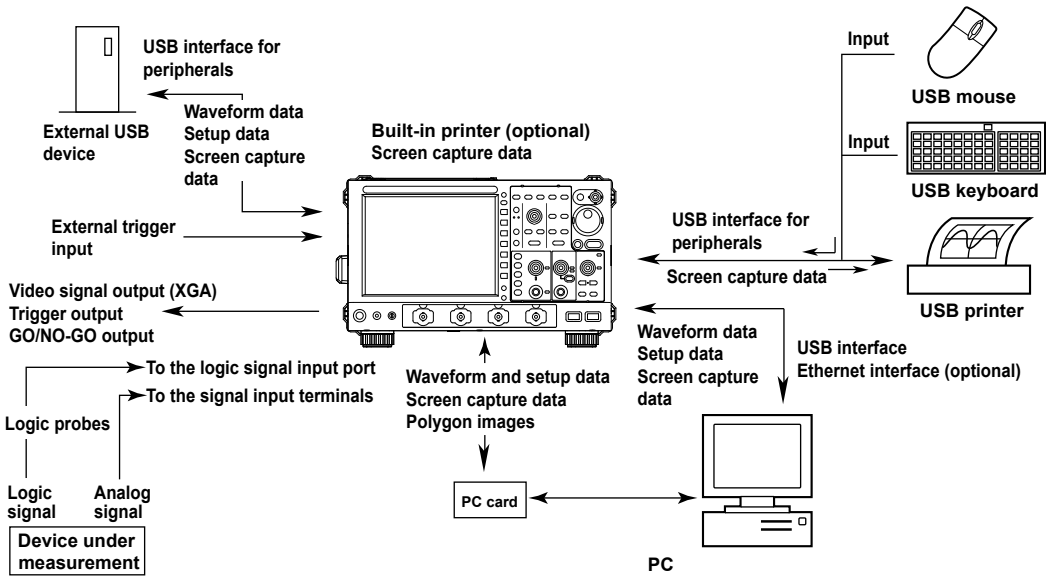


2.1 System Configuration

DL6000 Series

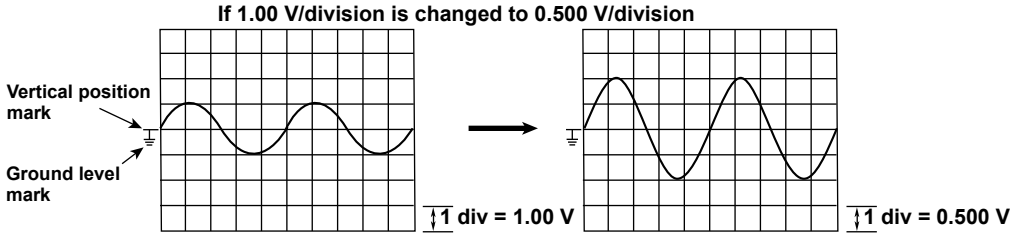


DLM6000 Series



2.2 Vertical (Analog Signal) and Horizontal Axes

The vertical scale is used to adjust the displayed waveform amplitude so that you can view signals easily (for information about logic signals, see section 2.5). Set the vertical scale by voltage per grid square (V/div) or current per grid square (A/div) on the screen.
You can change the voltage sensitivity in steps, as in 1 V/div to 2 V/div to 5 V/div, by switching between different attenuators and changing the amplification of the pre-amplifier.



Note

Measurement Resolution and Effective Data Range

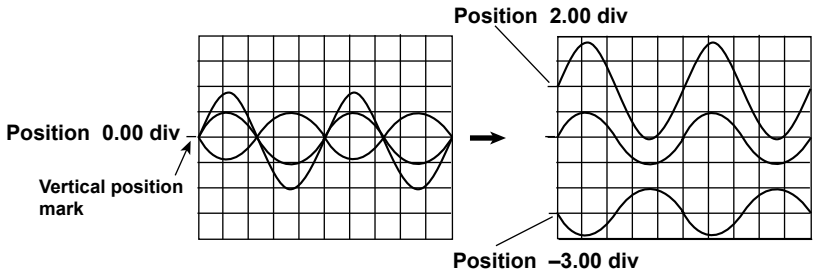
The DL6000/DLM6000 samples input signals using an 8-bit A/D converter. The DL6000/DLM6000's effective data range is 250 levels (LSB first).
The DL6000/DLM6000 displays waveforms using 25 levels per division on the screen. The effective data range is ±5 divisions from the center of the screen, but only ±4 divisions can be displayed. If you move the vertical scale position after stopping waveform acquisition, you can change the display range of the effective data.

Vertical Scale Setting

To measure the voltage or current with high accuracy, set the vertical scale so that the input signal is measured with the largest possible amplitude.
If you display multiple waveforms without dividing the screen so that the waveforms do not overlap (by setting the vertical scale to a low value), then you cannot take advantage of the A/D converter's resolution. To make accurate measurements, divide the screen and set the waveforms' vertical scales to high values.

Vertical Positions of Waveforms ► section 5.1 for the procedure

Because the DL6000/DLM6000 can display eight waveform channels, including computation channels, the waveforms may overlap each other and be difficult to read. When this happens, you can make waveforms easier to view by changing their display positions on the vertical axis (the vertical positions) in the range of ±4 divisions. When you change the vertical scale, the location of the vertical position mark does not change.



Input Coupling ► section 5.1 for the procedure

If you only want to observe the amplitude of an AC signal, it is best to remove its DC component. On the other hand, there are times when you want to check the ground level or observe the entire signal including both the DC and AC components. In these kinds of situations, you should change the input coupling setting. By changing the setting, you can choose how the vertical-axis (voltage-axis) control circuit is coupled to the analog signal. You can set the input coupling to one of the settings listed below.

AC1MΩ

The analog signal is coupled to the attenuator of the vertical control circuit through a capacitor. Use this setting when you want to observe only the amplitude of the AC signal without the DC component.

DC1MΩ

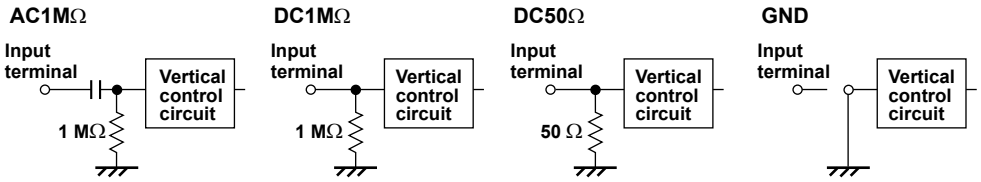
The analog signal is coupled directly to the attenuator of the vertical control circuit. Use this setting when you want to observe the entire signal including both the DC and AC components.

DC50Ω

The same as the DC1MΩ setting described above, except the input impedance is 50 Ω. Remember that the maximum input voltage is lower when you use this setting.

GND

The analog signal is coupled to the ground rather than to the attenuator of the vertical control circuit. You can use this setting to check the ground level on the screen.



Probe Attenuation and Current-to-Voltage Conversion Ratio ► section 5.1 for the procedure

Normally, a probe is used to connect the circuit under measurement to a signal input terminal. Using a probe has the following advantages.

- Does not disturb the voltage and current of the circuit being measured.
- Allows signals to be applied with no distortion.
- Expands the voltage range that the DL6000/DLM6000 can measure.

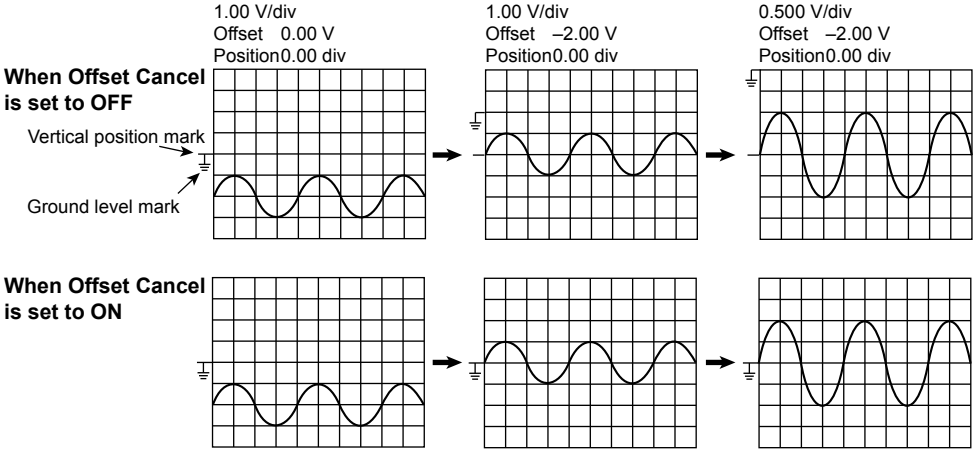
The DL6000/DLM6000 comes with 500 MHz passive probes. The probes attenuate the measured voltage signal by a factor of 1/10. When you use a probe, to read the measurement voltage correctly, you must set the attenuation on the DL6000/DLM6000 to match the probe attenuation. When you connect the supplied 500 MHz passive probes (voltage probes) to the DL6000/DLM6000, the DL6000/DLM6000 automatically recognizes the probes and sets the attenuation ratio to 10:1.
On the DL6000/DLM6000, you can choose one of the following attenuation ratios or current-to-voltage conversion ratios.
Voltage Probe Attenuation Ratios
Auto, 1:1, 2:1, 5:1, 10:1, 20:1, 50:1, 100:1, 200:1, 500:1, and 1000:1
Current-to-Voltage Conversion Ratios
Auto, 1A:1V, 10A:1V, and 100A:1V

When using a probe, set the DL6000/DLM6000 attenuation ratio or current-to-voltage conversion ratio to match that of the probe.
For the procedure to connect the logic probe when measuring logic signals, see section 3.6.

Offset Voltage ► section 5.1 for the procedure

When observing an analog signal riding on top of a predetermined voltage, you can subtract the predetermined offset voltage so that you can observe the changes in the signal by themselves with higher vertical sensitivity.

Usually, the offset voltage does not affect cursor measurement values, automated measurements of waveform parameters, or computed values. However, when you set Offset Cancel to ON (see section 5.1), cursor measurement values, automated measurements of waveform parameters, and computed values are determined from values that have had the offset voltage subtracted from them.



Inverted Waveform Display ► section 5.1 for the procedure

This feature inverts the waveform display around the vertical position. Because only the display is inverted, the measured values do not change. Turning the inverted display on and off does not affect the automated measurements of waveform parameters or calculations.

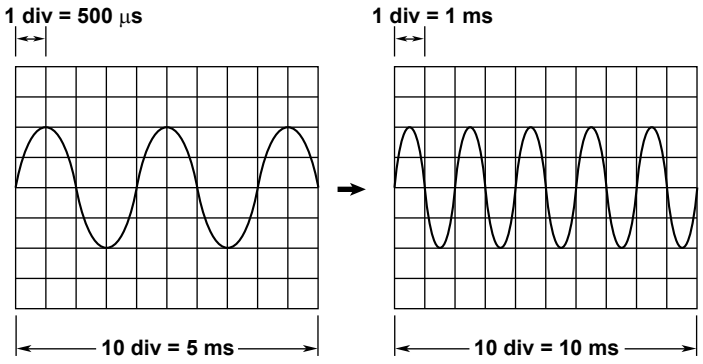
Bandwidth Limit ► section 5.1 for the procedure

You can set bandwidth limits for analog signals by specifying cutoff frequencies for each channel. You can view signals with the noise above a specified frequency removed. You can set the bandwidth to: 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, or 8 kHz.

Horizontal Axis (Time Axis) ► section 5.3 for the procedure

Time Axis Setting ►section 5.8 for the procedure

The time scale is set as a length of time per grid division. You can set the scale to a value from 500 ps/division to 50 s/division. Because the horizontal display range is 10 divisions, the amount of time displayed is equal to Time/div × 10.



Relationship between the Specified Record Length, Time Axis Setting, Sample Rate, and Display Record Length

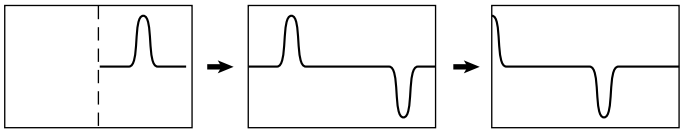
If you change the time axis setting with respect to the specified record length of the acquisition memory, the sample rate and display record length will change (see section 2-16 for details).

Time Axis Setting and Roll Mode Display

When the trigger mode is Auto or Auto Level and the time scale is longer than 100 ms/div, instead of updating waveforms through triggering (update mode), the DL6000/DLM6000 displays the waveforms in roll mode. In roll mode, waveforms scroll from right to left as new data is captured and the oldest values are deleted from the screen. This allows waveforms to be observed in the same way as on a pen recorder. Roll mode is useful for observing low-frequency signals and signals that change slowly.

The DL6000/DLM6000 will not display waveforms in roll mode when the acquisition mode is set to Average.

* The DL6000/DLM6000 also displays waveforms in roll mode when the trigger mode is set to Single (using the SINGLE key). However, scrolling stops when a trigger occurs.



2.3 Triggering

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

Trigger Modes ►section 6.1 for the procedure

The trigger mode determines the conditions for updating the displayed waveforms. There are 5 different trigger modes.

Auto Mode

The DL6000/DLM6000 automatically updates the displayed waveform if the trigger condition is not met within the timeout value (approximately 100ms).

Auto Level Mode

The DL6000/DLM6000 updates the displayed waveform just like in Auto mode except that if the edge trigger is being used and the time limit passes without the trigger condition being met, the DL6000/DLM6000 will measure the amplitude of the waveform and automatically set the trigger level to the amplitude's center value.

Normal Mode

The DL6000/DLM6000 will only update the displayed waveform when the trigger condition is met. There is no automatic updating when the DL6000/DLM6000 does not trigger.

N Single Mode

The DL6000/DLM6000 acquires signals and stores them to separate memory locations each time the trigger conditions are met until a specified number of signals have been acquired. Then, the DL6000/DLM6000 displays the waveforms of all the acquired signals.

Single Mode

When the trigger conditions are met, the DL6000/DLM6000 updates the displayed waveform once and stops signal acquisition. When you press SINGLE on the front panel, the DL6000/DLM6000 acquires waveforms in Single mode.

Trigger Type ►sections 6.3 to 6.13 for the procedures

The following trigger types are available.

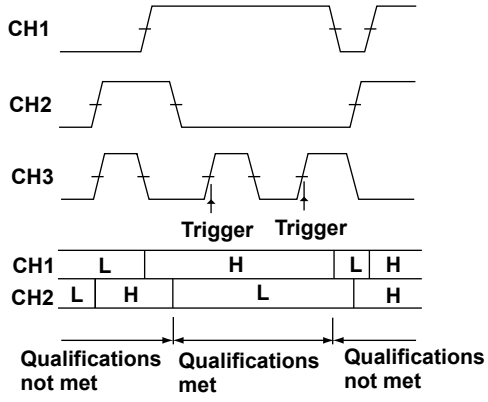
Edge Trigger (EDGE)

The DL6000/DLM6000 triggers on trigger source edges (rising or falling edges). You can set the trigger source to one of the measured input signals, to an external trigger signal, or to the DL6000/DLM6000 power source. When you set the trigger to the DL6000/DLM6000 power source, the DL6000/DLM6000 only triggers on rising edges.

Edge Qualified and Logic Edge Qualified Triggers (ENHANCED)

The DL6000/DLM6000 triggers on the edge of a single trigger source when the conditions of the input signals meet the specified qualifications. You cannot trigger using combinations of analog and logic signal qualifications.

Qualifications: CH1 = H, CH2 = L, AND; Trigger source: CH3, ↓
where L is low level and H is high level



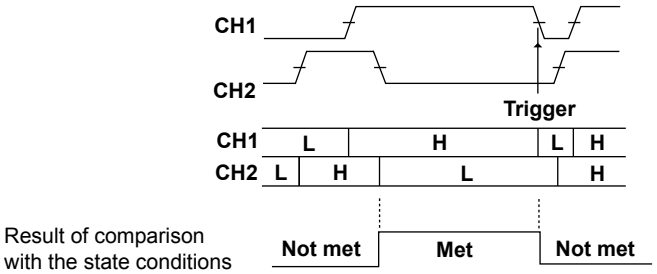
Edge OR Trigger (ENHANCED)

The DL6000/DLM6000 triggers on multiple trigger source edges.
When the DL6000/DLM6000 triggers using Edge OR, the trigger source frequency is limited to 200 MHz or less.

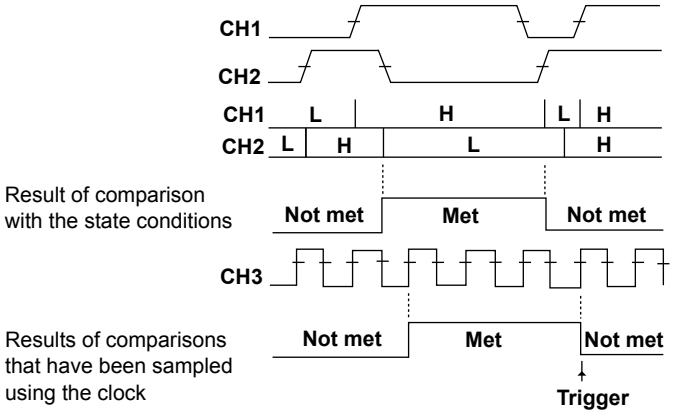
State and Logic State Triggers (ENHANCED)

The DL6000/DLM6000 triggers when the result of comparing the signal states to their specified state conditions changes from met to not met or from not met to met. If you specify a clock source, the DL6000/DLM6000 samples the comparison results using the clock and detects the point of change in sync with the clock.
You cannot trigger using combinations of analog and logic signal states.

Clock source: None
State: CH1 = H, CH2 = L, other channels = X, AND
Condition: Exit



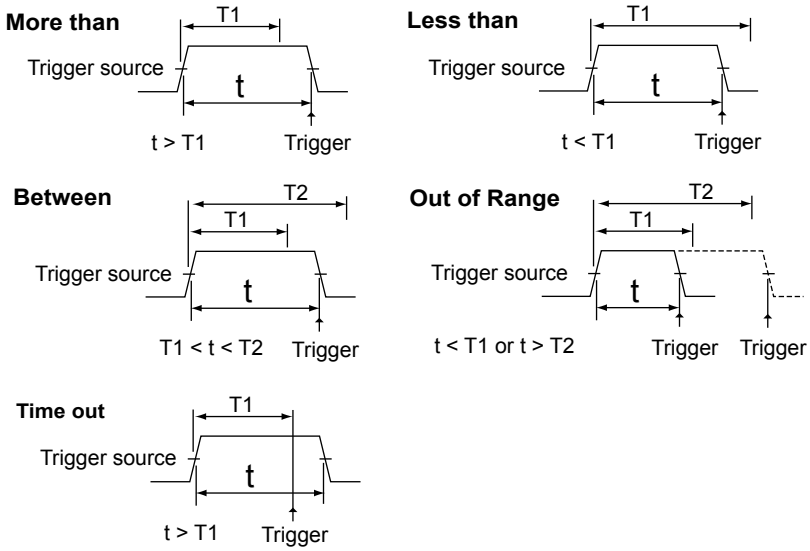
Clock source: CH3, ↓
State: CH1 = H, CH2 = L, CH4 = X, AND
Condition: Exit



Pulse and Logic Pulse Triggers (ENHANCED)

You can make the DL6000/DLM6000 trigger when the specified relationship between the reference times and the pulse width of a single trigger source is established. The DL6000/DLM6000 can be made to trigger:

- At the end of a pulse that is longer than the specified time (More than)
- At the end of a pulse that is shorter than the specified time (Less than)
- At the end of a pulse that is longer than T1 and shorter than T2 (Between)
- At the end of a pulse that is shorter than T1 or longer than T2 (Out of range)
- When the pulse width exceeds the specified time (Time out)



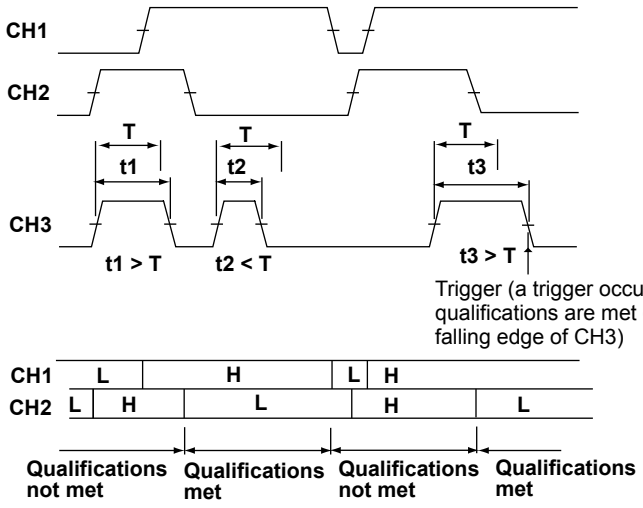
Pulse Qualified Trigger (ENHANCED)

The DL6000/DLM6000 triggers when the conditions of the input signals meet the specified qualifications and the specified relationship between the reference times and the pulse width of a single trigger source is established.

The trigger timings that can be specified are the same as those for the Pulse trigger.

This trigger cannot be used on logic signals.

State: CH1 = H, CH2 = L, AND; Trigger source: CH3, ⎍ , More than
where L is low level and H is high level



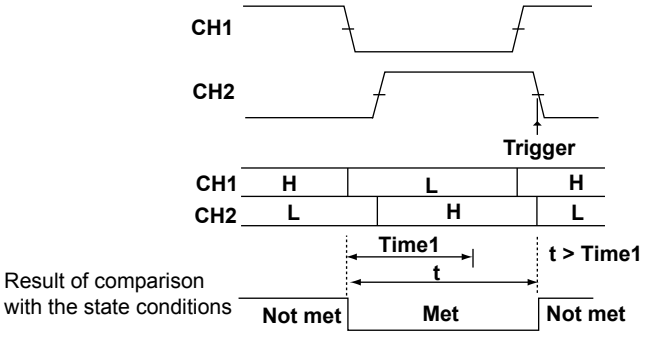
Pulse State and Logic Pulse State Triggers (ENHANCED)

The DL6000/DLM6000 triggers when the time width mode condition is met and the result of state comparison changes from “met” to “not met” or from “not met” to “met.” The time width mode condition specifies a relationship between the reference times and the result of state comparison. State comparison is the comparison of the signal states to their specified state conditions. If you specify a clock source, the DL6000/DLM6000 samples the comparison results using the clock and triggers on the point of change in sync with the clock.

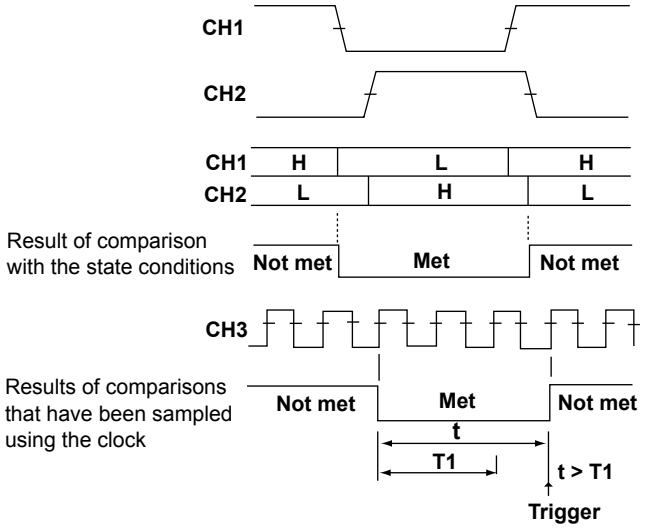
* If the time width mode is set to TimeOut, the DL6000/DLM6000 triggers when the specified amount of time elapses.

You cannot trigger using combinations of analog and logic signal pulse states.

Mode: More than; Clock source: None
State: CH1 = H, CH2 = L, other channels = X, AND
Condition: False

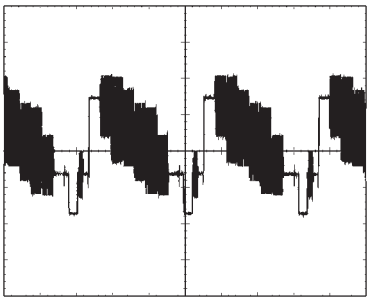


Mode: More than; Clock source: CH3, ↑
State: CH1 = H, CH2 = L, other channels = X, AND
Condition: False



TV Trigger (ENHANCED)

Use this trigger to observe video signals. The trigger supports NTSC (525/60/2), PAL (625/50/2), SDTV (480/60p), and HDTV broadcasting systems. You can also specify the horizontal sync frequency and trigger on the video signals of broadcasting systems other than those listed above.



Serial Trigger (ENHANCED)

This is one of the triggers that you can use on serial bus signals. You can use it to capture serial patterns.

The DL6000/DLM6000 synchronizes to the selected clock signal and detects a specified serial data pattern. You can specify up to 128 bits for the serial data pattern used for triggering. You can set the CS signal, which controls the period over which the data source is checked, and the latch source, which specifies when patterns are compared.

For information about I^2C, CAN, LIN, SPI, and UART triggering, see the *Serial Bus Signal Analysis Manual, IM DLM6054-51EN*.

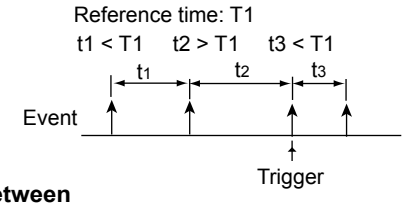
Event Interval Trigger (ENHANCED)

You can use this feature to trigger by treating the occurrences of the trigger conditions, except for Edge OR and TV triggers, as events. You can make the DL6000/DLM6000 trigger when the interval between two events (either the same or different) meets the specified time conditions. The time conditions that you can set are the same as those that you can set for the Width trigger.

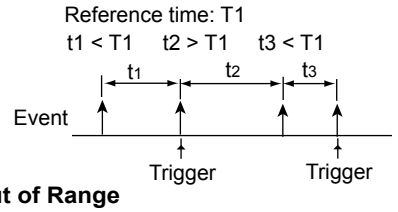
Event Cycle

The DL6000/DLM6000 triggers when the specified relationship between the event interval and the reference times is established.

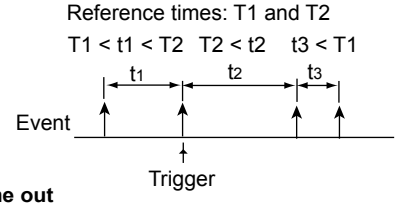
More than



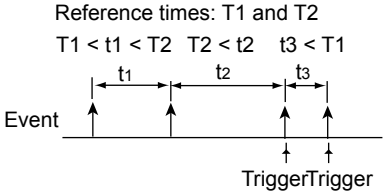
Less than



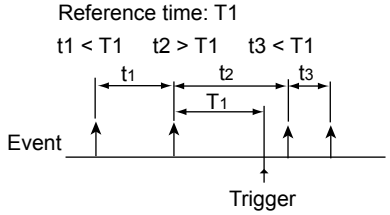
Between



Out of Range



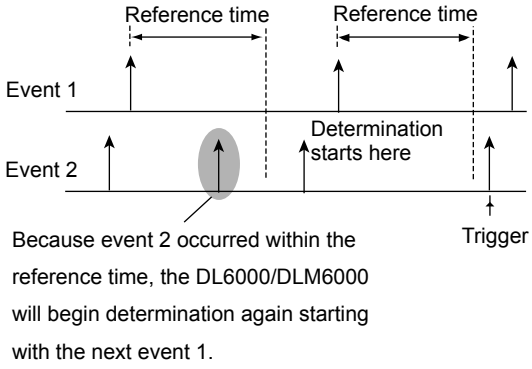
Time out



Event Delay

The DL6000/DLM6000 will trigger when the specified relationship is established between the set time and the time interval from the occurrence of event 1 to the first occurrence of event 2. If the specified relationship is not established, the DL6000/DLM6000 will search for the time conditions again after event 1 occurs.
The following is an example for when the specified relationship is “More than.”

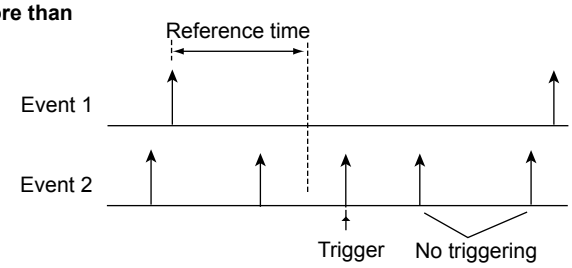
More than



Event Sequence

The DL6000/DLM6000 will trigger when the specified relationship is established between the set time and the time interval from the occurrence of event 1 to the first occurrence of event 2. If the specified relationship is not established, the DL6000/DLM6000 will ignore the first occurrence of event 2 and wait until event 2 occurs at a time that satisfies the time conditions.
The following is an example for when the specified relationship is “More than.”

More than



B Trigger (BTRIG)

The DL6000/DLM6000 can trigger on the combination of trigger A (condition A) and trigger B (condition B).
The trigger conditions you set using the EDGE or ENHANCED key are the trigger A conditions. The trigger conditions you set using the B TRIG key are the trigger B conditions. The trigger type for trigger B is fixed at Edge.

Trigger Combination (Combination)

Set how to combine the trigger A and B conditions.

- OFF: The DL6000/DLM6000 only triggers on the trigger A conditions (the trigger B conditions are not used).
- A Delay B: After the trigger A conditions are met and the specified amount of time elapses, the DL6000/DLM6000 triggers when the trigger B conditions are met.
- A→B(N): After the trigger A conditions are met, the DL6000/DLM6000 triggers when the trigger B conditions are met N times.

Trigger Source, Slope, and Level ►section 6.3 for the procedure

Trigger Source

The trigger source is the signal that is used to check for the trigger condition.

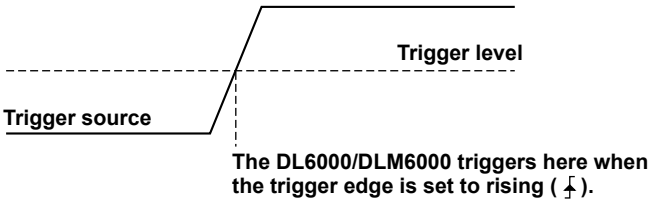
Trigger Slope or Polarity

Slope refers to the signal movement from a low level to a high level (rising slope) or from a high level to a low level (falling slope). When a slope is used as one of the trigger conditions, it is called a trigger slope.

Trigger level

Trigger level refers to the level that the trigger source must pass through to trigger the DL6000/DLM6000.

With simple triggers such as the edge trigger (see below for further details), the DL6000/DLM6000 triggers when the trigger source level passes through the specified trigger level.



* Edge: An edge is a point where the trigger source passes through the trigger level (or when hysteresis is enabled, a point where the trigger source passes through the hysteresis area around the trigger level).

Trigger Position ►section 6.2 for the procedure

When you start waveform acquisition, the DL6000/DLM6000 triggers on the set trigger condition and displays the waveforms stored in the acquisition memory. When the trigger delay, explained in the next section, is set to 0 s, the trigger position and the place where the trigger condition is met are the same. By moving this trigger position on the screen, you can change the ratio between the portion of the acquired waveform data displayed before the trigger point (pre-data), and the portion of the acquired waveform data displayed after the trigger point (post-data).

Trigger Delay ►section 6.2 for the procedure

The DL6000/DLM6000 normally displays waveforms before and after the trigger point. You can set a trigger delay to display waveforms that the DL6000/DLM6000 has acquired a specified amount of time after the trigger occurrence.

Trigger Holdoff ►section 6.1 for the procedure

When Trigger Holdoff is set, the DL6000/DLM6000 will wait for a certain period of time after the trigger event before it searches for the next trigger event. This is useful when you want to change the acquisition interval. You may want to change the acquisition interval when you are dealing with pulse string signals such as PCM signals or when you are using the history feature, which is discussed on page 2-20.

Trigger Coupling ►section 6.3 for the procedure

Input coupling can be switched for the trigger source (not available with logic signals), just as with the measured analog signals. Choose the input coupling that is appropriate for the trigger source.
There are two options available for input coupling with the trigger source:

- DC: The DL6000/DLM6000 uses the trigger source as the trigger signal without processing it.
- AC: The DL6000/DLM6000 removes the DC component from the trigger signal.

HF Rejection ►section 6.3 for the procedure

Use HF rejection to remove high frequency components (above 15 kHz or 20 MHz) from the source signal. This helps prevent high frequency noise from causing the DL6000/DLM6000 to trigger in unexpected places (does not apply to logic signals).

Trigger Hysteresis ►section 6.3 for the procedure

When there is noise in the trigger source and no tolerance in the trigger level, the trigger point will fluctuate each time the DL6000/DLM6000 triggers, and the displayed waveform will be unstable. Also, when there is noise near the threshold, a slope whose polarity is opposite that of the set slope may cause the DL6000/DLM6000 to trigger. To avoid these kinds of circumstances, you can set a range of tolerance, the hysteresis, around the trigger level (not available with logic signals).
On the DL6000/DLM6000, you can set the hysteresis width to ⩘ (narrow) or ⩘ (wide). When you select ⩘, a wide hysteresis range is set. This reduces false triggers and trigger offsets caused by noise and results in a stable waveform display. However, this setting can decrease the accuracy of trigger detection and make it more difficult for the DL6000/DLM6000 to trigger on sources with low amplitudes. When dealing with stable waveforms that do not have noise or with waveforms with low amplitudes, set the Hysteresis to ⩘.

Window Comparator ►section 6.3 for the procedure

The window comparator qualifies conditions that are determined by a waveform's rising/falling edge or high/low state by whether or not they fall within a given range (Window IN/OUT). It qualifies trigger conditions, qualifications, and state conditions.
You can enable or disable the window comparator separately for each channel. Adjusting the window comparator on a channel that is set as the trigger source will alter the trigger condition.
For example, if you enable the window comparator on the source channel for an edge trigger, you can only make the oscilloscope trigger within (Enter) or outside of (Exit) the set area.

2.4 Displaying and Triggering on Logic Signals

The DL6000/DLM6000 can display and trigger on the 32-bit logic signal (16-bit on 16-bit models) that it receives through its rear-panel logic signal input ports.

Displaying Logic Signals ►section 5.2 for the procedure

When you turn on the logic signal display, the screen is divided vertically in two. The logic signal area is displayed below the normal analog waveform area.

Grouping

You can assign the 32 logic signal bits (16 on 16-bit models) to five different groups.

Display Order

You can set the order in which groups are displayed.

Vertical Display Range

You can set the vertical display range for logic signals.

Vertical Position

You can set the vertical display position of the logic signal in the logic signal area.

Bus Display

You can show bus displays for each group in hexadecimal or binary format.

State Display

With this feature, you can use the edges of a specified clock signal to trigger the acquisition of the state of the input logic signal. Even if the logic signal changes, the state will not change until the next clock edge.

Threshold Level ►section 5.2 for the procedure

For each logic signal bit, you can set the threshold level used to detect whether the logic signal is high or low. The threshold level setting that you can select from are CMOS(5V), CMOS(3.3V), CMOS(2.5V), CMOS(1.8V), ECL, and User (custom value).

Deskewing ►section 5.2 for the procedure

You can view the signals after correcting the time offset (skew) between the logic signals and the other signals.
Deskewing is performed on all bits collectively.

Trigger Type ►sections 6.3 to 6.13 for the procedure

As with analog signals, the DL6000/DLM6000 can trigger on logic signals. You can specify an edge, qualified edge, state, pulse, state pulse, event cycle, event delay, or event sequence trigger. For details about each trigger, see the explanations in section 2.3 and the various procedure explanations for the triggers.

2.5 Acquisition Conditions

Acquisition Mode ►section 7.1 for the procedure

When the DL6000/DLM6000 stores the sampled data in the acquisition memory, it processes the data using the selected method, and then the processed data can be used to display a waveform (does not apply to logic signals). The three methods that can be selected are listed below.

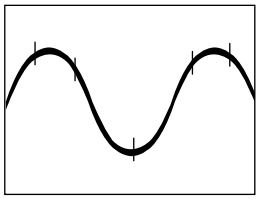
Normal Mode

In this mode, sampled data is stored directly to the acquisition memory and no special data processing takes place.

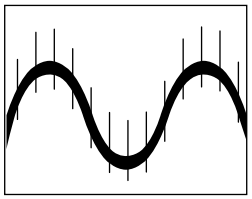
Envelope Mode

The DL6000/DLM6000 determines the maximum and minimum values among the data sampled at 2.5 GS/s (5 GS/s when Interleave mode is on)[1] at a time interval that is twice the sampling period (the inverse of the sample rate) of Normal mode and displays the values as pairs when it displays the waveform.

This mode is effective when you want to avoid aliasing, because the sample rate is essentially kept high regardless of the time axis setting. It is also effective when you want to detect glitches (narrow pulse signals) or when you want to display the envelope of a modulated signal. This mode can be used when the sample rate is 1.25 GS/s or less.[2]



Normal mode



Envelope mode

[1] This sample rate applies to the DL6054, DL6104, DLM6054, and DLM6104. On the DL6154, the sample rate is 5 GS/s (10 GS/s when Interleave mode is on).

[2] The sample rate at which the acquisition mode changes to Envelope mode varies depending on whether high resolution mode is on or off.

		DL6054, DL6104, DLM6054, and DLM6104	DL6154
High resolution mode	**Off**	1.25 GS/s or less	2.5 GS/s or less
	On	625 MS/s or less	1.25 GS/s or less

Average Mode

In Average mode, the DL6000/DLM6000 acquires waveforms multiple times, averages the same time points relative to the trigger point, and displays averaged waveforms. Average mode is useful when you want to remove random noise from waveforms.

The averaging method varies depending on the trigger mode.

- Auto, Auto Level, or Normal mode: Exponential averaging
- Single mode (using the SINGLE key): Linear averaging
- N Single Mode: The DL6000/DLM6000 acquires the number of waveforms specified in the MODE menu (N) and displays the linear average of the history waveforms (All Half Tone).

Exponential Average
(When the trigger mode is set to Auto, Auto Level, or Normal)

$$An = \frac{1}{N}\{(N-1)An - 1 + Xn\}$$

An : n^{th} averaged value
Xn : n^{th} measured value
N : Attenuation constant
(2 to 1024 in 2^n steps)

Simple Average
(Using the SINGLE key)

$$AN = \frac{\sum_{n=1}^{N} Xn}{N}$$

Xn : n^{th} measured value
N : Number of times to average
(2 to 1024 in 2^n steps)

High Resolution Mode ►section 7.1 for the procedure

Ordinarily, converted digital data from the 8-bit A/D converter is processed using the selected method, and stored in the acquisition memory as 8-bit data.
Setting a bandwidth limit on an analog signal reduces data quantization noise and enables the DL6000/DLM6000 to handle high resolution data that is greater than 8 bits. This increases the practical resolution of the A/D converter.
In high resolution mode, the process described above is used and the DL6000/DLM6000 saves data using 16 bits (up to 12 effective bits).

Interleave Mode ►section 7.1 for the procedure

When you turn Interleave mode on, the number of usable channels decreases, but you can set the sample rate to 5 GS/s in real-time sampling mode (2.5 GS/s in high resolution mode).
When you set the sample rate to 5 GS/s (2.5 GS/s in high resolution mode), CH2 and CH4 automatically become unusable.

* This sample rate applies to the DL6054, DL6104, DLM6054, and DLM6104. On the DL6154, the sample rate is 10 GS/s (5 GS/s in high resolution mode).

Record Length ►section 7.1 for the procedure

The record length is the number of data points that can be stored into the acquisition memory per channel. You can set the record length to 2.5 kpoints (2500 points), 6.25 kpoints, 12.5 kpoints, 25 kpoints, 62.5 kpoints, 125 kpoints, 250 kpoints, 625 kpoints, 1.25 Mpoints, 2.5 Mpoints, or 6.25 Mpoints (the maximum record length varies depending on the model).
Ordinarily, when you adjust the time axis settings, the sample rate is automatically adjusted to match the set record length. When this happens, the specified record length is the same as the display record length.
Depending on conditions such as the combination of the time axis setting and the sampling mode, the record length (the display record length) may change. When this happens, the amount of data that corresponds to the display record length, not to the specified record length, is saved in the acquisition memory.

Sampling Mode ►section 7.1 for the procedure

The DL6000/DLM6000 samples data using a 2.5 GS/s A/D converter, so the maximum sample rate in normal sampling mode (real-time sampling mode) is 2.5 GS/s.*
If you decrease the time axis setting when measuring fast phenomena, the sample rate will reach its maximum rate (2.5 GS/s) at a certain point.*If you decrease the time axis setting further, the number of displayed points and the display record length decrease.
The DL6000/DLM6000 has two modes for interpolating missing data between data points. Select one of the interpolation modes when you want to make measurements by setting a sample rate that is higher than the real-time sampling mode's maximum sample rate (2.5 GS/s).*

- Interpolation mode:
  The DL6000/DLM6000 interpolates between data points using the (sinx)/x function. This mode is effective for single-shot signals.
- Repetitive sampling mode: The DL6000/DLM6000 interpolates through random sampling. This mode is effective for repeating signals.

* This sample rate applies to the DL6054, DL6104, DLM6054, and DLM6104. On the DL6154, the sample rate is 5 GS/s.

Relationship between the Time Axis Setting, Record Length, and Sample Rate

The relationship between the time axis setting, record length, and sample rate is as follows:
When the record length (display record length) and the time axis are set so that the sample rate is at the maximum rate, if you decrease the time axis setting further, the record length (display record length) is reduced.
Sample rate = Display record length/(time axis setting [s/division] × 10 [divisions])

Real-time Sampling Mode (Realtime)

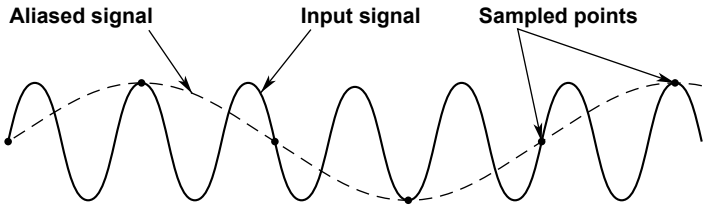
When you change the time axis setting, the sample rate changes. You can sample data at a maximum sample rate of 2.5 GS/s.[1] (The maximum sample rate is 5 GS/s when Interleave mode is on.)[2]

In this mode, the DL6000/DLM6000 can only display waveforms whose frequency is one-half the sample rate, in accordance with the sampling theorem.[3] Therefore, this mode is suitable for observing waveforms whose frequency is lower than one-half the sample rate.

1 On the DL6054, DL6104, DLM6054, and DLM6104 (1.25 GS/s in high resolution mode). On the DL6154, the sample rate is 5 GS/s (2.5 GS/s in high resolution mode).

2 On the DL6054, DL6104, DLM6054, and DLM6104 (2.5 GS/s in high resolution mode). On the DL6154, the sample rate is 10 GS/s (5 GS/s in high resolution mode).

3 If the sample rate is comparatively low with respect to the input signal frequency, the harmonics contained in the signal are lost. When this happens, some of the harmonics will be misread as low-frequency waves due to the effects described by the Nyquist sampling theorem. This phenomenon is called aliasing. You can avoid aliasing by acquiring waveforms with the acquisition mode set to Envelope.



Interpolation Mode

In Interpolation mode, the DL6000/DLM6000 interpolates the data sampled at 2.5 GS/s up to 1000 times (2000 times in High Resolution mode) using the (sinx)/x function.*

This essentially increases the sample rate to up to 2.5 TS/s.

Interpolation mode is effective for single-shot signals. If the input signal frequency is high relative to the sample rate (2.5 GS/s here),* aliasing may occur.

* This sample rate applies to the DL6054, DL6104, DLM6054, and DLM6104. On the DL6154, the sample rate is 5 GS/s.

Repetitive Sampling Mode

In this mode, one waveform is created from several cycles of a repeating signal. This is equivalent to sampling the signal at a higher sample rate than the actual sample rate. The equivalent sample rate is 2.5 TS/s maximum.

The DL6000/DLM6000 uses random sampling, which takes advantage of the fact that the time difference between the trigger point and sampled points is random. The DL6000/DLM6000 realigns the trigger point each time it acquires a waveform.

This mode is effective for repeating signals, and aliasing rarely occurs.

Action-on-Trigger ►section 6.14 for the procedure

Determination based on specified conditions can be performed at the zone through which waveforms or automated measurements of waveform parameters pass. If the conditions are met, a given action can be executed at the same time as the signal acquisition (this does not apply to logic signals). You can set the action to be carried out to the sounding of an alarm, the saving of measured or screen capture data, the printing of a screen image, the sending of e-mail, etc.

You can execute the action-on-trigger by pressing the Exec soft key. You cannot use the RUN/STOP key for this purpose. When action-on-trigger is executed, the trigger mode switches to Normal.

GO/NO-GO Determination ►sections 6.15 to 6.17 for the procedures

The DL6000/DLM6000 uses the result of GO/NO-GO determination to decide whether to perform an action-on-trigger action. The DL6000/DLM6000 determines whether the acquired waveform meets the determination conditions (NO-GO) or not (GO). This feature cannot be used on logic signals. The determination result can be transmitted through the rear-panel GO/NO-GO I/O terminal. The result can also be used to cause an action-on-trigger action to occur.

This feature is useful for signal testing on electronic device production lines and for tracking down abnormal phenomena.

You can perform GO/NO-GO determination using:

- A waveform zone on the screen.
- A rectangular zone on the screen.
- A polygonal zone on the screen.
  You can create polygon images on a PC by using the software that comes with the DL6000/DLM6000.
- A waveform parameter range.
- A cyclic parameter statistic range.
- An FFT parameter range.
- An XY parameter range.
- A mask test item range.

History Feature ►Chapter 11 for the procedures

When signals are being measured, the signal stored in the acquisition memory as a result of a trigger occurrence is displayed as a waveform on the DL6000/DLM6000 screen and can be viewed. When signal acquisition is being triggered in succession and an abnormal waveform appears, it is impossible to stop measurement before a new waveform appears on the screen. Normally, it would be impossible to view the abnormal waveform. However, with the history feature, you can view the past signal data (history waveforms including the current displayed waveform) stored in the acquisition memory when signal acquisition is stopped.

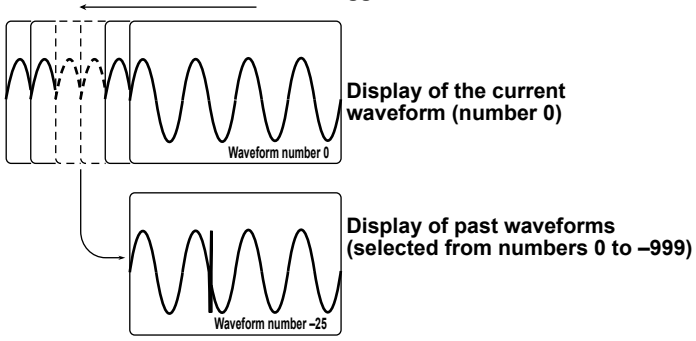
You can select different formats for viewing the history waveforms. You can view:

- A single waveform.
- All waveforms, with a color or intensity gradation applied to them.
- All waveforms with the selected waveform highlighted and no gradation.
- The simple arithmetic mean of all waveforms.

You can also automatically replay waveforms from newest to oldest or from oldest to newest.

The number N of waveforms that can be acquired and held as history waveforms varies from 1 to 2000 depending on the record length setting. If N is exceeded, the oldest history waveform is cleared. The waveform currently displayed on the screen (newest waveform) is counted as the first waveform. The oldest waveform that you can display is the one whose number is N-1. The following is an example when N = 1000.

Waveform data for the last 1000 triggers is stored.



History Search

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

Zone Search ►section 11.2 for the procedure

You can search for history waveforms that did or did not pass through a specified search zone. The three types of search zones are listed below.

- **Waveform Zone**
  You can create a zone on the screen using a waveform.
- **Rectangular Zone**
  You can create a rectangular zone on the screen.
- **Polygonal Zone**
  You can load a polygonal zone that you have created on a PC.

Waveform Parameter Search ►section 11.3 for the procedure

You can search for history waveforms that do or do not meet specified search parameter conditions. The three types of search parameters are listed below.

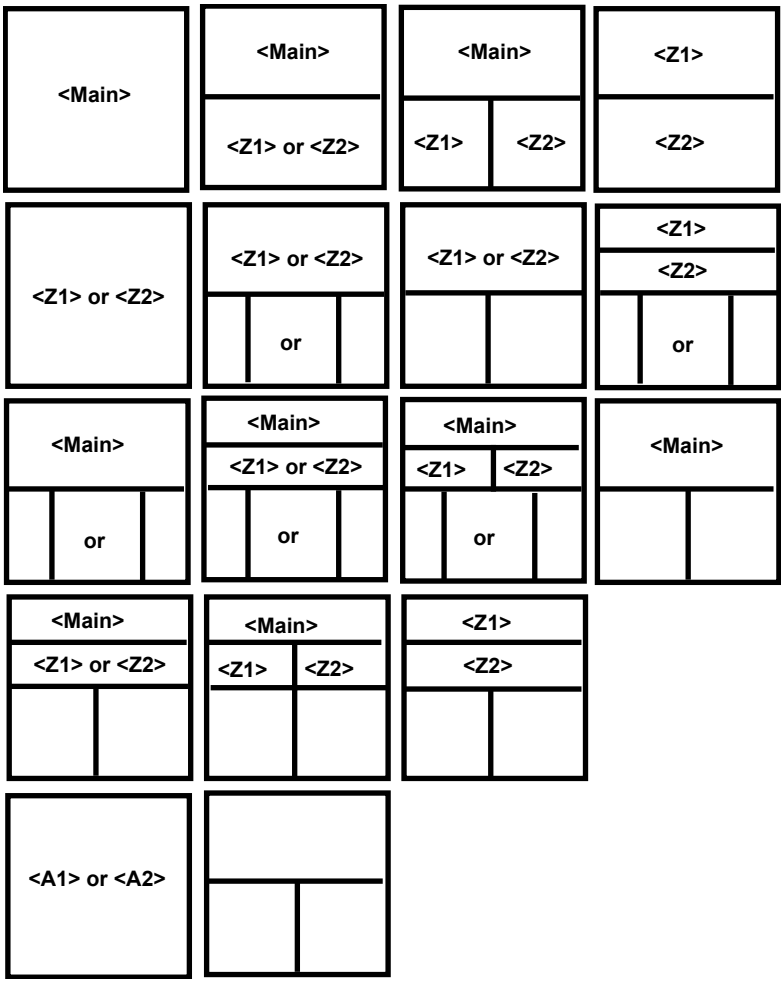
- **Waveform Parameter**
  You can search for automated measurements of waveform parameters.
- **FFT Parameter**
  You can search for FFT peak cursor measurements.
- **XY Waveform Measurement Value**
  You can search for XY waveform areas or values that have been computed using XY waveform areas.

2.6 Display

Waveform Zoom ►sections 8.4 and 8.5 for the procedures

You can magnify the displayed waveforms vertically or horizontally. This feature is useful when you set a long acquisition time and want to observe a portion of the waveform closely. The zoom area can be set in units of grid divisions.

You can view up to two different zoomed waveforms (this feature is referred to as dual zoom). The main waveform area, the zoomed waveform areas (Z1 and Z2), and the analysis areas (A1 and A2), can be arranged in the following ways.



When the main area and Zoom1 or Zoom2 are being displayed simultaneously, a “zoom box” showing the zoom areas is displayed in the main window so that you can confirm the zoom locations. The center of a zoom box is the same as the center of the zoom. For a graphic example, see “Screen Displaying Zoomed Waveforms” in section 1.3.

You can set the displayed waveforms and the display format for the zoomed waveform area independently of the main waveform area.

With the voltage-axis zoom, you can select a waveform and zoom it to 1.05 to 10 times its original vertical size.

You can zoom along the time axis until there are only 10 data points in the zoomed waveform area.

You can set the DL6000/DLM6000 to zoom in on a point that meets certain conditions (which can be set like the trigger conditions). You can also automatically change the location of the zoomed area.

Display Format ►section 8.1 for the procedure

Splitting the Screen

To get a clearer view of analog signals and computed waveforms, you can display waveforms on split screens. The following split screen settings are available.
Single (no splitting), Dual (split in half), Triad (split into thirds), and Quad (split into quarters)

Waveform Mapping

You can specify how channels are assigned to split screens.

- **Auto**
  The waveforms whose display is turned on are assigned in order starting with the top screen.
- **Manual**
  You can assign any waveform to any of the split screens regardless of whether the display of the waveform is turned on or off.

Display Interpolation ►section 8.1 for the procedure

If there is not enough data within 10 divisions of the time axis to fill every point, the DL6000/DLM6000 can use interpolated data to fill in the gaps when it displays waveforms (only pulse interpolation can be used with logic signals).

Sine Interpolation

The DL6000/DLM6000 interpolates between two data points using the (sinx)/x function. This method is suitable for the observation of sine waves.

Linear Interpolation

The DL6000/DLM6000 fills in the space between two data points with a straight line.

Pulse Interpolation

The DL6000/DLM6000 interpolates between two points in a staircase pattern.

Interpolation OFF

The DL6000/DLM6000 displays the data using dots without interpolation.

Accumulated Display ►section 8.2 for the procedure

By setting older waveforms to remain on the screen for a period of time that is longer than the waveform update period, you can continue displaying new waveforms while older ones remain on the display. The following two modes are available:

- **Count**
  The DL6000/DLM6000 accumulates a set number of waveforms. Frequency of data occurrence is indicated through different brightness levels or colors. Frequency of data occurrence is not indicated for logic signals.
- **Time**
  The DL6000/DLM6000 accumulates waveforms for a set period of time. Data recency is indicated through different brightness levels or colors. Data recency is not indicated for logic signals.

Both of the preceding two modes can be displayed in one of the following two ways:

- **Inten**
  Different brightness levels are used.
- **Color**
  Different colors are used.

The accumulated display is useful for observing waveforms with noise and jitter or for observing a phenomenon with a low frequency of occurrence.
Accumulated waveforms can be saved.

Displaying Labels ►section 5.1 for the procedure

You can create and display labels of up to eight characters in length for each of the waveforms.

Snapshot ►section 8.3 for the procedure

You can use the snapshot feature to continue displaying a waveform on the screen after the screen is updated (which is when the waveform would have ordinarily been cleared). Snapshot waveforms appear in white. You can compare them with new waveforms. Snapshot waveforms can be printed as part of the screen capture data, but they cannot be made the object of cursor measurement, automated measurement of waveform parameters, zooming, calculation, etc.

Translucent ►section 16.3 for the procedure

In translucent display, the dialog boxes that appear when you configure settings are translucent so that you can see what is displayed below them.

Displaying Scale Values ►section 8.1 for the procedure

You can display the upper and lower limits (scale values) of each waveform's vertical and horizontal axes.

2.7 Computed and Reference Waveforms

Displaying Computed Waveforms ►section 9.1 for the procedure

By specifying expressions for M1 to M4, you can display up to four computed waveforms.

Displaying Reference Waveforms ►section 9.8 for the procedure

You can display up to four reference waveforms by assigning them to M1 to M4.
If you set the measurement source to a channel from M1 to M4 when a reference waveform is displayed, cursor measurements and automated measurements of waveform parameters are performed relative to the reference waveform. You can also use the reference waveform in calculations.
The following waveforms can be used as reference waveforms.

- Waveforms that appear on the screen (CH1 to CH4 and M1 to M4)
- Saved waveforms

Addition, Subtraction, and Multiplication ►section 9.2 for the procedure

In calculations for M1, addition, subtraction, and multiplication can be performed on two channels from CH1 to CH4. In calculations for M2 to M4, addition, subtraction, and multiplication can be performed on two channels from M1 and CH1 to CH4.
Addition and subtraction are useful for comparing a signal with a reference signal, checking signal logic, and comparing phases. Multiplication can be used to produce a power waveform when the DL6000/DLM6000 is receiving voltage and current signals.

Integration ►section 9.4 for the procedure

You can integrate the selected waveform. The DL6000/DLM6000 takes the specified integration start point as 0 and calculates the value for the entire area, counting up toward the newest data and down toward the oldest data. In calculations for M1, you can integrate a channel from CH1 to CH4. In calculations for M2 to M4, you can integrate M1 or a channel from CH1 to CH4.

Delay (Phase shift) ►section 9.3 for the procedure

You can display a waveform with its phase shifted. To advance the phase, set a positive value. To delay the phase, set a negative value.

IIR Filter ►section 9.3 for the procedure

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

Smoothing ►section 9.3 for the procedure

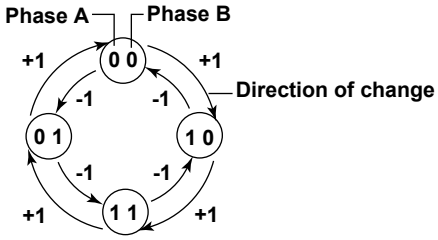
You can use moving averaging to display a smooth waveform whose noise has been eliminated.

Edge Count ►section 9.5 for the procedure

You can count the edges of the selected waveform. The DL6000/DLM6000 takes the specified counting start point as 0 and counts all the edges in the entire area, counting up toward the newest data and down toward the oldest data. In calculations for M1, you can count the edges of a channel from CH1 to CH4. In calculations for M2 to M4, you can count the edges of M1 or a channel from CH1 to CH4.

Rotary Count ►section 9.6 for the procedure

The DL6000/DLM6000 counts up and down according to phase changes between phase A (Source 1) and phase B (Source 2), taking a rise above a specified level as 1, and a fall below the level as 0. The DL6000/DLM6000 takes the specified start point as 0 and calculates the value for the entire area, counting up toward the newest data down toward the oldest data. In calculations for M1, you can count the phase changes of a channel from CH1 to CH4. In calculations for M2 to M4, you can count the phase changes of M1 or a channel from CH1 to CH4.



D/A Conversion ►section 9.7 for the procedure

You can perform digital to analog conversion on logic signals by group.

Converting the Scale of a Computed Waveform ►section 9.1 for the procedure

Normally auto scaling is performed when a computed waveform is displayed, but manual scaling can also be selected.

In auto scaling, the DL6000/DLM6000 automatically determines the signal level[1] at the vertical center (Center) of the screen area and the sensitivity (Sensitivity)[2] when it displays computed waveforms.

In manual scaling, you can set the Center and Sensitivity values as necessary.

1 Voltage level for a voltage waveform.

2 Voltage per division for a voltage waveform.

User-Defined Computation (Option) ►section 9.10 for the procedure

User-defined computation is available on models that have the /G4 or /G2 option.

You can combine the following operators and constants to define expressions.

Operators

Operators	Examples	Description
Basic functions		
+,-,*,/	C1+C2-C3	Basic arithmetic of input values
ABS	ABS(C1)	Absolute value of an input value
SQRT	SQRT(C2)	Square root of an input value
LOG	LOG(C1)	Logarithm of an input value
LN	LN(C1)	Natural logarithm of an input value
EXP	EXP(C1)	Exponent of an input value
P2	P2(C1)	Square of an input value
-	-(C1)	Opposite of an input value
Trigonometric functions		
SIN	SIN(C1)	Sine of an input value
ASIN	ASIN(C1)	Arc sine of an input value
COS	COS(C1)	Cosine of an input value
ACOS	ACOS(C1)	Arc cosine of an input value
TAN	TAN(C1)	Tangent of an input value
ATAN	ATAN(C1)	Arc tangent of an input value
PH	PH(C1,C2)	Phase difference between two input values
Differentiation and integration		
DIFF	DIFF(C1)	Derivative of an input waveform
INTEG	INTEG(C1)	Integral of an input waveform

Operators	Examples	Description
Filter functions		
FILT1	FILT1(C1)	Application of a digital filter to the input waveform
FILT2	FILT2(C1)	Application of a digital filter to the input waveform
HLBT	HLBT(C1)	Hilbert function of the input waveform
MEAN	MEAN(C1,10)	Moving average of an input waveform
DELAY	DELAY(C1,0.001)	Phase shifting of an input waveform
BIN	BIN(CH1,1,-1)	Binary conversion of an input waveform
Pulse width computation		
PWHH	PWHH(C1,1,-1)	Pulse width computation of an input waveform from one rising edge to the next rising edge
PWHL	PWHL(C1,1,-1)	Pulse width computation of an input waveform from a rising edge to the next falling edge
PWLH	PWLH(C1,1,-1)	Pulse width computation of an input waveform from a falling edge to the next rising edge
PWLL	PWLL(C1,1,-1)	Pulse width computation of an input waveform from one falling edge to the next falling edge
PWXX	PWXX(C1,1,-1)	Pulse width computation of the input waveform from one rising or falling edge to the next rising or falling edge
FV	FV(C1,1,-1)	Reciprocal of the computed pulse width PWHH
DUTYH	DUTYH(C1,1,-1)	Duty ratio of the high side of each period of an input waveform
DUTYL	DUTYL(C1,1,-1)	Duty ratio of the low side of each period an input waveform

Constants

Symbol	Description
K1 to K4	Constants
0 to 9	–
Exp	E notation Used to enter a number in scientific notation in expressions. (1E+3 = 1000, 2.5E-3 = 0.0025) It is displayed as “E” in expressions to distinguish it from the “EXP” operator.
PI	Pi (π)
e	Euler’s number (Napier’s constant) Base of the natural logarithm (e=2.71828...). It is displayed as “eul” in expressions to distinguish it from the “E” that represents exponents.
fs	The sample rate. The DL6000/DLM6000 sample rate at the time that computation is executed. The value changes in accordance with changes in the time axis and record length settings.
1/fs	Number of samples per second. Computed based on the DL6000/DLM6000 sample rate when computation is executed. The value changes in accordance with changes in the time axis and record length settings.
Measure	A waveform parameter value can be used. Example: P.Max(C1)

Waveform

A channel from CH1 to CH4 or from M1 to M3.

2.8 Analysis and Searching

Cursor Measurement ►section 10.1 for the procedure

You can move cursors on the waveforms displayed on the screen to view the measured values at the points where the cursors intersect the waveforms. There are six types of cursors.

ΔV Cursors

Two parallel dotted lines appear on the horizontal axis (the ΔV cursors). You can use them to measure the Y-axis values at the cursor location. You can also measure the level difference between the two cursors.
You can also define and display the results of calculations made using the cursors' measured values.

ΔT Cursors

Two parallel dotted lines appear on the vertical axis (the ΔT cursors). You can measure the time between the trigger position and each cursor and measure the time difference and the reciprocal of the time difference between the cursors.
You can also define and display the results of calculations made using the cursors' measured values.

ΔT&ΔV Cursors

The ΔT cursors and ΔV cursors are displayed at the same time.

VT Cursor

One dotted line appears on the vertical axis (this is the VT cursor). The measured value at the VT cursor and the measured time between the trigger position and the VT cursor are displayed.
You can also define and display the results of calculations made using the cursor's measured values.
The VT cursor can be used with logic signals. The value at the cursor position of every group will be displayed.

Marker Cursors

Four markers are displayed on the selected waveform. You can measure the level at each marker, the amount of time from the trigger position to each marker, and the level and time differences between markers.
You can also define and display the results of calculations made using the markers' measured values.

Serial Cursors

One dotted line appears on the vertical axis (this is the serial cursor). The result of digitizing the waveform at the location of the cursor is calculated and displayed in accordance with the bitrate, bit length, and threshold settings.

Automated Measurement of Waveform Parameters

Automated Measurement of Waveform Parameters ►section 10.2 for the procedure

The DL6000/DLM6000 can perform automated measurements of various parameters on the currently displayed acquired waveform.
Up to 100,000 results of automated measurement can be stored to a file.
There are 36 different items that can be automatically measured. The DL6000/DLM6000 can display a total of 16 measured items at a time. You can specify calculations to be made using the results of automated measurement and display the results of those calculations.

Statistical Processing ►section 10.3 for the procedure

You can perform statistical processing on the automated measurement results described above. You can display the five statistical processing results listed below for the values of two automated measurement items.

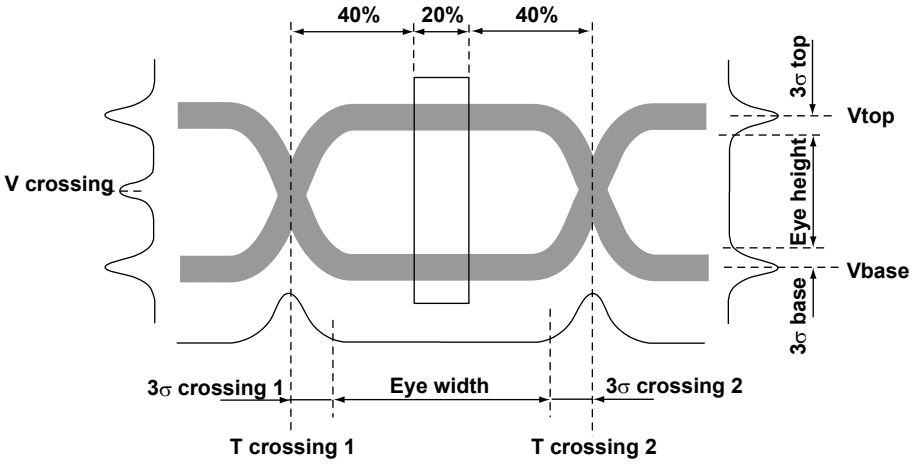
- Maximum (Max)
- Minimum (Min)
- Mean (Mean)
- Standard deviation (σ)
- The number of measured values used to calculate the statistics (Cnt)

Statistical processing can be performed in the following three ways.

- **Normal statistical processing**
  While acquiring signals, the DL6000/DLM6000 calculates the statistics of the specified number of waveforms, starting with the most recently acquired waveform. If you stop waveform acquisition and then restart it, the DL6000/DLM6000 will continue statistical processing and include the data from before waveform acquisition was stopped. To reset statistical processing, press the Restart soft key.
- **Statistical Processing within One Cycle of Measurement or the Measurement Time Range**
  The DL6000/DLM6000 determines periods in order from the oldest data of the displayed waveform, measures the selected automated measurement items within each period, and performs statistical processing on the results of automated measurement. The method used to determine the period is the same as the method used to determine the Period waveform parameter.
- **Statistical Processing of History Waveforms**
  The DL6000/DLM6000 performs automated measurement on the selected range of the history waveform and uses the results to calculate statistics. Statistical processing begins with the oldest waveform.

Mask Test ►section 10.8 for the procedure

There are two available tests: a mask test for analyzing a communication signal, and a test for automatically measuring the waveform parameters of an eye pattern.
Measurement is performed on the accumulated waveforms when the mode is set to Count.
In a mask test, you can create a mask pattern with the free software supplied by YOKOGAWA, load it into the DL6000/DLM6000, and count the number of waveforms that pass through the mask.
In an eye pattern test, the following eye pattern items are measured.



Vtop	Average top peak voltage of the vertical histogram
Vbase	Average bottom peak voltage of the vertical histogram
σ top	Standard deviation of the top peak voltage of the vertical histogram
σ base	Standard deviation of the bottom peak voltage of the vertical histogram
Tcrossing1	Average time of the first crossing point
Tcrossing2	Average time of the second crossing point
Vcrossing	Voltage at the point where the rising edge and the falling edge cross
Crossing %	Level where the rising edge and the falling edge of the eye pattern intersect, expressed as a percentage with respect to the difference between Vtop and Vbase
Eye Height	Height of the eye
Eye Width	Width of the eye
Q Factor	Quality factor of the eye diagram expressed as a ratio of the eye height with respect to the noise at both the high and low voltage levels
Jitter	Magnitude of the time fluctuation of the first crossing point (crossing1)
Jitter2	Magnitude of the time fluctuation of the second crossing point (crossing2)
Duty Cycle Distortion %	Time difference between the falling edge intermediate point and the rising edge intermediate point as determined by the intermediate threshold level expressed as a percentage with respect to the full bit width
Ext Rate dB	Extinction rate in dB
Rise	Rise time between the specified lower and upper threshold levels
Fall	Fall time between the specified upper and lower threshold levels

The following formulas are used to calculate each item.

$$\text{Crossing\%} = 100\,\frac{\text{V crossing} - \text{V base}}{\text{Vtop} - \text{Vbase}}$$

$$\text{Duty Cycle Distortion\%} = 100\,\frac{|\text{Trising 50\%} - \text{Tfalling 50\%}|}{\text{T crossing 2} - \text{T crossing 1}}$$

Eye height = (Vtop – 3σtop) – (Vbase + 3σbase)

Eye width = (T crossing 2 – 3σ crossing 2) – (T crossing 1 + 3σ crossing 1)

Jitter = σ crossing 1

Jitter2 = σ crossing 2

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

$$\text{ExtRatedB} = 10\log\left(\frac{\text{Vtop} - \text{Vdark}}{\text{Vbase} - \text{Vdark}}\right)$$

X-Y Analysis ►section 10.4 for the procedure

You can observe the correlation between two input signal levels by displaying one signal level on the X-axis (horizontal axis) and a second signal level on the Y-axis (vertical axis). You can display X-Y waveforms at the same time as normal T-Y (time and level) waveforms.

It is also possible to specify the ranges for X-Y analysis and to perform analysis according to the level of the specified signal.

You can use cursors to measure the X-Y analysis results. You can also compute the area of the X-Y waveform. For information about how the area of the X-Y waveform is computed, see Appendix 1, “How Waveform Areas Are Calculated.”

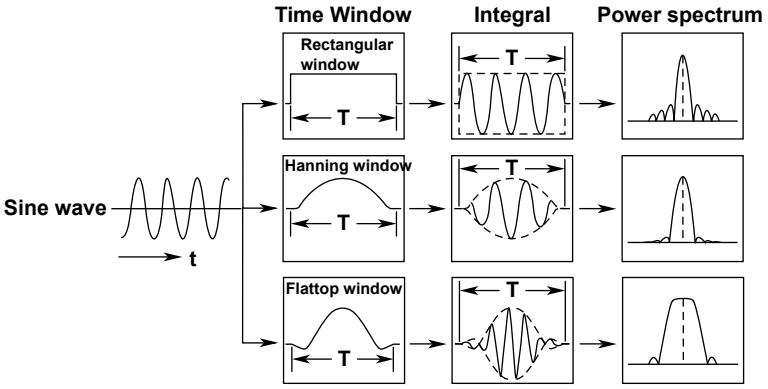
You can use the X-Y waveform display to measure the phase angle between two sine wave signals. An X-Y display of two sine waves produces a Lissajous curve, from which the phase angle can be read.

Lissajous Curves

0° phase angle			
45° phase angle			
90° phase angle			
Frequency ratio (X:Y)	**1:1**	**1:2**	**1:3**

FFT Analysis ►section 10.5 for the procedure

You can execute a fast Fourier transform (FFT) and display a power spectrum.
You can enable and disable the traces of the real and imaginary parts. If the trace of the imaginary part is not enabled, only the real part is used for calculation, and negative frequencies are not displayed.
You can use a rectangular, Hanning, or flattop time window.
The rectangular window is best suited to transient signals, such as impulse waves, which attenuate completely within the time window. The Hanning and flattop windows allow continuity of the signal by gradually attenuating the parts of the signal located near the ends of the time window down to the 0 level. Hence, they are best suited to continuous signals. The Hanning window provides a higher frequency resolution compared to the flattop window. However, the flattop window has a higher level of accuracy. When the waveform being analyzed is a continuous signal, choose the appropriate window for the situation.
You can set the number of points in the FFT to 2.5 k, 6.25 k, 12.5 k, 25 k, 62.5 k, 125 k, or 250 k.
You can set the FFT range to one of the displayed windows (the main, Zoom1, or Zoom2 window).
If the record length of the selected window is greater than the number of FFT points, the data is downsampled before computation.
You can perform marker measurements and measure the peak values on an FFT waveform.



Rectangular window : W(t) = u(t) – u(t – T) u(t): Step function

Hanning window : $W(t) = 0.5 - 0.5\cos(2\pi \frac{t}{T})$

Flattop window : $W(t) = \{0.54 - 0.46\cos(2\pi \frac{t}{T})\} \frac{\sin\{2\pi(1 - 2t/T)\}}{2\pi(1 - 2t/T)}$

FFT Function

Given that the complex function resulting after the FFT is G = R + jI, the power spectrum can be expressed as follows.

DC Component $10 \log(R^2 + I^2)$

AC component $10 \log\left(\frac{R^2 + I^2}{2}\right)$

R: Real Part, I: Imaginary Part
Log magnitude reference (0 dB): 1 $Vrms^2$

Waveform Parameter Histogram, Trend and List Displays ► section 10.6 for the procedure

You can display a histogram or trend of the selected waveform parameter. In the histogram display, you can measure values such as the mean, standard deviation, and peak values of the selected waveform parameter. In the trend display, you can observe the changes in the waveform parameter over time and use cursors to measure levels.
Automated measurements of waveform parameters can also be displayed in a list.

Accumulated Histogram Display ►section 10.7 for the procedure

You can display a frequency distribution histogram (vertical or horizontal) for the specified region of a repeatedly captured signal. On the histogram, you can measure values such as the mean, standard deviation, maximum, minimum, peak, and median values. You can also measure X-axis and time values with the cursors. You can perform calculations using the above measured values.
This feature is useful for measuring jitter.

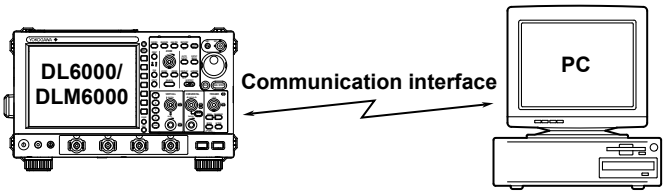
Searching Waveforms ►section 10.9 for the procedure

You can search through the analog, logic, and serial bus signals that the DL6000/DLM6000 has acquired. You can zoom in on detected points and select which of the multiple detected points to display.

2.9 Communication

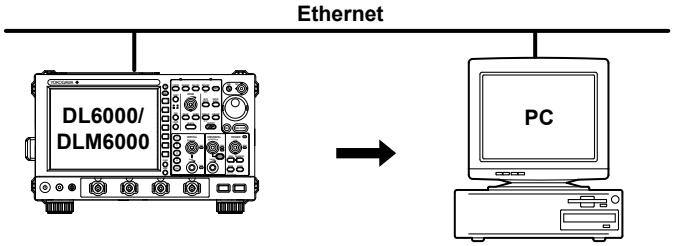
Communicating by Using Commands (USB or Ethernet) ► Communication Interface User's Manual included on the CD for the procedures

The DL6000/DLM6000 comes standard-equipped with a USB interface. An Ethernet interface is available as an option. Using communication commands, you can transmit measured data to a PC for data analysis or control the DL6000/DLM6000 using an external controller and perform waveform measurements.



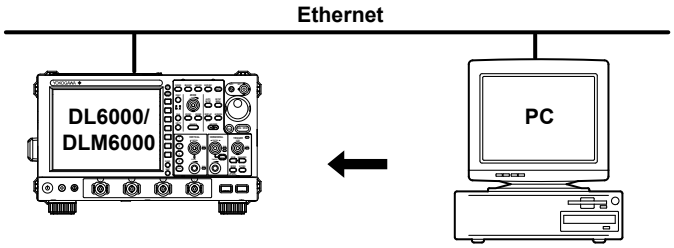
Saving and Loading Data on a Network Drive ►section 14.3 for the procedure

Just as you can with the internal storage medium, you can save and load measurement and setup data and save screen capture data to a PC that is connected to the DL6000/DLM6000 over a network.



Accessing the DL6000/DLM6000 from a PC ►sections 14.6 and 14.7 for the procedure

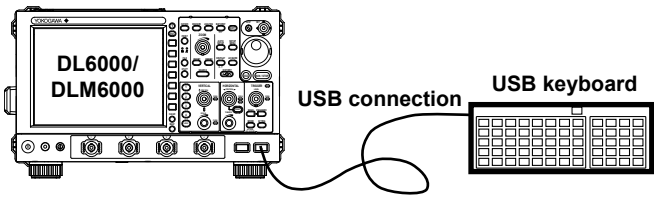
You can access the DL6000/DLM6000 from a PC over a network and load files from the DL6000/DLM6000 internal storage medium (using the DL6000/DLM6000 as an FTP or file server).
You can also monitor the DL6000/DLM6000 screen from the PC (using the Web server feature).



2.10 Other Useful Features

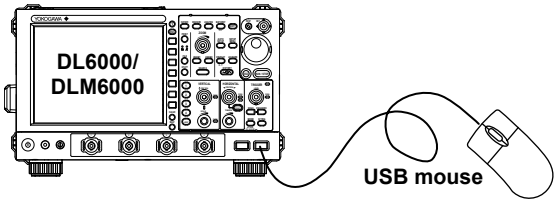
Entering Numbers and Text from a USB Keyboard ►section 4.3 for the procedure

You can connect a USB keyboard to the DL6000/DLM6000 and use it to enter file names, comments, etc. You can also use the keys on a USB keyboard to perform the same operations that can be performed using the front panel keys.



Operating the DL6000/DLM6000 Using a USB Mouse ►section 4.3 for the procedure

You can connect a USB mouse to the DL6000/DLM6000 and use it to perform the same operations that you can perform using the DL6000/DLM6000 keys. Also, by clicking a menu item, you can perform the same operation that you can perform by pressing the menu item's soft key or selecting the menu item and pressing the SET key.



Default Setup ►section 4.4 for the procedure

You can return the various settings to their default values. Some settings cannot be reset (see section 4.4 for details). To reset all settings except for the date and time settings to their factory default values (the display on/off setting will be reset), turn the power switch on while holding down RESET (⊘). Then, release RESET after you hear a beeping sound.

Auto Setup ►section 4.5 for the procedure

You can use the auto setup feature to automatically configure settings such as the voltage axis, time axis, and trigger settings according to the analog signals. This feature is useful when you are not sure what type of signal is being applied to the DL6000/DLM6000. However, the auto setup feature will not work properly on all input signals.

Serial Bus Auto Setup ►the Serial Bus Signal Analysis Manual for the procedures

You can use the serial bus auto setup feature to automatically configure settings such as the voltage axis, time axis, and trigger settings according to the serial bus signal. The auto setup feature will not work properly on all input signals. This feature can only be used on models that are equipped with the /F3 or /F4 option.

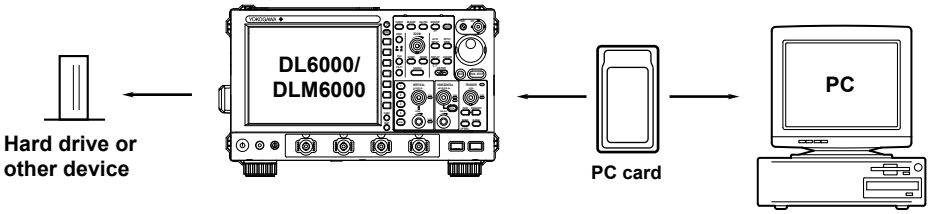
Printing a Screen Image ►chapter 12 and section 14.8 for the procedures

You can use the screen capture feature to print a screen image to the built-in printer (optional) or to a USB or network printer (on models that are equipped with the Ethernet interface option).

Saving and Loading Data to a Storage Medium ►chapter 13 for the procedure

The DL6000/DLM6000 can save and load various types of data to the following kinds of storage media.

- PC cards (standard)
- External USB devices (USB memory cards, hard drives, etc.)
- Network drives (on models with the Ethernet interface option)



Saving and Loading Setup Data, Measured Data, and Waveform Data ►sections 13.4 to 13.9 for the procedures

You can save and load setup data, measured data, snapshot data, and accumulated waveform data to a selected storage medium.

Saving Screen Capture Data ►section 13.11 for the procedure

You can save screen capture data to a selected storage medium. You can save the screen capture data in BMP, PNG, or JPEG format. This enables you to paste the image data into a document that you have created using DTP software.

Saving Analysis Results ►section 13.6 for the procedure

You can save automated measurements of waveform parameters, accumulated waveform histograms, FFT analysis waveforms, and serial bus signal analysis results 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 vi and vii.

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 iv 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.

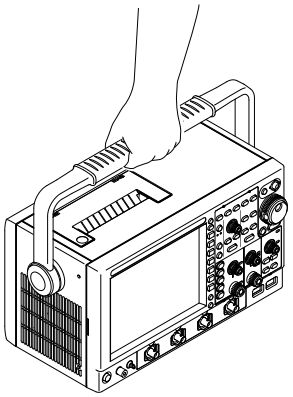
Cleaning

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.

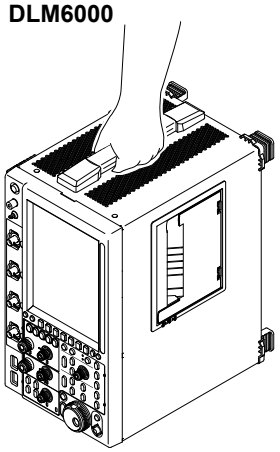
When Carrying the Instrument

Remove the power cord and connecting cables. Hold the handle to carry the the DL6000/DLM6000.

DL6000



DLM6000

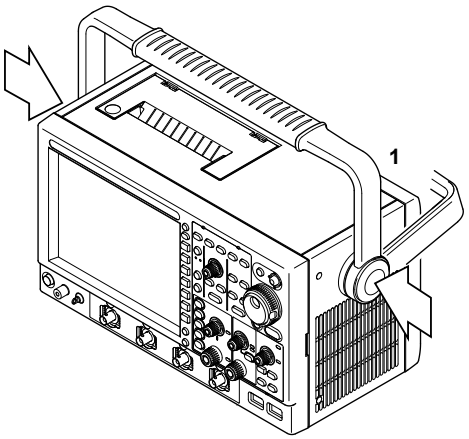


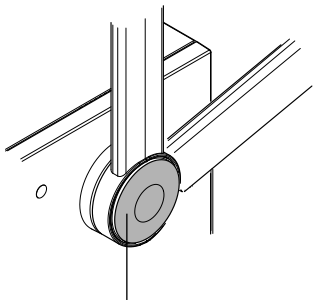
Using the Handle (DL6000)

CAUTION

- Do not try to move the handle with excessive force. Doing so may break the handle.
- Make sure that the blue handle holders do not turn as you move the handle. If you turn the handle holders, they may break.
  The handle holders may move as you turn the handle if you push down on them too hard when you release the handle lock or if you continue pushing down on them after you have already released the lock.

This instrument's handle locks into place in positions 1 and 2 indicated in the figure below. To move the handle, first push the blue handle holders on the left and right sides of the handle (indicated in the figure below) to release the lock. Make sure that the handle holders do not turn as you move the handle. Move the handle until it clicks into place.





While pushing down on these parts (the handle holders), turn the handle slightly to release the lock.
After you have released the lock and start turning the handle, make sure that these parts do not turn.

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.

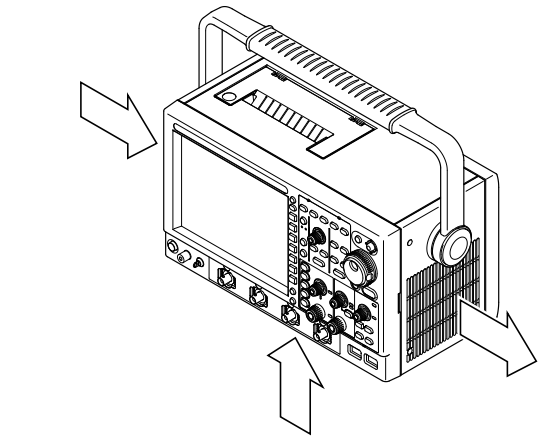
Well-Ventilated Location

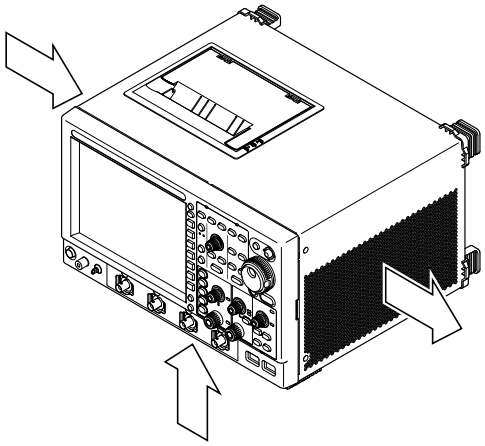
Inlet holes are located on the left and bottom sides of the instrument. There are also exhaust holes on the right side. To prevent internal overheating, allow for enough space around the instrument (see the figure below) and do not block the inlet and exhaust holes.

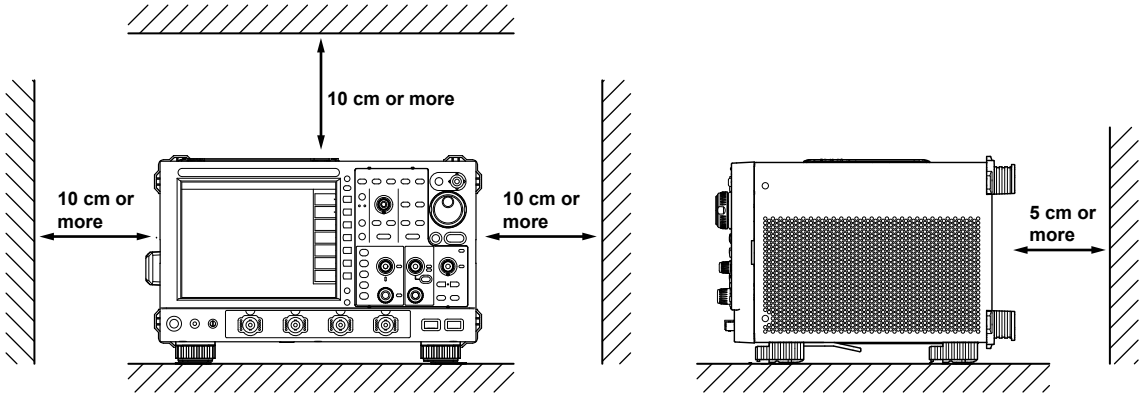
CAUTION

If the inlets on the left and bottom sides of the instrument, and exhaust holes on the right side are blocked, the temperature of the instrument will rise, and can result in damage.

DL6000 **DLM6000**







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 to 40°C
Ambient humidity	20 to 80% RH when the printer is not used. (No condensation) 35 to 80% 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.

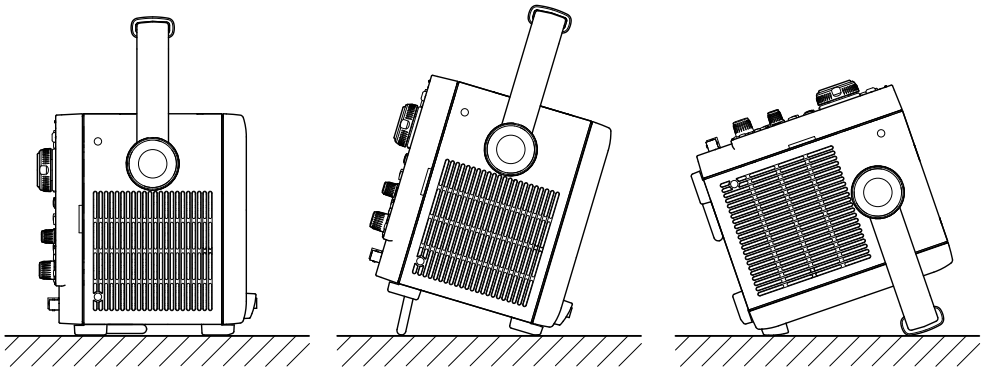
Do not install the instrument in the following places.

- 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.

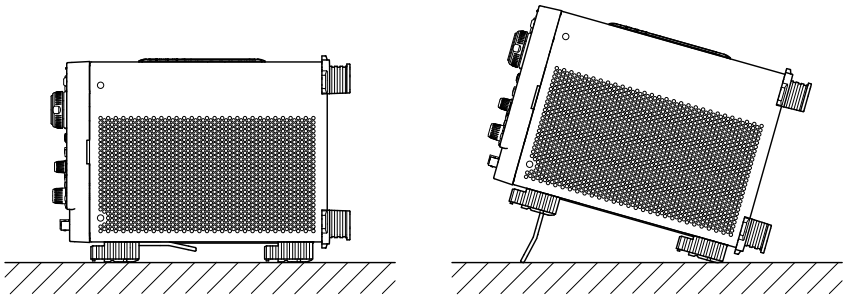
Installation Position

Place the instrument in a horizontal position or inclined position using the stand (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. Do not install the DL6000/DLM6000 in a position other than those indicated below.

DL6000



DLM6000



Rubber Feet

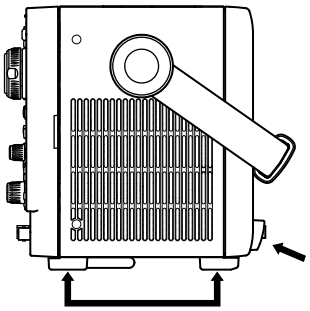
DL6000

Rubber stoppers can be attached to the four feet on the bottom and two locations on the back of the DLM6000. Six rubber stoppers are included with the DLM6000.

DLM6000

Rubber stoppers can be attached to the four feet on the bottom of the DLM6000. Four rubber stoppers are included with the DLM6000.

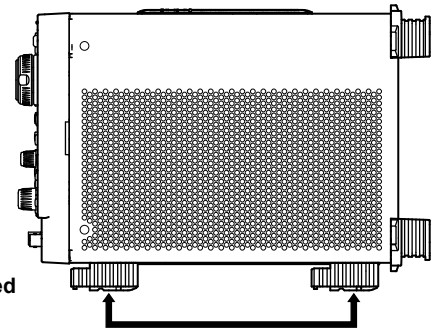
DL6000



Two stoppers located on the left and right

Four stoppers

DLM6000



Four stoppers

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

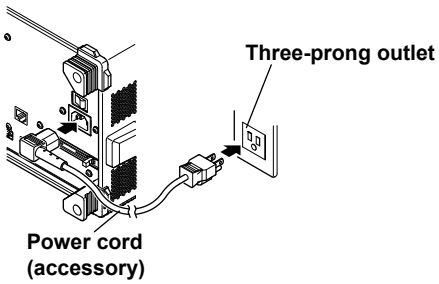
- Before connecting the power cord, ensure that the source voltage matches the rated supply voltage of the instrument and that it is within the maximum rated voltage of the provided power cord.
- Check that both the main power switch and power switch of the DL6000/DLM6000 are off before connection the 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 DL6000/DLM6000 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.

Rated supply voltage*	100 to 120 VAC/220 to 240 VAC (automatic switching)
Permitted supply voltage range	90 to 132 VAC/198 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 DL6000/DLM6000 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 DL6000/DLM6000 is less than or equal to the maximum rated voltage of the provided power cord (see page iii) before using it.



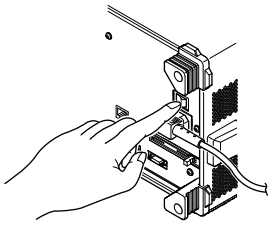
Turning On the Power Switch

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

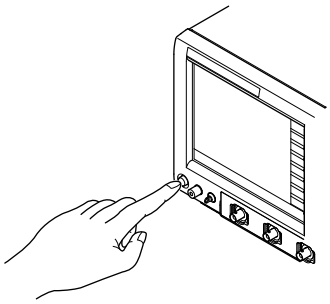
Turning On the Main Power Switch

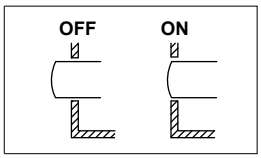
1. Switch the rear panel power switch to the on (|) position.



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 DL6000/DLM6000 internal fan has stopped, and that the screen is blank, then switch the power switch on the rear panel to the off (O) 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 page 3-5).
  - 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, “Returning to the Default 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 Time/div is changed and signal acquisition is started.

Power Down Operation

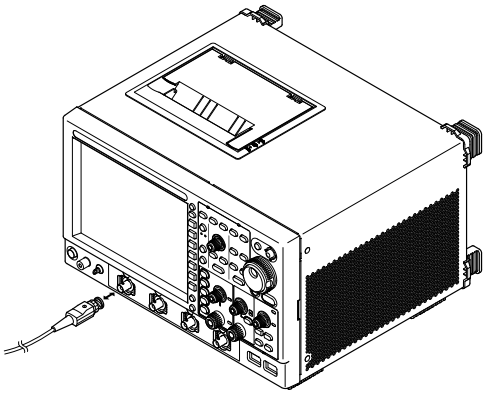
The settings just prior to turning off the power (or when the power cord is unplugged) are stored. Therefore, the next time the power is turned on, waveforms are measured using those settings.

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.

3.4 Connecting the 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 in parallel, or 50 Ω ± 1.5%.



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

- 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	1.3 m	—
Connector type	BNC	—
Input impedance	10 MΩ ± 2%	Together with an oscilloscope of input impedance 1 MΩ ± 1%
Input capacitance	Approx. 10.5 pF	
Attenuation ratio	Not exceeding 10:1 ± 2%	
Bandwidth	DC to 500 MHz (not exceeding –3 dB)	
Rise time	700 ps or less (typical*)	
Maximum input voltage	600 V (DC+ACpeak) 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.
- Measurement will only be correct if the attenuation ratio is set properly. Check the attenuation ration of the probe that you are using and set it properly.

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 6.6 to set the DL6000/DLM6000 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 to the DL6000/DLM6000, 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 terminals.
- You can execute automatic zero adjustment (see section 5.1) on a current probe that is compatible with the probe interface connector.

* For a list of compatible probes, see “Optional Accessories” on page v.

Connecting FET Probe, Current Probe, Differential Probe, or Deskew Correction Signal Source

If you are using the YOKOGAWA’s FET Probes, Current Probes, Differential Probes, or Deskew Correction Signal Source, use the probe power terminal (option) on the DL6000/DLM6000 rear panel for the power supply. For details on the connection procedure, see the manual that comes with the respective product.

* For a list of probes and signal sources, see “Optional Accessories” on page v.

CAUTION

Do not use the Probe Power Terminal (option) on the DL6000/DLM6000 rear panel for purposes other than supplying power to the FET Probe, Current Probe, Differential Probe, or Deskew Correction Signal Source. Also, be sure that the total current of the four Probe Power Terminals and the four Probe Interface Terminals does not exceed 1.2 A. Otherwise, the device connected to the Probe Power Terminals or to the DL6000/DLM6000 may break.

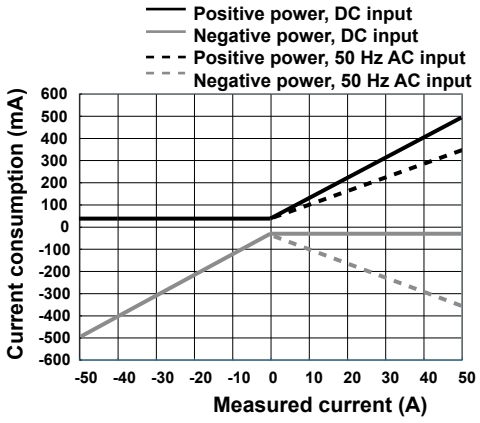
* This applies to the DLM6000. For the DL6000, do not supply more than a total of 1.2 A to the two probe power terminals and the four probe interface terminals.

Handling Precautions of the Probe Interface Terminals and Probe Power Terminals

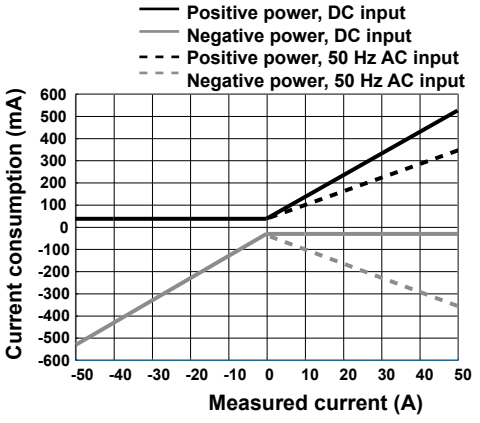
If you are connecting the YOKOGAWA's FET Probes, Current Probes, Differential Probes, or Deskew Correction Signal Source to the Probe Power Terminals (Option) on the rear panel, be sure that the total current of the four Probe Power Terminals and the four Probe Interface Terminals does not exceed 1.2 A.* Otherwise, the DL6000/DLM6000 operation may become unstable due to the activation of the excessive current protection circuit of the power supply.

* This applies to the DLM6000. For the DL6000, do not supply more than a total of 1.2 A to the two probe power terminals and the four probe interface terminals.

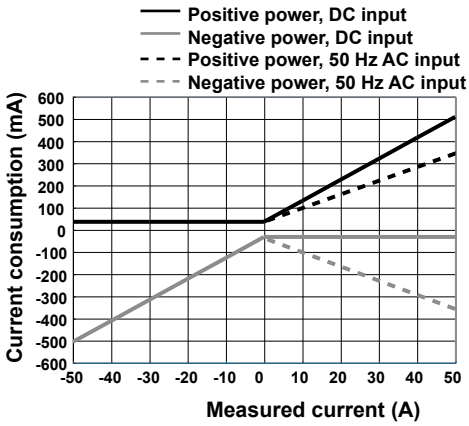
- When using current probes, the number of probes is limited, depending on the measured current (the current measured by the current probes). The characteristics of measured current versus current consumption for active probes that can be connected to the DL6000/DLM6000 are as follows.



Measured current versus consumed current (characteristic curves) for current probe 701928.



Measured current versus consumed current (characteristic curves) for current probe 701929.



Measured current versus consumed current (characteristic curves) for current probe 701932/701933.

- The current consumption of the FET probe (700939) and differential probe (700924, 700925, 701920, 701921, or 701922) should be calculated as a maximum of 125 mA for both negative and positive.
- Calculate the power consumption of the Deskew Correction Signal Source (701935) as 150 mA (positive power supply).

3.5 Compensating the Probe (Phase Correction)

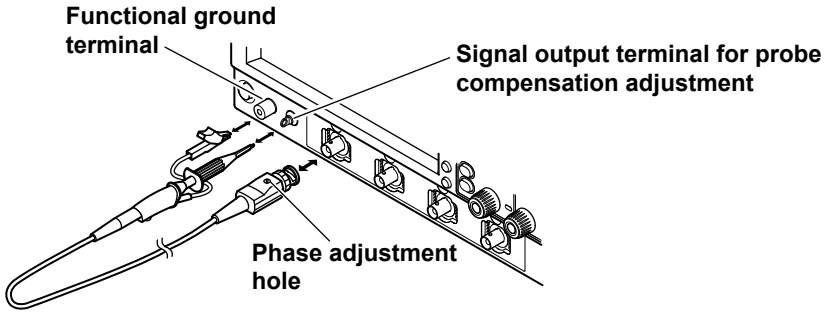
Be sure to perform phase correction of the probe first when using a probe to make measurements.

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.



Explanation

Necessity of Phase Correction of the Probe

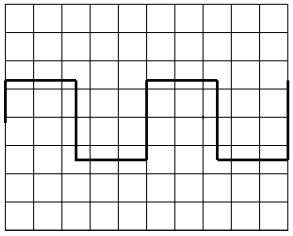
The probe comes with its phase corrected approximately to match the input capacitance of the relevant oscilloscope. However, there is variance in the input resistance and input capacitance of each input channel of individual oscilloscopes. This results in a mismatch in the voltage divider ratio between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

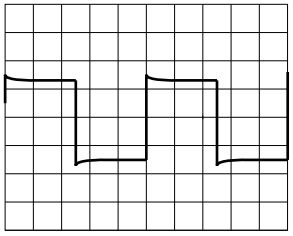
The following square wave signal is output from the signal output terminal for probe compensation adjustment.
Frequency: Approx. 1 kHz
Amplitude: Approx. 1 V

Differences in the Waveform due to the Phase Correction of the Probe

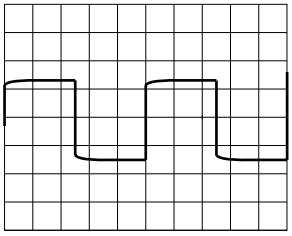
Correct waveform



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 Connecting Logic Probes

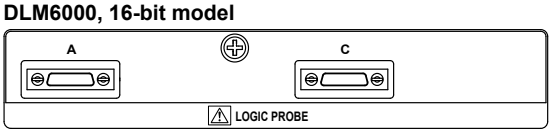
CAUTION

- The non-destructive input voltage range for logic probe input is ±40 V (DC + peak AC) or 28 Vrms on the 701980, 701981, and 701989 and ±42 V (DC + peak AC) or 29 Vrms on the 701988. Applying a voltage greater than either of the specified limits may damage the logic probe or the DLM6000. If the frequency is high, the DLM6000 may be damaged at even lower voltages. For information about derating based on frequency for a particular logic probe, see the probe's user's manual.
- The 8 input lines on each port have a common ground. In addition, the ground for the DLM6000 and the ground for each port are also common. Do not connect inputs that have different common voltages, as doing so may cause damage to the DLM6000, logic probe, or other connected instruments.
- Make sure to turn off the power to the DLM6000 before connecting or disconnecting a logic probe cable.

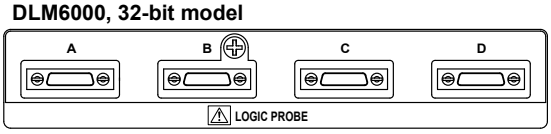
Logic Signal Input Ports

Connect the logic probe (701980/701981/701988/701989) to any of the four logic signal input ports (POD A, POD B, POD C, and POD D) on the rear panel.

DLM6000, 16-bit model



DLM6000, 32-bit model



About the Logic Probe

The logic probe (701980/701981) is designed exclusively for the logic signal input ports of the DLM6000. Use the connection lead (accessory) to connect to the point of measurement. Do not alter the connection lead, as it may cause the lead from satisfying the specifications.

Each port has 8 lines of logic input terminals. You can set the threshold level from the DLM6000 menu (see section 5.2).

Logic Input Specifications When Used on the DLM6000

Item	When using the 701981	When using the 701980
Maximum toggle frequency[1]	250 MHz	100 MHz
Number of inputs	32 (when using four logic probes)	Same as the 701981
Non-destructive input voltage range[2]	±40 V(DC + ACpeak) or 28 Vrms	Same as the 701981
Input range	±10 V	±40 V
Maximum sample rate	2.5 GS/s (interleave mode off) 5 GS/s (interleave mode on)	Same as the 701981
Threshold level	±10 V (resolution: 0.1 V)	±40 V (resolution: 0.1 V)
Threshold accuracy[1]	±(100 mV + 3% of setting)	Same as the 701981
Minimum input voltage[1]	500 mVp-p	Same as the 701981
Input impedance (typical value)[3]	Approx. 10 kΩ, approx. 9 pF	Approx. 1 MΩ, approx. 10 pF
Preset threshold value	CMOS (5 V) = 2.5 V, CMOS (3.3 V) = 1.6 V, CMOS (2.5 V) = 1.2 V, CMOS (1.8 V) = 0.9 V, ECL = –1.3 V	Same as 701981

1 Under standard operating conditions (see section 18.11) after a 30-minute warm-up.
2 For information about derating based on frequency for a particular logic probe, see the probe's user's manual.
3 Typical value represents a typical or average value. It is not strictly warranted.

Item	When using the 701989	When using the 701988
Maximum toggle frequency[1]	250 MHz	100 MHz
Number of inputs	32 (when using four logic probes)	Same as 701989
Non-destructive input voltage range[2]	±40 V(DC + ACpeak) or 28 Vrms	±42 V(DC + ACpeak) or 29 Vrms
Input range	± 6 V (from the threshold level)	±40 V
Maximum sample rate	2.5 GS/s (interleave mode off) 5 GS/s (interleave mode on)	Same as 701989
Threshold level	±6 V (resolution: 0.1 V)	±40 V (resolution: 0.1 V)
Threshold accuracy[1]	±(100 mV + 3% of setting)	Same as 701989
Minimum input voltage[1]	300 mVp-p	500 mVp-p
Input impedance (typical value)[3]	Approx. 100 kΩ, approx. 3 pF	Approx. 1 MΩ, approx. 10 pF
Preset threshold value	CMOS (5 V) = 2.5 V, CMOS (3.3 V) = 1.6 V, CMOS (2.5 V) = 1.2 V, CMOS (1.8 V) = 0.9 V, ECL = –1.3 V	Same as 701989

1 Under standard operating conditions (see section 18.11) after a 30-minute warm-up.
2 For information about derating based on frequency for a particular logic probe, see the probe's user's manual.
3 Typical value represents a typical or average value. It is not strictly warranted.

Connection Procedure

For instructions on how to connect a particular logic probe, see its user's manual.

Make sure to turn off the power to the DLM6000 before connecting or disconnecting a logic probe cable.

Note

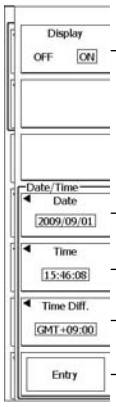
If the logic probe is not connected to the DLM6000, the logic probe input is at low level.

3.7 Setting the Date and Time

Procedure

UTILITY System Configuration Menu

Press **UTILITY**, the **System Configuration** soft key, and then the **Date/Time** soft key to display the following menu.



Turns the date and time display on and off

Set the date (set the year, month, and day using the jog shuttle).

Set the time (set the hour, minute, and second using the jog shuttle).

Set the time difference from GMT.

Applies the settings

Explanation

Date and Time

Date (Year/Month/Day)

Enter the year using four digits.

Time (Hour/Minute/Second)

Set the hour using a 24-hour clock.

Time Difference from GMT

Set the time difference from GMT according to the region where you are using the DL6000/DLM6000.*
Set the time difference properly so that the following functions work properly.

- Mail transmission using the SMTP function (see section 14.4)
- Monitoring of the DL6000/DLM6000 using the Web server function (see section 14.7)

* GMT information can be obtained from an SNTP server (see section 14.5).

Time Difference from GMT

Set the time difference from –12 hours 00 minutes to 13 hours 00 minutes.
For example, set Time Hour to 9 and Minute to 00 for Japan standard time.

Checking the Standard Time

You can check the standard time for your region in the following ways.

- Check the Date, Time, Language, Regional Options on your Windows PC.
- Check the following website. http://www.worldtimeserver.com/

Note

- The DL6000/DLM6000 does not support Daylight Savings time. Adjust the time difference from GMT to obtain the same effect.
- The date and time settings are backed up with the internal Lithium battery. The settings remain even if you turn the DL6000/DLM6000 off.
- The DL6000/DLM6000 manages leap years.

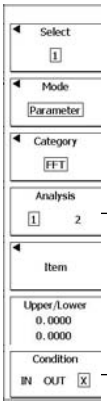
4.1 Key and Dialog Box Operations

Key Operations

How to Use Setup Menus That Appear When Keys Are Pressed

You can perform one of the following actions depending on the type of soft key menu that appears.

Select One of the Displayed Items

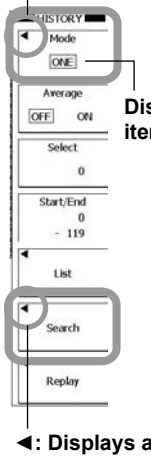


Switches between 1 and 2 each time you press the soft key

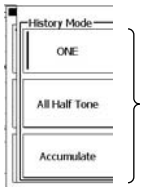
Switches between IN, OUT, and X each time you press the soft key

Select an Item from the Menu or Display a Related Menu

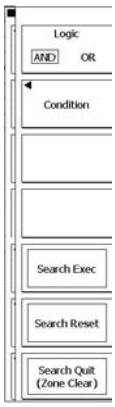
◀: Displays the selected menu



Displays the selected item

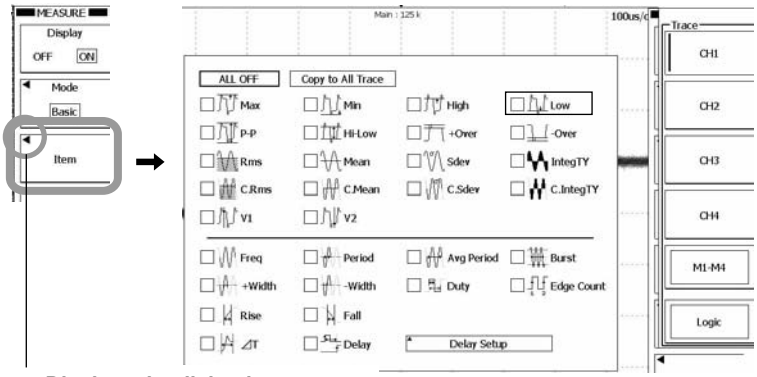


Select an option.
(A green line appears next to the selected option.)



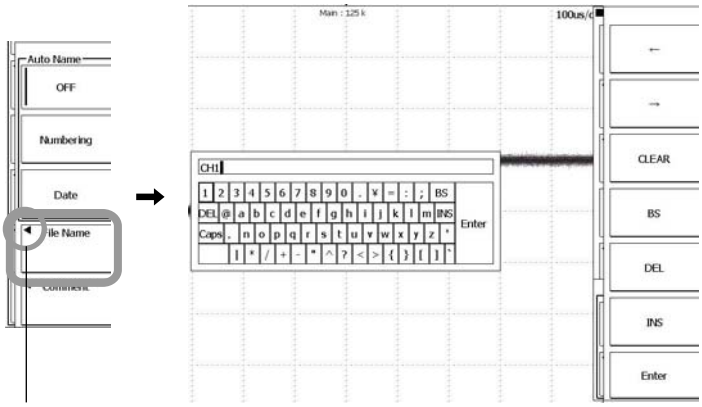
◀: Displays a related menu

Display a Dialog Box



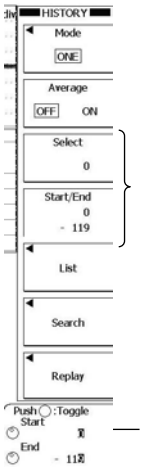
◀: Displays the dialog box

Display a Keyboard



◀: Displays a keyboard

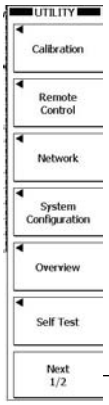
Switching the Setting That the Jog Shuttle Adjusts



Press the soft key of the item that you want to set using the jog shuttle.

Set values (using the jog shuttle).
When, as in this example, there are two items that you can set with the jog shuttle, press SET to switch between them. You can also switch between the items by pressing the Start/End soft key.

Switching Pages in Setup Menus



Displays the next page of the menu.
(Press Back 2/2 to display the previous page of the menu.)

Note

When there are multiple pages in a setup menu, the DL6000/DLM6000 remembers the page that was last selected until the power is turned off. This means that if you switch out of a setup menu by pressing another panel key and then open the setup menu again, the last page that you were viewing will appear.
The explanations in this manual are written under the assumption that the first page of a setup menu will appear when you press its corresponding panel key.
The menu that actually appears when you press a panel key may be different from the menu described in this manual.

Using the RESET (⊘) and SET (O) Keys

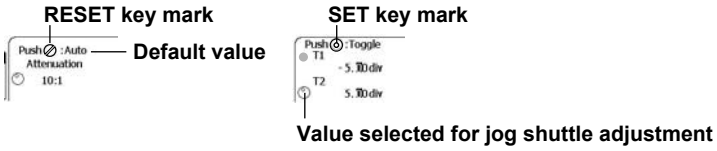
When you specify a value with the jog shuttle, a RESET key mark or a SET key mark will appear in the jog shuttle setup menu.

RESET Key Mark

If the RESET key mark is displayed, you can press RESET to reset the value to its default. (Depending on the condition of the DL6000/DLM6000, the value may not return to its default.) The default value is displayed next to the RESET key mark.

SET Key Mark

If there are two values to set, the SET key mark appears. Press SET to select which value you want to set using the jog shuttle. The jog shuttle mark of the selected value is larger.
Just as when the RESET key mark is displayed, you can press RESET to reset the value to its default.



How to Display the Setup Menus That Are Written in Purple below the Keys

In the explanations in this manual, “SHIFT+key name (written in purple)” is used to indicate the following operation.

1. Press **SHIFT**. The SHIFT key illuminates to indicate that the keys are shifted.
   Now you can select the setup menus written in purple below the keys.
2. Press the key for the setup menu that you want to display.

How to Clear Setup Menus and Setup Dialog Boxes

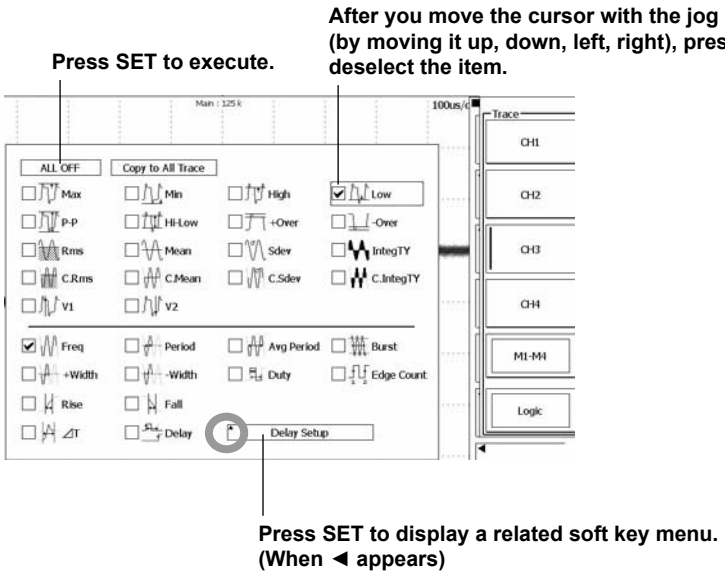
Press **ESC** to clear the active setup menu or setup dialog box.

How to Enter Values in Setup Dialog Boxes

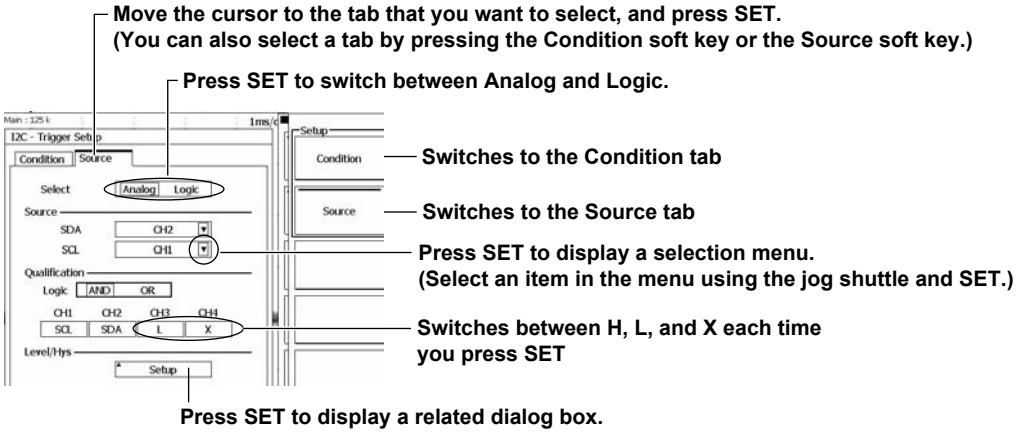
Use the jog shuttle or the SET key to move the cursor up, down, left, and right. Depending on the position of the cursor, pressing SET can have one of the following effects:

- Turns a check box on or off.
- Performs an action.
- Displays a related soft key menu.
- Changes a setting.
- Displays the selected menu. (After you select a menu with the jog shuttle, you can press SET to confirm the selection.)
- Displays a related dialog box.
- Displays a keyboard. (For information about how to operate the keyboard, see section 4.2.)

Dialog Box Operation Example 1



Dialog Box Operation Example 2



4.2 Entering Values and Strings

Entering Values

Using Dedicated Knobs

You can use the following dedicated knobs to set values directly.

- POSITION knobs (VERTICAL and HORIZONTAL)
- SCALE knob (VERTICAL)
- TIME/DIV knob
- LEVEL knob (TRIGGER)
- ZOOM knob

Using the Jog Shuttle

Select the appropriate item using the soft keys, and change the value using the jog shuttle and the SET key.

This manual sometimes describes this operation simply as “using the jog shuttle.”

Note

Items that can be set using the jog shuttle are reset to their default values when you press the RESET key.

Entering Character Strings

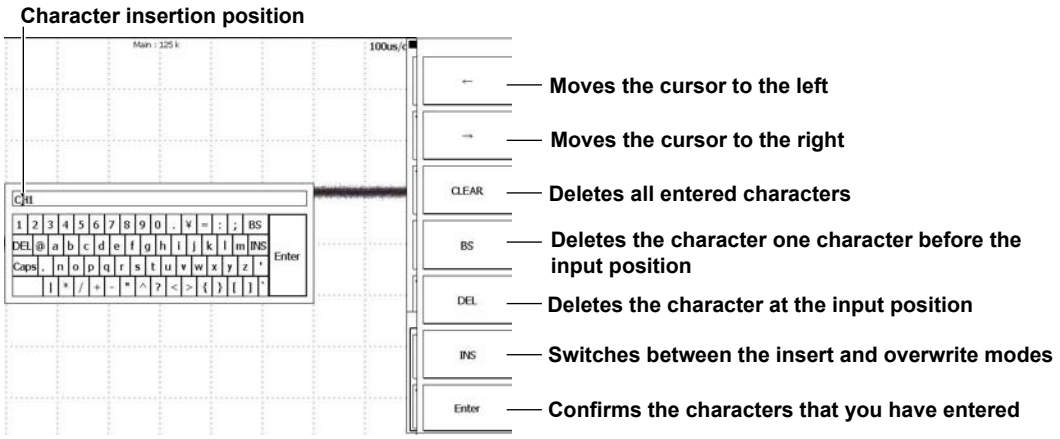
Use the keyboard that appears on the screen to enter character strings such as file names and comments. Use the jog shuttle and the SET key to navigate the keyboard and enter a character string.

How to Operate the Keyboard

1. Use the jog shuttle to move the cursor to the character that you want to enter. You can also move the cursor by moving the **SET** key up, down, left, and right.
2. Press **SET** to enter the character.

- If a character string has already been entered, use the arrow soft keys to move the cursor to the position you want to insert characters into.
- You can switch between the insert and overwrite modes by pressing the INS soft key.
- When the keyboard is set to insert mode, the cursor appears between characters.
- When the keyboard is set to overwrite mode, the cursor appears over the current character.

3. Repeat steps 1 and 2 to enter all the characters in the string.
4. To confirm the character string and clear the keyboard, press the **Enter** soft key, or move the cursor to **ENTER** on the keyboard and press **SET**.



Note

- @ cannot be entered consecutively.
- File names are not case-sensitive. Comments are case-sensitive. The following file names cannot be used due to MS-DOS limitations:
  AUX, CON, PRN, NUL, CLOCK, COM1 to COM9, and LPT1 to LPT9

4.3 Using USB Keyboards and Mouse Devices

Connecting a USB Keyboard

You can connect a USB keyboard and use it to enter file names, comments, and other items.

Usable Keyboards

You can use the following keyboards conforming to USB Human Interface Devices (HID) Class Ver. 1.1.

- When the USB keyboard language is English: 104 keyboard
- When the USB keyboard language is Japanese: 109 keyboard

Changing the Keyboard Language

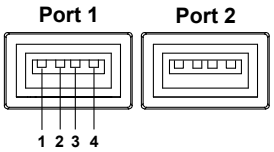
Follow the instructions in section 18.3 to set the USB keyboard language.

Note

- Do not connect incompatible keyboards.
- The operation of USB keyboards that have USB hubs or mouse connectors is not guaranteed.
- For USB keyboards that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

USB Ports for Peripherals

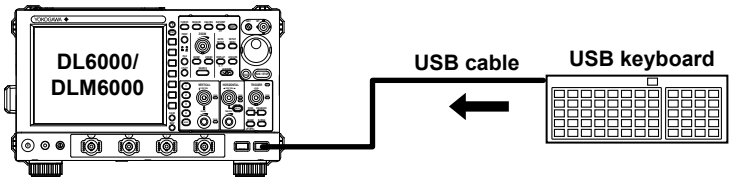
Connect a USB keyboard to one of the USB ports for peripherals on the front panel. There are two ports.



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

Connection Procedure

Connect a USB keyboard directly to the DL6000/DLM6000 using a USB cable as shown in the figure below. You can connect or remove the USB cable regardless of whether or not the DL6000/DLM6000 power switch is turned on (hot-plugging is supported). Connect the type A connector of the USB cable to the DL6000/DLM6000, and connect the type B connector to the keyboard. When the power switch is on, the keyboard is detected and enabled approximately 6 seconds after it is connected.



Note

- Only connect a compatible USB keyboard, mouse, printer, or storage device to a USB port for peripherals.
- Do not connect multiple keyboards. You can connect one keyboard, one mouse, and one printer to the DL6000/DLM6000.
- Do not connect and disconnect multiple USB devices repetitively. Wait for at least 10 seconds after you connect or remove one USB device before you connect or remove another USB device.
- Do not remove USB cables during the time from when the DL6000/DLM6000 is turned on until key operation becomes available (approximately 20 to 30 seconds).

Entering File Names, Comments, and Other Items

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

Using a USB Mouse

You can connect a USB mouse and use it to perform the same operations that you can perform with the DL6000/DLM6000 keys. Also, by clicking a menu item, you can perform the same operation that you can perform by pressing the menu item's soft key or selecting the menu item and pressing the SET key.

USB Ports for Peripherals

Connect a USB mouse to one of the USB ports for peripherals on the front panel of the DL6000/DLM6000. For details about the USB ports for peripherals, see page 4.7.

Usable USB Mouse Devices

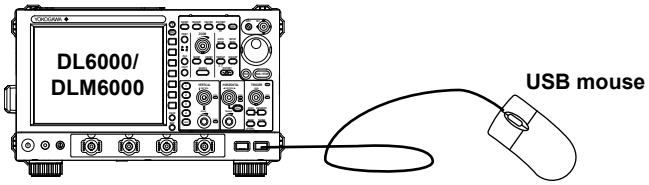
You can use mouse devices that are compliant with USB HID Class Version 1.1.

Note

For USB mouse devices that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

Connection Procedure

To connect a USB mouse to the DL6000/DLM6000, use one of the USB ports for peripherals. You can connect or disconnect the USB mouse at any time regardless of whether the DL6000/DLM6000 is on or off (hot-plugging is supported). When the power switch is on, the mouse is detected approximately 6 seconds after it is connected, and the mouse pointer (↖) appears.



Note

- Only connect a compatible USB keyboard, mouse, printer, or storage device to a USB port for peripherals.
- Even though there are two USB ports for peripherals, do not connect two mouse devices to the DL6000/DLM6000.

Operating the DL6000/DLM6000 Using a USB Mouse

Setup Menu Operations (Same as soft key operations)

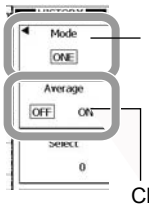
Selecting a Setup Menu Item

Click the setup menu item that you want to select.

If a selection menu appears after you select an item, click the selection menu item that you want to choose.

If an item such as ON or OFF appears, click the item to change its setting.

To select a menu item that is normally selected using the jog shuttle and the SET key, click it. Click the item again to confirm your selection and close the dialog box.



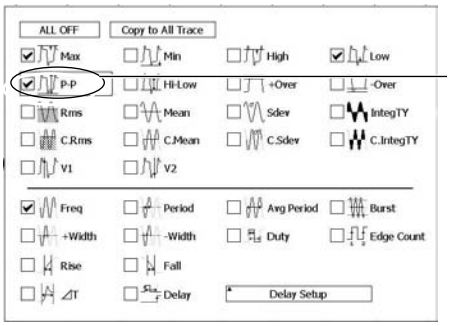
Click in this area to display a selection menu.
Clicking the selection menu item that you want to select will confirm your selection.

Click in this area to change the selected item.

Selecting Check Boxes

To select a check box, click it. To clear a check box, click it again.

You can close a dialog box by clicking the area outside of it.



Click the item that you want to select.

Note

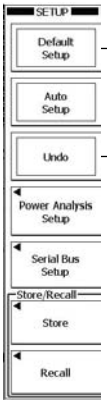
To close an error dialog box, click the area outside of it.

4.4 Returning to the Default Settings

Procedure

Default Setup Item in the SETUP Menu

Press **SETUP MENU** to display the following menu.



Returns to the default setup

Undoes a return to the default setup

Explanation

You can return the DL6000/DLM6000 settings to their factory default values. This feature is useful when you want to cancel all of the settings that you have entered or when you want to redo measurement from scratch. Select the Default Setup menu item to return the DL6000/DLM6000 settings to their factory default values.

Settings That Cannot Be Returned to Their Default Values

The following settings cannot be returned to their factory default values.

- Date and time settings
- Communication settings
- The language setting (English or Japanese)

Undoing a Return to the Default Setup (Undo)

If you return to the default setup by mistake, you can restore the previous settings by pressing the Undo soft key.

To Reset All Settings to Their Default Values

While holding down RESET, turn the power switch on. All settings will be reset to their factory default values except for the date and time settings (the display on/off setting will be reset) and the setup data stored in internal memory.

4.5 Performing Auto Setup

Procedure

You can perform auto setup by pressing AUTO SETUP on the front panel or by pressing SETUP MENU and then pressing the Auto Setup soft key.

Auto Setup (AUTO SETUP)

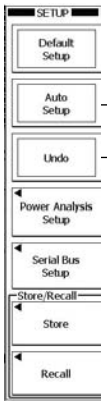
Press **AUTO SETUP**. The Undo soft key appears, and auto setup begins.

Undoing Auto Setup (Undo)

Press the **Undo** soft key to revert to the settings that were in effect before executing auto setup.

Auto Setup Item in the SETUP Menu

Press **SETUP MENU** to display the following menu.

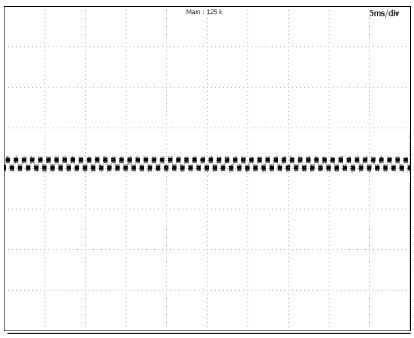


Executes auto setup

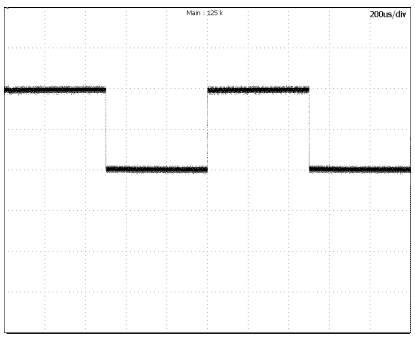
Undoes auto setup

Explanation

The auto setup feature automatically sets the V/div, TIME/DIV, trigger level, and other settings to the most suitable values for the input signals.



Before auto setup



After auto setup

Center Position after the Execution of Auto Setup

The center position after you execute auto setup will be 0.00 div.

Affected Channels

Auto setup is performed on all channels.

Waveforms Displayed before the Execution of Auto Setup

When you perform auto setup, the data in the acquisition memory is overwritten, and the waveforms that were displayed before you executed auto setup are cleared.

Undoing Auto Setup

After you execute auto setup, you can press the Undo soft key to return to the previous settings. The Undo soft key that appears when you press AUTO SETUP will disappear when you change setup menus or press ESC, but you can still undo the auto setup by pressing SETUP MENU and then the Undo soft key.

Signals That Auto Setup Can Be Applied To

Frequency	Approx. 50 Hz or higher
Absolute input voltage	Max. value of approx. 20 mV or greater (when the probe attenuation is set to 1:1)
Type	Simple, repeating signals

Note

The auto setup feature may not work properly for some signals, such as those that include a DC component or high-frequency components.

Settings after the Execution of Auto Setup

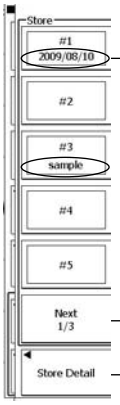
CH1 to CH4 settings	
Position	0div
Coupling	Settings other than DC50Ω are set to DC1MΩ. Settings of DC50Ω do not change.
BW	FULL
Offset	0V
Invert	OFF
Acquisition settings	
Mode	Normal
High Resolution	OFF
Sampling and length settings	
Sampling Mode	Interpolation
Interleave	OFF
Length	125kpoints
Trigger settings	
Mode	Auto
HoldOff	20ns
Delay	OFF
Position	50%
Type	Edge
Polarity	Rise
Coupling	DC
Hysteresis	Small
HF Rej	OFF
Window	OFF
Accumulation settings	
Mode	OFF
Screen settings	
Mapping	Auto
Dot Connect	Sine
Intensity	8
Brightness	8
Zoom settings	
Zoom	OFF
Main	ON
Cursor settings	
Display	OFF
Waveform parameter settings	
Display	OFF
Mask settings	
Display	OFF
Analysis settings	
Display	OFF
Settings that depend on the input signal	
CH On/Off	On if the DL6000/DLM6000 detects a voltage of ±7 mV or higher and Off otherwise
V/div	The range that has the highest sensitivity and that does not exceed ±3.5 divisions
Trigger Level	Center
Trigger Source	The channel with the lowest frequency among the signals whose amplitude (Max – Min) is at least 1 division
TIME/DIV	The fastest time axis setting that allows at least two periods of the fastest signal among the signals whose amplitude is at least 1 division to be observed. The time axis setting must be at least 5 ms/division.
Display Format	One to four areas depending on the number of active channels

4.6 Storing and Recalling Setup Information

Procedure

SETUP Store Menu

Press **SETUP MENU** and then the **Store** soft key to display the following menu.



When data is stored to a number, a comment or the date the data was stored appears here.

Set the internal memory number that you want to store to (and execute the store operation).

Displays the next page of the menu (so that you can store to numbers greater than 5)

Configure the details of the stored information.

Configuring the Details of the Stored Information (Store Detail)

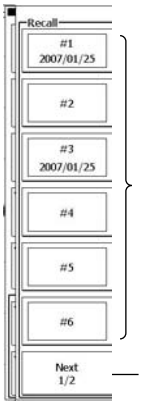
Press the **Store Detail** soft key to display the Store Detail dialog box.

Enter a comment.

Select this check box to prevent setup information from being overwritten. (You can select and unselect the box by pressing SET.)

SETUP Recall Menu

Press **SETUP MENU** and then the **Recall** soft key to display the following menu.



Set the setup information that you want to recall.

Displays the next page of the menu (so that you can recall numbers greater than 6)

Explanation

You can save up to 12 sets of setup information to internal memory. You can also load and apply the previously saved settings.

Stored Settings

The DL6000/DLM6000 stores the channel on/off settings and all the settings made using the soft key menus and the jog shuttle.

Storing Setup Information

You can store 12 sets of setup information, numbered 1 through 12, to internal memory.
If setup information has already been stored to the number that you specify, the previous information is overwritten. However, the information will not be overwritten if the number that you specify has been locked in the Store Detail menu.

Recalling Setup Information

You can recall one of the 12 sets of setup information, numbered 1 through 12, that are stored in internal memory.
You can only select a number if setup information has been stored to it.

Stored Information Details

The date when the setup information was stored to internal memory appears.
You can enter comments of up to 16 characters in length. The comments appear beneath the setup information numbers in the Store and Recall menus.
When a number's Lock check box is selected, the number's setup information cannot be overwritten.

Note

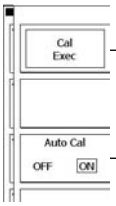
- Even if you initialize the settings, the stored setup information is not deleted.
- If you recall setup information while a waveform is being acquired, the waveform acquisition is restarted.

4.7 Calibrating the DL6000/DLM6000

Procedure

UTILITY Calibration Menu

Press **UTILITY** and then the **Calibration** soft key to display the following menu.



Executes calibration

Turns auto calibration on and off

Explanation

Calibration

The following items are calibrated. Execute calibration when you want to make accurate measurements.

- Vertical axis ground level and gain
- Trigger threshold level
- Measured time value for repetitive sampling

Note

Calibration is performed automatically when the power switch is turned on.

Notes about Calibration

- Allow the DL6000/DLM6000 to warm up for at least 30 minutes before you execute calibration. If you execute calibration immediately after power-on, the calibrated values may drift due to temperature changes or other environmental changes.
- Execute calibration in an environment with a stable temperature ranging from 5 to 40°C (23 ± 5°C recommended).
- Do not apply signals when calibrating. Calibration may not be executed properly if input signals are being applied to the DL6000/DLM6000.

Auto Calibration (Auto Cal)

Auto calibration is executed when you start waveform acquisition if you have changed TIME/DIV and any of the time periods listed below has elapsed since the power was turned on.

- 3 minutes
- 10 minutes
- 30 minutes
- One hour and every hour thereafter

If calibration is executed while signals are being applied to the DL6000/DLM6000, we recommend that you stop signal application and recalibrate the DL6000/DLM6000.

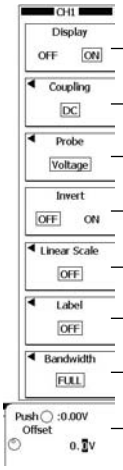
5.1 Vertical Axis Settings for Analog Input Signals

This section explains how to configure the vertical scale, vertical position, input coupling, probe attenuation, linear scaling, and bandwidth limit settings of the CH1 through CH4 input signals.

Procedure

CH Menu

Press a key from **CH1** to **CH4** to display the following menu.



Turns the waveform display on and off

Set the input coupling (AC, DC, GND, DC50).

Set the probe attenuation.

Turns inverted waveform display on and off

Set the linear scaling.

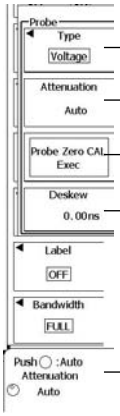
Configure label settings (turn the label on or off and set the label name).

Set the bandwidth limit (FULL, 200MHz, 20MHz, 8M-1MHz, 500k-8kHz).

Set the offset voltage.

Setting the Probe Attenuation (Probe)

Press the **Probe** soft key to display the following menu.



Set the probe type (voltage, current).

Set the attenuation (using the jog shuttle).

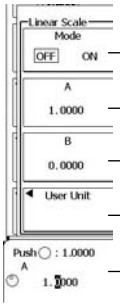
Executes automatic zero adjustment for the current probe.
(Zero adjustment can only be executed when a probe is connected.)

Set the deskew value (using the jog shuttle).

Set the attenuation and the deskew value.

Setting the Linear Scaling (Linear Scale)

Press the **Linear Scale** soft key to display the following menu.



Turns linear scaling on and off

Set scaling coefficient A (using the jog shuttle).

Set offset B (using the jog shuttle).

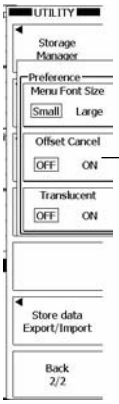
Set the unit.

Set scaling coefficient A and offset B.

UTILITY Preference Menu

Turning Offset Cancel On and Off

Press **UTILITY**, the **Next** soft key, and then the **Preference** soft key to display the following menu.



Turns Offset Cancel on and off

Setting the Vertical Scale (SCALE)

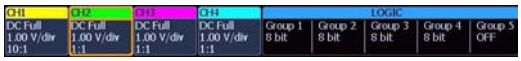
Press a key from **CH1** to **CH4** to select the channel whose vertical scale you want to set.

The LED between the SCALE and POSITION knobs illuminates in the representative color for the selected channel (yellow, green, magenta, or cyan).

Turn the **SCALE** knob to set the vertical scale.

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

Displays the vertical scale, input impedance, and probe attenuation for each channel



Setting the Vertical Position (POSITION)

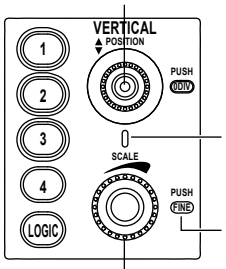
Press a key from **CH1** to **CH4** to select the channel whose vertical position you want to set.

The LED between the SCALE and POSITION knobs illuminates in the representative color for the selected channel (yellow, green, magenta, or cyan).

Turn the **POSITION** knob to set the vertical position.

You can set the vertical position to 0 div by pressing the knob.

POSITION knob



Illuminates in the representative color for the selected channel

When the FINE indicator is illuminated, you can set the vertical position at a higher resolution. (Press the push knob to turn on the FINE indicator.)

SCALE knob

Explanation

Waveform Display (Display)

The keys of the displayed channels (CH1 to CH4) illuminate.

When you press a channel key that is not illuminated, the key illuminates, and the channel's waveform is displayed.

When you press a channel key that is illuminated, the key light turns off, and the channel's waveform display is cleared.

Note

When Interleave mode (described in section 7.1) is on, you cannot display the waveforms for CH2 and CH4.

Input Coupling (Coupling)

You can choose one of the following methods for coupling the vertical control circuit to the input signal.

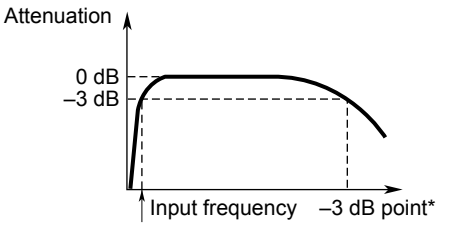
AC	Only the waveform produced from the input signal's AC component is displayed
DC	The waveform produced from both the DC and AC components of the input signal is displayed. (The input impedance is 1 MΩ.) You can only select this option when you are measuring voltage.
GND	Use this input coupling method to check the ground level.
DC50	The waveform produced from both the DC and AC components of the input signal is displayed. (The input signal impedance is set to 50 Ω.)

Input Coupling Settings and Frequency Response

The frequency responses for the AC and DC input coupling methods are shown below.

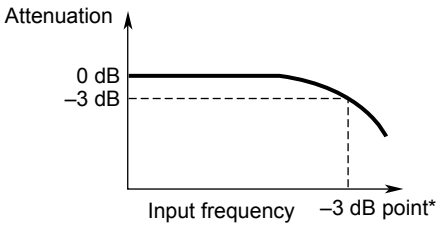
Please note that, as is indicated in the figure shown below, when the DL6000/DLM6000 is set to AC, it does not acquire low frequency signals or low frequency components.

When Coupling Is Set to AC



With a 1:1 probe and a frequency less than or equal to 10 kHz
With a 10:1 probe and a frequency less than or equal to 1 kHz

When Coupling Is Set to DC



* The high-frequency –3 dB point differs based on the model and the voltage scale settings.

CAUTION

- When the input impedance is 1 MΩ and the frequency is less than or equal to 1 kHz, the maximum input voltage is 150 Vrms. Applying a greater voltage may damage the input section. For frequencies above 1 kHz, damage may occur even if the voltage is less than 150 Vrms.
- When the input impedance is 50 Ω, the maximum input voltage is 5 Vrms or 10 Vpeak. Applying a voltage greater than either of these limits may damage the input section.

Note

If you are using a probe that is compatible with the DL6000/DLM6000 probe interface, the DL6000/DLM6000 automatically configures the input impedance (50 Ω or 1 MΩ) and the probe attenuation.

Probe Attenuation (Probe)

To use a probe, you must align the DL6000/DLM6000's attenuation setting with the probe attenuation so that voltage or current values and scale values are displayed correctly. Set an appropriate attenuation for the probe. If you set the attenuation to Auto and you are using a probe that is compatible with the DL6000/DLM6000 probe interface, the DL6000/DLM6000 automatically sets an appropriate attenuation for the probe.

Probe Type (Type)

Select the type of probe that you want to set the attenuation of from the following options.

- Voltage: Voltage probe
- Current: Current probe

Attenuation (Attenuation)

Set the attenuation to one of the settings below.

- **For voltage probes**
  Auto, 1:1, 2:1, 5:1, 10:1, 20:1, 50:1, 100:1, 200:1, 500:1, or 1000:1
- **For current probes**
  Auto, 1A:1V, 10A:1V, or 100A:1V

Note

The DL6000/DLM6000 can only display input signal voltage values and scale values correctly if you set the correct probe type. For example, if you use a 10:1 voltage probe but set the probe type to 1:1, the automatically measured amplitude of the waveform will be 1/10 the real value.

Automatic Zero Adjustment for Current Probes

You can perform automatic zero adjustment on a current probe when all of the following conditions are met.

- A current probe that is compatible with the DL6000/DLM6000 probe interface is connected to the input terminal.*

* The compatible probes are the PBC100 (701928) and PBC050 (701929), which are produced by Yokogawa.

- The input coupling is set to DC.

Note

- For instructions on how to handle your current probe, refer to its user's manual.
- An error may occur when automatic zero adjustment is executed if the current probe's residual offset is large. If this happens, adjust the current probe's residual offset to zero.

Inverted Waveform Display (Invert)

Invertible Waveforms

You can invert the displays of each of the individual waveforms of CH1 to CH4.
The waveforms are inverted with respect to the vertical position.

Notes about Inverted Waveform Display

- Even when inverted waveforms are displayed, cursor measurements, automated measurements of waveform parameters, and computations are performed on uninverted waveforms.
- Even when inverted waveforms are displayed, triggering is based on the uninverted waveforms.

Linear Scaling (Linear Scale)

Using specified scaling coefficient A and offset B, the DL6000/DLM6000 performs the following computation to scale the cursor measurement values and the automated measurements of waveform parameters. You can assign units to the scaled values.

Y = AX + B (where X is the measured value and Y is the result of linear scaling)

Scaling Coefficient A and Offset B

Settable range for A and B	–10.000E+30 to +10.000E+30
Default settings	A: 1.0000E+00 B: 0.0000E+00

Turning Linear Scaling On and Off (Mode)

Select whether or not to use linear scaling.

ON: Linear scaling is used.

OFF: Linear scaling is not used.

Unit (User Unit)

You can specify a unit using up to four alphanumeric characters.

Labels (Label)

Turning Labels On and Off (Display)

Select whether or not to display labels.

Label (Name)

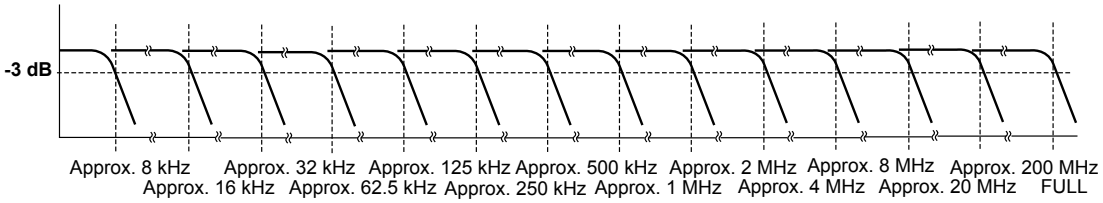
When you turn the label display on, you can set the labels using up to eight characters.

Bandwidth (Bandwidth)

You can set bandwidth limitations for analog signals by specifying cutoff frequencies for each channel. You can view signals with the frequency components above a specified frequency removed.

Set the cutoff frequency to one of the settings below.

FULL (no bandwidth limit), 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, or 8 kHz



Note

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

Offset Voltage (Offset)

The offset voltage setting applies to all input coupling settings (AC, DC, DC50, and GND).

Settable Offset Voltage Range

Voltage Scale (With probe = 1:1)	Settable Offset Voltage Range
2 to 50 mV/division	–1.0 to 1.0 V
0.1 to 0.5 V/division	–10.0 to 10.0 V (–5.0 to 5.0 V when the input coupling is set to DC50)
1 to 5 V/division	–100.0 to 100.0 V

You can set the offset in 0.01-division steps. For 2 mV/division, you can set the offset in 0.02-mV steps.

Resetting the Offset

Press RESET to set the offset value to 0 V.

Note

- If you change the probe attenuation, the offset voltage is determined using the new attenuation ratio.
- The offset voltage does not change even if you change the voltage scale. However, if the offset voltage goes outside of the settable range indicated above, it is set to the maximum or minimum value in the voltage scale range. If you set the voltage scale back to its original value without changing the offset voltage, the offset voltage returns to its original value.

Offset Cancelling

You can turn offset cancelling on and off. The offset cancel setting affects all channels. The default setting is OFF.

OFF: The offset value does not affect the results of computation or automated measurement. Waveforms appear without having offset voltages (DC voltages) subtracted from them. The vertical position on the screen corresponds to the offset voltage.

ON: The offset value affects the results of computation and automated measurement. Using the offset values set for each channel, the DL6000/DLM6000 displays waveforms with offset voltages (DC voltages) subtracted from them. The vertical position corresponds to 0 V.

Note

You can access the offset cancel setting from the UTILITY menu.

Vertical Scale (SCALE)

The vertical scale is used to adjust the displayed waveform amplitude so that you can view signals easily. Set the vertical scale by voltage per grid square (V/div) or current per grid square (A/div) on the screen.

Use the SCALE knob to set the vertical scale for each channel.

The same SCALE knob is used to adjust the scale of each channel. Press a key from CH1 to CH4 to select the channel whose vertical scale you want to set. The LED between the SCALE and POSITION knobs illuminates in the representative color for the selected channel (yellow, green, magenta, or cyan).

Note

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

Preview

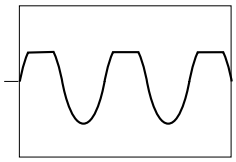
- If you change the vertical scale when waveform acquisition is stopped, the waveform is displayed expanded or reduced vertically.
- If you change the vertical position when waveform acquisition is stopped, only the waveform display position changes.

Vertical Position (POSITION)

You can move each waveform's vertical display position within ±4 divisions.
When you change the vertical scale, the location of the vertical position mark does not change.
Use the POSITION knob to set the vertical position for each channel.
The POSITION knob is used to adjust the position of each channel. Press a key from CH1 to CH4 to select the channel whose vertical position you want to set. The LED between the SCALE and POSITION knobs illuminates in the representative color for the selected channel (yellow, green, magenta, or cyan).

Note

- If you change the vertical position when waveform acquisition is stopped, only the display position of the waveform preview changes.
- If you change the vertical position after stopping waveform acquisition, the data that exceeds the measurement range is handled as overflow data. As shown in the figure below, waveforms may appear cut off when there is overflow data.



5.2 Vertical Axis Settings for Logic Input Signals

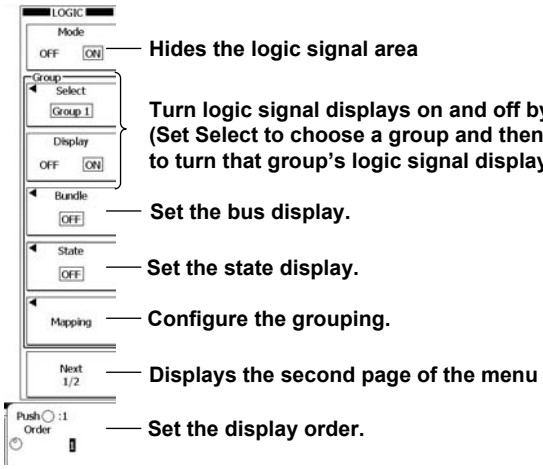
This section explains how to turn the bus display on and off and how to set the vertical display range, position, grouping, threshold, and other settings of a logic input signal (LOGIC).
You can apply logic signals to the logic signal input ports (POD A, POD B, POD C, and POD D) on the DLM6000 rear panel.*

* On 16-bit models, the logic signal input ports are POD A and POD C.

Procedure

LOGIC Menu

Press **LOGIC** to display the first page of the following two-page menu.



Hides the logic signal area

Turn logic signal displays on and off by group. (Set Select to choose a group and then set Display to turn that group's logic signal display on or off.)

Set the bus display.

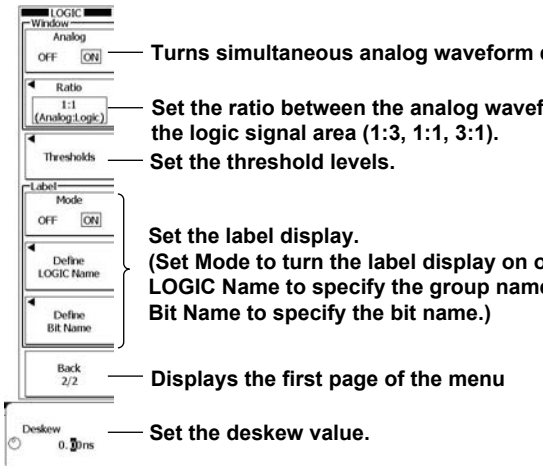
Set the state display.

Configure the grouping.

Displays the second page of the menu

Set the display order.

Press the **Next** soft key to display the second page of the menu.



Turns simultaneous analog waveform display on and off

Set the ratio between the analog waveform area and the logic signal area (1:3, 1:1, 3:1).

Set the threshold levels.

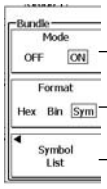
Set the label display. (Set Mode to turn the label display on or off. Set Define LOGIC Name to specify the group name. Set Define Bit Name to specify the bit name.)

Displays the first page of the menu

Set the deskew value.

Configuring the Bus Display (Bundle)

Press the **Bundle** soft key to display the following menu.



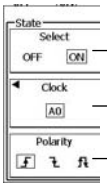
Turns the bus display on and off. (Select ON for bus display or OFF for bit display.)

Set the format (Hex, Bin, Sym).

Configure symbols (only when Format is set to Sym).

Configuring the State Display (State)

Press the **State** soft key to display the following menu.



Turns state display on and off

Set the clock bit (A0–A7, B0–B7, C0–C7, D0–D7).*

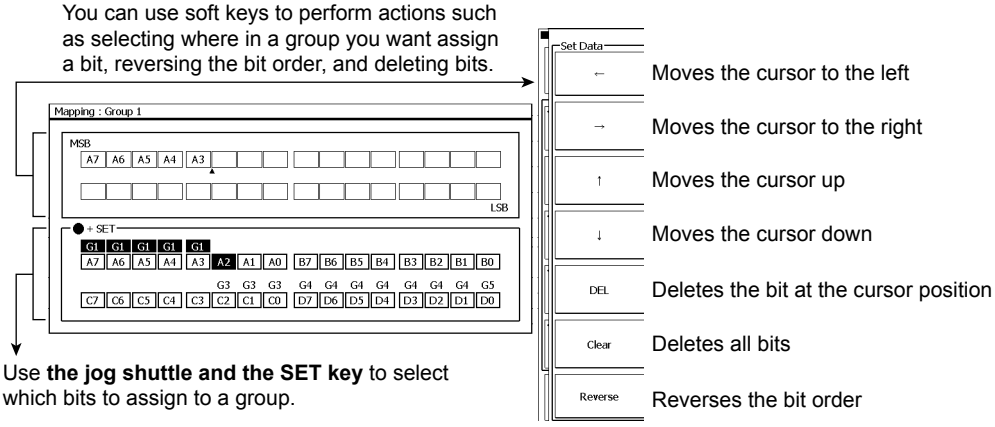
Set the clock signal polarity (, ,).

*** On 16-bit models, you can select from bits A0 to A7 or C0 to C7.**

Configuring Grouping (Mapping)

Press the **Mapping** soft key to display the following menu.

You can use soft keys to perform actions such as selecting where in a group you want assign a bit, reversing the bit order, and deleting bits.



Moves the cursor to the left

Moves the cursor to the right

Moves the cursor up

Moves the cursor down

Deletes the bit at the cursor position

Deletes all bits

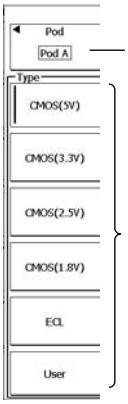
Reverses the bit order

Use **the jog shuttle and the SET key** to select which bits to assign to a group.

You can choose bits from A0 to A7, B0 to B7, C0 to C7 and D0 to D7.
(On 16-bit models, you can choose bits from A0 to A7 and C0 to C7.)

Setting the Threshold Levels (Thresholds)

Press the **Thresholds** soft key to display the following menu.



Select the port whose threshold you want to set (Pod A–Pod D).

Set the threshold level.

Setting the Vertical Display Range (SCALE)

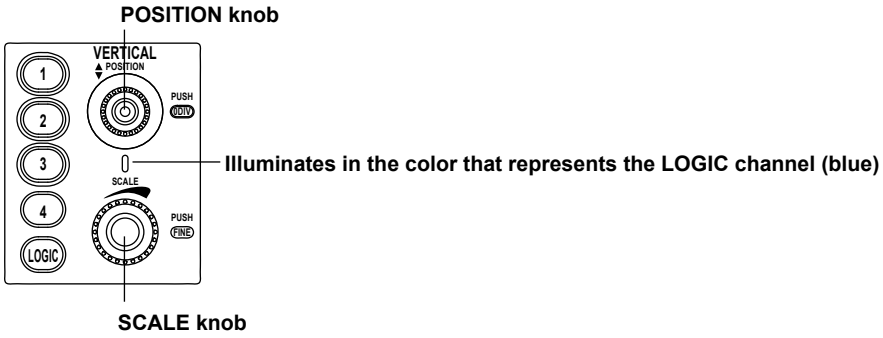
Press **LOGIC** to make the SCALE knob control the LOGIC setting.

Turn the **SCALE** knob to set the vertical display range.

Setting the Vertical Position (POSITION)

Press **LOGIC** to make the POSITION knob control the LOGIC setting.

Turn the **POSITION** knob to set the vertical position.



Explanation

Hiding the Logic Signal Area (Mode)

When you press the LOGIC key, it illuminates, the screen is divided in two, and a logic signal area appears below the normal analog signal area.

When you set Mode to OFF, the logic signal area is hidden. The logic signal area is also hidden if you press LOGIC when the LOGIC key menu is displayed.

Turning Logic Signal Displays On and Off by Group (Select, Display)

You can turn the display of logic signals on and off by group. To assign logic signals to groups, press the Mapping soft key.

Note

- Groups that do not have logic signals (bits) assigned to them will not appear.
- Logic signals (bits) that have not been assigned to groups will not appear.

Display Order (Order)

You can specify the order in which the five groups in the logic signal area are displayed.

Bus Display (Bundle)

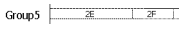
You can show the logic signals of each group using the bus display. In the bus display, you can display signals in hexadecimal or binary format or by using symbols. For information about how bits are handled when you select the hexadecimal format, see “Grouping Settings.”

* Symbols are a way of expressing bit sequences that include “don’t cares” (Xs). You can load physical value/symbol definition files (with .sbl extensions) that you have edited using the Symbol Editor tool.

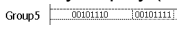
When the Bus Display is Off

When the Bus Display is On

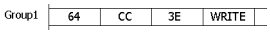
- Hexadecimal display (Hex)



- Binary display (Bin)



- Symbol display (Sym)



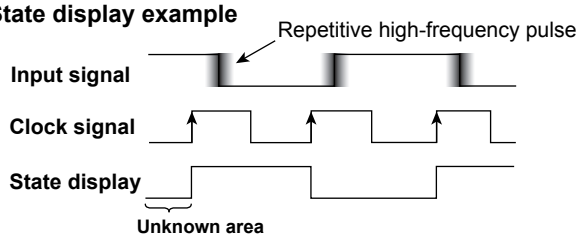
State Display (State)

With this feature, you can use the edges of a specified clock signal to trigger the acquisition of the state of the input logic signal. Even if the logic signal changes, the state will not change until the next clock edge.

- Clock signal
  You can select the clock signal from bits A0 to A7, B0 to B7, and D0 to D7. (On 16-bit models, you can select from bits A0 to A7 and C0 to C7.)
- Polarity
  Select the clock edges upon which you want to detect and display the logic signal state.

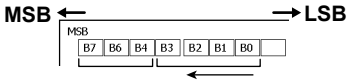
↑	Rising edges
↓	Falling edges
↕	Rising and falling edges

State display example



Grouping (Mapping)

- You can assign logic signals from bits A0 to A7, B0 to B7, and D0 to D7 (bits A0 to A7 and C0 to C7 on 16-bit models) to Group 1 to Group 5.
- Out of the assigned logic signals, the logic signal that is closest to the LSB side of the Mapping dialog box is the LSB. The assigned logic signals are arranged between the LSB and the MSB in order from the lowest digit. When the bits are counted or displayed in hexadecimal format, they are divided into groups of four starting from the LSB.



When the bits are counted or displayed in hexadecimal format, they are divided into groups of four starting from the LSB. The digit containing the MSB may not contain four bits.

Note

- You cannot assign the same bit to the same group multiple times.
- You cannot assign the same bit to multiple groups. If you assign a bit to the group that you are editing and that bit has already been assigned to another group, the bit will be removed from its previous group.

Example for When B5 Is Deleted

All of the bits that are closer to the LSB than the deleted bit move one space closer to the MSB.

Simultaneous Analog Waveform Display (Analog)

The analog waveform area and the logic signal area are displayed together by default. If you only want to observe logic signals, you can hide the analog waveform area and display the logic signal area over the entire screen.

Analog Waveform and Logic Signal Display Ratio (Ratio)

You can set the ratio of the analog waveform area to the logic signal area to 1:3, 1:1 (this is the default setting), or 3:1.

Threshold Levels (Thresholds)

You can set threshold levels for each of the logic signal input ports (Pod A to Pod D). You can set a port's threshold level to one of the settings listed below. You can use the threshold levels to detect the high and low states (polarities) of the logic signals.

Setting	Threshold level
CMOS(5V)	2.5 V
CMOS(3.3V)	1.6 V
CMOS(2.5V)	1.2 V
CMOS(1.8V)	0.9 V
ECL	–1.3 V
User	User-specified Settable range: ±40 V when using logic probe 701988 or ±6 V when using logic probe 701989 Resolution: 0.05 V

Note

Even when you use logic probe 701989, the threshold level is the same for all eight bits.

Labels (Label)

You can specify and display names (labels) of up to eight characters in length for Group1 to Group5.

ON: Labels are displayed.

OFF: Labels are not displayed.

Deskewing (Deskew)

The deskew feature enables you to view the signals after correcting the time offset (skew) between the logic signals and the other signals. The deskew feature affects all of the logic signals. You cannot deskew by group or bit.

Selectable range	–80.00 to 80.00 ns (The default value is 0.00 ns.)
Resolution	0.01 ns

Display Size (SCALE)

You can set the logic signal's display size to one of five levels.

Press LOGIC so that the key illuminates, and then use the SCALE knob to set the size.

Vertical Position (POSITION)

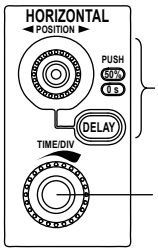
The vertical position can be moved until only the highest or lowest of the displayed logic signals is displayed.

Press LOGIC so that the key illuminates, and then use the POSITION knob to set the vertical position.

5.3 Horizontal (Time) Axis Settings

Procedure

Turn the **TIME/DIV** knob to set Time/div.



For details, see section 6.2.

TIME/DIV knob

Explanation

Set the amount of time that corresponds to one grid square (division) on the screen.

Settable Range for Time/div

500 ps/div to 50 s/div

Time/div and Roll Mode

If you set Time/div to a value from 100 ms/div to 50 s/div under the conditions listed below, the display switches to roll mode.

- The acquisition mode is not set to Average.
- The trigger mode is set to Auto, Auto Level, or Single (using the SINGLE key).

Note

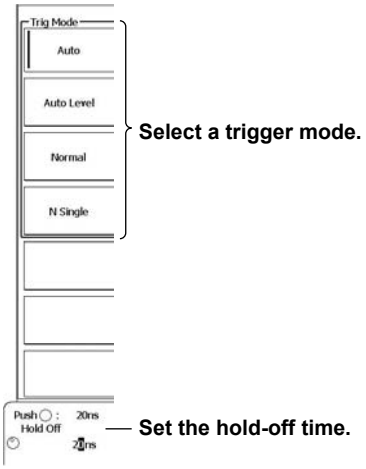
If you change the time scale when waveform acquisition is stopped, the waveform preview is displayed expanded or reduced along the horizontal (time) axis.

6.1 Setting the Trigger Mode and Hold-off Time

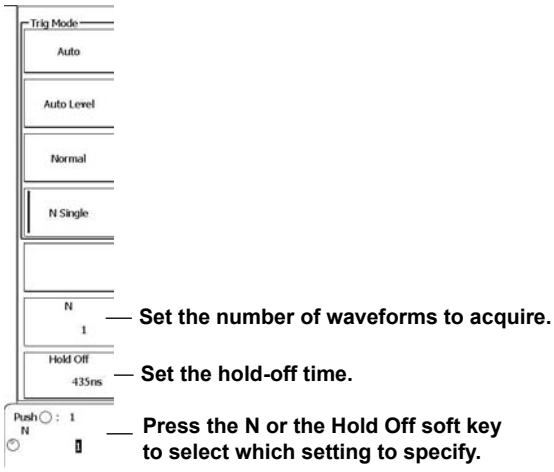
Procedure

MODE Menu

Press **MODE** to display the following menu.



When the trigger mode is N Single



Explanation

Trigger Mode (Mode)

Auto: If the trigger conditions are met within approximately 100 ms, the DL6000/DLM6000 updates the displayed waveforms on each trigger occurrence. If not, the DL6000/DLM6000 automatically updates the displayed waveforms. If the time axis is set to a value that causes the display to switch to roll mode (see page 2-6), roll mode display will be enabled.

Auto Level: If a trigger occurs before a timeout, the DL6000/DLM6000 updates the waveform in the same way as Auto mode. If a trigger does not occur, the DL6000/DLM6000 automatically changes the trigger level to the center value of the trigger source amplitude, triggers on that value, and updates the displayed waveform. Auto Level mode is valid when the trigger source is set to a channel from CH1 to CH4. For all other cases, Auto Level mode operates in the same way as Auto mode.
If the time axis is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled.

Normal: The DL6000/DLM6000 only updates the waveform display when the trigger conditions are met. If no triggers occur, the display is not updated. If you want to view waveforms that the DL6000/DLM6000 cannot trigger on, or if you want to check the ground level, use Auto mode.

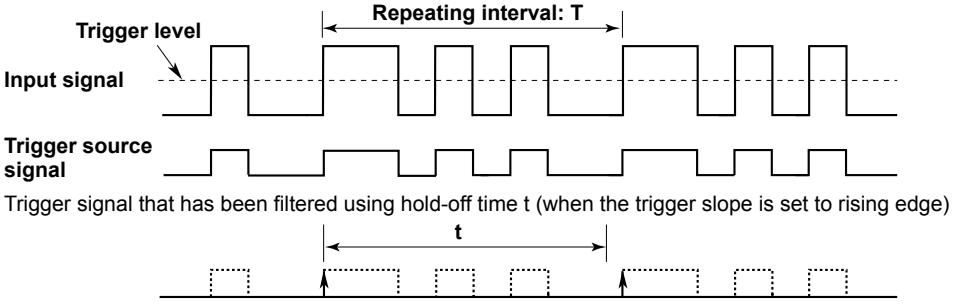
N Single: The DL6000/DLM6000 acquires signals each time the trigger conditions are met until a specified number of signals have been acquired, and then displays the waveforms of all of the acquired signals.

Note

- Single Mode
  There is also a Single trigger mode in which the DL6000/DLM6000 updates the displayed waveform once and stops waveform acquisition when the trigger conditions are met. Press SINGLE on the front panel to execute Single Mode waveform acquisition.
- The trigger mode setting applies to all trigger types.
- The trigger conditions that were used to acquire the displayed waveform appear at the upper right of the screen.

Hold-off Time

This setting is used to prevent the DL6000/DLM6000 from triggering the specified time after a trigger occurrence. This is useful when you want the DL6000/DLM6000 to trigger in sync with a repeating signal.



Hold-Off Time Range

You can set the hold-off time to a value in the range of 20 ns to 10.0000 s in 5 ns steps (the default value is 20 ns).

Note

- In repetitive sampling mode, waveform updating may slow down. If this happens, reduce the hold-off time setting.
- To set the hold-off time to 100 ms or longer, set the trigger mode to Normal.
- You cannot set the hold-off time when UART signal triggering is enabled.

6.2 Setting the Trigger Position and Trigger Delay

Procedure

Setting the Trigger Position (POSITION)

Turn the **POSITION** knob to set the trigger position.
If you press the **POSITION** knob, the position returns to 50%.
The specified trigger position is shown at the top of the display during operation.
The display disappears approximately 3 seconds after the last operation.
You can set the trigger position even when waveforms are not being acquired.

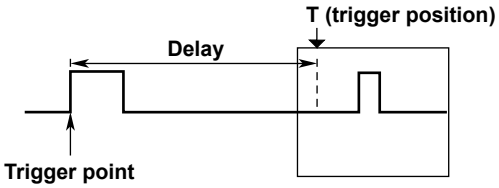
Setting the Trigger Delay (DELAY)

Press **DELAY**. After the DELAY key lights, turn the **POSITION** knob to set the trigger delay. If you press the **POSITION** knob, the position returns to 0 s.
You can press **DELAY** again to turn off the **DELAY** key and enable the setting of the trigger position.
The specified trigger delay is shown at the top of the display during operation.
The display disappears approximately 3 seconds after the last operation.
You can set the trigger delay even when waveforms are not being acquired.

Explanation

Trigger Position (POSITION)

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



Trigger Position Range

You can set the trigger position to 0 to 100% of the display record length (in 1% steps).

Trigger Position Indication

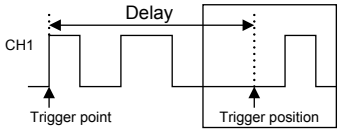
The ▼ mark at the top of the screen indicates the trigger position.

Note

- If you change the trigger position when waveform acquisition is stopped, the DL6000/DLM6000 re-displays the waveform using the new position.
- The time values of cursor measurements are based on the trigger position, so if you change the trigger position, the measured values will change (except during roll mode display).
- If you change the Time/div setting, the time axis setting changes without the location of the trigger position changing.

Trigger Delay (DELAY)

The DL6000/DLM6000 normally displays waveforms before and after the trigger point, but you can set a trigger delay to display waveforms that the DL6000/DLM6000 has acquired a specified amount of time after the trigger occurrence.
You can set the trigger delay to a value within the range of –(time length of the post-trigger section) to 10 s in 1/100 Time/div steps.
The time length of the post-trigger section is the amount of time from the trigger position to the right edge of the main window.



Note

The delay value is retained even if you change the Time/div setting.

6.3 Triggering on an Edge Trigger

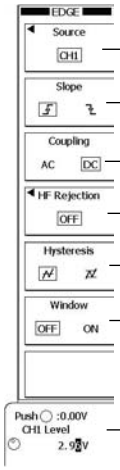
Procedure

EDGE Menu

Press **EDGE** to open one of the menus shown below. The menu that opens varies depending on the specified trigger source.

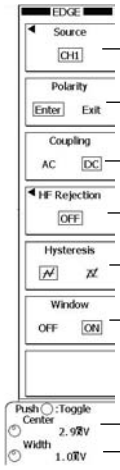
When the Trigger Source Is a Channel from CH1 to CH4

When the Window Comparator Is Off



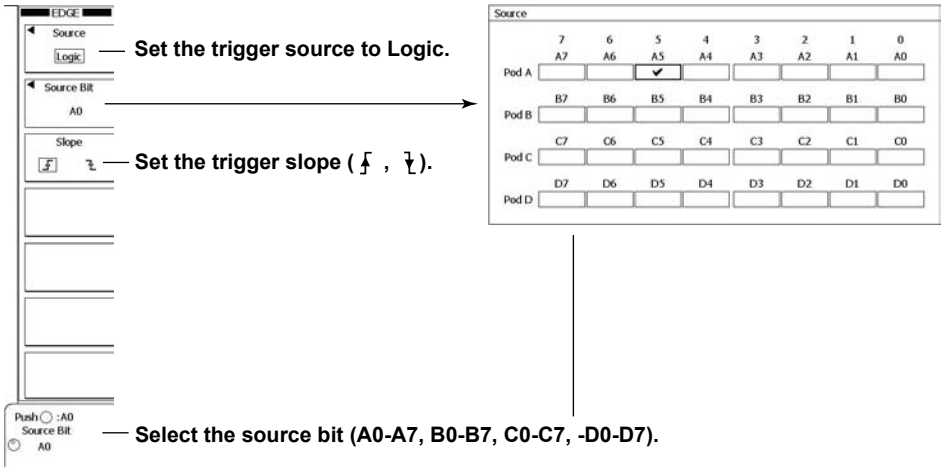
Set the trigger source (CH1-CH4).
Set the trigger slope (,).
Set the trigger coupling (AC, DC).
Set the HF rejection (OFF, 20 MHz, 15 kHz).
Set the hysteresis (,).
Turn the window comparator off.
Set the trigger level (with the LEVEL knob).

When the Window Comparator Is On



Set the trigger source (CH1-CH4).
Set the trigger slope (Enter, Exit).
Set the trigger coupling (AC, DC).
Set the HF rejection (OFF, 20 MHz, 15 kHz).
Set the hysteresis (,).
Turn the window comparator on.
Set the window center point (using the jog shuttle or the LEVEL knob).
Set the window width (using the jog shuttle).

When the Trigger Source is LOGIC (DLM6000)

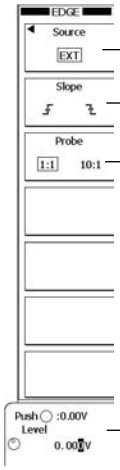


Set the trigger source to Logic.

Set the trigger slope (,).

Select the source bit (A0-A7, B0-B7, C0-C7, -D0-D7).

When the Trigger Source Is EXT



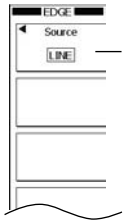
Set the trigger source to EXT.

Set the trigger slope (,).

Set the probe attenuation (1:1, 10:1).

Set the trigger level.

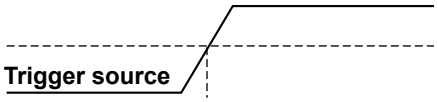
When the Trigger Source Is LINE



Set the trigger source to Line.

Explanation

The DL6000/DLM6000 triggers on trigger source edges (rising or falling edges). An edge refers to a point where the trigger source passes through the trigger level.



The DL6000/DLM6000 triggers here when the trigger edge is set to rising ( ).

Trigger Source (Source)

Trigger source refers to the signal that is used to check the specified trigger conditions. You can set the trigger source to one of the settings below.

A Channel from CH1 to CH4

The signal that is received through one of the front panel input terminals (terminals 1 through 4).

Logic (A0 to D7)

The signal that is received through the rear-panel LOGIC signal input port.
You can set the source signal to a bit from A0 to A7, B0 to B7, C0 to C7, or D0 to D7. (On 16-bit models, you can select from bits A0 to A7 and C0 to C7.)

External Signal (EXT)

The signal that is received through the rear-panel TRIG IN input terminal.

The DL6000/DLM6000 Power Source (LINE)

The commercial power that the DL6000/DLM6000 is connected to.
The DL6000/DLM6000 only triggers on the rising edge.

Trigger Slope (Slope/Polarity)

When the Trigger Source Is EXT or a Channel from CH1 to CH4

You can select how the DL6000/DLM6000 will trigger on the trigger source signal.

	The DL6000/DLM6000 triggers when the trigger source changes from a level below the trigger level to a level above the trigger level (rising).
	The DL6000/DLM6000 triggers when the trigger source changes from a level above the trigger level to a level below the trigger level (falling).
Enter	The DL6000/DLM6000 triggers when the trigger source level enters the specified voltage range (when the window comparator is on).
Exit	The DL6000/DLM6000 triggers when the trigger source level exits from the specified voltage range (when the window comparator is on).

When the Trigger Source Is the Logic Signal

You can select which signal polarity the DLM6000 will trigger on. The DLM6000 detects the trigger source polarity using the thresholds (see section 5.2) that you have set.

	The DL6000/DLM6000 triggers on rising edges.
	The DL6000/DLM6000 triggers on falling edges.

Trigger Coupling (Coupling)

You can select the trigger coupling when the trigger source is a channel from CH1 to CH4.

AC	The DL6000/DLM6000 removes the DC component from the trigger signal.
DC	The DL6000/DLM6000 uses the trigger source as the trigger signal without making any changes.

Note

- The trigger coupling is fixed at DC when the trigger source is set to Logic, EXT, or LINE.

HF Rejection (HF Rejection)

Set HF rejection to 15 kHz or 20 MHz when you want to remove the high-frequency components (above approximately 15 kHz or 20 MHz) from the trigger signal. You can set HF rejection when the trigger source is a channel from CH1 to CH4.

Hysteresis (Hysteresis)

You can use hysteresis to give width to the trigger level so that the DL6000/DLM6000 does not trigger on small fluctuations in the signal. You can set HF rejection when the trigger source is a channel from CH1 to CH4.

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

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

Window Comparator (Window)

The window comparator qualifies conditions that are determined by a waveform's rising/falling edge or high/low state by whether or not they fall within a given range (Window IN/OUT). It qualifies trigger conditions and the Qualify conditions and state conditions discussed later in this section.
You can enable or disable the window comparator separately for each channel. The trigger and state conditions vary as shown below depending on whether the window comparator is enabled or disabled.

Window OFF	Window ON
Rising ()	Enter
Falling ()	Exit
High	IN
Low	OUT

The ranges and resolutions are indicated below.

Setting	Range	Resolution
Center	±4 divisions around the screen center	0.01 divisions
Width	±4 divisions around the center	0.02 divisions

Note

You can set the Width value to a value greater than ±4 divisions from the screen center. However, if the high or low level goes outside the screen, the DL6000/DLM6000 operation becomes unstable.

Trigger Level (LEVEL)

You can set the signal level to use as a reference for detecting a signal's rising and falling edges or high and low states. With the edge trigger, the DL6000/DLM6000 triggers when the trigger source level passes through the specified trigger level.

The analog signals (CH1 to CH4) and the logic signal (LOGIC) have different trigger level ranges.

Analog Signals

Range: 8 divisions within the screen

Resolution:0.01 divisions (for example: 0.02 V when the time axis is set to 2 V/division)

Logic Signal (DLM6000)

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

- Model 701981: ±10 V (0.1 V resolution)
- Model 701980: ±40 V (0.1 V resolution)
- Model 701988: ±40 V (0.05 V resolution)
- Model 701989: ±6 V (0.05 V resolution)

Note

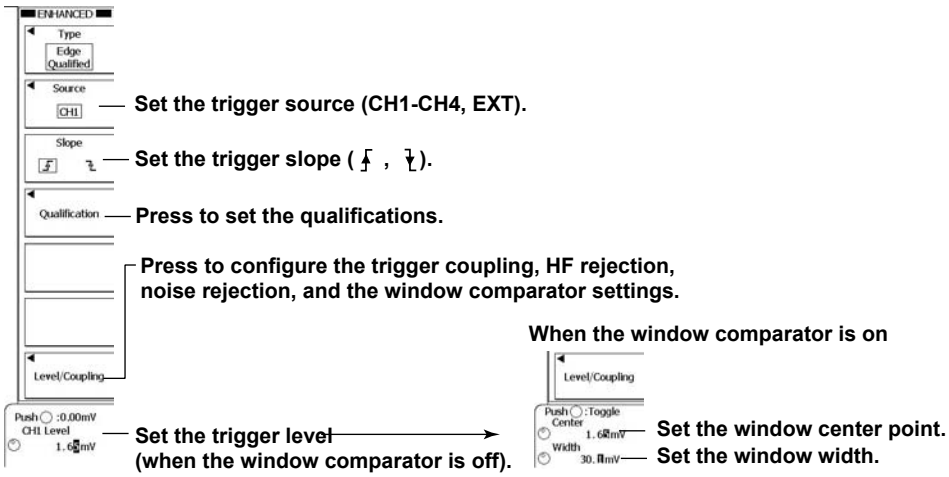
- The trigger level is set using the jog shuttle. If a single trigger source is used (Edge, Edge Qualified, Pulse Width, CAN, LIN, UART, or TV), you can also use the front-panel LEVEL knob to set the trigger level.
- When the front-panel LEVEL knob is valid, you can press it to automatically set the trigger level.
- If the jog shuttle is controlling the trigger level, you can press RESET to reset the trigger level to the current offset voltage.
- The range of threshold levels that you can use to detect logic signal bit states is the same as the range of the source bit trigger level.
- You can set the logic signal's bit levels using Threshold in the LOGIC key menu (see section 5.2).
- You can reset the trigger level to the current offset voltage by pressing RESET.
- When the window comparator is on, set the window width and the window center point.

6.4 Triggering on an Edge Condition

Procedure

ENHANCED Edge Qualified Menu

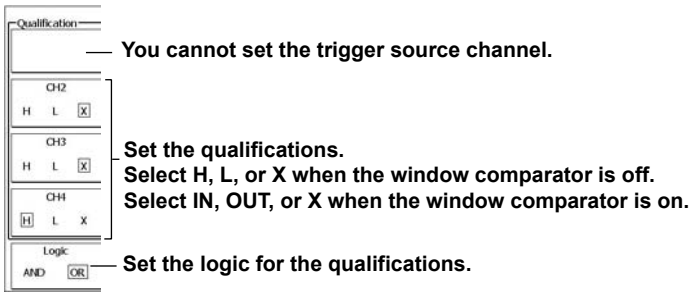
Set a trigger using an external signal (EXT) or a channel from CH1 to CH4 as the trigger source. Press **ENHANCED**, the **Type** soft key, the **Edge/State** soft key, and then the **Edge (Qualified)** soft key to display the following menu.



Setting the Qualifications (Qualification)

Press the **Qualification** soft key to display one of the menus shown below. The menu that is displayed varies depending on the specified trigger source.

When the Trigger Source Is a Channel from CH1 to CH4



When the Trigger Source Is EXT

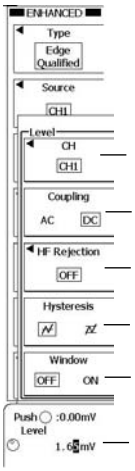
The same menu appears as that shown above for when the trigger source is from CH1 to CH4. Because the trigger source is an external signal (EXT), you can specify all of the signal states for CH1 to CH4 and LOGIC as qualifications.

Configuring the Level, Coupling, HF Rejection, Hysteresis, and Window Comparator Settings (Level/Coupling)

You can set the level (the trigger level for the trigger source channel and the level used to determine high/low states for channels with conditions applied to them), coupling, HF rejection, hysteresis, and window comparator settings for each channel.

Press the **Level/Coupling** soft key to display the following menu.

When Source Is Set to a Channel from CH1 to CH4



— **Select a channel (CH1-CH4).**

— **Set the coupling (AC, DC).**

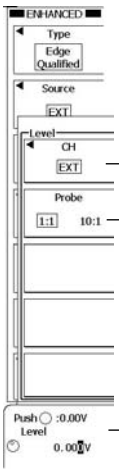
— **Set the HF rejection (OFF, 20 MHz, 15 kHz).**

— **Set the hysteresis (,).**

— **Turns the window comparator on and off**

— **Set the values used to determine the trigger level and the H, L, IN, and OUT states.**

When Source Is Set to EXT



— **Select a channel (CH1-CH4).**

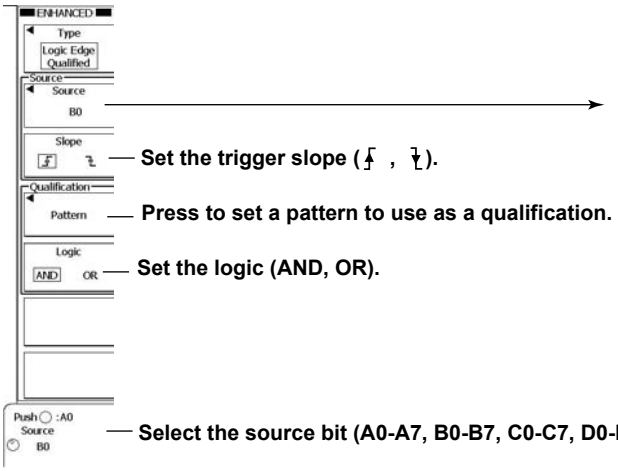
— **Set the probe attenuation (1:1, 10:1).**

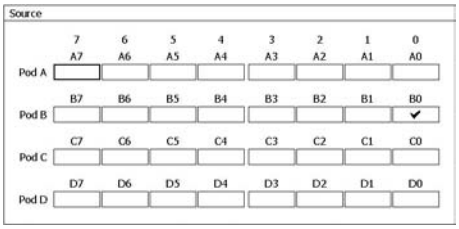
— **Set the trigger level.**

ENHANCED Logic Edge Qualified Menu (DLM6000)

Set a trigger using a logic signal bit as the trigger source.

Press **ENHANCED**, the **Type** soft key, the **Edge/State** soft key, and then the **Logic Edge (Qualified)** soft key to display the following menu.





— **Set the trigger slope (,).**

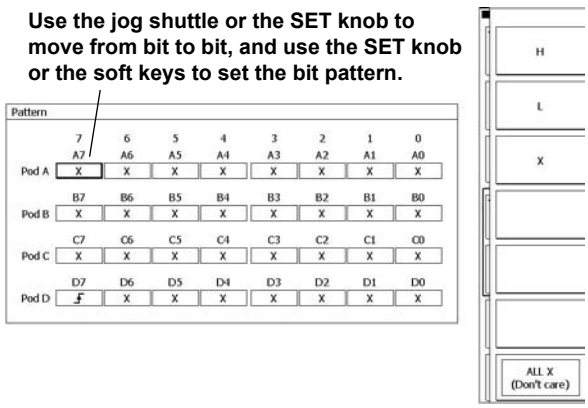
— **Press to set a pattern to use as a qualification.**

— **Set the logic (AND, OR).**

— **Select the source bit (A0-A7, B0-B7, C0-C7, D0-D7).**

Setting Patterns to Use as Conditions (Pattern)

Press the **Pattern** soft key to display the following menu.



Explanation

You can use this feature to make the DL6000/DLM6000 trigger on the trigger source edge when the conditions of the signals other than the trigger source meet the specified qualifications.
The settings for this feature vary depending on whether the trigger source is an analog or logic waveform.

Triggering on an External Signal or a Channel from CH1 to CH4 (Edge Qualified)

Trigger Source

You can set the trigger source to a channel from CH1 to CH4, or EXT.

Triggering on an External Signal

To use the external signal that the DL6000/DLM6000 receives through the rear-panel TRIG IN terminal as the trigger source, set SOURCE to EXT.

Trigger Slope

You can select how the DL6000/DLM6000 will trigger on the trigger source signal.

⎍	The DL6000/DLM6000 triggers when the trigger source changes from a level below the trigger level to a level above the trigger level (rising).
⎎	The DL6000/DLM6000 triggers when the trigger source changes from a level above the trigger level to a level below the trigger level (falling).
Enter	The DL6000/DLM6000 triggers when the trigger source level enters the specified voltage range (when the window comparator is on).
Exit	The DL6000/DLM6000 triggers when the trigger source level exits from the specified voltage range (when the window comparator is on).

Qualification

For each signal, you can set the condition that must be met for the trigger to be valid to H, L, or X

H	The signal level must be high.
L	The signal level must be low.
IN	The signal level must be within the specified voltage range (when the trigger source is a channel from CH1 to CH4 and the window comparator is on).
OUT	The signal level must be outside the specified voltage range (when the trigger source is a channel from CH1 to CH4 and the window comparator is on).
X	No conditions have to be met (“don’t care”).

Logic

You can set the logic for all of the conditions to AND or OR.

AND	The DL6000/DLM6000 triggers when all of the specified conditions are met.
OR	The DL6000/DLM6000 triggers when any of the specified conditions is met.

Trigger Level

This is the same as the setting for the edge trigger. For details, see section 6.3.

Note

You cannot specify qualifications for the trigger source signal.

Coupling, HF Rejection, Hysteresis, and Window Comparator

Set the conditions for determining the trigger condition and the qualifications. These settings are the same as the settings for the edge trigger.

Triggering on a Logic Signal Bit (Logic Edge Qualified)

Trigger Source

You can set the trigger source to a bit from A0 to A7, B0 to B7, C0 to C7, or D0 to D7. (On 16-bit models, you can select from bits A0 to A7 and C0 to C7.)

Trigger Slope

You can select which signal polarity the DLM6000 will trigger on. The DLM6000 detects the trigger source polarity using the thresholds (see section 5.2) that you have set.

↑	The DLM6000 triggers on rising edges.
↓	The DLM6000 triggers on falling edges.

Qualification

For each signal, set the conditions that must be met for the DLM6000 to trigger.

H	The signal level must be high.
L	The signal level must be low.
X	No conditions have to be met (“don’t care”).

Logic

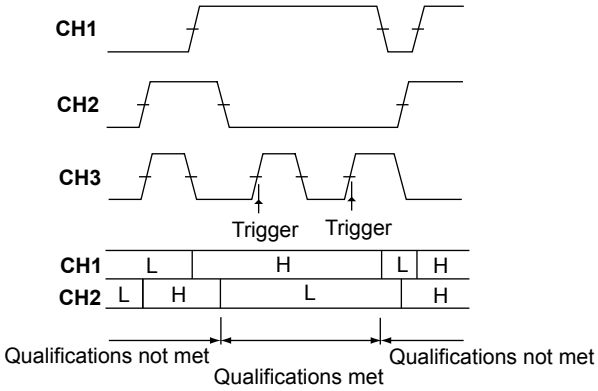
The settings are the same as those for analog signals.

Note

- You cannot specify qualifications for the trigger source bit.
- When triggering in sync with the trigger source, the DLM6000 may not trigger properly if the pattern setup time or hold time for the trigger source is less than 1 ns.

Example

Trigger source: CH3, ↑
Qualifications: CH1 = H, CH2 = L, other channels = X, AND

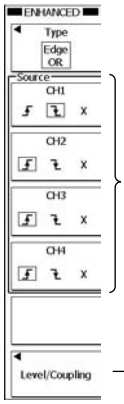


6.5 Triggering on the OR of Multiple Edge Triggers

Procedure

ENHANCED Edge OR Menu

Set a trigger using channels from CH1 to CH4 as the trigger sources.
Press **ENHANCED**, the **Type** soft key, the **Edge/State** soft key, and then the **Edge OR** soft key to display the following menu.



Set the trigger sources and slopes (, , X).
(Set the slope to Enter, Exit, or X when the window comparator is on.)

Press to configure the trigger coupling, HF rejection, noise rejection, and window comparator settings. ▶ section 6.3.

Explanation

You can use this feature to make the DL6000/DLM6000 trigger on multiple trigger source edges. The DL6000/DLM6000 acquires waveforms whenever edge triggers occur.

Setting the Trigger Sources and Slopes (Source)

All the channels whose trigger slope setting is set to an option other than X are used as trigger sources. This means that you can select multiple trigger sources.
The trigger slope setting determines how the DL6000/DLM6000 will trigger on a trigger source signal.

	The DL6000/DLM6000 triggers when the trigger source changes from a level below the trigger level to a level above the trigger level (rising).
	The DL6000/DLM6000 triggers when the trigger source changes from a level above the trigger level to a level below the trigger level (falling).
Enter	The DL6000/DLM6000 triggers when the trigger source level enters the specified voltage range (when the window comparator is on).
Exit	The DL6000/DLM6000 triggers when the trigger source level exits from the specified voltage range (when the window comparator is on).
X	The DL6000/DLM6000 does not trigger on the signal (“don’t care”).

Configuring the Trigger Coupling, HF Rejection, Hysteresis, Noise Rejection, Window Comparator, and Trigger Level Settings (Level/Coupling)

These settings are the same as the settings for the edge trigger. For details, see section 6.3.

6.6 Triggering on State Conditions

Procedure

ENHANCED Edge State Menu

Set a trigger using a channel from CH1 to CH4 as the trigger source.
Press **ENHANCED**, the **Type** soft key, the **Edge/State** soft key, and then the **Edge State** soft key to display the following menu.

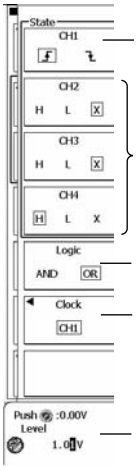
Press to configure the state conditions.

Set the trigger condition (Enter, Exit).

Press to configure the trigger coupling, HF rejection, noise rejection, and window comparator settings. ▶ section 6.3.

Setting the State Conditions (State)

Press the **State** soft key to set the state conditions and the clock channel.



Set the slope for the clock source signal.
- **Select ↓ or ↑ when the window comparator is off.**
- **Select Enter or Exit when the window comparator is on.**

Set the state conditions for signals other than the clock source.
- **Select H, L, or X when the window comparator is off.**
- **Select In, Out, or X when the window comparator is on.**

Set the state condition logic (AND, OR).

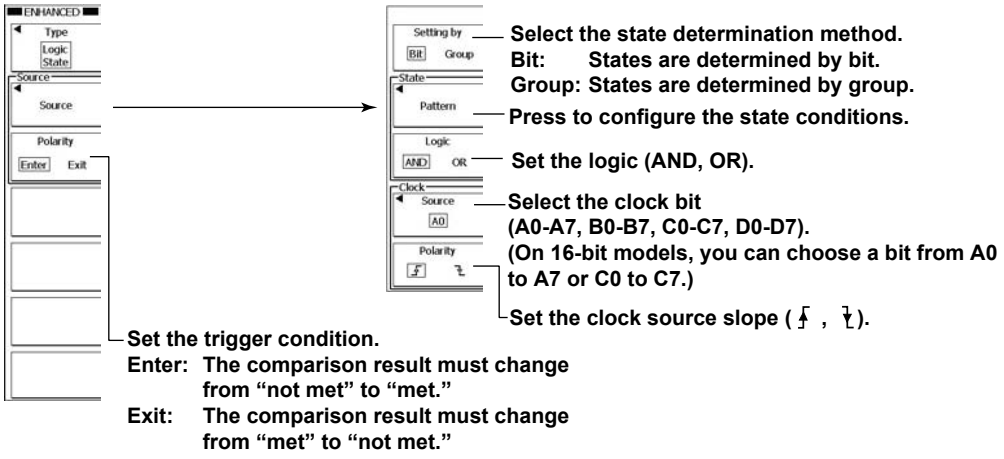
Set the clock source (CH1-CH4, X).

Set the value used to determine the H, L, IN, and OUT states.

ENHANCED Logic State Menu (DLM6000)

Set a trigger using a logic signal bit as the trigger source.

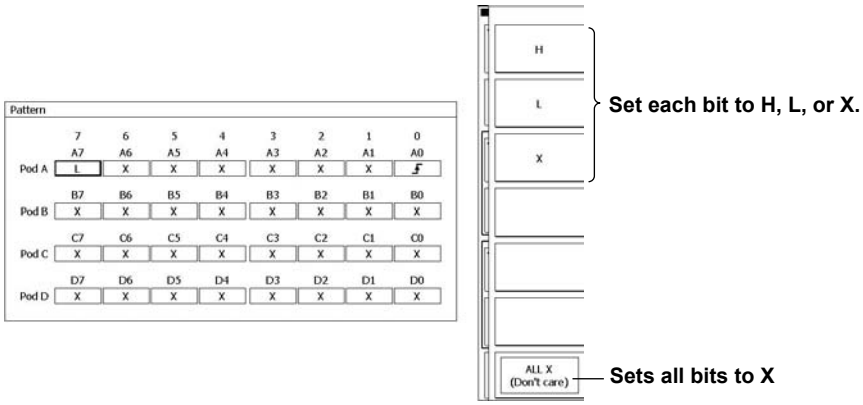
Press **ENHANCED**, the **Type** soft key, the **Edge/State** soft key, and then the **Logic State** soft key to display the following menu.



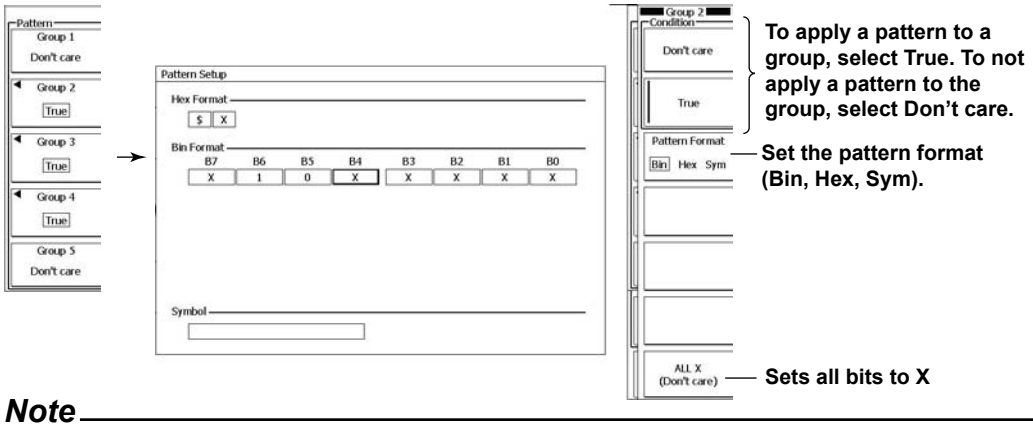
Setting the State Condition (Pattern)

Press the **Pattern** soft key to display the following menu.

When "Setting by" Is Set to "Bit"



When "Setting by" Is Set to "Group"



Note

- Groups that do not have logic signal bits assigned to them and groups that contain the logic signal bit that has been selected as the clock source are always set to "Don't care."
- If there is even one X in a group of four bits in the binary format row, the corresponding indication in the hexadecimal format row will be a dollar sign ($).

Explanation

The DL6000/DLM6000 triggers when the result of comparing the signal states to their specified state conditions changes from met to not met or from not met to met. If you specify a clock source, the DL6000/DLM6000 samples the comparison results using the clock and detects the point of change in sync with the clock.

When Triggering on CH1 through CH4 (State)

Clock Source (Clock)

You can set the clock source to a channel from CH1 to CH4. You can specify a clock source to execute triggering in sync with the clock source's rising or falling edges. If you do not specify a clock source, the DL6000/DLM6000 just triggers on the state conditions.

Clock Source Slope or Polarity

Select the clock source slope or polarity.

↑	When the clock source changes from a level below the specified level to a level above the specified level (rising)
↓	When the clock source changes from a level above the specified level to a level below the specified level (falling)
Enter	When the clock source level enters the specified voltage range (when the window comparator is on)
Exit	When the clock source level exits from the specified voltage range (when the window comparator is on)

State Conditions (CH1 to CH4)

You can set the state condition for each signal to H, L, or X. When the comparison of the selected state conditions and the states of the input signals meets the requirement of the Logic setting, the result of the comparison is "met."

H	The signal level must be high.
L	The signal level must be low.
IN	The signal level must be within the specified voltage range (when the window comparator is on).
OUT	The signal level must be outside the specified voltage range (when the window comparator is on).
X	No conditions have to be met ("don't care").

Note

You cannot set a state condition for the signal that is selected as the clock source.

Logic (Logic)

Set the logic for comparing the signal states to their state conditions to AND or OR.

AND	The result of comparing the signal states to their specified state conditions is set to "met" when all of the states match.
OR	The result of comparing the signal states to their specified state conditions is set to "met"when any of the states match.

Trigger Condition (Polarity)

Select how the result of comparing the signal states to their state conditions must change for the DL6000/DLM6000 to trigger.

Enter	The result must change from not met to met.
Exit	The result must change from met to not met.

Level

The range is the same as that of the edge trigger level. For details, see section 6.3.

Configuring the Trigger Coupling, HF Rejection, Hysteresis, Noise Rejection, Window Comparator, and Trigger Level Settings (Level/Coupling)

These settings are the same as the settings for the edge trigger. For details, see section 6.3.

Triggering on a Logic Signal Bit (Logic State)

Clock Source (Clock)

You can set the source to a bit from A0 to A7, B0 to B7, C0 to C7, or D0 to D7. (On 16-bit models, you can select from bits A0 to A7 and C0 to C7.)If you do not specify a clock source, the DLM6000 just triggers on the state conditions.

Clock Source Polarity

The DLM6000 detects the clock source polarity using the thresholds (see section 5.2) that you have set.

	DLM6000 triggers on rising edges.
	DLM6000 triggers on falling edges.

Note

- You cannot set a state condition for the bit that is selected as the clock source.
- When checking the state conditions in sync with the clock source, the DLM6000 may not trigger properly if the pattern setup time or hold time for the clock source is less than 1 ns.

Setting the State Conditions for Each Bit

- **Pattern**

  You can set the state condition for each bit to H, L, or X.

H	The signal must be high.
L	The signal must be low.
X	No conditions have to be met (“don’t care”).

- **Logic**

  You can set the logic for all the conditions to AND or OR.

AND	The DLM6000 triggers when all the specified conditions are met.
OR	The DLM6000 triggers when any of the specified conditions is met.

Setting State Conditions for Groups

- Pattern

  You can specify state conditions for groups of bits in hexadecimal, binary, or symbol format.

- Hex

0 to F	For information about how bits are handled when you select the hexadecimal format, see section 5.17.
X	No conditions have to be met (“don’t care”).

- Bin

0	The signal must be low.
1	The signal must be high.
X	No conditions have to be met (“don’t care”).

- Symbol
  Symbols are a way of expressing bit sequences that include “don’t cares” (Xs). You can load physical value/symbol definition files (with .sbl extensions) that you have edited using the Symbol Editor tool.

- **Logic (Logic)**
  When you set state conditions for groups of bits, the logic is fixed at AND. The result of comparing the bit states to their specified state conditions is set to “met” when all the states match.

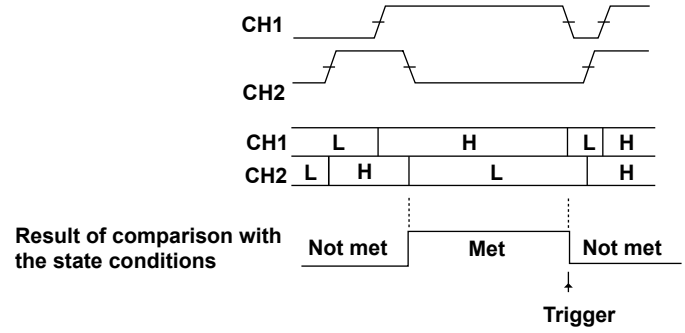
Trigger Condition (Polarity)

Select how the result of comparing the signal states to their state conditions must change for the DLM6000 to trigger.

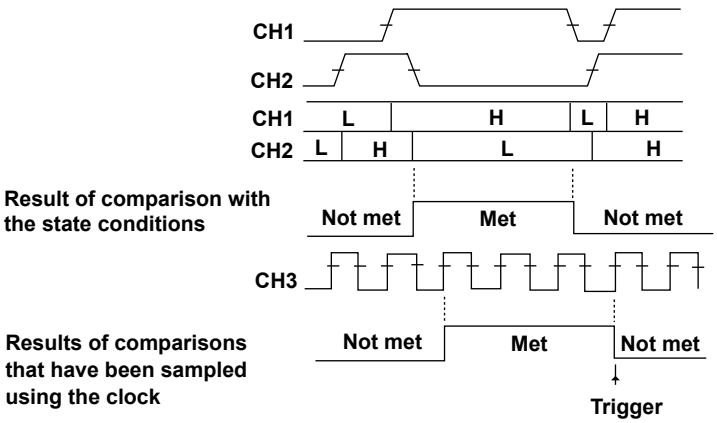
Enter	The result must change from not met to met.
Exit	The result must change from met to not met.

Examples

Clock source: None
State: CH1 = H, CH2 = L, other channels = X, AND
Condition: Exit



Clock source: CH3, ↓
State: CH1 = H, CH2 = L, CH4 = X, AND
Condition: Exit

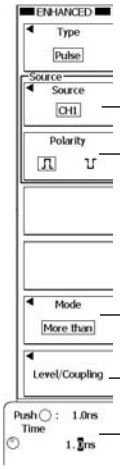


6.7 Triggering on a Pulse Width Condition

Procedure

ENHANCED Pulse Menu

Set a trigger using an external signal (EXT) or a channel from CH1 to CH4 as the trigger source.
Press **ENHANCED,** the **Type** soft key, the **Width** soft key, and then the **Pulse** soft key to display the following menu.



Set the trigger source (CH1-CH4, EXT).

Select the kind of pulse to compare to the specified time.
- **Select ⎍ or ⎏ when the window comparator is off.**
- **Select IN or OUT when the window comparator is on.**

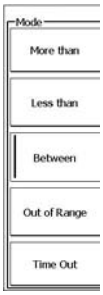
Set the time width mode.

Press to configure the trigger coupling, HF rejection, noise rejection, and window comparator settings. ▶ section 6.3.

Set the reference time.

Setting the Time Width Mode (Mode)

Press the **Mode** soft key to display the following menu.



Set what kind of relationship must be established between the trigger source's pulse width and the specified reference times for the DL6000/DLM6000 to trigger.

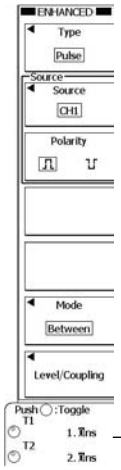
More than: The pulse width must be longer than the specified reference time.
Less than: The pulse width must be shorter than the specified reference time.
Between: The pulse width must be longer than T1 and shorter than T2.
Out of Range: The pulse width must be shorter than T1 or longer than T2.
Time Out: The pulse width must be longer than the specified reference time.

Setting the Reference Times

When the Time Width Mode Is "More than," "Less than," or "Time Out"

Set the reference time.

When the Time Width Mode Is "Between" or "Out of Range"

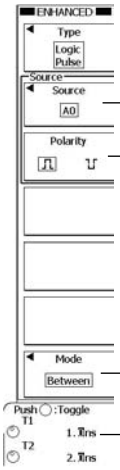


Set reference times T1 and T2.

ENHANCED Logic Pulse Menu (DLM6000)

Set a trigger using a logic signal bit as the trigger source.

Press **ENHANCED**, the **Type** soft key, the **Width** soft key, and then the **Logic Pulse** soft key to display the following menu.



Select the trigger source (A0-A7, B0-B7, C0- C7, D0-D7).
(On 16-bit models, you can select a bit from A0 to A7 or C0 to C7.)

Select the kind of pulse to compare to the specified time (⎍ , ⎎).

Set the time width mode.

Set the reference time.

Setting the Time Width Mode (Mode)

Press the **Mode** soft key. This setting is the same as the setting in the Pulse menu.

Setting the Reference Times (Time1 and Time2)

These settings are the same as the setting in the Pulse menu.

Explanation

With this feature, you can make the DL6000/DLM6000 trigger when the specified relationship is established between the reference times and the length of time for which a condition is met or not met.

Time Width Mode (Mode)

You can make the DL6000/DLM6000 trigger when the specified relationship between the reference times and the pulse width of a single trigger source is established. You can specify one of the following relationships.

More than	The DL6000/DLM6000 triggers when the pulse width is longer than the specified reference time and the condition changes.
Less than	The DL6000/DLM6000 triggers when the pulse width is shorter than the specified reference time and the condition changes.
Between	The DL6000/DLM6000 triggers when the pulse width is longer than T1 and shorter than T2 and the condition changes.
Out of Range	The DL6000/DLM6000 triggers when the pulse width is shorter than T1 or longer than T2 and the condition changes.
Time Out	The DL6000/DLM6000 triggers when the pulse width is longer than the specified reference time.

Reference Times (Time)

You can set each of the reference times to a value from 1.0 ns to 10.0000 s in 0.5 ns steps.

Note

The DL6000/DLM6000 may not trigger properly if the spacing between signals or the signal pulse width is less than 2 ns. Under standard operating conditions, the pulse width accuracy is ±(0.2% of the set value + 1 ns) immediately after calibration. The “set value” in the above expression is the T2 value when T1 < Pulse < T2.

Triggering on an External Signal or a Channel from CH1 to CH4 (Pulse)

Trigger Source

You can set the trigger source to a channel from CH1 to CH4, or EXT.

Triggering on an External Signal

To use the external signal that the DL6000/DLM6000 receives through the rear-panel TRIG IN terminal as the trigger source, set SOURCE to EXT.

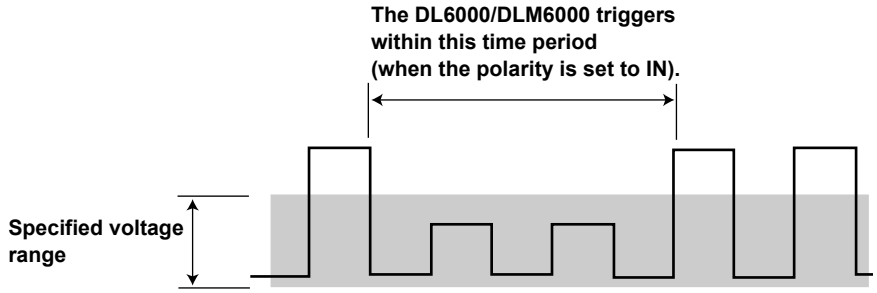
Polarity

You can select which trigger source polarity will cause the DL6000/DLM6000 to compare the pulse width to the reference times. The trigger source polarity is based on the trigger level.

⎍	When the signal level is high
⎎	When the signal level is low
IN	When the trigger source level is within the specified voltage range (when the window comparator is on)
OUT	When the trigger source level is outside the specified voltage range (when the window comparator is on)

How the Window Comparator Affects Triggering

If you set the trigger source to a signal whose window comparator is on, the DL6000/DLM6000 can trigger according to the length of time the trigger source is within or outside the specified voltage range.



Configuring the Trigger Coupling, HF Rejection, Hysteresis, Noise Rejection, Window Comparator, and Trigger Level Settings (Level/Coupling)

These settings are the same as the settings for the edge trigger. For details, see section 6.3.

Triggering on a Logic Signal Bit (Logic Pulse)

Trigger Source

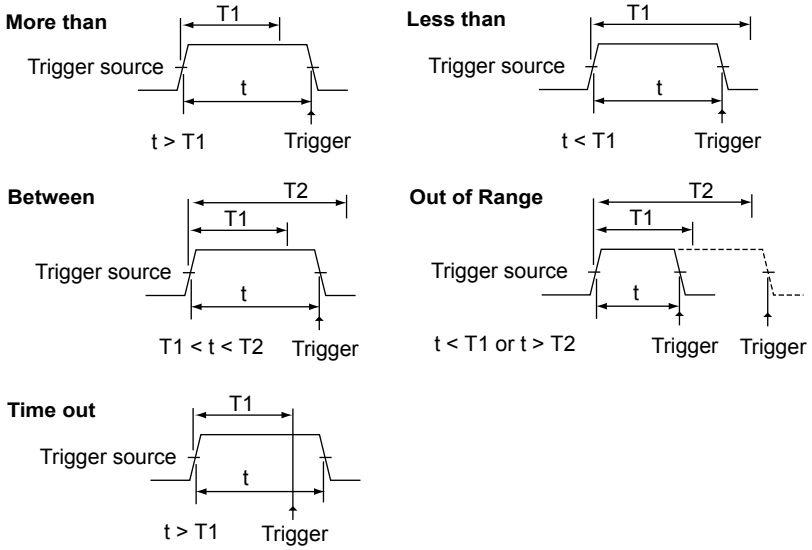
You can set the source signal to a bit from A0 to A7, B0 to B7, C0 to C7, or D0 to D7. (On 16-bit models, you can select from bits A0 to A7 and C0 to C7.)

Polarity

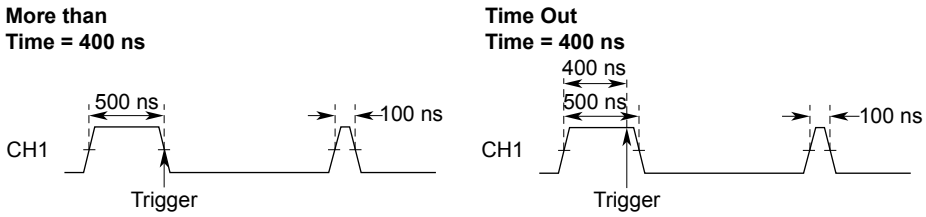
You can choose whether to use the pulse width of the high or low polarity of the signal. The DLM6000 detects the trigger source polarity using the thresholds (see section 5.2) that you have set.

⎍	The width of the high level is used.
⎎	The width of the low level is used.

Examples



The figures below show how the trigger point is different in the “More than” and “Time Out”.



6.8 Triggering on a Pulse Width Condition under Specified Qualifications

Procedure

ENHANCED Pulse Qualified Menu

Press **ENHANCED**, the **Type** soft key, the **Width** soft key, and then the **Pulse Qualified** soft key to display the following menu.

Set the trigger source (CH1-CH4, EXT).

Select the kind of pulse to compare to the specified time.
- **Select ⎍ or ⎎ when the window comparator is off.**
- **Select IN or OUT when the window comparator is on.**

Set the qualifications.

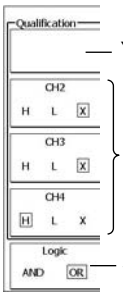
Set the time width mode. ▶ section 6.7.

Press to configure the trigger coupling, HF rejection, noise rejection, and window comparator settings. ▶ section 6.3.

Set the reference time.

Setting the Qualifications (Qualification)

Press the **Qualification** soft key to display one of the menus shown below. The menu that is displayed varies depending on the specified trigger source.



You cannot set the trigger source channel.

Set the qualifications.
Select H, L, or X when the window comparator is on.
Select IN, OUT, or X when the window comparator is off.

Set the logic for the qualifications.

Explanation

With this feature, you can make the DL6000/DLM6000 trigger when the specified relationship between the pulse width of a single trigger source and the reference times is established and when the specified qualifications are met.

Time Width Mode (Mode) and Reference Times (Time)

These settings are the same as the settings for the pulse width trigger. For details, see section 6.7.

Trigger Source (Source)

You can set the trigger source to a channel from CH1 to CH4, or EXT.

Triggering on an External Signal

To use the external signal that the DL6000/DLM6000 receives through the rear-panel TRIG IN terminal as the trigger source, set SOURCE to EXT.

Polarity (Polarity)

You can select which trigger source polarity will cause the DL6000/DLM6000 to compare the pulse width to the reference times. The trigger source polarity is based on the trigger level.

⎍	When the signal level is high
⎎	When the signal level is low
IN	When the trigger source level is within the specified voltage range (when the window comparator is on)
OUT	When the trigger source level is outside the specified voltage range (when the window comparator is on)

Qualification

For each signal, you can set the condition that must be met for the trigger to be valid to H, L, or X.

H	The signal level must be high.
L	The signal level must be low.
IN	The trigger source level must be within the specified voltage range (when the window comparator is on).
OUT	The trigger source level must be outside of the specified voltage range (when the window comparator is on).
X	No conditions have to be met (“don’t care”).

Logic

You can set the logic for all of the conditions to AND or OR.

AND	The DL6000/DLM6000 triggers when all of the specified conditions are met.
OR	The DL6000/DLM6000 triggers when any of the specified conditions is met.

Note

You cannot specify qualifications for the trigger source signal.

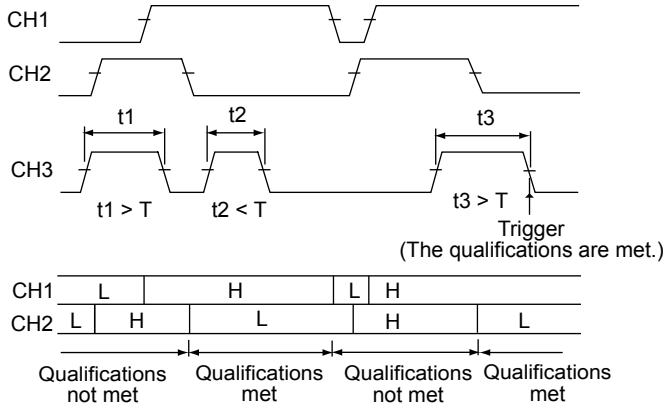
Level/Coupling

You can configure the trigger coupling, HF rejection, hysteresis, noise rejection, window comparator, and trigger level settings.

These settings are the same as the settings for the edge trigger. For details, see section 6.3.

Examples

Trigger source: CH3, More than
Qualifications: CH1 = H, CH2 = L, other channels = X, AND



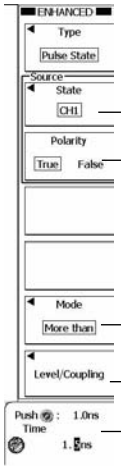
6.9 Triggering on a State Width Condition

Procedure

ENHANCED Pulse State Menu

Set a trigger using a channel from CH1 to CH4 as the trigger source.

Press **ENHANCED**, the **Type** soft key, the **Width** soft key, and then the **Pulse State** soft key to display the following menu.



Press to configure the state conditions.

Set the trigger condition.
True: The time for which the state conditions are met is compared with the reference time.
False: The time for which the state conditions are not met is compared with the reference time.

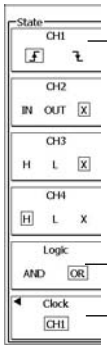
Set the time width mode.

Press to configure the trigger coupling, HF rejection, noise rejection, and window comparator settings. ▶ section 6.3.

Set the reference time.

Setting States (State)

Press the **State** soft key to display the following menu.



Set the slope for the clock source signal.
- **Select ↓ or ↑ when the window comparator is off.**
- **Select Enter or Exit when the window comparator is on.**

Set the state conditions for signals other than the clock source.
- **Select H, L, or X when the window comparator is off.**
- **Select IN, OUT, or X when the window comparator is on.**

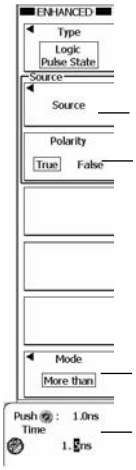
Set the state condition logic (AND, OR).

Set the clock source (CH1-CH4, X).

ENHANCED Logic Pulse State Menu (DLM6000)

Set a trigger using a logic signal bit as the trigger source.

Press **ENHANCED**, the **Type** soft key, the **Width** soft key, and then the **Logic Pulse State** soft key to display the following menu.



Set the trigger source.

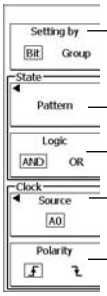
Set the trigger condition.
True: The time for which the state conditions are met is compared with the reference time.
False: The time for which the state conditions are not met is compared with the reference time.

Set the time width mode.

Set the reference time.

Setting the Source (Source)

Press the **Source** soft key to display the following menu.



Select the state determination method.
Bit: States are determined by bit.
Group: States are determined by group.

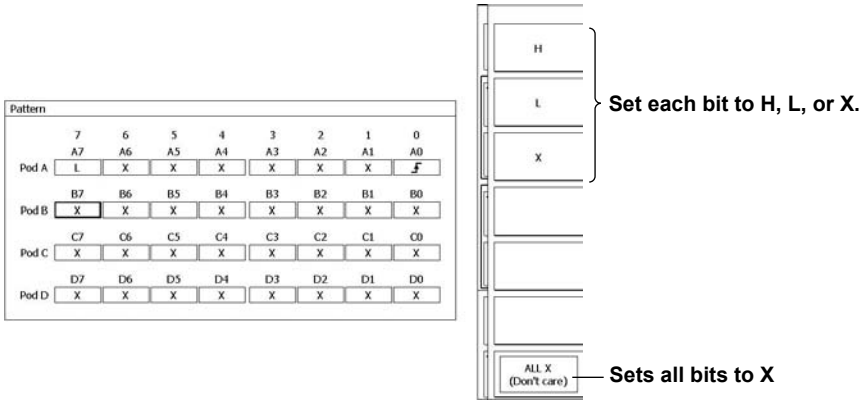
Press to configure the state conditions.

Set the logic (AND, OR).

Select the clock bit (A0-A7, B0-B7, C0-C7, D0-D7).
(On 16-bit models, you can choose a bit from A0 to A7 or C0 to C7.)

Set the clock source slope (,).

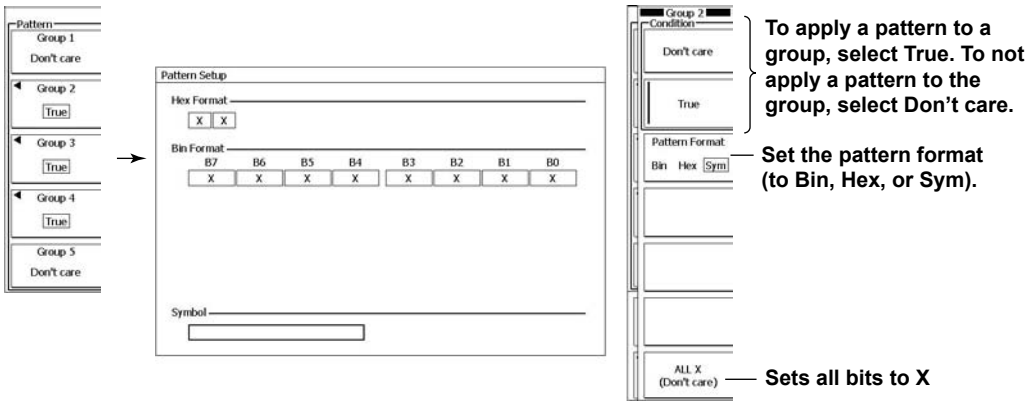
Setting States by Bit



Set each bit to H, L, or X.

Sets all bits to X

Setting States by Group



Note

- Groups that do not have logic signal bits assigned to them and groups that contain the logic signal bit that has been selected as the clock source are always set to “Don’t care.”
- If there is even one X in a group of four bits in the binary format row, the corresponding indication in the hexadecimal format row will be a dollar sign ($).

Explanation

The DL6000/DLM6000 triggers when the time width mode condition is met and the result of state comparison changes from “met” to “not met” or from “not met” to “met.” The time width mode condition specifies a relationship between the reference times and the result of state comparison. State comparison is the comparison of the signal states to their specified state conditions. If the time width mode is set to TimeOut, the DL6000/DLM6000 triggers when the specified amount of time elapses. If you specify a clock source, the DL6000/DLM6000 samples the comparison results using the clock and triggers on the point of change in sync with the clock.

Time Width Mode (Mode)

You can make the DL6000/DLM6000 trigger when the specified relationship is established between the reference times (T1 and T2) and the duration of the result (“met” or “not met”) of state comparison.

More than	The DL6000/DLM6000 triggers when the duration of the result (“met” or “not met”) of state comparison is longer than the specified reference time and the condition changes.
Less than	The DL6000/DLM6000 triggers when the duration of the result (“met” or “not met”) of state comparison is shorter than the specified reference time and the condition changes.
Between	The DL6000/DLM6000 triggers when the duration of the result (“met” or “not met”) of state comparison is longer than T1 and shorter than T2 and the condition changes.
Out of Range	The DL6000/DLM6000 triggers when the duration of the result (“met” or “not met”) of state comparison is shorter than T1 or longer than T2 and the condition changes.
Time Out	The DL6000/DLM6000 triggers when the duration of the result (“met” or “not met”) of state comparison is longer than the specified reference time.

Reference Times (Time)

You can set each of the reference times to a value from 1.0 ns to 10.0000 s in 0.5 ns steps.

Note

The DL6000/DLM6000 may not trigger properly if the spacing between signals or the signal pulse width is less than 2 ns. Under standard operating conditions, the time width accuracy is ±(0.2% of the set value + 1 ns) immediately after calibration. The “set value” in the above expression is the T2 value when T1 < Pulse < T2.

When Triggering on CH1 through CH4 (Pulse)

Source

This is the same as triggering on state conditions. For details, see section 6.6.

Logic (Logic)

Set the logic for comparing the signal states to their state conditions to AND or OR.

AND	The result of comparing the signal states to their specified state conditions is set to “met” when all of the states match.
OR	The result of comparing the signal states to their specified state conditions is set to “met” when any of the states match.

Configuring the Trigger Coupling, HF Rejection, Hysteresis, Noise Rejection, Window Comparator, and Trigger Level Settings (Level/Coupling)

These settings are the same as the settings for the edge trigger. For details, see section 6.3.

Triggering on a Logic Signal Bit (Logic Pulse)

Source

This is the same as triggering on state conditions. For details, see section 6.6.

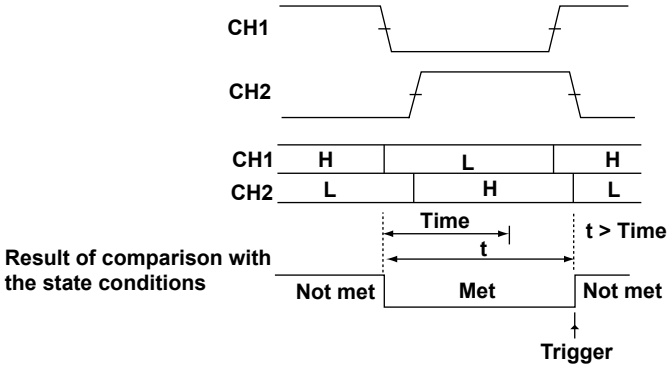
Trigger Condition (Polarity)

Select how the result of comparing the signal states to their state conditions must change for the DLM6000 to trigger.

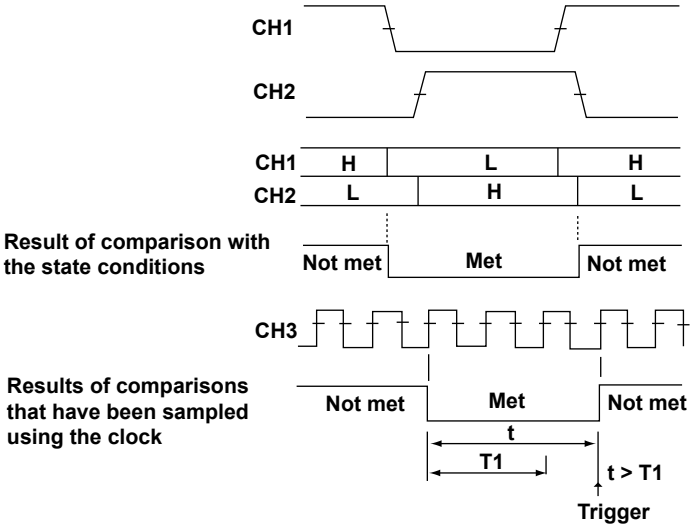
Enter	The result must change from not met to met.
Exit	The result must change from met to not met.

Examples

Mode: More than; Clock source: None
State: CH1 = H, CH2 = L, other channels = X, AND
Condition: False



Mode: More than; Clock source: CH3, ↑
State: CH1 = H, CH2 = L, other channels = X, AND
Condition: False



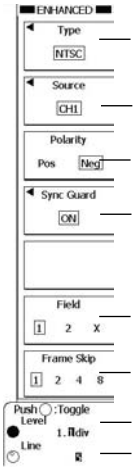
6.10 Triggering on a TV Trigger

Procedure

The setup menus vary depending on the selected broadcasting system.

NTSC Menu

Press **ENHANCED**, the **Type** soft key, the **TV** soft key, and then the **NTSC** soft key to display the following menu.

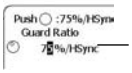


Set the trigger type to NTSC.
Select the source (CH1-CH4).
Set the polarity (Pos, Neg).
Press to configure the sync guard.
Set the field number (1, 2, X).
Set the frame skip (1, 2, 4, 8).
Set the level used to detect source states.
Set the line number.

Configuring Sync Guard (Sync Guard)

Press the **Sync Guard** soft key to display the following menu.

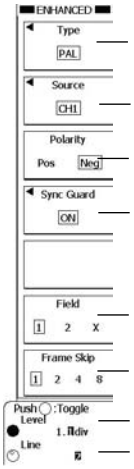
Turns the sync guard on and off
Set the sync guard frequency (using the jog shuttle).



Set the sync guard frequency.

PAL Menu

Press **ENHANCED**, the **Type** soft key, the **TV** soft key, and then the **PAL** soft key to display the following menu.



Set the trigger type to PAL.

Select the source (CH1, CH4).

Set the polarity (Pos, Neg).

Press to configure the sync guard (same as NTSC).

Set the field number (1, 2, X).

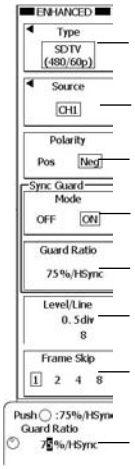
Set the frame skip (1, 2, 4, 8).

Set the level used to detect source states.

Set the line number.

SDTV Menu

Press **ENHANCED**, the **Type** soft key, the **TV** soft key, and then the **SDTV** soft key to display the following menu.



Set the trigger type to SDTV.

Select the source (CH1-CH4).

Set the polarity (Pos, Neg).

Turns the sync guard on and off

Set the sync guard frequency (using the jog shuttle).

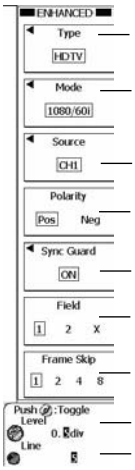
Set the line number and the level for determining the source state (using the jog shuttle).

Set the frame skip (1, 2, 4, 8).

Set the sync guard frequency, the line number, and the level for determining the source state.

HDTV Menu

Press **ENHANCED**, the **Type** soft key, the **TV** soft key, and then the **HDTV** soft key to display the following menu.



Set the trigger type to HDTV.

Set the video format (the effective number of scan lines/frame rate) to 1080/60i, 1080/50i, 720/60p, 1080/25p, 1080/24p, 1080/24sF, or 1080/60p.

Select the source (CH1-CH4).

Set the polarity (Pos, Neg).

Press to configure the sync guard (same as NTSC).

Set the field number (1, 2, X).

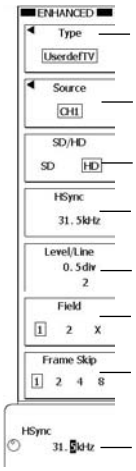
Set the frame skip (1, 2, 4, 8).

Set the level used to detect source states.

Set the line number.

UserdefTV Menu

Press **ENHANCED**, the **Type** soft key, the **TV** soft key, and then the **UserdefTV** soft key to display the following menu.



Set the trigger type to UserdefTV.

Set the source.

Set the resolution (SD, HD).

Set the horizontal sync frequency (using the jog shuttle).

Set the line number and the level for determining the source state (using the jog shuttle).

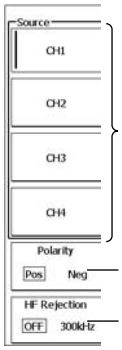
Set the field number (1, 2, X).

Set the frame skip (1, 2, 4, 8).

Set the horizontal sync frequency, the line number, and the level for determining the source state.

Setting the Source (Source)

Press the **Source** soft key to display the following menu.



Select the source (CH1-CH4).

Set the polarity (Pos, Neg).

Set the HF rejection (OFF, 300 kHz).

Explanation

Broadcasting Systems That You Can Set TV Triggers For (Type)

You can select one of the following broadcasting systems.
NTSC (525/60/2), PAL (625/50/2), SDTV (480/60p), HDTV (1080/60i, 1080/50i, 720/60p, 1080/25p, 1080/24p, 1080/24sF, 1080/60p), and UserdefTV

Sync Signal Guard Frequency (Sync Guard)

You can specify a portion of the horizontal sync frequency range to guard when triggering.
You can specify the range to guard as a percentage of the horizontal sync frequency.

Polarity (Polarity)

Select which TV signal polarity will cause the DL6000/DLM6000 to trigger. The TV signal polarity is based on the trigger level.

Pos: The DL6000/DLM6000 triggers on positive polarities.

Neg: The DL6000/DLM6000 triggers on negative polarities.

Trigger Level (Level)

Set the trigger level in units of divisions with the start value equal to 0 divisions.

Range: 0.1 to 2.0 divisions

Resolution: 0.1 divisions

The default setting is 0.5 divisions.

Field Number (Field)

Select the field number to detect.

You can only set the field number for NTSC, PAL, and HDTV (1080/60i, 1080/50i, or 1080/24sF) broadcast systems.

1	The DL6000/DLM6000 detects fields whose vertical sync pulse starts at the same time as the start of a line.
2	The DL6000/DLM6000 detects fields whose vertical sync pulse starts 1/2H (where H is the horizontal scanning period) behind the start of a line.
X	The DL6000/DLM6000 detects both kinds of field.

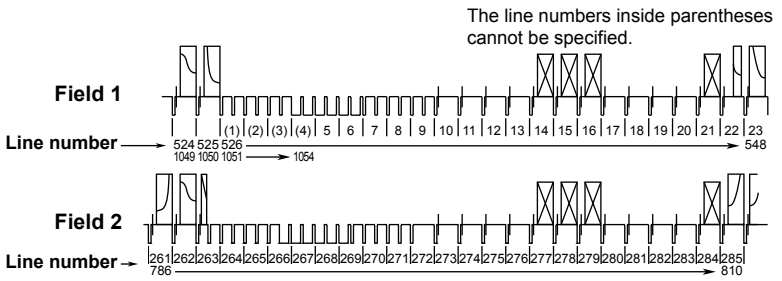
Line Number (Line)

The DL6000/DLM6000 triggers on the start of the selected line number.

Broadcast System	Range
NTSC	5 to 1054
PAL	2 to 1251
SDTV	8 to 2251
HDTV	2 to 2251
UserdefTV	2 to 2251

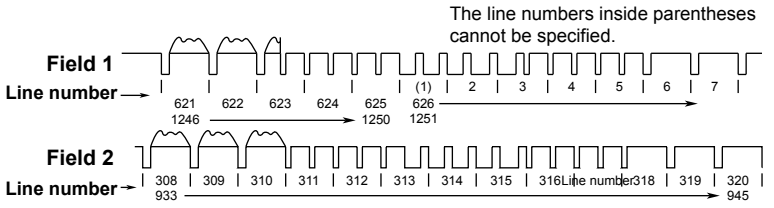
- **NTSC Example**

The following line numbering results when the field number is set to 1 (if the field number is set to 2, the DL6000/DLM6000 assigns the numbers sequentially by setting 268 to 5).

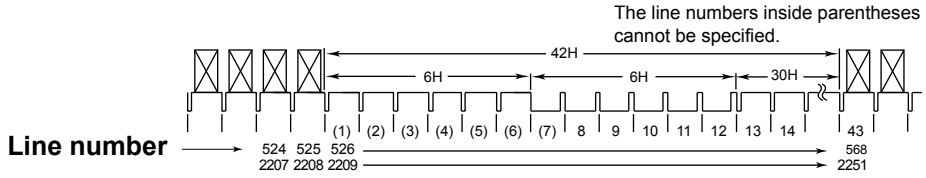


- **PAL Example**

The following line numbering results when the field number is set to 1 (if the field number is set to 2, the DL6000/DLM6000 assigns the numbers sequentially by setting 315 to 2).

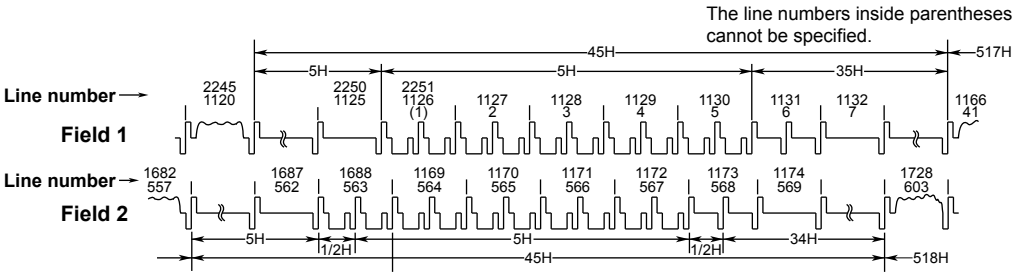


- **SDTV Example**

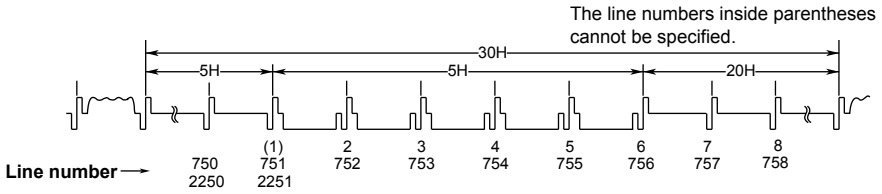


- **Example for 1080/60i, 1080/50i, and 1080/24sF**

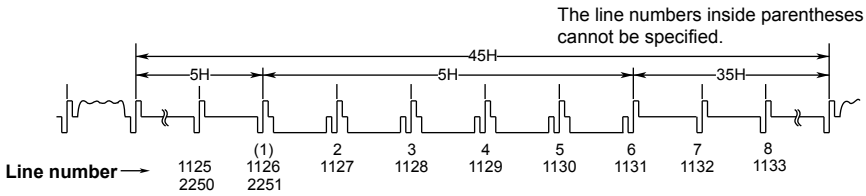
The following line numbering results when the field number is set to 1 (if the field number is set to 2, the DL6000/DLM6000 assigns the numbers sequentially by setting 565 to 2).



- **720/60p Example**



- **Example for 1080/25p, 1080/24p, and 1080/60p**



Frame Skip (Frame Skip)

This feature skips frames in cases such as when the color burst is inverted for every frame. You can select how many frames to skip.

1	The DL6000/DLM6000 triggers on the specified field of every frame.
2	The DL6000/DLM6000 skips one frame and triggers on the specified field of the subsequent frame. This operation is repeated every two frames.
4	The DL6000/DLM6000 skips three frames and triggers on the specified field of the subsequent frame. This operation is repeated every four frames.
8	The DL6000/DLM6000 skips seven frames and triggers on the specified field of the subsequent frame. This operation is repeated every eight frames.

User-Defined (Userdef TV)

You can specify custom values for the definition, horizontal sync frequency, sync guard frequency, and other settings.

Trigger Source (Source), Polarity (Polarity), Trigger Level (Level), Line Number (Line), Field Number (Field), and Frame Skip (Frame skip)

These settings are the same as the settings for specific broadcasting systems.

HF Rejection (HF Rejection)

Select whether or not to remove high-frequency components (300 kHz or higher) from the trigger signal.

300kHz: High-frequency components greater than or equal to 300 kHz are removed.

OFF: High-frequency components are not removed.

When the broadcasting system is not set to User Define, the HF rejection setting is configured as follows:

NTSC, PAL, and SDTV:

Fixed at 300 kHz

HDTV: Fixed at OFF

Note

Hold-off, trigger coupling, and HF rejection settings are ignored.

Horizontal Sync Frequency (HSync)

Set the horizontal sync frequency. Pressing RESET sets the frequency to 31.5 kHz.

Definition (Definition)

You can set the definition to one of the following options.

SD: Standard (bi-level sync signal)

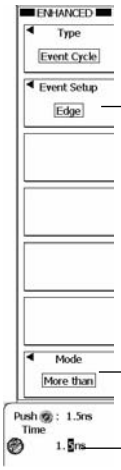
HD: High definition (tri-level sync signal)

6.11 Triggering on Period, Delay, and Sequence Events

Procedure

Event Cycle Menu

Press **ENHANCED**, the **Type** soft key, the **Event Interval** soft key, and then the **Event Cycle** soft key to display the following menu.



Press to configure the event.
(The same as configuring a trigger.)

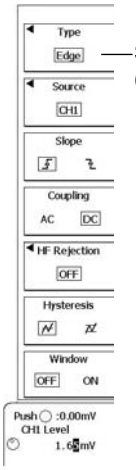
Set the time width mode.

Set the reference time.

Configuring Events (Event Setup)

Press the **Event Setup** soft key to display the following menu.

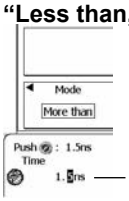
The event settings are the same as the trigger settings. For details about the settings, see the various sections that explain triggering.



Set the event type.
(See the trigger type explanations for details.)

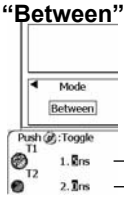
Setting the Time Width Mode (Mode)

When the Time Width Mode Is "More than," "Less than," or "Time Out"



Set the reference time.

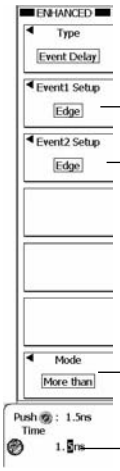
When the Time Width Mode Is "Between" or "Out of Range"



Set reference time T1.
Set reference time T2.

Event Delay Menu

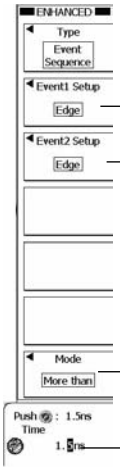
Press **ENHANCED**, the **Type** soft key, the **Event Interval** soft key, and then the **Event Delay** soft key to display the following menu.



Press to configure the event 1. (The same as configuring a trigger.)
Press to configure event 2. (The same as configuring a trigger.)
Set the time width mode (same as Event Cycle).
Set the reference time.

Event Sequence Menu

Press **ENHANCED**, the **Type** soft key, the **Event Interval** soft key, and then the **Event Sequence** soft key to display the following menu.



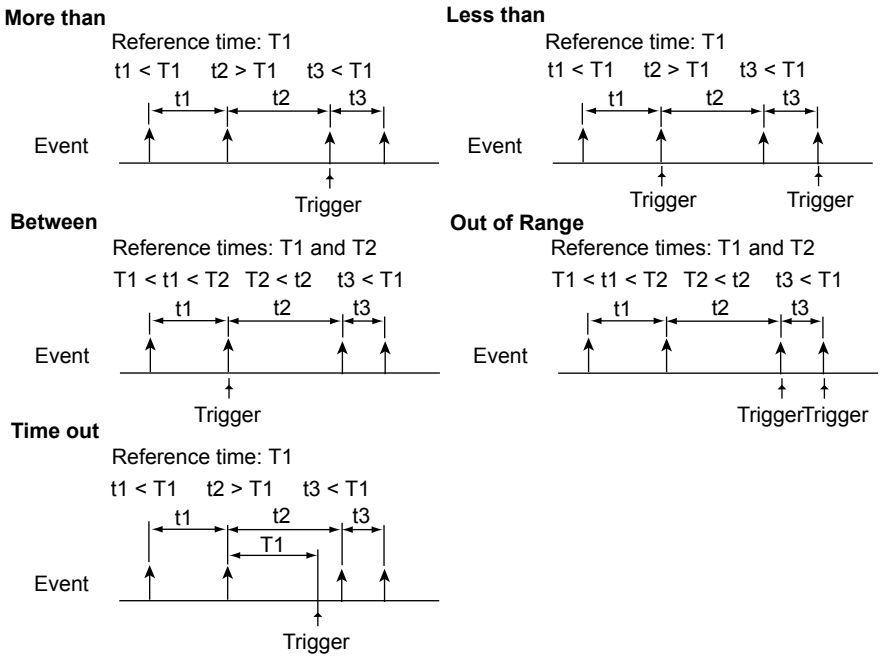
Press to configure the event 1. (The same as configuring a trigger.)
Press to configure event 2. (The same as configuring a trigger.)
Set the time width mode (same as Event Delay).
Set the reference time.

Explanation

You can use this feature to trigger by treating the occurrences of the trigger conditions as events.

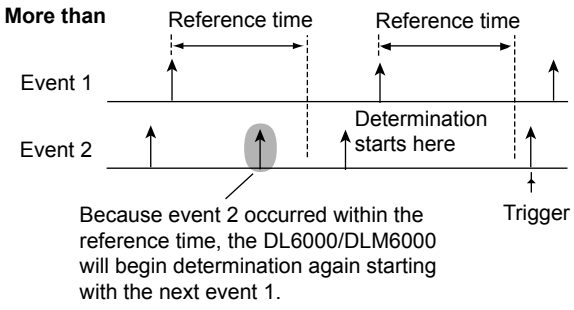
Event Interval (Event Cycle)

The DL6000/DLM6000 triggers when the interval between event occurrences meets the specified time conditions.



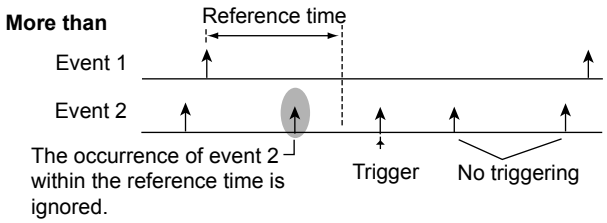
Event Delay (Event Delay)

The DL6000/DLM6000 triggers according to the relationship between two events.
The DL6000/DLM6000 will trigger when the specified relationship is established between the set time and the time interval from the occurrence of event 1 to the first occurrence of event 2. If the time interval from the occurrence of event 1 to the first occurrence of event 2 does not match the specified time conditions, the DL6000/DLM6000 will search for the conditions again after event 1 occurs. The following is an example for when the time width mode is set to “More than.”



Event Sequence (Event Sequence)

The DL6000/DLM6000 triggers according to the relationship between two events.
The DL6000/DLM6000 will trigger when the specified relationship is established between the set time and the time interval from the occurrence of event 1 to the first occurrence of event 2. If the time interval between from the occurrence of event 1 to the first occurrence of event 2 does not match the specified time conditions, the DL6000/DLM6000 will ignore the first occurrence of event 2 and wait until event 2 occurs at a time that satisfies the time conditions. The following is an example for when the time width mode is set to “More than.”



Time Width Modes (Mode)

For Event Cycle

More than	The DL6000/DLM6000 triggers on the ends of event intervals that exceed the specified reference time.
Less than	The DL6000/DLM6000 triggers on the ends of event intervals that are shorter than the specified reference time.
Between	The DL6000/DLM6000 triggers on the ends of event intervals that are longer than T1 and shorter than T2.
Out of Range	The DL6000/DLM6000 triggers on the ends of event intervals that are shorter than T1 or longer than T2.
Time out	The DL6000/DLM6000 triggers when an event interval exceeds the specified reference time.

For Event Delay and Event Sequence

More than	The DL6000/DLM6000 triggers on the occurrence of event 2 when the time between the occurrence of event 1 and the occurrence of event 2 is longer than the specified reference time.
Less than	The DL6000/DLM6000 triggers on the occurrence of event 2 when the time between the occurrence of event 1 and the occurrence of event 2 is shorter than the specified reference time.
Between	The DL6000/DLM6000 triggers on the occurrence of event 2 when the time between the occurrence of event 1 and the occurrence of event 2 is longer than T1 and shorter than T2.
Out of Range	The DL6000/DLM6000 triggers on the occurrence of event 2 when the time between the occurrence of event 1 and the occurrence of event 2 is shorter than T1 or longer than T2.
Time out	The DL6000/DLM6000 triggers when the time between the occurrence of event 1 and the occurrence of event 2 exceeds the specified reference time.

Event Reference Time

For Event Cycle

You can set the reference time to a value from 1.5 ns to 10.00 s in 0.5 ns steps.

Note

The DL6000/DLM6000 may not trigger properly if the spacing between signals or the signal pulse width is less than 2 ns. Under standard operating conditions, the time width accuracy is ±(0.2% of the set value + 1 ns) immediately after calibration. The “set value” in the above expression is the T2 value when T1 < Pulse < T2.

For Event Delay and Event Sequence

- When event 1 and event 2 are both based on analog signals or both based on logic signal bits, you can set each of the reference times to a value from 1.5 ns to 10.00 s in 0.5 ns steps.
- When event 1 and event 2 are based on different types of signals (one is based on a logic signal bit and the other is based on an analog signal), you can set each of the reference times to a value from 20.0 ns to 10.00 s in 0.5 ns steps.

Note

- When event 1 and event 2 are both based on analog signals or both based on logic signal bits, the DL6000/DLM6000 may not trigger properly if the spacing between signals or the signal pulse width is less than 2 ns. Under standard operating conditions, the time width accuracy is ±(0.2% of the set value + 1 ns) immediately after calibration. The “set value” in the above expression is the T2 value when T1 < Pulse < T2.
- When event 1 and event 2 are based on different types of signals (one is based on a logic signal bit and the other is based on an analog signal), the time width accuracy is ±(0.2% of the set value + 10 ns). The “set value” in the above expression is the T2 value when T1 < Pulse < T2.

Event Type

You can use any trigger as an event except for Edge OR, TV, and UART triggers. For more details, see the various sections that explain triggering.

Event Source

Sent an event source that matches the specified event type. For more details, see the various sections that explain triggering.

6.12 Triggering on Combination Triggers (B TRIG)

Procedure

B TRIG Menu

Press **B TRIG** to display the following menu.

A Delay B Trigger

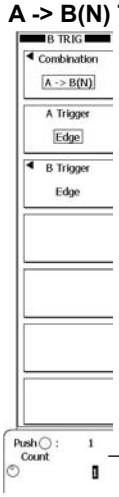
Set the combination type (OFF, A Delay B, A -> B(N)).

The A trigger (indicates the selected trigger type)

Press to configure the B trigger (Type is fixed at Edge).

Set the delay value.

A -> B(N) Trigger



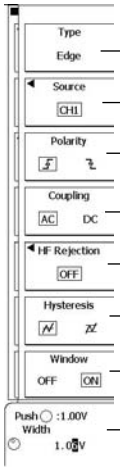
Set the number of times condition B must be met.

Configuring Trigger B (B Trigger)

Press the **B Trigger** soft key to display the following menu.

The trigger type for trigger B is fixed at Edge. For an explanation of the edge trigger settings, see section 6.3.

When the Trigger Source Is a Channel from CH1 to CH4



Fixed at edge

Set the trigger source (CH1, CH4).

Set the trigger slope.

Set the trigger coupling (AC, DC).

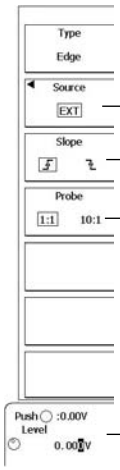
Set the HF rejection (OFF, 20 MHz, 15 kHz).

Set the hysteresis (,).

Turns the window comparator on and off

Set the trigger level.

When the Trigger Source Is EXT



— Set the trigger source to EXT.

— Set the trigger slope (,).

— Set the probe attenuation (1:1, 10:1).

— Set the trigger level.

Explanation

The DL6000/DLM6000 can trigger on the combination of trigger A (condition A) and trigger B (condition B).

Trigger Combination (Combination)

Set how to combine the trigger A and B conditions.

- OFF: The DL6000/DLM6000 only triggers on the trigger A conditions (the trigger B conditions are not used).
- A Delay B: After the trigger A conditions are met and the specified amount of time elapses, the DL6000/DLM6000 triggers when the trigger B conditions are met.
  You can set the delay time to a value from 0 to 10 s in 2 ns steps.
- A → B(N): After the trigger A conditions are met, the DL6000/DLM6000 triggers when the trigger B conditions are met N times.
  You can set the number of times that the trigger B conditions must be met to a value from 0 to 10^9 in steps of 1.

Trigger A (A Trigger)

The trigger conditions you set using the EDGE or ENHANCE key are the trigger A conditions. You cannot set the trigger A conditions in the B TRIG menu.

Note

When the trigger mode is Auto, the timeout only applies to the trigger A conditions.

Trigger B (B Trigger)

The trigger type for trigger B is fixed at Edge. You can set the conditions for trigger B in the B TRIG menu.

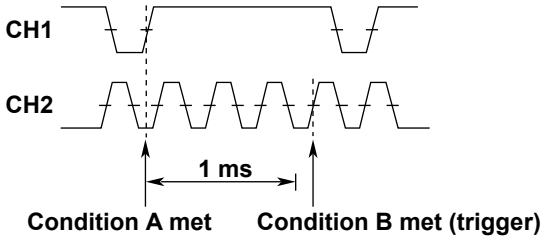
Note

The Auto and Auto Level trigger modes do not affect trigger B.

Examples

A Delay B Trigger

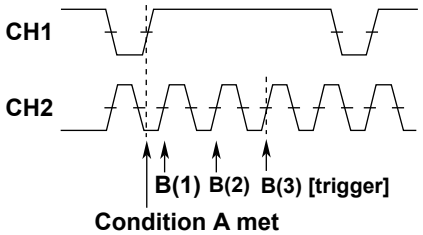
After the trigger A conditions are met and the specified amount of time elapses, the DL6000/DLM6000 triggers when the trigger B conditions are first met.



Condition A: Edge trigger, CH1 = ↓,
Condition B: Edge trigger, CH2 = ↓, Delay = 1 ms

A→B(N) Trigger

After the trigger A conditions are met, the DL6000/DLM6000 triggers when the trigger B conditions are met N times.



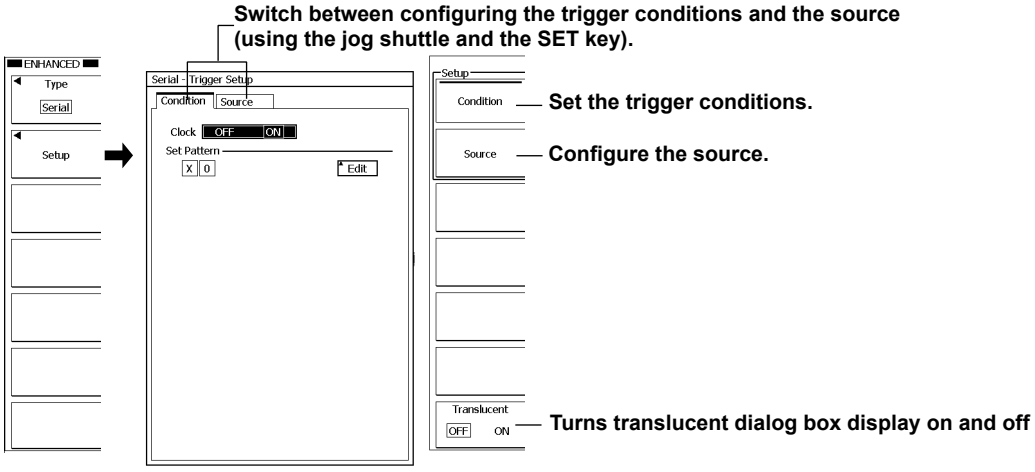
Condition A: Edge trigger, CH1 = ↓,
Condition B: Edge trigger, CH2 = ↓, N = 3

6.13 Triggering on a Serial Pattern Signal

Procedure

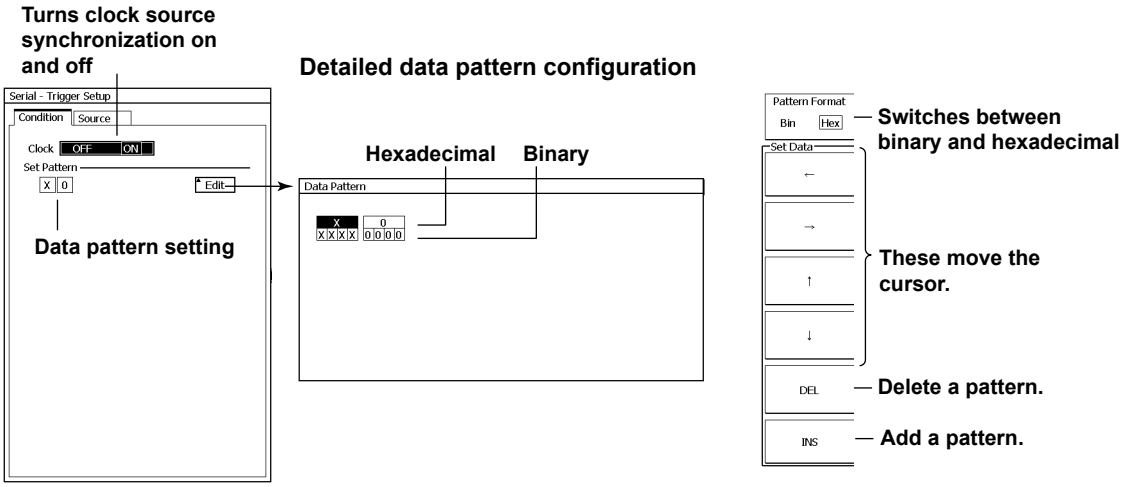
Serial Menu

Press **ENHANCED**, the **Type** soft key, the **Serial Bus** soft key, and then the **Serial** soft key to display the following menu.



Setting Trigger Conditions (Condition)

Specify the data pattern to compare with the trigger source.



Adding a Data Pattern

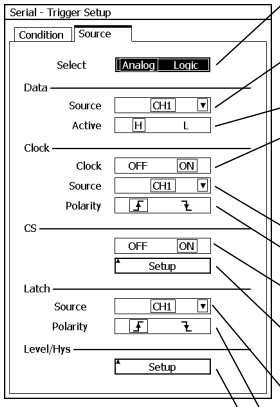
Press the **INS** soft key to activate the data pattern insertion mode. A triangular mark will appear at the data insertion point. Press **SET** to insert the data pattern.

Setting the Trigger Source (Source)

Specify the trigger source to compare with the data pattern and the comparison conditions.

For Analog Sources

When Clock Is Set to ON



Set the trigger source type to Analog.

Select the data source (CH1-CH4).

Select the active state.

Turns clock source synchronization on and off (the same as the Clock setting in the Condition tab)

Select the clock source.

Select rising or falling.

Turns state condition comparison on and off

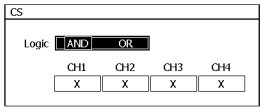
Set the state conditions (when CS is set to ON).

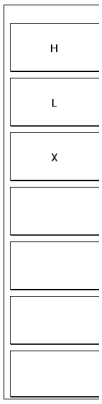
Select the latch source. (Select a channel from CH1 to CH4 or select X to not specify a latch.)

Select rising or falling.

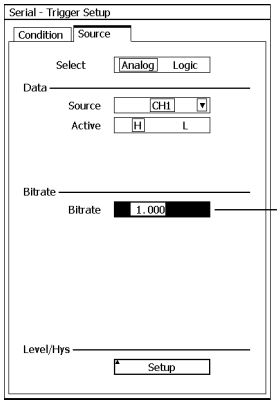
Press to configure the levels and hysteresis for the data, clock, CS, and latch sources.

State condition settings



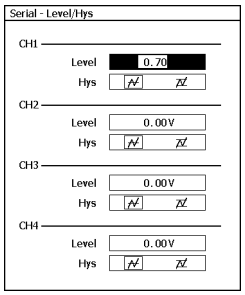


When Clock Is Set to OFF



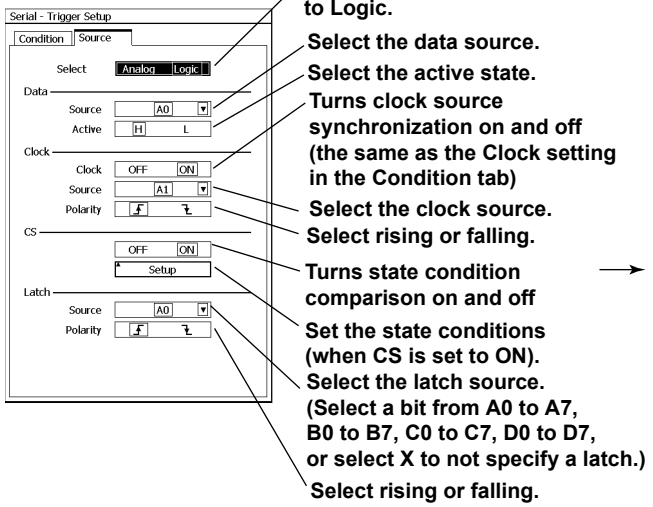
Set the bit rate.

Configure the detection level and hysteresis settings.

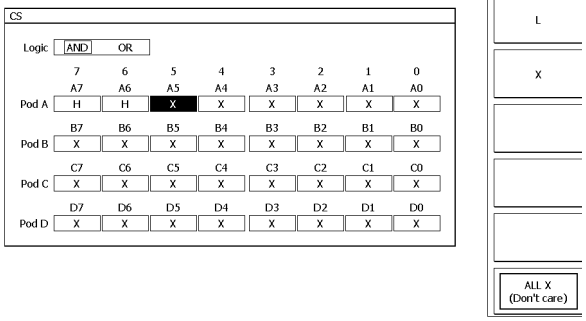


For Logic Sources

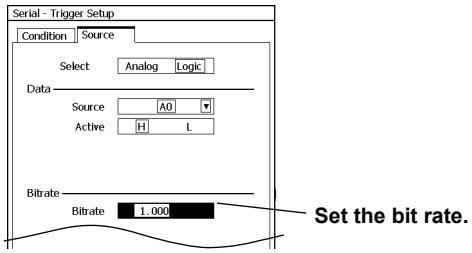
When Clock Is Set to ON



State condition settings



When Clock Is Set to OFF



Explanation

You can use this feature to trigger on a serial pattern signal. The DL6000/DLM6000 compares the source signal with the data pattern that you set and triggers when the two match.

Data, Clock, CS, and Latch Sources (Select)

You can set the sources for the data, clock, CS, and latch signals to analog signals or logic signal bits.
When you choose analog signals, you can select the sources from CH1 to CH4.
When you choose the logic signal, you can select the sources from bits A0 to A7, B0 to B7, and D0 to D7. (On 16-bit models, you can select from bits A0 to A7 and C0 to C7.)

Clock

Clock Setting

You can select whether or not to sample the data source in sync with the selected clock source.

ON	The DL6000/DLM6000 samples in sync with the clock source.
OFF	The DL6000/DLM6000 does not synchronize to the clock source.

Sample Timing

You can select which edge of the clock source to sample data patterns on.

↑	On the rising edge
↓	On the falling edge

Data Pattern (Set Pattern)

You can use a data pattern as a trigger condition. The data pattern trigger condition is met when the sampled data source pattern matches the specified pattern.

- You specify patterns of up to 128 bits in length in hexadecimal or binary format.
- If you specify an X in a pattern, the condition is assumed to be met regardless of the corresponding bit status.
- If a binary pattern contains any Xs, the corresponding hexadecimal display will be “$.”

Bit Rate (Bitrate)

If Clock is set to OFF, the DL6000/DLM6000 samples the data source at the specified bit rate.
Range: 1 kbps to 50 Mbps in 1 kbps steps

State (CS)

When Clock is set to ON, you can control the period during which the data source is tested by using the state conditions (CS).

ON	The data source is tested when the state conditions are met.
OFF	The data source is always tested.

State Conditions

You can set the state condition for each signal to H, L, or X. When the comparison of the selected state conditions and the states of the input signals meets the requirement of the Logic setting described below, the result of the comparison is “met.”,

H	The signal level must be high.
L	The signal level must be low.
X	No conditions have to be met (“don’t care”).

* For CH1 to CH4, the DL6000/DLM6000 determines the high and low reference levels using the trigger levels described below. For bits A0 to D7, the DLM6000 determines the high and low levels using the threshold level setting described in section 5.2.

Logic

You can select the logic for the state conditions. When the result of comparing the state conditions is true according to the specified logic, the result of comparison is set to “met.”

AND	All the signal states must match their specified state conditions.
OR	One or more of the signal states must match their specified state condition.

Latch

When Clock is set to ON, you can specify the timing at which the sampled data source pattern is compared with the specified trigger condition pattern. If you set the source to X, the patterns are compared at each sample.
You can select which latch source edge causes the data patterns to be compared.

↑	The rising edge
↓	The falling edge

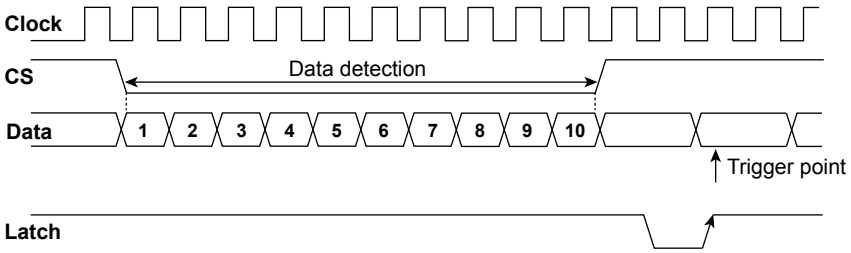
Threshold Level and Hysteresis (Level/Hys)

You can specify the threshold level when you have set the source signal type (Select) to Analog.

- You can set the threshold level in 0.01 division steps to a value that fits within the 8 divisions of the screen. For example, when the voltage scale is 2 V/division, you can set the threshold in 0.02 V steps.
- You can reset the trigger level to the current offset voltage by pressing RESET.

The hysteresis setting is the same as that for the Edge trigger. For details, see section 6.3.

Examples



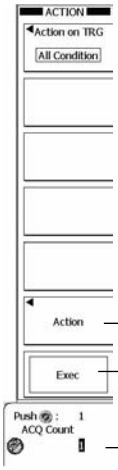
The latch signal specifies the time when data is compared.

6.14 Setting the Action-On-Trigger

Procedure

Action on Trig Menu

Press **SHIFT**+**MODE**(ACTION GO/NO-GO), the **Mode** soft key, the **Action on Trig** soft key, and then the **All Condition** soft key to display the following menu.



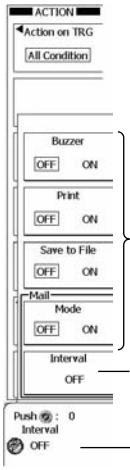
Press to configure the action settings.

Executes action-on-trigger

Set the acquisition and action counts.

Setting the Actions to Execute (Action)

Press the **Act on** soft key to display the following menu.



These turn each action on and off.

Set the interval (OFF, 1 to 1440 min).

Set the interval (OFF, 1 to 1440 min).

Executing Actions (Exec)

After specifying the action mode, the actions to execute, and the number of actions, press the **Exec** soft key. The DL6000/DLM6000 executes the actions each time it triggers until the specified number of actions has been reached.

While actions are being executed, Exec changes to Abort. If you want to stop the execution of actions, press the **Abort** soft key.

Note

When one of the actions to execute is e-mail transmission, the DL6000/DLM6000 sends the number of messages specified by either Action Count or Mail Count, whichever is lower.

Explanation

You can use this feature to perform specified actions when a trigger occurs.

Action Mode (Action on TRIG)

You can choose one of the methods listed below for triggering an action. Pressing the Exec soft key will temporarily switch the trigger mode to Normal and cause the selected actions to be executed.

OFF

The DL6000/DLM6000 will acquire the number of signals specified by ACQ Count and then stop. No actions are performed.

All Condit on

The DL6000/DLM6000 executes the specified actions whenever a trigger occurs. The DL6000/DLM6000 will acquire the number of signals specified by ACQ Count and then stop.

Zone/Parameter (GoNogo)

The DL6000/DLM6000 performs GO/NO-GO determination using a zone or parameter. The DL6000/DLM6000 executes the specified actions whenever the result is no-go. For details, see sections 6.15 and 6.16.

Mask (GoNogo)

The DL6000/DLM6000 performs GO/NO-GO determination using a mask test or eye pattern. The DL6000/DLM6000 executes the specified actions whenever the result is no-go. For details, see section 6.17.

Trigger Actions (Action)

You can make the DL6000/DLM6000 perform the following actions when a trigger occurs.

Buzzer (Buzzer)

The DL6000/DLM6000 generates an alarm.

Print or Save the Screen Image (Print)

The DL6000/DLM6000 prints the screen image to the printer specified by “Copy to” in the PRINT menu or stores the screen image data to the specified storage medium. The available printer options are Built-in Printer, USB Printer, and Network Printer.

Save the Measured Data (Save to File)

The DL6000/DLM6000 saves the measured data to the save destination specified in the FILE menu. You can choose to save the data in binary, ASCII, or floating point format. The format that the data is saved in depends on the data type setting in the FILE menu (see chapter 13 for details).

Send an E-mail (Mail-Mode/Interval)

The DL6000/DLM6000 sends an e-mail to the specified addresses (if it is equipped with the Ethernet interface option).
To set the e-mail address, see section 14.4.

Note

When you set e-mail transmission as a trigger action, we recommend that you set a limit on the number of e-mail transmissions to avoid overloading the mail server. You can set the upper limit for mail transmissions to the ACQ count or the NO-GO count (when GO/NO-GO determination is used).

Action Count

- 1 to 1000000
  The DL6000/DLM6000 performs the specified actions for the set number of times.
- Infinite
  The DL6000/DLM6000 continues performing the specified actions until signal acquisition is stopped.

How the DL6000/DLM6000 Operates When the Action Setting Is Print or Save to File

The DL6000/DLM6000 operates according to the settings in the Print menu or FILE menu. To access these menus and their settings, see chapter 12, “Printing Screen Captures,” and chapter 13, “Saving and Loading Data.” When the File Menu’s auto naming feature is OFF, file names will be assigned through numbering. When auto naming is not off, the files are saved using the specified method.

Trigger Mode

The trigger mode temporarily switches to Normal.

This trigger mode is independent from the trigger mode set according to the procedure described in section 6.1.

Mail Transmission Operations

Enabling and Disabling Mail Transmission (Mode)

When Mode is ON, e-mails will be sent to the addresses specified in: UTILITY menu > Network > E-mail Setup > Address (To Address/From Address).

E-mail Transmission Interval (Interval)

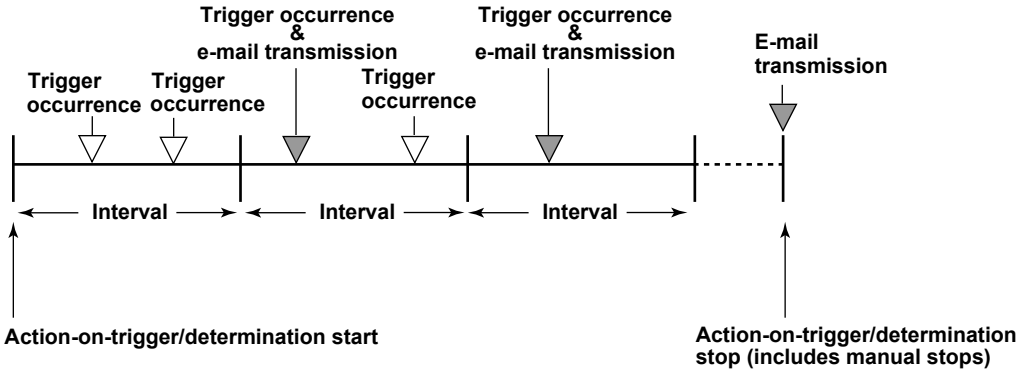
The DL6000/DLM6000 will send an e-mail at the first trigger occurrence after the interval specified here elapses.

An e-mail will also be sent when the action-on-trigger stops (stopping includes manual stops).

The range of e-mail transmission intervals that you can set is indicated below. If you select OFF, an e-mail will be sent whenever a trigger occurs.

OFF to 1440 min (in 1 min steps)

An example of e-mail transmission with a set interval:



E-mail Content

The e-mail content varies depending on the selected actions and GO/NO-GO conditions.

When All Condition Is Set as an Action

<Subject>: The subject of the e-mail. It may be labeled differently depending on the e-mail software (as “title” for example). The content of the subject is indicated below. The number in parentheses is the number of returned NO-GO results.
All Condition Triggered Report (No.) or All Condition Interval Report (No.)

[Comment]: Comments

[Trigger Date and Time]:
The time of trigger occurrence

[ACQ Count]: The action count

Example of a Typical E-Mail
<Subject> All Condition Interval Report 2
----------Body
[Comment] Sample-All Condition
[Trigger Date and Time] 2009/11/01 16:47:04
[ACQ Count] 1367

Note

Points to Consider When Configuring Action-on-Trigger

- You cannot change settings while the action-on-trigger feature is active.
- Exponential averaging is used.

Points to Consider When Setting the Action Setting to “Save to File”

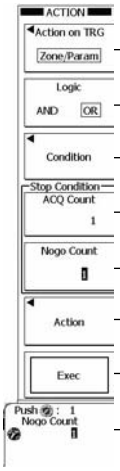
- If you set sequential numbering as the auto naming method (using the FILE menu), as the number of saved files increases, the amount of time required to save a file will also increase. Also, the maximum number of files that can be saved using sequential numbering is 1000. To save more than 1000 files, set the auto naming feature so that files are named by date.
- Up to 2500 files and folders can be displayed in the file list. If there are more than a total of 2500 files and folders in a given folder, the file list for that folder will only display 2500 files and folders. There is no way to set which files and folders are displayed.

6.15 Performing GO/NO-GO Determination with Zones

Procedure

Action Go/Nogo Menu

Press **SHIFT**+**MODE**(ACTION GO/NO-GO), the **Action on TRIG** soft key, and then the **Zone Param** soft key to display the following menu.



Set the GO/NO-GO determination type to Zone/Param.

Set the determination logic (AND, OR).

Press to configure the determination conditions.

Set the number of waveform acquisitions (using the jog shuttle).

Set the number of NO-GO determinations (using the jog shuttle).

Press to set the actions to perform when the conditions are met.

Executes (Exec) or stops (Abort) GO/NO-GO determination

Set the waveform acquisition count and the NO-GO determination count.

Setting Conditions for Determination (Condition)

Press the **Condition** soft key to display the following menu.

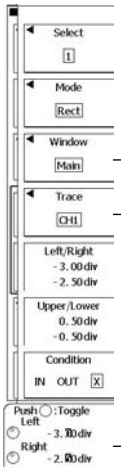
Set the determination condition number.

Set the determination mode (Rect, WAVE, Polygon, Parameter*).
*** See section 6.16 for details.**

The setup menu varies depending on the determination mode.

Set the reference condition (IN, OUT, X).

Using a Rectangular Zone for Determination (Rect)



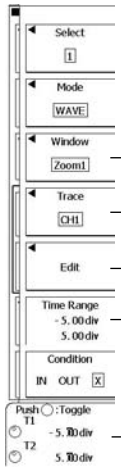
Set the determination source window (Main, Zoom1, Zoom2, XY1, XY2).

Select the source waveform (CH1-CH4, M1-M4).

Edit the rectangular zone
(by setting the upper, lower, left, and right limits using the jog shuttle).

Set the left, right, upper, and lower limits of the rectangular zone.

Using a Waveform Zone for Determination (WAVE)



Set the determination source window (Main, Zoom1, Zoom2).

Select the source waveform (CH1-CH4, M1-M4).

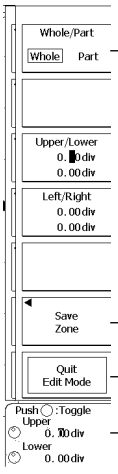
Press to edit the waveform zone.

Switches the item that the jog shuttle adjusts (between T1 and T2).

Set the determination time range.

Creating a New Waveform Zone (New REF Trace)

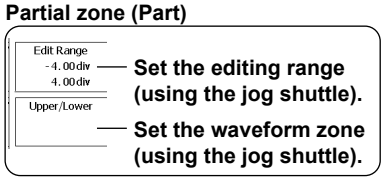
Press the **Edit** soft key, the **New REF Trace** soft key, and then a soft key from **CH1** to **CH4** or **M1** to **M4** to display the following menu.



Set the zone to edit.
(Select Whole to edit the entire waveform zone or Part to edit part of it.)

Partial zone (Part)

Set the upper, lower, left, and right limits of the waveform zone using the jog shuttle.



Set the editing range (using the jog shuttle).

Set the waveform zone (using the jog shuttle).

Saves the edited zone
(to a number from 1 to 4)

Finishes editing

Set the waveform zone and the editing range
(Upper/Lower, Left/Right, and E-Range1/2).

Creating a New Zone from a Previously Saved Zone (Load Zone)

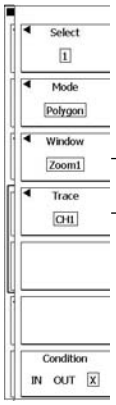
Press the **Edit** soft key, the **Load Zone** soft key, and then a soft key from **#1** to **#4**. The zone that you specified is loaded.

Editing Zones (Modify Zone)

Press the **Edit** soft key and then the **Modify Zone** soft key to display the waveform zone edit menu.

Using a Polygonal Zone for Determination (Polygon)

Using the **FILE** menu, load a polygon image into a specified zone (Zone1 to Zone4).



Set the determination source window (Main, Zoom1, Zoom2, XY1, XY2).

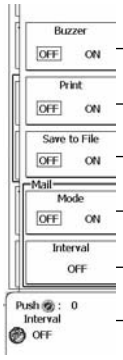
Select the source waveform (CH1-CH4, M1-M4).

Note

You can create polygon images on a PC by using the Mask Editor Software.

Actions to Execute When Conditions Are Met (Action)

Press the **Action** soft key to display the following menu.



Turns the buzzer on and off

Turns screen capture printing and saving on and off

Turns the saving of measured data on and off

Turns mail transmission on and off

Set the e-mail transmission interval (using the jog shuttle).

Set the transmission interval.

Explanation

The DL6000/DLM6000 determines whether the acquired waveform meets the reference conditions (NO-GO result) or not (GO result). When the DL6000/DLM6000 produces a NO-GO result, it executes the specified actions.
You can specify up to four determination conditions. You can also apply AND or OR logic to the four determination conditions.
You can use the following types of zones as determination conditions.
Rectangular, waveform, and polygonal zones

GO/NO-GO Determination Mode (Action on TRIG)

You can set the GO/NO-GO determination mode to one of the settings below.

- OFF: The DL6000/DLM6000 will acquire the number of signals specified by ACQ Count and then stop.
- All Condition: The DL6000/DLM6000 executes the specified actions whenever a trigger occurs (see section 6.13 for details).
- Zone/Parameter (GoNogo):
  Select this mode when you want to perform GO/NO-GO determination using a zones or parameter.
- Mask (GoNogo): Select this mode when you want to perform GO/NO-GO determination using a mask test or eye pattern (see section 6.17 for details).

Determination Logic (Logic)

You can set the determination logic for determination condition numbers 1 to 4.

- AND: The DL6000/DLM6000 executes the specified actions whenever all the determination conditions are NO-GO.
- OR: The DL6000/DLM6000 executes the specified actions whenever any of the determination conditions are NO-GO.

Determination Condition Numbers (Select)

For determination conditions 1 to 4, set the source waveform, determination range (the waveform zone upper and lower limits), and the reference condition.

Determination Mode (Mode)

You can select the determination mode from the following options.

- Rect: You can create a rectangular zone by specifying upper, lower, left, and right limit values and perform GO/NO-GO determination based on whether or not the waveform is within the zone.
- WAVE: You can create a zone based on a reference waveform and perform GO/NO-GO determination based on whether or not the waveform is within the zone.
- Polygon: You can load a polygonal zone that you have created on a PC and perform GO/NO-GO determination based on whether or not the waveform is within the zone (see section 6.19 for details).
- Parameter: See section 6.16 for details.

Reference Condition (Condition)

Select whether the source waveform must be in or out of the determination range to produce a NO-GO result.

- IN: Waveforms that are inside of the determination range are detected.
- OUT: Waveforms that are outside of the determination range are detected.
- X: The source waveform is not used for GO/NO-GO determination.

Determination Source Window

You can select the determination source window from the following options. However, you cannot set the determination source window to XY1 or XY2 when you are using a waveform zone.

- Main: GO/NO-GO determination is performed on the waveform in the main window.
- Zoom1: GO/NO-GO determination is performed on the waveform in the Zoom1 window.
- Zoom2: GO/NO-GO determination is performed on the waveform in the Zoom2 window.
- XY1: GO/NO-GO determination is performed on the waveform in the XY1 window.
- XY2: GO/NO-GO determination is performed on the waveform in the XY2 window.

Source Waveform (Trace)

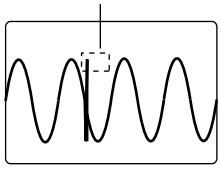
Select a waveform from CH1 to CH4 or M1 to M4.

Determination Zone (Edit)

Rectangular Zones

To create a rectangle, use the jog shuttle or the **SET** key to set the top, bottom, right, and left boundaries of the rectangle.

When the reference condition is set to IN and the waveform enters the specified rectangular zone, a NO-GO judgment is made.



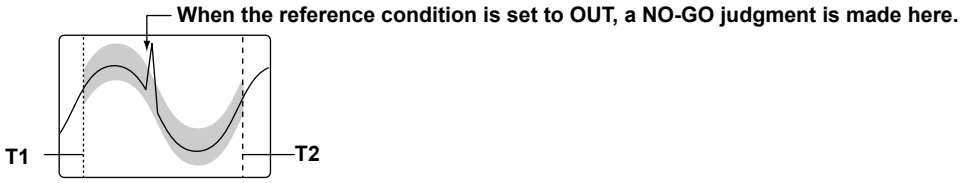
Creating a Zone (Upper/Lower and Left/Right)

When you create a rectangular zone:

- You can set the left and right boundaries to values that are ±5 divisions from the screen center in 0.01 division steps.
- You can set the top and bottom boundaries to values that are ±4 divisions from the screen center in 0.01 division steps.

Waveform Zones

Create a zone based on a specified waveform. You can create up to four waveform zones and use one of them for GO/NO-GO determination.



Determination Time Range (Time Range)

The DLM2000 performs GO/NO-GO determination on the waveform in the area specified by T1 and T2. The default setting is ±5 divisions on the time axis in the display area.

Creating a New Waveform Zone (New REF Trace)

You can select the base waveform for creating the waveform zone from one of the options below.
A channel from CH1 to CH4 or M1 to M4.

Loading Waveform Zones (Load Zone)

You can select a waveform to edit from one of the waveform zones (numbered 1 through 4) in internal memory.

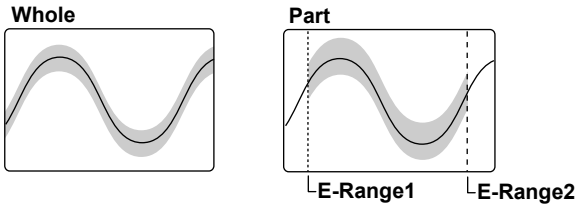
Editing the Waveform Zone (Modify Zone)

You can re-edit the determination zone displayed on the screen.

Editing Waveform Zones (Whole and Part)

You can create a vertical or horizontal zone on the entire waveform or on a portion of the waveform. The waveform zone that you create can be stored in internal memory.

- Whole: You can edit the entire waveform.
- Part: You can edit a portion of the waveform.



Setting Zones (Upper/Lower, Left/Right, and Edit Range)

You can set the vertical and horizontal zone boundaries.

- You can set the vertical zone range to a value within ±8 divisions from the base waveform.
- You can set the horizontal zone range to a value within ±5 divisions from the center of the screen.

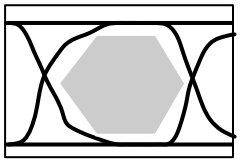
Saving Waveform Zones (Save Zone)

You can save the current waveform zone to internal memory.

Polygonal Zones (Polygon-Zone)

You can create polygonal zones by using polygon images. You can create polygon images by using the Mask Editor Software on a PC. You can create up to four polygonal zones and use one of them for GO/NO-GO determination.

You can download the Mask Editor Software from the YOKOGAWA website.



Loading a Polygon Image

Using the **FILE** Menu, load a polygon image into a specified zone (Zone No.1 to 4).

Note

The rectangular zone is cleared if you set Condition to X or if you turn off the determination source waveform display.

Number of Actions (ACQ Count/Nogo Count)

Signal acquisition stops when the specified ACQ Count or Nogo Count is reached.

- **ACQ Count**

  You can specify how many times you want to acquire the signal.

1 to 1000000	After the set number of signals has been acquired, acquisition stops.
Infinite (0)	Acquisition continues until you press the Abort soft key or RUN/STOP.

- **Nogo Count**

  The DL6000/DLM6000 stops acquisition after it returns the set number of NO-GO results.

1 to 1000	Acquisition stops after the set number of NO-GO results are returned.
Infinite (0)	Acquisition continues until you press the Abort soft key or RUN/STOP.

Actions to Execute When Conditions Are Met (Action)

The DL6000/DLM6000 executes the specified actions each time the conditions are met. You can specify any of the four actions below.

Buzzer (Buzzer)

The DL6000/DLM6000 generates an alarm.

Print or Save the Screen Image (Print)

The DL6000/DLM6000 prints the screen image to the printer specified by “Copy to” in the PRINT menu or stores the screen image data to the specified storage medium. The available printer options are Built-in Printer, USB Printer, and Network Printer.

Save the Measured Data (Save to File)

The DL6000/DLM6000 saves the measured data to the save destination specified in the FILE menu. You can choose to save the data in binary, ASCII, or floating point format. The format that the data is saved in depends on the data type setting in the FILE menu.

Send E-mail (Mail)

The DL6000/DLM6000 sends an e-mail to the specified addresses (if it is equipped with the Ethernet interface option).
To set the e-mail addresses, see “Configuring E-Mail Transmission” in Chapter 14.

Mail Transmission Operations

- **Enabling and Disabling Mail Transmission (Mode)**
  When Mode is ON, e-mails will be sent to the addresses specified in: UTILITY menu > Network > E-mail Setup > Address (To Address/From Address).

- **E-mail Transmission Interval (Interval)**
  The DL6000/DLM6000 will send an e-mail at the first NO-GO result after the interval specified here elapses. An e-mail will also be sent when GO/NO-GO determination stops (stopping includes manual stops).
  The range of e-mail transmission intervals that you can set is indicated below. If you select OFF, an e-mail will be sent whenever a NO-GO result occurs.
  OFF to 1440 min (in 1 min. steps)

E-mail Content

- **When Interval is set to OFF**

  <Subject>: The subject of the e-mail. The content of the subject is indicated below. The number in parentheses is the number of returned NO-GO results.
  GoNogo Triggered Report (No.)

  [Comment]:
  Comment

  [Setup Information]:
  Information about GO/NO-GO conditions 1 to 4.
  Logic(AND/OR)
  Stop Nogo/ACQ Count (The number of NO-GO results/the acquisition count)

  [Trigger Date and Time]:
  The time of trigger occurrence

  [Nogo/Exec Count]:
  The number NO-GO results/the number of judgments performed

  [Nogo Factor]:
  Information, including measured values, about the conditions that returned NO-GO results*

  * Measured values are only sent for GO/NO-GO determinations based on waveform parameters.

- **When Interval is set to a value other than OFF**

  <Subject>: The subject of the e-mail. The content of the subject is indicated below. The number in parentheses is the number of returned NO-GO results.
  GoNogo Interval Report (No.)

  [Comment]:
  Comment

  [Setup Information]:
  Information about GO/NO-GO conditions 1 to 4.
  Logic(AND/OR)
  Stop Nogo/ACQ Count (The number of NO-GO results/the acquisition count)

  [TimeRange]:
  The amount of time that has elapsed since the start of data acquisition

  [Nogo/Exec Count]:
  The number NO-GO results/the number of judgments performed

  [EachNogoCount]:
  The number of NO-GO results for each GO/NO-GO condition (when OR logic is used).
  This is not displayed when AND logic is used.

Note

Notes about GO/NO-GO Determination

- The DL6000/DLM6000 displays the determination results on the screen (the total number of results and the number of NO-GO results).
- During GO/NO-GO determination, only the Abort soft key and RUN/STOP are valid. (When Remote is set to ON, the Exec (One Shot) soft key is also valid.)
- The DL6000/DLM6000 automatically changes the trigger mode to Normal when it executes GO/NO-GO determination.

Points to Consider When Setting the Action Setting to "Save to File"

- If you set sequential numbering as the auto naming method (using the FILE menu), as the number of saved files increases, the amount of time required to save a file will also increase. Also, the maximum number of files that can be saved using sequential numbering is 1000. To save more than 1000 files, set the auto naming feature so that files are named by date.
- If you use the auto naming feature to save data to files, GO/NO-GO determination will stop if the same file name exists in the same folder. To prevent this from happening, you can either create a new empty folder before you start GO/NO-GO determination, or you can make sure that there are no files in the destination folder.
- Up to 2500 files and folders can be displayed in the file list. If there are more than a total of 2500 files and folders in a given folder, the file list for that folder will only display 2500 files and folders. There is no way to set which files and folders are displayed.

Points to Consider when Setting Mail as an Action

- We recommend that you set a limit on the e-mail transmission number to avoid overloading the mail server. You can set the upper limit for e-mail transmissions using the ACQ Count or NO-GO Count setting (when GO/NO-GO determination is used).
- The DL6000/DLM6000 can attach a screen image to an e-mail when Interval is set to OFF, but it cannot attach a screen image when Interval is set to a period of time.

Executing GO/NO-GO Determination (Exec)

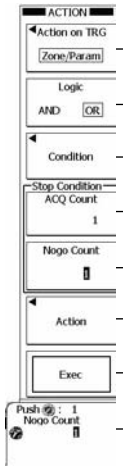
The DL6000/DLM6000 starts determination using the conditions that you specified and performs the specified actions when the conditions are met.

6.16 Performing GO/NO-GO Determination with Parameters

Procedure

Action Go/Nogo Menu

Press **SHIFT**+**MODE**(ACTION GO/NO-GO), the **Action on TRIG** soft key, and then the **Zone Param** soft key to display the following menu.



Set the GO/NO-GO determination type to Zone or Param.

Set the determination logic (AND, OR).

Press to configure the determination conditions.

Set the number of waveform acquisitions (using the jog shuttle).

Set the number of NO-GO determinations (using the jog shuttle).

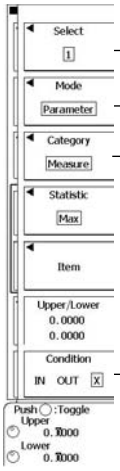
Press to set the actions to perform when the conditions are met.
▶ section 6.15.

Executes (Exec) or stops (Abort) GO/NO-GO determination.

Set the waveform acquisition count and the NO-GO determination count.

Setting Conditions for Determination (Condition)

Press the **Condition** soft key to display the following menu.



Set the determination condition number.

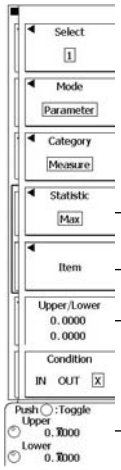
Set the determination mode to Parameter.

Set the category (Measure, FFT, XY).

The setup menu varies depending on the category.

Set the reference condition (IN, OUT, X).

Using Waveform Parameters for Determination (Measure)



Select the item to perform statistical analysis on (Max, Min, Mean, σ)*.
*** Only when the waveform mode is Cycle Statistics**

Press to set which parameter to use for determination.

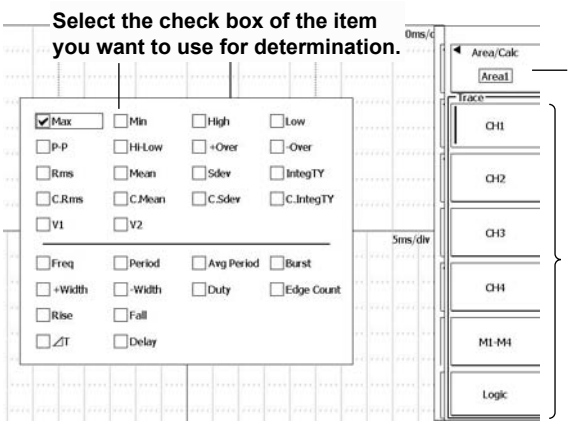
Switches the item that the jog shuttle adjusts (between Upper and Lower).

Set the upper and lower limits of the determination range.

Selecting Which Parameter to Use for Determination (Item)

Press the **Item** soft key to display the following menu.

When Mode in the MEASURE Menu Is Set to Basic, Continuous Statistics, or History Statistics



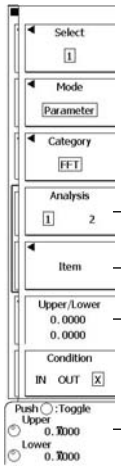
Select the check box of the item you want to use for determination.

Select the item to use for determination (Area1, Area2, Calc).*

Set the source waveform (CH1-CH4, M1-M4, LOGIC).

*** When the waveform mode is Cycle Statistics, this becomes the Select soft key (Basic/Calc).**

Using FFT Parameters for Determination



Set the number of the analysis that you want to use for determination (1, 2).

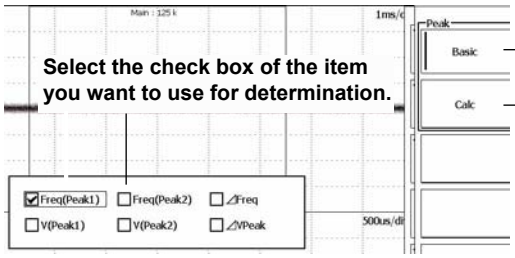
Press to set the FFT parameter to use for determination.

Switches the item that the jog shuttle adjusts (between Upper and Lower).

Set the upper and lower limits of the determination range.

Selecting Which Parameter to Use for Determination (Item)

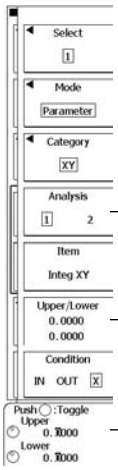
Press the **Item** soft key to display the following menu.



Select if you want to use a standard analysis item (Peak).

Select if you want to use a registered expression.

Using XY Parameters for Determination



Set the number of the analysis that you want to use for determination (1, 2).

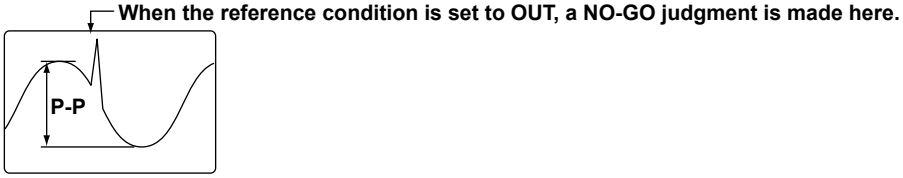
Switches the item that the jog shuttle adjusts (between Upper and Lower).

Set the upper and lower limits of the determination range.

Explanation

The DL6000/DLM6000 determines whether the acquired waveform meets the reference conditions (NO-GO result) or not (GO result). When the DL6000/DLM6000 produces a NO-GO result, it executes the specified actions.
You can specify up to four determination conditions. You can also apply AND or OR logic to the four determination conditions.
You can use the following types of parameters as determination conditions.
Waveform parameter values, FFT analysis items, and XY waveform areas

When the P-P Value Is Used for Determination



GO/NO-GO Determination Mode (Action on TRIG)

You can set the GO/NO-GO determination mode to one of the settings below.

- OFF: The DL6000/DLM6000 will acquire the number of signals specified by ACQ Count and then stop.
- All Condition: The DL6000/DLM6000 executes the specified actions whenever a trigger occurs (see section 6.13 for details).
- Zone/Parameter (GoNogo): Select this mode when you want to perform GO/NO-GO determination using a zone or parameter.
- Mask (GoNogo): Select this mode when you want to perform GO/NO-GO determination using a mask test or eye pattern (see section 6.17 for details).

Determination Logic (Logic)

You can set the determination logic for determination condition numbers 1 to 4.

- AND: The DL6000/DLM6000 executes the specified actions whenever all the determination conditions are NO-GO.
- OR: The DL6000/DLM6000 executes the specified actions whenever any of the determination conditions are NO-GO.

Determination Condition Numbers (Select)

For determination conditions 1 to 4, set the determination source window (only for FFT and XY parameters), the determination range (the parameter upper and lower limits), and the reference condition.

Parameter (Item)

When Using Waveform Parameters (Measure)

Selecting the Item That You Want to Use for Determination (Area, Calc, or Select)

- Area1 or Area2: You can select the item from the standard waveform parameters. You can select whether to use the standard waveform parameters in Area1 or Area2.
- Calc: You can select an item from the expression values registered in the MEASURE menu.
- Basic: You can select an item from the standard waveform parameters. You can select this option when the Mode item in the MEASURE menu is set to Cycle Statistics.

Determination Source Waveform

You can select the determination source waveform from the following options.
A channel from CH1 to CH4 or M1 to M4, or LOGIC

When Using FFT Parameters

Selecting Which Item to Use for Determination (Peak)

- Basic: You can select from the standard FFT analysis items (Peak).
- Calc: You can select from the expressions that have been registered in the FFT menu (which you can open by pressing SHIFT+MATH/REF).

When Using XY Waveform Parameters

You can perform determination on the area that has been determined using Loop and Polarity according to the settings in the XY menu (which you can open by pressing SHIFT+DISPLAY).

Upper and Lower Parameter Limits (Upper/Lower)

Range for upper and lower limits: –1.0E + 31 to 1.0E + 31

Executing GO/NO-GO Determination (Exec)

The DL6000/DLM6000 starts determination using the conditions that you specified and performs the specified actions when the conditions are met.

Determination Mode (Mode)

You can select the method for specifying the determination range from the following options.

- Rect (see section 6.15 for details)
- WAVE (see section 6.15 for details)
- Polygon (see section 6.15 for details)
- Parameter: You can perform determination using the following types of parameters.
  - Measure: You can perform determination based on whether the value of a particular measurement item falls within specified upper and lower limits.
  - FFT: You can perform determination based on whether the value of a particular FFT analysis result falls within specified upper and lower limits.
  - XY: You can perform determination based on whether the XY waveform area falls within specified upper and lower limits.

Reference Condition (Condition)

You can set whether the waveform parameter value, FFT analysis value, or XY waveform area must be in or out of the determination range to produce a NO-GO result.

- IN: The value must be inside of the determination range.
- OUT: The value must be outside of the determination range.
- X: The value is not used for GO/NO-GO determination.

Determination Source (Analysis)

When the determination mode is FFT or XY, you can specify the search source.

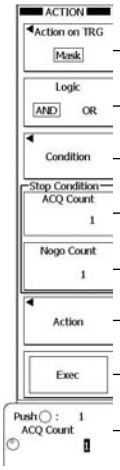
- 1: The FFT or XY waveform of Analysis 1 in the ANALYSIS menu.
- 2: The FFT or XY waveform of Analysis 2 in the ANALYSIS menu.

6.17 Performing GO/NO-GO Determination with Mask Tests and Eye Patterns

Procedure

Action Go/Nogo Menu

Press **SHIFT**+**MODE**(ACTION GO/NO-GO), the **Action on TRIG** soft key, and then the **Mask** soft key to display the following menu.



Set the GO/NO-GO determination type to Mask.

Set the determination logic (AND, OR).

Press to configure the determination conditions.

Set the number of waveform acquisitions (using the jog shuttle).

Set the number of NO-GO determinations (using the jog shuttle).

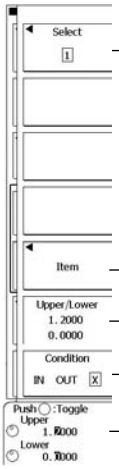
Press to set the actions to perform when the conditions are met
▶ section 6.15.

Executes (Exec) or stops (Abort) GO/NO-GO determination

Set the waveform acquisition count and the NO-GO determination count.

Setting Conditions for Determination (Condition)

Press the **Condition** soft key to display the following menu.



Set the determination condition number.

Press to set the parameter to use for determination.

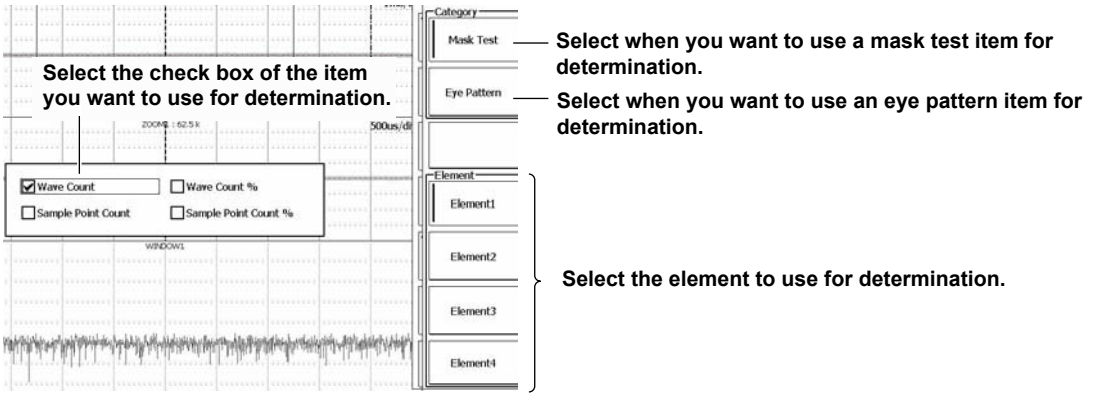
Switches the item that the jog shuttle adjusts (between Upper and Lower).

Set the reference condition (IN, OUT, X).

Set the upper and lower limits of the determination range.

Selecting Which Parameter to Use for Determination (Item)

Press the **Item** soft key to display the following menu.



Explanation

The DL6000/DLM6000 uses a mask test or eye pattern to determine whether the acquired waveform meets the reference conditions (NO-GO result) or not (GO result). When the DL6000/DLM6000 produces a NO-GO result, it executes the specified actions.

You can specify up to four determination conditions. You can also apply AND or OR logic to the four determination conditions.

GO/NO-GO Determination Mode (Action on TRIG)

You can set the GO/NO-GO determination mode to one of the settings below.

- OFF: The DL6000/DLM6000 will acquire the number of signals specified by ACQ Count and then stop.
- All Condition: The DL6000/DLM6000 executes the specified actions whenever a trigger occurs (see section 6.14 for details).
- Zone/Parameter (GoNogo): Select this mode when you want to perform GO/NO-GO determination using a zone or parameter (see sections 6.15 and 6.16 for details).
- Mask (GoNogo): Select this mode when you want to perform GO/NO-GO determination using a mask test or eye pattern.

Determination Condition Numbers (Select)

For search conditions 1 to 4, set the determination range (the parameter upper and lower limits) and the reference condition.

Parameter (Item)

Mask Test

Select the parameter that you want to use for determination from the measured mask test items. You can select a determination source element from Element1 to Element4.

Eye Pattern

Select the parameter that you want to use for determination from the eye pattern test items.

Upper and Lower Parameter Limits (Upper/Lower)

Range for upper and lower limits: –1.0E + 31 to 1.0E + 31

Reference Condition (Condition)

Select whether the mask test or eye pattern value of the source waveform must be in or out of the determination range to produce a NO-GO result.

- IN: The value must be inside of the determination range.
- OUT: The value must be outside of the determination range.
- X: The value is not used for GO/NO-GO determination.

Note

Because the sample point count is calculated using interpolated data, the value returned for it may not correspond to the record length.

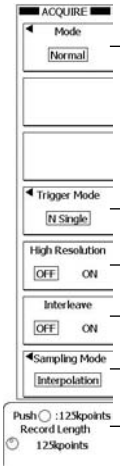
7.1 Setting Conditions for Waveform Acquisition

Procedure

ACQUIRE Menu

Press **ACQUIRE** to display the following menu.

- **When the Acquisition Mode (Mode) Has Been Set to Normal or Envelope**



Set the acquisition mode (Normal, Envelope, Average).

Set the trigger mode (Auto, Auto Level, Normal, N Single).

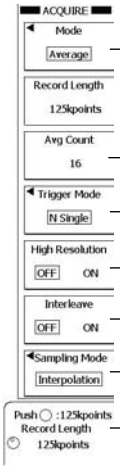
Turns high resolution mode on and off

Turns interleave mode on and off

Set the sampling mode (Realtime, Interpolation, Repetitive).

Set the record length.

- **When the Acquisition Mode (Mode) Has Been Set to Average**



Set the acquisition mode (Normal, Envelope, Average).

Set the attenuation constant or the average count.

Set the trigger mode (Auto, Auto Level, Normal, N Single).

Turns high resolution mode on and off

Turns interleave mode on and off

Set the sampling mode (Realtime, Interpolation, Repetitive).

Set the record length.

Explanation

Record Length (Record Length)

By specifying the record length, you can set the number of data points to store in the acquisition memory to one of the values listed below.

2.5 kpoints, 6.25 kpoints, 12.5 kpoints, 25 kpoints, 62.5 kpoints, 125 kpoints, 250 kpoints, 625 kpoints, 1.25 Mpoints, 2.5 Mpoints, and 6.25 Mpoints

Note

Depending on conditions such as the combination of the time axis setting and the sampling mode, the specified record length and the display record length may not match.

When this happens, the amount of data that corresponds to the display record length is saved in the acquisition memory.

Acquisition Mode (Mode)

You can select the acquisition mode from the options below. The default setting is Normal.

Normal Mode (Normal)

The DL6000/DLM6000 saves sampled data to the acquisition memory without performing any special data processing. You can set the number of waveforms to acquire with the jog shuttle.

Envelope Mode (Envelope)

The DL6000/DLM6000 samples data at 2.5 GS/s.* It determines the highest and lowest values from the sampled data stream at each acquisition interval, saves those values to the acquisition memory, and displays the values in an envelope waveform. You can set the number of waveforms to acquire with the jog shuttle.

* This sample rate applies to the DL6054, DL6104, DLM6054, and DLM6104. For the DL6154, the sample rate is 5 GS/s.

Averaging Mode (Average)

In Averaging mode, the DL6000/DLM6000 acquires waveforms multiple times, averages the same time points relative to the trigger point, and displays averaged waveforms. Averaging mode is useful when you want to remove random noise from waveforms.

The averaging method varies depending on the trigger mode.

- Auto, Auto Level, or Normal mode: Exponential averaging
- Single mode (using the SINGLE key): Linear averaging
- N Single Mode: The DL6000/DLM6000 acquires the number of waveforms specified in the MODE menu (N) and displays the linear average of the history waveforms (All Half Tone). (see section 11.1).

Exponential Average
(When the trigger mode is Auto, Auto Level, or Normal)

$$An = \frac{1}{N}\{(N-1)An-1 + Xn\}$$

An : n^{th} averaged value
Xn : n^{th} measured value
N : Attenuation constant (2 to 1024 in 2^n steps)

Simple Average
(When you press the SINGLE key)

$$AN = \frac{\sum_{n=1}^{N} Xn}{N}$$

Xn : n^{th} measured value
N : Number of times to average (2 to 1024 in 2^n steps)

Note

Notes about Averaging

- Only repeating signals are averaged.
- Logical signals are not averaged.
- If the trigger is not consistent and the waveform is not completely synchronized, the waveform will not be averaged correctly, and the waveform will be distorted.
- Roll mode is not valid when averaging is used.
- If you stop acquisition by pressing RUN/STOP, averaging will also stop. When you restart acquisition, values will be averaged from the beginning.
- With simple averaging, acquisition stops when the number of waveforms specified by the acquisition count have been acquired.
- When waveforms are acquired in averaging mode, the following data is saved to the history memory.
  - Exponential averaging (when the trigger mode is Auto, Auto Level, or Normal)
    Each waveform averaged over a set time interval is saved to a separate record.
  - Simple averaging (using the SINGLE key)
    The averaged waveform produced using the set number of waveforms is saved to the history memory.
  - For information about averaging when the trigger mode is N Single, see section 11.1.
- The maximum record length for an averaged waveform is 1.25 Mpoint. Even if you set the record length to a value greater than 1.25 Mpoint, the DL6000/DLM6000 will change the record length to 1.25 Mpoint when it averages waveforms.

Trigger Mode (Trig Mode)

You can select one of the following conditions for updating the displayed waveforms. You can also set the trigger mode by pressing the MODE key (see section 6.1 for details).
Auto, Auto Level, Normal, and N Single

High Resolution Mode (High Resolution)

Bandwidth filtering reduces data quantization noise and enables the DL6000/DLM6000 to produce high resolution data that is greater than 8 bits. Normally, data is stored to the acquisition memory using 8 bits, and higher resolution data is converted to 8-bit data before it is saved. When you turn high resolution mode ON, the DL6000/DLM6000 saves data using 16 bits (up to 12 effective bits).
If you turn high resolution mode ON, the maximum record length will change from 6.25 to 2.5 Mpoint.
If you turn high resolution mode ON when the bandwidth limit is set to FULL, the bandwidth limit will automatically change to 200 MHz.

Note

High Resolution mode does not apply to logic waveforms.

Interleave Mode (Interleave)

When you turn Interleave mode on, the number of usable channels decreases, but you can set the sample rate to 5 GS/s in real-time sampling mode (2.5 GS/s in high resolution mode).*
When you set the sample rate to 5 GS/s(2.5 GS/s in high resolution mode), CH2 and CH4 automatically become unusable.*

* This sample rate applies to the DL6054, DL6104, DLM6054, and DLM6104. On the DL6154, the sample rate is 10 GS/s (5 GS/s in high resolution mode).

Sampling Mode (Sampling Mode)

The DL6000/DLM6000 samples data using a 2.5 GS/s A/D converter, so the maximum sample rate in normal sampling mode (real-time sampling mode) is 2.5 GS/s.*
If you decrease the time axis setting when measuring fast phenomena, the sample rate will reach its maximum rate (2.5 GS/s) at a certain point.* If you decrease the time axis setting further, the number of displayed points decreases (the display record length decreases).
The DL6000/DLM6000 has two modes for interpolating additional points between data points. Select one of the interpolation modes when you want to make measurements by setting a sample rate that is higher than the real-time sampling mode's maximum sample rate (2.5 GS/s).*

- Interpolation mode:
  The DL6000/DLM6000 interpolates between data points using the (sinx)/x function. This mode is effective for single-shot signals.
- Repetitive sampling mode: The DL6000/DLM6000 interpolates through random sampling. This mode is effective for repeating signals.

* This sample rate applies to the DL6054, DL6104, DLM6054, and DLM6104. For the DL6154, the sample rate is 5 GS/s.

Relationship between the Time Axis Setting, Record Length, and Sample Rate

The relationship between the time axis setting, record length, and sample rate is as follows:
When the record length (display record length) and the time axis are set so that the sample rate is at the maximum rate, if you decrease the time axis setting further, the record length (display record length) is reduced.
Sample rate = Record length/(time axis setting [s/division] × 10 [divisions])

Real-time Sampling Mode (Realtime)

When you change the time axis setting, the sample rate changes. You can sample data at a maximum sample rate of 2.5 GS/s.[1] (The maximum sample rate is 5 GS/s when Interleave mode is on.)[2]

In this mode, the DL6000/DLM6000 can only display waveforms whose frequency is up to one-half the sample rate, in accordance with the sampling theorem.[3] Therefore, this mode is suitable for observing waveforms whose frequency is lower than one-half the sample rate.

1 On the DL6054, DL6104, DLM6054, and DLM6104 (1.25 GS/s in high resolution mode). On the DL6154, the sample rate is 5 GS/s (2.5 GS/s in high resolution mode).

2 On the DL6054, DL6104, DLM6054, and DLM6104 (2.5 GS/s in high resolution mode). On the DL6154, the sample rate is 10 GS/s (5 GS/s in high resolution mode).

3 If the sample rate is comparatively low with respect to the input signal frequency, the harmonics contained in the signal are lost. When this happens, some of the harmonics will be misread as low-frequency waves due to the effects described by the Nyquist sampling theorem. This phenomenon is called aliasing. You can avoid aliasing by acquiring waveforms with the acquisition mode set to Envelope.

Interpolation Mode (Interpolation)

The DL6000/DLM6000 interpolates the data sampled at 2.5 GS/s up to 1000 times (2000 times in High Resolution mode) using the (sinx)/x function.[1, 2] This essentially increases the sample rate to up to 2.5 TS/s.

Interpolation mode is effective for single-shot signals. If the input signal frequency is high relative to the sample rate (2.5 GS/s here), aliasing may occur.[1]

1 This sample rate applies to the DL6054, DL6104, DLM6054, and DLM6104. For the DL6154, the sample rate is 5 GS/s.

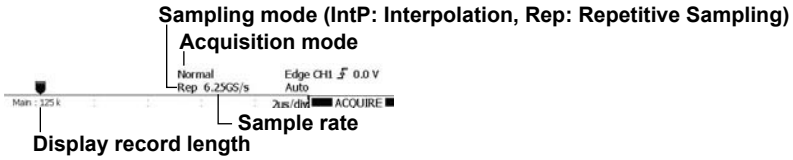
2 These interpolation numbers apply to the DL6054, DL6104, DLM6054, and DLM6104. For the DL6154, the maximum number of interpolations is 500 (1000 in High Resolution mode).

Repetitive Sampling Mode (Repetitive)

In this mode, one waveform is created from several cycles of a repeating signal. This is equivalent to sampling the signal at a higher sample rate than the actual sample rate. The equivalent sample rate is 2.5 TS/s maximum.

The DL6000/DLM6000 uses random sampling, which takes advantage of the fact that the time difference between the trigger point and sampled points is random. The DL6000/DLM6000 realigns the trigger point each time it acquires a waveform.

This mode is effective for repeating signals, and aliasing rarely occurs.



Note

- Even if Interpolation or Repetitive Sampling mode is selected, the DL6000/DLM6000 runs in real-time sampling mode when the sample rate is less than or equal to 1.25 GS/s,[1] or 2.5 GS/s when Interleave mode is on.[2] When the DL6000/DLM6000 is running in Interpolation or Repetitive Sampling mode, “Intp” or “Rep” appears at the upper right of the screen.
- When the sample rate is at the maximum rate in real-time sampling mode, if you decrease the time axis setting, the number of displayed data points (the display record length) is reduced. However, after the display record length reaches 100 points, if you decrease the time axis setting further, the DL6000/DLM6000 switches to Repetitive Sampling mode.[3]
- When the sample rate is at its maximum rate (2.5 TS/s) in Interpolation or Repetitive Sampling mode, if you decrease the time axis setting, the display record length is reduced.
- If the trigger mode is set to N Single and the sampling mode is set to Repetitive Sampling, the DL6000/DLM6000 actually runs in Interpolation mode.

1 This sample rate applies to the DL6054, DL6104, DLM6054, and DLM6104. For the DL6154, the sample rate is 5 GS/s.

2 This sample rate applies to the DL6054, DL6104, DLM6054, and DLM6104. For the DL6154, the sample rate is 10 GS/s.

3 For the DL6054, DL6104, DLM6054, and DLM6104, the maximum sample rate is 2.5 GS/s. For the DL6154, the maximum sample rate is 5 GS/s.

7.2 Acquiring Waveforms

Procedure

Waveform Acquisition (RUN and STOP)

Press **RUN/STOP** to start or stop waveform acquisition.
The key illuminates while the DL6000/DLM6000 is acquiring waveforms.

Waveform Acquisition (SINGLE)

Press the **SINGLE** key. The key illuminates while the DL6000/DLM6000 is acquiring waveforms. When the trigger conditions are met, the DL6000/DLM6000 updates the displayed waveform once and stops waveform acquisition. The key light turns off after acquisition stops.
To cancel waveform acquisition, press **RUN/STOP**.

Explanation

Waveform Acquisition (RUN and STOP)

When you execute (RUN) waveform acquisition, the DL6000/DLM6000 stores waveform data to the acquisition memory and updates the displayed waveforms each time the DL6000/DLM6000 triggers. The acquisition memory is divided according to the specified record length, and the maximum number of acquirable waveforms are stored in the memory. You can recall past waveforms that are stored in the memory by using the history feature when waveform acquisition is not running.

Waveform Acquisition and Indicators

- When the **RUN/STOP** key illuminates, the DL6000/DLM6000 is acquiring waveforms. “Running” appears at the upper left of the screen.
- When the **RUN/STOP** key is not illuminated, waveform acquisition is stopped. “Stopped” appears at the upper left of the screen.

DL6000/DLM6000 Operation When the Acquisition Mode Is Set to Averaging

- Averaging stops when you stop waveform acquisition.
- If you restart waveform acquisition again, averaging starts over.

RUN and STOP Operations during Accumulation

Accumulation stops when you stop waveform acquisition.
If you restart waveform acquisition, past waveforms are cleared, and accumulation starts over.

Waveform Acquisition (SINGLE)

When you execute waveform acquisition (SINGLE) and the trigger conditions are met, the DL6000/DLM6000 updates the displayed waveform once and stops waveform acquisition. If no triggers occur, the display is not updated. If Time/div is set to a value that would cause the display to switch to roll mode (100 ms/div to 50 s/div), roll mode is used until a trigger occurs. When a trigger occurs, the display switches out of roll mode. This mode is suitable for the observation of single-shot signals.

Note

- If you start waveform acquisition using the **RUN/STOP** key, past data stored in the acquisition memory is cleared.
- You can use the snapshot feature to retain the displayed waveform on the screen (see section 8.3 for details). This feature allows you to update the display without having to stop waveform acquisition.
- To update the displayed waveform once when the trigger condition is met and then stop waveform acquisition, press the **SINGLE** key.

The RUN/STOP Key Is Disabled:

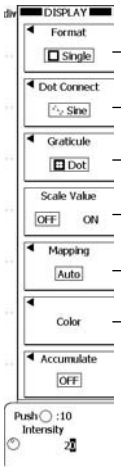
- When the DL6000/DLM6000 is in remote mode.
- When the DL6000/DLM6000 is printing to a printer, when it is being set up automatically, or when it is accessing a storage medium.
- If you press the **HISTORY** key during waveform acquisition, waveform acquisition stops.
- If you change the waveform acquisition conditions and start waveform acquisition, the past data stored in the acquisition memory is cleared.

8.1 Setting Display Conditions

Procedure

DISPLAY Menu

Press **DISPLAY** to display the following menu.



Set the display format (Single, Dual, Triad, Quad).

Set the display interpolation (OFF, Pulse, Line, Sine).

Set the graticule display (Dot, Line, Frame, Cross Hair).

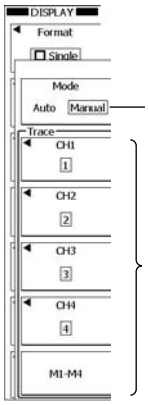
Turns the scale value display on or off

Press to set waveform mapping.

Press to set the waveform display color and grid, zoom box, cursor, and marker settings.

Setting Waveform Mapping (Mapping)

Press the **Mapping** soft key to display the following menu.

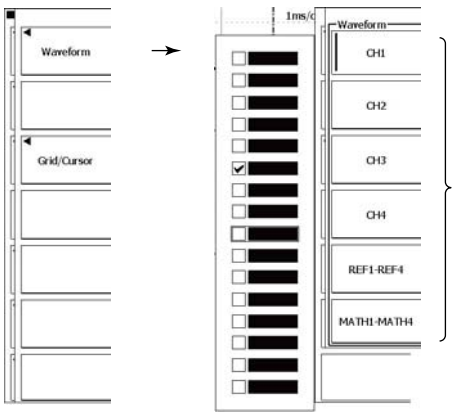


Set the waveform mapping mode (Auto, Manual).

Set the channel to set (CH1–CH4, M1–M4).

Setting Waveform Display Colors (Waveform)

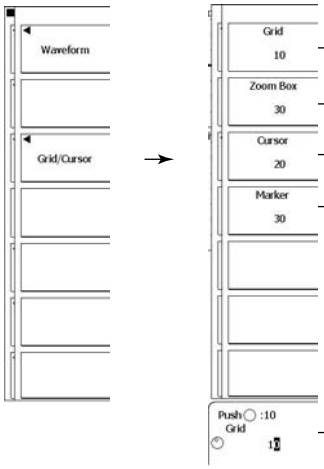
Press the **Color** soft key and then the **Waveform** soft key to display the following menu.



Set the waveform display colors (for CH1–CH4, REF1–REF4, MATH1–MATH4).

Setting the Intensity of the Grid, Zoom Box, Cursor, and Marker (Grid/Cursor)

Press the **Color** soft key and then the **Grid/Cursor** soft key to display the following menu.



Set the grid intensity (using the jog shuttle).

Set the zoom box intensity (using the jog shuttle).

Set the cursor intensity (using the jog shuttle).

Set the marker intensity (using the jog shuttle).

Set the intensity of the grid, zoom box, cursor, or marker.

Explanation

Display Format (Format)

You can choose how much you want to divide the analog waveform display window. The positions in which each of the channels waveforms are displayed vary depending on the display format.
Single (no splitting), Dual (split in half), Triad (split into thirds), and Quad (split into quarters)

Display Interpolation (Dot Connect)

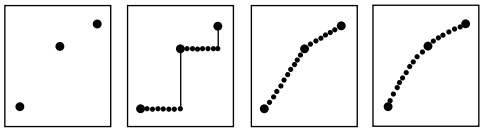
Set the method used to connect the sampled data points in the displayed waveform. In the Main, Zoom1, and Zoom2 windows, when the display record length is one of the values listed below, interpolation just involves connecting the sampled data points vertically. It does not matter whether you select Pulse, Line, or Sine.

- 4 kpoints and 5 kpoints
- Above 10 kpoints

When the display record length is set to a value other than those listed above, the specified interpolation method is used to produce points between the sampled data, and those points are connected vertically.

OFF: The DL6000/DLM6000 does not perform interpolation.
Pulse: The DL6000/DLM6000 draws a horizontal line to the time value of the next sampled data point and then draws a vertical line up to point.
Line: The DL6000/DLM6000 interpolates between two points using a straight line.
Sine: The DL6000/DLM6000 interpolates between two points using the sin x/x function.

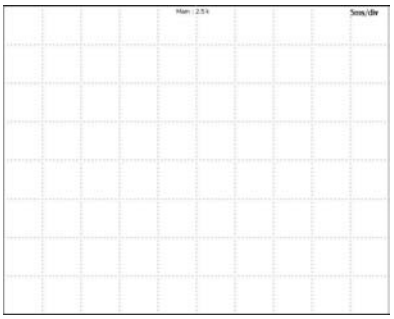
Illustrations of Interpolation Methods



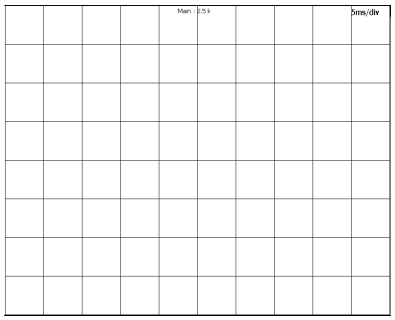
OFF **Pulse** **Line** **Sine**

Graticule (Graticule)

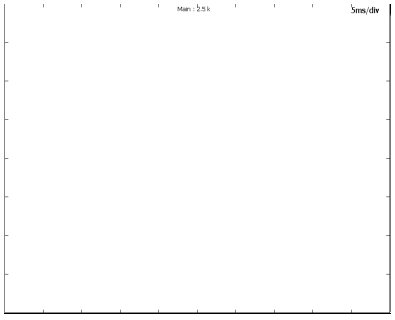
Set the window grid to one of the settings below.



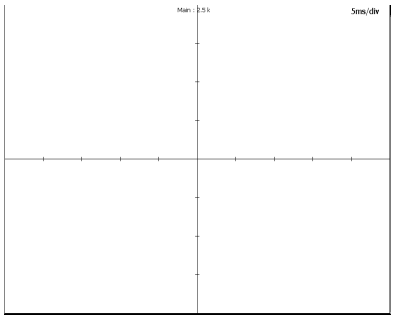
Dot



Line



Frame



Cross Hair

Scale Value Display (Scale Value)

You can display the upper and lower limits (scale values) of each waveform's vertical and horizontal axes.

ON: Scale values are displayed.

OFF: Scale values are not displayed.

Waveform Mapping (Mapping)

You can specify how channels are assigned to divided areas.

Auto: Waveforms are assigned from the uppermost divided area in the following order: CH1, CH2, CH3, CH4, M1, M2, M3, M4. Once the lowest divided area is reached, the waveform assignment continues from the uppermost divided area. Channels whose displays are disabled are not assigned to divided areas.

Manual: You can specify where to assign CH1 to CH4 and M1 to M4. The number of points that you can display in the upper and lower eight divisions varies depending on the display format as shown below (when only the main window is displayed). The vertical resolution does not change.

Single (□): 640 points, Dual (⊟): 320 points, Triad (⊟): 208 points, Quad (⊟): 160 points

Waveform Display Color (Waveform)

You can individually assign 16 colors to use to display the waveforms of analog input waveform channels CH1 to CH4, reference waveform channels REF1 to REF4, computed waveform channels MATH1 to MATH4, and the logic signal channel LOGIC.

The colors you select also affect the color of the title bar of the menu that appears when you press a channel's key.

Intensity (Grid/Cursor)

You can set the intensities of the grid (Grid), zoom box (Zoom Box), cursor (Cursor), and marker (Marker) to values within the range of 0 to 31.

Note

Initializing Waveform Display Colors and Intensity Settings

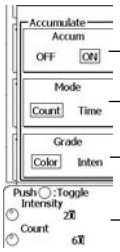
You can reset the selected setting (waveform display color or grid, zoom box, cursor, or marker intensity) to its default value by pressing the RESET key.

8.2 Displaying Accumulated Waveforms

Procedure

DISPLAY Accumulate Menu

Press **DISPLAY** and then the **Accumulate** soft key to display the following menu.



Turns accumulation on and off

Set the accumulation mode (Count, Time).

Set the gradation mode (Color, Inten).

Set the intensity and the accumulation count (accumulation time).

Explanation

Ordinarily, momentary waveform anomalies are difficult to recognize because the display is updated whenever the trigger is activated. The accumulated waveform display allows you to observe momentary anomalies by continuing to display each acquired data waveform for a set time.

Turning Accumulated Waveform Display On and Off (Accum)

ON: Accumulated waveforms are displayed.

OFF: Accumulated waveforms are not displayed.

Accumulation Mode (Mode)

Count: The DL6000/DLM6000 displays the current waveform and a set number of waveforms before it.

Time: The DL6000/DLM6000 continues to display acquired waveforms for a set period of time. A waveform's intensity decreases as time passes.

Accumulation Count

When the accumulation mode is Count, set the number of waveform accumulations to a number from 0 to the number of history waveforms. Waveforms will accumulate infinitely if you choose 0. The default value is the maximum number of savable history waveforms.

Accumulation Time

When the accumulation mode is Time, you can choose to accumulate waveforms infinitely, or for a period of time between 100 ms and 100 s. Waveforms will accumulate infinitely if you choose Infinite. The default value is 100 ms.

Gradation Mode (Grade)

Color: The DL6000/DLM6000 indicates 15 frequency levels using different colors. The color changes from blue to green to yellow to red to white as the frequency increases.

Inten: The DL6000/DLM6000 indicates frequency using different intensity levels. You can set the number of intensity values to a number from 1 to 20. The default value is 8.

Note

- If you press the CLEAR key, the accumulated waveforms are cleared.

Notes about Displaying Accumulated Waveforms

- Automated measurement of waveform parameters and GO/NO-GO determination are performed on the most recent waveform.
- If you press RUN/STOP to stop waveform acquisition, accumulation stops. When you restart, accumulation will also restart, but the previously accumulated waveforms will be cleared.
- If you change the display format when accumulated waveforms are displayed, the DL6000/DLM6000 operates in the following manner.
  - During accumulation: The DL6000/DLM6000 does not clear the accumulated waveforms.
  - When accumulation has been stopped in Time mode:
    The DL6000/DLM6000 clears the accumulated waveforms and only shows the most recent waveform.
  - When accumulation has been stopped in Count mode:
    If the accumulation is infinite, the DL6000/DLM6000 will display all of the history waveforms in the acquisition memory. The display may change.
    If the accumulation is not infinite, the DL6000/DLM6000 will display the set number of accumulated history waveforms.

8.3 Taking Snapshots and Clearing Traces

Procedure

Snapshot

Press **SNAP** to retain the currently displayed waveform on the screen as a snapshot displayed in white. Snapshot waveforms remain on the screen until you execute a clear trace operation.

Clear Trace

Press **CLEAR** to clear all of the waveforms that are displayed on the screen.

Explanation

Snapshot (SNAP)

You can use this feature to retain the currently displayed waveform on the screen. This feature allows you to update the display without having to stop waveform acquisition. It is a useful feature when you want to compare waveforms.

- You cannot perform the following operations on snapshot waveforms.
  Cursor measurement, automated measurements of waveform parameters, zooming, and computation
- Snapshot waveforms can be saved and loaded. For details, see sections 13.6 and 13.9.

Clear Trace (CLEAR)

Clears all of the waveforms that are displayed on the screen.

If you change the display format or perform other similar operations, the DL6000/DLM6000 redisplays the channel waveforms, computed waveforms, and loaded waveforms that were displayed before you executed the clear trace operation.

If you execute a clear trace operation during waveform acquisition, the DL6000/DLM6000 restarts waveform acquisition (from the first acquisition). All history waveforms that have been stored up to that point are cleared.

Note

The SNAP and CLEAR keys are disabled:

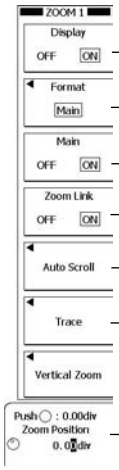
- When the DL6000/DLM6000 is printing, when it is executing auto setup, or when it is accessing a storage medium.
- When GO/NO-GO determination is in progress, when action-on-trigger is in progress, or when searching is in progress.

8.4 Zooming in on Waveforms

Procedure

ZOOM Menu

Press **ZOOM1** or **ZOOM2** to display the following menu.



Turns zooming on and off

Set the display format (Main, Single, Dual, Triad, Quad, Hexa).

Turns the main window display on and off

Turns zoom linking on and off

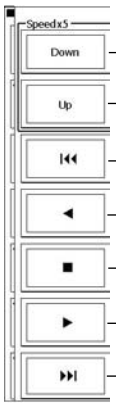
Press to configure automatic scrolling.

Set the waveforms to zoom (CH1–CH4, M1–M4).
If you select ALL ON, all waveforms are zoomed.

Set the zoom position.

Setting Automatic Scrolling (Auto Scroll)

Press the **Auto Scroll** soft key to display the following menu.



Decreases the speed by one level

Increases the speed by one level

Zooms in on the left edge of the main window

Scrolls to the left

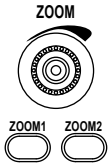
Stops auto scrolling

Scrolls to the right

Zooms in on the right edge of the main window

Zoom Factor (ZOOM knob)

Use the **ZOOM** knob to set the zoom factor. The ZOOM knob controls the waveforms in the window whose corresponding key, ZOOM1 or ZOOM2, is illuminated more brightly.
When you turn the ZOOM knob and change the zoom factor, the zoom factor appears in the upper right of the ZOOM1 or ZOOM2 window for a few seconds and then disappears.
The horizontal (Time/div) and vertical (V/div) units of the zoomed waveform appear in the upper right of the ZOOM1 or ZOOM2 window.



Explanation

The zoomed waveforms of two locations can be displayed simultaneously (the dual zoom feature). You can also specify which channel you want to zoom in on. You cannot zoom if the number of displayed points on the screen is less than or equal to 10 (or less than or equal to 50 points for FFT waveforms).

Turning the Zoom Windows On and Off (Display)

You can set whether or not to display the zoom windows.
OFF: The zoom windows are not displayed.
ON: The zoom windows are displayed.

Note

The ZOOM1 and ZOOM2 keys illuminate when the zoom feature is on.

Zoom Waveform Display Format (Format)

You can select the waveform area vertical display format from the following options: Main, Single, Dual, Triad, and Quad.

- When you select Main, the display format is the same as the format that you chose in section 8.1.
- When you select Single, Dual, Triad, or Quad, the waveform area is not divided or is divided into two, three, or four areas, respectively.

Displaying the Main Window (Main)

Select whether or not to display the main window.
OFF: The main window is not displayed.
ON: The main window is displayed.

Zoom Link (Zoom Link)

You can choose whether or not to maintain the relationship between the horizontal positions of the two zoom boxes, Zoom1 and Zoom2, when you set the zoom position.
OFF: The relationship between the horizontal positions of the two zoom boxes is not maintained.
ON: The relationship between the horizontal positions of the two zoom boxes is maintained.

Auto Scroll (Auto Scroll)

This feature automatically moves the zoom position in the specified direction. You can view the waveform and stop scrolling at the appropriate position.

|◀◀ :Zooms in on the left edge of the main window
▶▶| :Zooms in on the right edge of the main window
◀ : Starts scrolling to the left
▶ : Starts scrolling to the right
■ : Stops auto scrolling

Scroll Speed (Down/Up)

There are six auto scroll speeds: ×1, ×2, ×5, ×10, ×20, and ×50.

Down: Decreases the scroll speed by one level.

Up: Increases the scroll speed by one level.

Zoomed Waveforms (Trace)

Select the waveforms that you want to zoom. You can select multiple waveforms. If you select ALL ON, all waveforms are zoomed. The available waveforms vary depending on the model.

CH1 to CH4, M1 to M4, and LOGIC

Note

If you select a waveform whose display is turned off in the main window, the zoom waveform does not appear.

Zoom Factor (ZOOM knob)

You can use the ZOOM knob to set separate horizontal zoom factors for ZOOM1 and ZOOM2. The zoom waveform area time axis changes automatically based on the specified zoom factor.

You can set each of the zoom factors to a value from twice the Time/div setting of the main window up to the ratio at which the number of data points in the zoom window is 12.5.

Note

- You can zoom until the number of data points in the window is 10.
- The zoom factor applies to all waveforms that are displayed in the zoom window.

Zoom Position (Zoom Position)

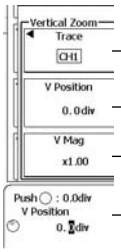
- Taking the center of the waveform area to be 0 divisions, you can set the central points that are zoomed in on (the centers of the zoom boxes) in the range of –5 to +5 divisions.
- The zoom box with solid lines is Zoom1, and the zoom box with dashed lines is Zoom2.

8.5 Vertically Zooming in on Waveforms

Procedure

ZOOM Vertical Zoom Menu

Press **ZOOM1** or **ZOOM2**, and then the **Vertical Zoom** soft key to display the following menu.



Set the waveform to zoom in on vertically (CH1–CH4, M1–M4).

Set the zoom position (using the jog shuttle).

Set the zoom factor (using the jog shuttle).

Set the zoom position and factor.

Note

You can reset the zoom factor and position by pressing the RESET key.

Explanation

You can magnify the displayed waveforms along the voltage (vertical) axis.

Zoomed Waveform (Trace)

Select the waveform that you want to zoom. You can only select one waveform.
The waveform that you can select varies depending on the model.
A channel from CH1 to CH4 or from M1 to M4.

Zoom Position (V Position)

Taking the vertical center of the main window to be 0 divisions, you can set the vertical center position of the zoom boxes in the range of –4 to 4 divisions. In the Main window, the zoom box with solid lines is ZOOM1, and the zoom box with dashed lines is ZOOM2.

Zoom Factor (V Mag)

You can set separate vertical zoom factors for ZOOM1 and ZOOM2. The zoom window vertical axis settings change automatically based on the specified zoom factors. You can set each of the zoom factors to a value as high as 10.
Use the rotary knob to set the zoom factors. Vertical zooming only affects the specified waveform in a particular window.

Initializing the Vertical Zoom

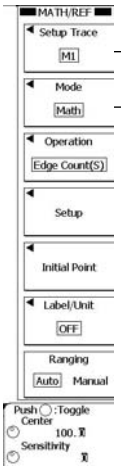
You can initialize the vertical zoom position and zoom factor settings by pressing the RESET key.

9.1 Setting the Computation Mode

Procedure

MATH/REF Menu

Press **MATH/REF** to display the following menu.



Set the trace number (M1–M4).

Set the computation mode (OFF, Math, Ref).

Explanation

The DL6000/DLM6000 can display up to four computed and reference waveforms.

Trace Number (Setup Trace)

You can select one of the four traces (M1 to M4) used for displaying computed and reference waveforms.

Computation Mode (Mode)

You can specify the computation mode for the selected trace number.

OFF: The trace will not display any waveforms.

Math: The trace will display a computed waveform.

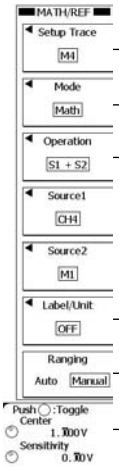
Ref: The trace will display a reference waveform (see section 9.8).

9.2 Performing Addition, Subtraction, and Multiplication

Procedure

MATH/REF Menu

Press **MATH/REF** to display the following menu.



Set the trace number.

Select Math.

Set the operator (S1 + S2, S1 - S2, S1 * S2).

Set the source waveforms for Source1 and Source2 (CH1–CH4, M1; you can select M1 when the selected trace number is one of the numbers from M2 to M4).

Enables or disables labels and units. ► section 9.9

Set the display range (Auto, Manual).

Set the display range (center and sensitivity) when Ranging is set to Manual.

Explanation

You can perform addition, subtraction, and multiplication on the two waveforms assigned to Source1 and Source2.

Computation Source Waveforms (Source1 and Source2)

You can select a waveform from CH1 to CH4 or M1.*

* You can select M1 when the selected trace number (Select Trace) is one of the numbers from M2 to M4.

Note

When M1 is set to user-defined computation, waveforms will not appear for trace numbers that use M1 in their computation.

Display Range (Ranging)

Set the waveform display range.

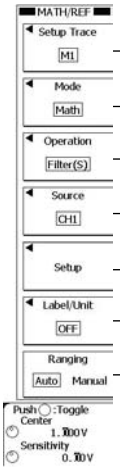
Auto	The DL6000/DLM6000 determines the display range automatically using conditions such as the V/div, operator, and offset value of the computation source waveforms.
Manual	You can determine the waveform display range by setting the value per division (Sensitivity) and the value of the center of the screen (Center). Depending on the type of computation that you select, a unit, such as a V, may appear. When you change the operator, the DL6000/DLM6000 changes the display range to the auto display range that corresponds to the new operator, but Ranging remains set to Manual.

9.3 Performing Filter Computations

Procedure

MATH/REF Menu

Press **MATH/REF** to display the following menu.



Set the trace number.

Select Math.

Set the operator to Filter.

Set the computation source waveform (CH1–CH4, M1; you can select M1 when the selected trace number is one of the numbers from M2 to M4).

Set the filter type.

Enables or disables labels and units. ► section 9.9

Set the display range. ► section 9.2

Filter Type (Filter Setup)

Press the **Setup** soft key and then the **Type** soft key to display the following menu.

Phase shift

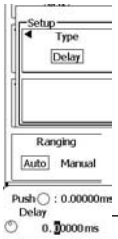
Smoothing

IIR lowpass filter

IIR highpass filter

Setting a Phase Shift Filter (Delay)

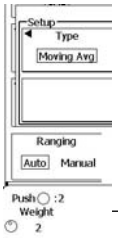
Press the **Delay** soft key to display the following menu.



Set the delay value.

Setting a Smoothing Filter (Moving Avg)

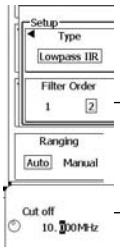
Press the **Moving Avg** soft key to display the following menu.



Set the weighted points.

Setting an IIR Filter (IIR Low Pass/IIR High Pass)

Press the **IIR Low Pass** or **IIR High Pass** soft key to display the following menu.



Set the filter order (1, 2).

Set the cutoff frequency.

Explanation

You can apply a phase-shift, moving-average, or IIR filter to the source waveform.

Filter Type (Setup)

Set the filter type to one of the settings listed below.

- Delay: Displays a phase-shifted waveform.
- Moving Avg: Displays a waveform whose noise has been eliminated through moving averaging.
- IIR Lowpass or IIR Highpass: Displays a waveform whose noise has been eliminated through an IIR filter.

IIR Filter (Low Pass IIR/High Pass IIR)

You can use a first-order low-pass filter and a differentiator to apply low-pass and high-pass filters.

Computation Source Waveform

You can select a waveform from CH1 to CH4 or M1.*

* You can select M1 when the selected trace number (Select Trace) is one of the numbers from M2 to M4.

Cutoff Frequency Setting (Cut off)

You can set the cutoff frequency to a value up to 1 GHz.

Filter Order Selection (Filter Order)

This setting varies depending on the selected filter type.

Filter Type	Order	Phase Change
High Pass	1	The phase advances.
Low Pass	1	The phase lags.
High Pass/Low Pass	2	The phase does not change.

Note

IIR filter calculation cannot be performed correctly immediately after the start of calculation, because the initial value is indeterminate. This why 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.

Smoothing (Moving Avg)

The DL6000/DLM6000 averages waveform values according to the following equation.

$$xn=\left(\sum_{i=n-N}^{n+N-1} xi + \sum_{i=n-N+1}^{n+N} xi\right)/(2N\times 2)$$

(when the weight is set to 2N)

Weighted Points

Set the number of points to use for moving averaging to a value from 2 to 128.

Phase Shift (Delay)

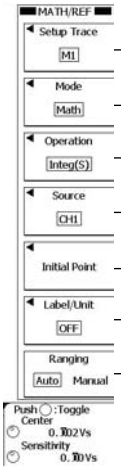
You can set the delay to a value within the range of time corresponding to ±5 divisions.

9.4 Performing Integration

Procedure

MATH/REF Menu

Press **MATH/REF** to display the following menu.



Set the trace number.

Select Math.

Set the operator to Integ.

Set the computation source waveform (CH1–CH4, M1; you can select M1 when the selected trace number is one of the numbers from M2 to M4).

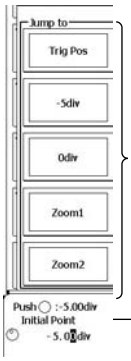
Set the initial point.

Enables or disables labels and units. ► section 9.9

Set the display range. ► section 9.2

Setting the Initial Computation Point (Initial Point)

Press the **Initial Point** soft key to display the following menu.



Set the initial point directly (Trig Pos, –5div, 0div, Zoom1, Zoom2).

Set the initial point.

Explanation

The DL6000/DLM6000 integrates the waveform assigned to Source with the initial computation point set to zero.

Initial Computation Point (Initial Point)

Set the initial point of computation.

- Settable range: –5 div to 5 div
- Default value: –5 div

You can also set the initial point to one of the following points.

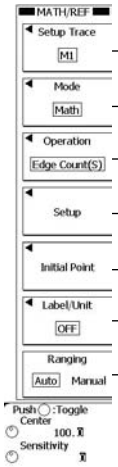
Trig Pos (trigger position), –5 divisions, 0 divisions, Zoom1 (the center of Zoom1), or Zoom2 (the center of Zoom2)

9.5 Counting Edges

Procedure

MATH/REF Menu

Press **MATH/REF** to display the following menu.



Set the trace number.

Select Math.

Set the operator to Edge Count.

Set the counting conditions.

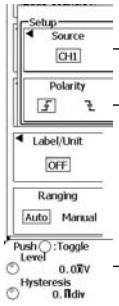
Set the count starting point (directly or using the jog shuttle).

Enables or disables labels and units. ► section 9.9

Set the display range. ► section 9.2

Setting the Counting Conditions (Setup)

Press the **Setup** soft key to display the following menu.



Set the computation source waveform (CH1–CH4, M1; you can select M1 when the selected trace number is one of the numbers from M2 to M4).

Set the slope to ⨍ or ⨏ .

Configure the detection level and the hysteresis.

Explanation

Taking the count starting point (Initial Point) to be zero, the DL6000/DLM6000 counts an edge each time the waveform assigned to Source passes through the specified detection level.

Count Conditions (Setup)

Detection Level (Threshold)

An edge is counted when the waveform passes the specified level.

Polarity (Polarity)

Select which waveform slope the DL6000/DLM6000 will detect edges on.

	Rising slopes are detected.
	Falling slopes are detected.

Hysteresis (Hysteresis)

You can use hysteresis to give width to the detection level so that the DL6000/DLM6000 does not detect edges on small fluctuations in the waveform.

Settable range: 0.0 to 4.0 divisions

Resolution: 0.1 divisions

Count Start Point (Initial Point)

Specify the point to start counting edges at.

Selectable range: –5.00 to 5.00 divisions

Resolution: 0.01 divisions

You can also set the count start point to one of the following points (Jump to).

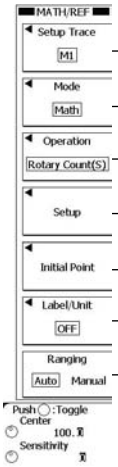
Trig Pos (trigger position), –5 divisions, 0 divisions, Zoom1 (the center of Zoom1), or Zoom2 (the center of Zoom2)

9.6 Performing Rotary Counting

Procedure

MATH/REF Menu

Press **MATH/REF** to display the following menu.



Set the trace number.

Select Math.

Set the operator to Rotary Count.

Set the counting conditions.

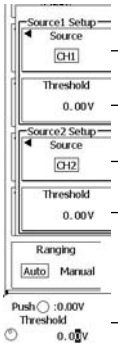
Set the count starting point (directly or using the jog shuttle).

Enables or disables labels and units. ► section 9.9

Set the display range. ► section 9.2

Setting the Counting Conditions (Setup)

Press the **Setup** soft key to display the following menu.



Set the source waveform for phase A (CH1–CH4, M1).*

Set the threshold for phase A (using the jog shuttle).

Set the source waveform for phase B (CH1–CH4, M1).*

*** You can select M1 when the selected trace number is one of the numbers from M2 to M4).**

Set the threshold for phase B (using the jog shuttle).

Set the thresholds for phases A and B.

Explanation

Taking the count starting point (Initial Point) to be zero, the DL6000/DLM6000 increments or decrements the counter based on the phase changes in the waveforms assigned to Source1 (phase A) and Source2 (phase B).
The DL6000/DLM6000 increments and decrements the counter depending on how phases A and B change, treating the state when the waveform is above the specified threshold level (Threshold1 or Threshold2) as 1 and the state when the waveform is below the threshold level as 0.

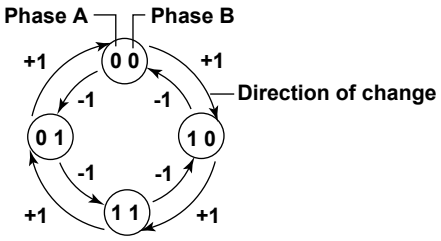
Count Conditions (Setup)

Threshold Level (Threshold1 and 2)

Set the level that the DL6000/DLM6000 uses to determine waveform state changes separately for phases A and B.

Changes in Phases A and B

As is shown below, how the counter is incremented or decremented is determined by how phases A and B change (between the 0 and 1 states).



Count Start Point (Initial Point)

Specify the point to start counting at.
Selectable range: –5.00 to 5.00 divisions
Resolution: 0.01 divisions
You can also set the count start point to one of the following points (Jump to).
Trig Pos (trigger position), –5 divisions, 0 divisions, Zoom1 (the center of Zoom1), or Zoom2 (the center of Zoom2)

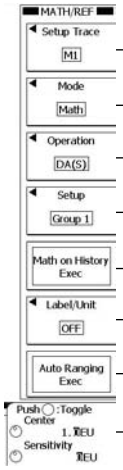
9.7 Performing D/A Conversion on Logic Signals

You can use the D/A conversion feature on DLM6000 models, which are equipped with logic inputs.

Procedure

MATH/REF Menu

Press **MATH/REF** to display the following menu.



Set the trace number.

Select Math.

Set the operator to DA.

Configure D/A conversion.

Executes D/A conversion of history waveforms

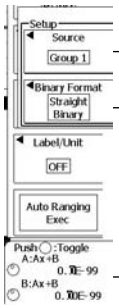
Enables or disables labels and units. ► section 9.9

Executes automatic configuration of the display range

Set the display range (by setting Center and Sensitivity).

Configuring D/A Conversion (Setup)

Press the **Setup** soft key to display the following menu.



Set the computation source group (Group1–Group 5).

Set the display format (Straight Binary, Two's Complement).

Set scaling coefficient A and offset B.

Explanation

You can perform D/A conversion on the logic signals of the specified group.

Configuring D/A Conversion (Setup)

Computation Source Signals (Source)

The DLM6000 converts the signals in the specified group to an analog signal by treating the MSB as the highest.

Display Format (Binary Format)

You can select the format for displaying converted binary values.

Straight Binary	This is the ordinary display. For example, a binary value written as FF in hexadecimal will be displayed as 255.
Two's Complement (Sign Bit)	This display shows the two's complement. For example, a binary value written as FF in hexadecimal will be displayed as –1.

Scaling

Using specified scaling coefficient A and offset B, the DLM6000 performs the following computation to scale the cursor measurement values and the automated measurements of waveform parameters.

Y = AX + B (where X is the value after D/A conversion and Y is the scaling value)

Scaling Coefficient A and Offset B

Settable range for A and B	–10.000E+30 to +10.000E+30
Default settings	A: 1.0000E+00 B: 0.0000E+00

Performing D/A Conversion on History Waveforms (Math on History Exec)

If you press the Math on History Exec soft key while waveform acquisition is stopped, D/A conversion is performed on all the history waveforms of the specified group.

Display Range (Auto Ranging Exec)

Auto Ranging Exec	The value per division (Sensitivity) and the value of the center of the screen (Center) are set automatically so that the entire amplitude of the waveform is visible. You can use the VT cursor to read the upper 14 bits as measured values.
Center/Sensitivity	You can determine the waveform display range by setting the value per division (Sensitivity) and the value of the center of the screen (Center).

Note

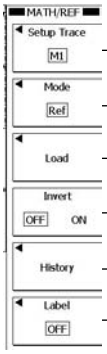
- You cannot perform D/A conversion on history waveforms during waveform acquisition.
- While D/A conversion is being performed on all the history waveforms, a "computing" icon appears in the lower left of the screen, and a progress bar appears in the center of the screen. All operations except for that of the Abort soft key are invalid.
- If you set the trigger mode to N Single and start waveform acquisition, after acquisition stops, the DLM6000 only performs D/A conversion on the last acquired waveform. To perform D/A conversion on all history waveforms, see "Performing D/A Conversion on History Waveforms."
- If you change a setting that would affect the results of D/A conversion, the DLM6000 only recomputes the values of the selected history waveform.
- The Average option in the HISTORY menu and the History Statistics option in the MEASURE menu only appear if all of the history waveforms are available. If the Average option in the history menu or the History Statistics option in the MEASURE menu does not appear, see "Performing D/A Conversion on History Waveforms."

9.8 Loading Reference Waveforms

Procedure

MATH/REF Menu

Press **MATH/REF** to display the following menu.



Set the trace number.

Select Ref.

Loads a reference waveform (CH1–CH4, M1–M4)

Turns inverted display on and off

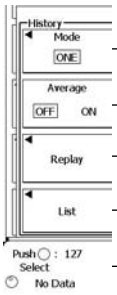
Displays history waveforms (and the Mode, Average, Replay, and List items)

Enables or disables labels and units. ► section 9.9

History Waveform Display (History)

Press the **History** soft key to display the following menu.

When the Display Mode Is ONE or All Half Tone



Set the display mode to ONE or All Half Tone.

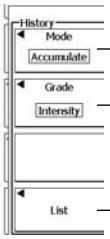
Turns averaging on or off

Replays history waveforms

Displays a list

Set the waveform to highlight (when Average is set to OFF).

When the Display Mode Is Accumulate



Set the display mode to Accumulate.

Set the gradation mode (Intensity, Color).

Displays a list

Explanation

You can display reference waveforms when the computation mode is set to REF. If you set the measurement source to a channel from M1 to M4 when a reference waveform is displayed, cursor measurements and automated measurements of waveform parameters are performed relative to the reference waveform.
You can specify equations that use the reference waveform while it is displayed.
(For example, when M1 is the reference waveform, you can specify the equation M2 = CH1 + M1.)

The following waveforms can be used as reference waveforms:

- Input waveforms (CH1 to CH4) and computed waveforms (M1 to M4).
- Waveforms saved in the past. (You can load a waveform using the FILE menu.)

History Waveform Display (History)

When you load a reference waveform, history waveforms are also loaded in addition to the currently displayed waveform. This means that you can use the following history features on reference waveforms. For details about history features, see chapter 11.

- Display mode settings (ONE, All Half Tone, and Accumulate)
- Averaging (Average)
- History waveform replay (Replay)
- List display (List)
- Gradation mode (Grade; only when the display mode is Accumulate)

Vertical Position (Position)

You can move the reference waveform vertical position within ±4 divisions.

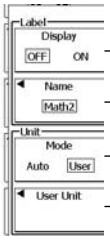
9.9 Setting Labels and Units

Procedure

MATH/REF Label and Unit Menus

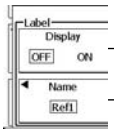
Press **MATH/REF** and then the **Label/Unit** soft key to display the following menu.
(When the computation mode is Ref, press **MATH/REF** and then the **Label** soft key.)

When the computation mode is Math



Turns labels on and off
Set the label.
Set the unit mode (Auto, User).
Specify a unit (when Mode is set to User).

When the computation mode is Ref



Turns labels on and off
Set the label.

Explanation

Setting Labels and Units (Label/Unit)

Turning Labels On and Off (Display)

Select whether or not to display labels.

Label (Name)

When you turn the label display on, you can set the MATH1 to MATH4 labels or the REF1 to REF4 labels using up to eight characters.

Unit (Unit)

You can assign a unit to the computed results.

- Auto

  The default unit for the current computation type is used.

Filter, addition, subtraction, or multiplication	V, A, VV, AA, or VA
Integration	Vs, As, VVs, AAs, or VAs
Edge count and rotary count	Blank
D/A conversion and user-defined computation	EU

- User

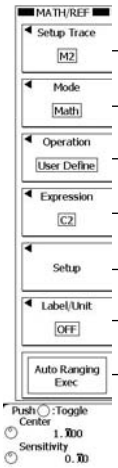
  You can specify a unit using up to four characters.

9.10 Performing User-Defined Computations (Optional)

Procedure

MATH/REF Menu

Press **MATH/REF** to display the following menu.



Set the trace number.

Select Math.

Set the operator to User Define.

Set the expression.

Set the computation conditions.

Enables or disables labels and units. ► section 9.9

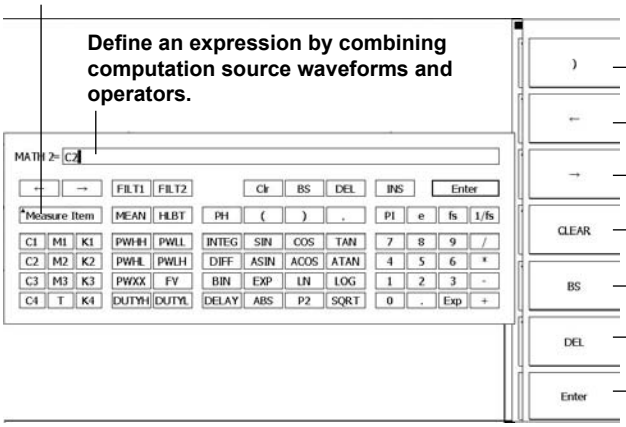
Set the display range. ► section 9.7

Creating Expressions (Expression)

Press the **Expression** soft key to display the following screen.

Add automated measurements of waveform parameters to expressions.

Define an expression by combining computation source waveforms and operators.



Inserts a)

Moves the cursor to the right

Moves the cursor to the left

Clears everything

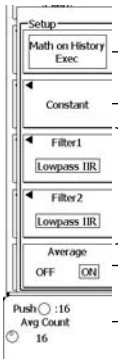
Backspace key

Deletes one character

Confirms the expression

Setting Computation Conditions (Setup)

Press the **Setup** soft key to display the following menu.



Performs computation on past waveforms

Set the constants (K1–K4).

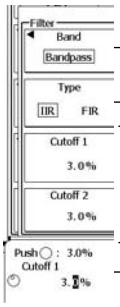
Set the digital filters.

Turns averaging on and off

Set the number of averaged values (when Average is set to ON).

Setting Digital Filters (Filter1 and Filter2)

Press the **Filter1** or **Filter2** soft key to display the following menu.



Set the frequency band (LowPass, BandPass, HighPass).

Set the filter type (IIR, FIR).

Set the cutoff frequency (using the jog shuttle).
*** You can only set Cutoff2 when Band is set to Bandpass.**

Set the cutoff frequency.

Explanation

You can define up to four original expressions.

Expressions (Expression)

Define expressions by combining computation source waveforms and operators.
You can enter up to 128 characters.

Computation Source Waveforms

You can use the following waveform data.

Menu Item	Description
C1 to C4	CH1 to CH4
M1 to M3	You can use M1 when Setup Trace is set to M2. You can use M1 and M2 when Setup Trace is set to M3 or M4. You can use M1 to M3 when Setup Trace is set to M4.
T	Amount of time elapsed from the screen's left edge

Operators

You can combine the following operators to define expressions.

Menu Item	Example	Description
Basic functions		
+,-,*,/	C1+C2-C3	Basic arithmetic of input values
ABS	ABS(C1)	Absolute value of an input value
SQRT	SQRT(C2)	Square root of an input value
LOG	LOG(C1)	Logarithm of an input value
LN	LN(C1)	Natural logarithm of an input value
EXP	EXP(C1)	Exponent of an input value
P2	P2(C1)	Square of an input value
-	-(C1)	Opposite of an input value
Trigonometric functions		
SIN	SIN(C1)	Sine of an input value
ASIN	ASIN(C1)	Arc sine of an input value
COS	COS(C1)	Cosine of an input value
ACOS	ACOS(C1)	Arc cosine of an input value
TAN	TAN(C1)	Tangent of an input value
ATAN	ATAN(C1)	Arc tangent of an input value
PH	PH(C1,C2)	Phase difference between two input values
Differentiation and integration		
DIFF	DIFF(C1)	Derivative of an input waveform
INTEG	INTEG(C1)	Integral of an input waveform
Filter functions		
FILT1	FILT1(C1)	Application of a digital filter to the input waveform
FILT2	FILT2(C1)	Application of a digital filter to the input waveform
HLBT	HLBT(C1)	Hilbert function of the input waveform
MEAN	MEAN(C1,10)	Moving average of an input waveform
DELAY	DELAY(C1,0.001)	Phase shifting of an input waveform
BIN	BIN(CH1,1,-1)	Binary conversion of an input waveform
Pulse width computation		
PWHH	PWHH(C1,1,-1)	Pulse width computation of an input waveform from one rising edge to the next rising edge
PWHL	PWHL(C1,1,-1)	Pulse width computation of an input waveform from a rising edge to the next falling edge
PWLH	PWLH(C1,1,-1)	Pulse width computation of an input waveform from a falling edge to the next rising edge
PWLL	PWLL(C1,1,-1)	Pulse width computation of an input waveform from one falling edge to the next falling edge
PWXX	PWXX(C1,1,-1)	Pulse width computation of the input waveform from one rising or falling edge to the next rising or falling edge
FV	FV(C1,1,-1)	Reciprocal of the computed pulse width PWHH
DUTYH	DUTYH(C1,1,-1)	Duty ratio of the high side of each period of an input waveform
DUTYL	DUTYL(C1,1,-1)	Duty ratio of the low side of each period an input waveform

Constants

Menu Item	Description
K1 to K4	Constants
0 to 9	–
Exp	E notation Used to enter a number in scientific notation in expressions. (1E+3 = 1000, 2.5E-3 = 0.0025) It is displayed as “E” in expressions to distinguish it from the “EXP” operator.
PI	Pi (π)
e	Euler’s number (Napier’s constant) Base of the natural logarithm (e=2.71828...). It is displayed as “eul” in expressions to distinguish it from the “E” that represents exponents.
fs	The sample rate. The DL6000/DLM6000 sample rate at the time that computation is executed. The value changes in accordance with changes in the time axis and record length settings.
1/fs	Number of samples per second. Computed based on the DL6000/DLM6000 sample rate when computation is executed. The value changes in accordance with changes in the time axis and record length settings.
Measure Item	A waveform parameter value can be used. Example: P.Max(C1)

Automated Measurements of Waveform Parameters (Measure)

You can use the automated measurements of waveform parameters in expressions.

- “P.” precedes waveform parameters when they are displayed in expressions.
- The DL6000/DLM6000 cannot retrieve waveform parameter values when the display of the measurement source waveform is off.

Computation Conditions (Setup)

You can configure constants (K1 to K4) and the digital filter and turn computation averaging on or off.

Constant Definitions (Constant)

Set a value for K1 to K4. This setting applies M1 through M4.

Settable range: –10E+30 to 10E+30

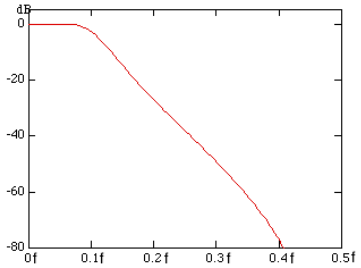
Digital Filter Definitions (Filter1/Filter2)

When using FILT1 or FILT2 in user-defined computation, set the digital filter’s filter type, frequency band, and cutoff frequency. This setting applies M1 through M4.

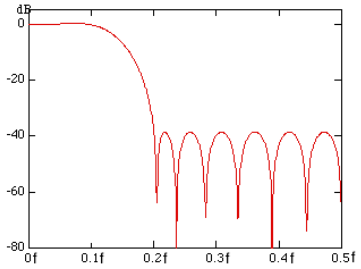
- **Filter Type (Type)**

  Select the filter type from one of the options below.
- IIR: Non-linear phase. Achieves adequate cutoff characteristics even at relatively low orders.
- FIR: Linear phase. Takes longer than IIR to process.

IIR (low pass; 10% cutoff)



FIR (low pass; 10% cutoff)



- **Frequency Band (Band)**
  You can set the frequency band to one of the settings below.
  - LowPass
  - BandPass
  - HighPass

- **Cutoff Frequency (Cutoff1/Cutoff2)**
  Set the cutoff frequency separately for Filter1 and Filter2.
  Settable range: 2.0% to 30.0% of the sampling frequency
  Resolution: 0.2% of the sampling frequency

Computed Data Averaging (Average)

Set whether or not to perform linear averaging on the results of user-defined computation. This setting applies M1 through M4.

- **Average Count (Average Count)**
  Settable range: 2 to 1024 in 2^n steps

Note

- If you change the computation conditions while computed data averaging is on, the computed data up to that point is cleared.
- You cannot average computed data if the trigger mode is set to N Single.
- You cannot average computed data during waveform acquisition.
- You cannot average computed data that has been recomputed after waveform acquisition.

Computation on History Waveforms (Math on History)

This feature performs computation on all history waveforms.
If waveform acquisition is stopped and you press the Math on History soft key, the DL6000/DLM6000 performs userdefined computation on all of the source channel's history waveforms.

Note

- You cannot execute [Math on History] during waveform acquisition.
- While [Math on History] is in progress, the "computing" icon and progress bar appear at the top of the screen. All operations except for that of the Abort soft key are invalid.
- If you set the trigger mode to N Single and start waveform acquisition, after acquisition stops, the DL6000/DLM6000 only performs user-defined computation on the last acquired waveform. To perform user-defined computation on all history waveforms, press the Math on History soft key.
- If you change a setting that would affect the results of user-defined computation, the DL6000/DLM6000 only recomputes the values of the selected history waveform.
- If an error occurs in the average display or statistical processing of a history waveform, press the Math on History soft key.

Examples of Expressions

For each operator, correct expressions and expression errors that are easy to make are listed. Incorrect examples are shaded.

DIFF and INTEG (Differentiation and integration) Examples

Syntax: DIFF(parameter), INTEG(parameter)

Parameter: Enter a waveform or an expression that contains waveforms.

DIFF(C1/3)	Derivative of the C1/3 waveform
INTEG(INTEG(C3))	Double integral of the C3 waveform
DIFF(DIFF(C4))	Double derivative of the C4 waveform
DIFF(5)	Not allowed because the parameter is a constant
INTEG(K1+10)	Not allowed because the parameter is a constant expression

FILT1 and FILT2 (Digital Filter) Examples

Syntax: FILT1(parameter), FILT2(parameter)

Parameter: Enter a waveform or an expression that contains waveforms.

FILT1(C1+C2)	Digital filtering of the C1+C2 waveform
FILT1(C3+K1)	Digital filtering of the C1+K1 waveform
FILT1(5)	Not allowed because the parameter is a constant
FILT2(K1+10)	Not allowed because the parameter is a constant expression

* The digital filters must be defined.

MEAN (Moving Average) Examples

Syntax: MEAN(parameter 1,parameter 2)

Parameter 1: Set the source waveform of the moving average. Enter a waveform or an expression that contains waveforms.

Parameter 2: Set the moving average order. Enter a constant or a constant expression.

MEAN(C1,10)	Moving average of waveform C1 with the order set to 10
MEAN(C2+C3,K1)	Moving average of the C2+C3 waveform with the order set to K1
MEAN(5,10)	Not allowed because parameter 1 is not a waveform or an expression that contains waveforms
MEAN(C1,C2)	Not allowed because parameter 2 is not a constant or a constant expression

DELAY (Phase Shift) Examples

Syntax: DELAY(parameter 1,parameter 2)

Parameter 1: Set the waveform whose phase you want to shift. Enter a single waveform.

Parameter 2: Set the amount of phase shift. Enter a constant or a constant expression.

DELAY(C1,5E-3)	Phase-shift waveform C1 by 0.005 s
DELAY(C2,P.Period(C2)*2)	Phase-shift waveform C2 by 2 periods of waveform C2
DELAY(C1,C2)	Not allowed because parameter 2 is not a constant or a constant expression
DELAY(C1+C2,5)	Not allowed because parameter 1 is not a single waveform

BIN (Conversion into Binary Values) Examples

Syntax: BIN(parameter 1,parameter 2,parameter 3)

Parameter 1: Set the waveform to convert into binary values. Enter a waveform or an expression that contains waveforms.

Parameter 2: Set the upper threshold level. Enter a constant or a constant expression.

Parameter 3: Set the lower threshold level. Enter a constant or a constant expression.

BIN(C1+C2,10+K1/2,10-K1/2)	Convert the C1+C2 waveform into binary values with Upper set to 10+K1/2 and Lower set to 10-K1/2
BIN(C2,P.High(C2),P.Low(C2))	Convert waveform C2 into binary values with Upper set to waveform C2's high value and Lower set to waveform C2's low value.
BIN(5,10,2)	Not allowed because parameter 1 is not a waveform or an expression that contains waveforms
BIN(C1,C2,-1)	Not allowed because parameter 2 is not a constant or a constant expression

PWHH to DUTYL (Pulse Width Computation) Examples

Syntax: PWHH(parameter 1,parameter 2,parameter 3)

Parameter 1: Set the waveform to compute the pulse width of. Enter a single waveform.

Parameter 2: Set the upper threshold level. Enter a constant or a constant expression.

Parameter 3: Set the lower threshold level. Enter a constant or a constant expression.

PWHH(C1,K1,K2)	Compute the pulse width of waveform C1 with Upper set to K1 and Lower set to K2
DUTYH(C2,P.High(C2),P.Low(C2))	Compute the pulse width of waveform C2 with Upper set to waveform C2's high value and Lower set to waveform C2's low value.
PWHH(5,10,2)	Not allowed because parameter 1 is not a waveform
PWHL(C1,C2,-1)	Not allowed because parameter 2 is not a constant or a constant expression
PWLL(C1+C2,1,-1)	Not allowed because parameter 1 is not a single waveform

Examples of Other Operators

Syntax: Operator(parameter)

Parameter: Specify a waveform, a constant, or an expression.

SIN(PI)	Example in which the parameter is set to a constant
COS(C1)	Example in which the parameter is set to a waveform
ABS(C1+C2*2)	Example in which the parameter is set to an expression that consists of waveforms and a constant
SQRT(ABS(C1+C2*2))	Example in which the parameter is set to an expression
SIN(2*PI*T*K1)	Example in which the parameter is set to an expression (that consists of elapsed time T and constants)

Combinations of Operators That Are Not Allowed

The Math1 expression cannot contain the Math2 expression. Example: Math1=M2+C3
An expression can only contain up to two FILT1 or FILT2 functions. Example: FILT1(C1)+FILT1(C2)+FILT1(C3)
Computation cannot be performed on a computed pulse width. Example: PWHH(C1, 1, 0)+C2
When converting to binary values or when computing pulse width, the source waveform can only be a single waveform. Examples: BIN(C1-C2, 1, -1), PWHH(C1*C2, 0, 0)

Note

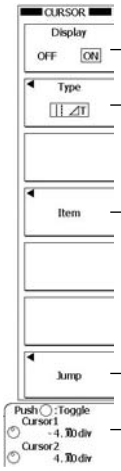
- Averaging cannot be performed on pulse width computation.
- If you want to covert the result of a computation such as C1+C2 to binary values or perform pulse width computation on it, define the Math1 and Math2 expressions in this manner: Math1 = C1+C2 and Math2 = BIN(M1, 0, 0).

10.1 Using Cursors to Make Measurements

Procedure

CURSOR ΔT Menu

Press the **CURSOR** key, the **Type** soft key, and then the **ΔT** soft key to display the following menu.



Turns cursor measurement on and off

Set the cursor type to ΔT.

Press to set measurement items.

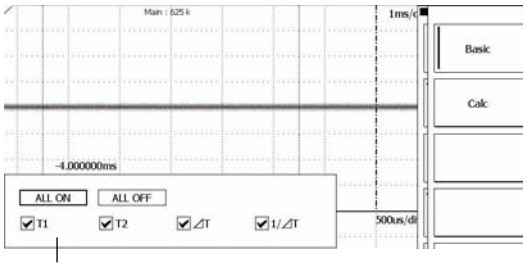
Press to specify where to make the cursors jump to (Zoom1, Zoom2).

Set the cursor positions (Cursor1 and Cursor2).

Setting Measurement Items (Item)

Press the **Item** soft key and then the **Basic** or **Calc** soft key to display one of the following menus.

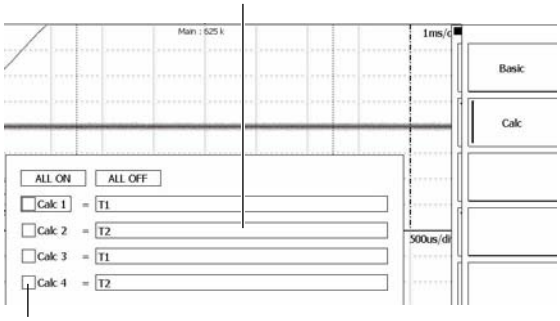
When You Press Basic



Set the items that you want to measure.

When You Press Calc

Define expressions using functions, arithmetic operators, and measurement items.



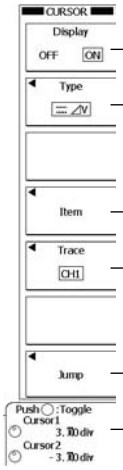
Set the expressions that you want to use.

Note

If you want to move the cursors while maintaining the same space between them, press SET repeatedly until the jog shuttle adjusts both Cursor1 and Cursor2.

CURSOR ΔV Menu

Press the **CURSOR** key, the **Type** soft key, and then the **ΔV** soft key to display the following menu.



Turns cursor measurement on and off

Set the cursor type to Δ.

Press to set measurement items.

Set the waveform to measure (CH1–CH4, M1–M4).

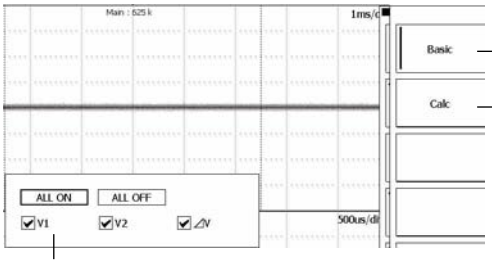
Press to specify where to make the cursors jump to (to Zoom1, to Zoom2).

Set the cursor positions (Cursor1 and Cursor2).

Setting Measurement Items (Item)

Press the **Item** soft key and then the **Basic** or **Calc** soft key to display one of the following menus.

When You Press Basic



Displays a basic measurement item dialog box

See page 10-1.

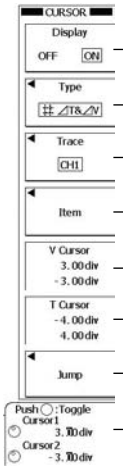
Set the items that you want to measure.

Note

If you want to move the cursors while maintaining the same space between them, press SET repeatedly until the jog shuttle adjusts both Cursor1 and Cursor2.

CURSOR ΔT&ΔV Menu

Press the **CURSOR** key, the **Type** soft key, and then the **ΔT&ΔV** soft key to display the following menu.



Turns cursor measurement on and off

Set the cursor type to ΔT&ΔV.

Set the waveform to measure (CH1–CH4, M1–M4).

Press to set measurement items.

Set the V cursor positions (using the jog shuttle).

Set the T cursor positions (using the jog shuttle).

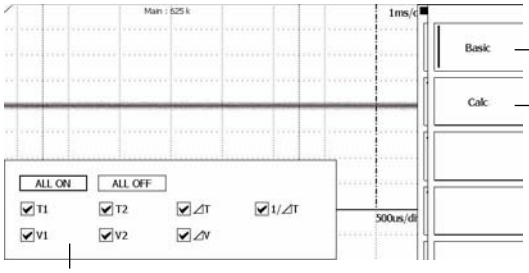
Press to specify where to make the cursors jump to (to Zoom1, to Zoom2).

Set the V cursor and T cursor positions (Cursor1 and Cursor2).

Setting Measurement Items (Item)

Press the **Item** soft key and then the **Basic** or **Calc** soft key to display one of the following menus.

When You Press Basic



Displays a basic measurement item dialog box.

See page 10-1.

Set the items that you want to measure.

Note

If you want to move the cursors while maintaining the same space between them, press SET repeatedly until the jog shuttle adjusts both Cursor1 and Cursor2.

CURSOR VT Menu

Press the **CURSOR** key, the **Type** soft key, and then the **VT** soft key to display the following menu.

Turns cursor measurement on and off

Set the cursor type to VT.

Press to set measurement items.

Press to set the logic signal format and bit order.

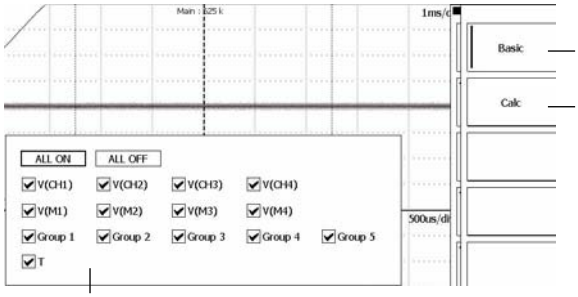
Press to specify where to make the cursors jump to (Zoom1, Zoom2).

Set the cursor position.

Setting Measurement Items (Item)

Press the **Item** soft key and then the **Basic** or **Calc** soft key to display one of the following menus.

When You Press Basic



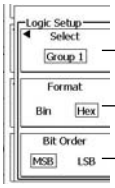
Displays a basic measurement item dialog box.

See page 10-1.

Set the items that you want to measure.

Setting the Logic Signal Format and Bit Order (Logic Setup)

Press the **Logic Setup** soft key to display the following menu.



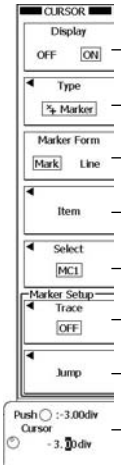
Select the group that you want to set.

Set the format (Bin, Hex).

Set the bit order (MSB, LSB).

CURSOR Marker Menu

Press the **CURSOR** key, the **Type** soft key, and then the **Marker** soft key to display the following menu.



Turns cursor measurement on and off

Set the cursor type to Marker.

Set the marker type (Mark, Line).

Press to set measurement items.

Set which cursor to configure (the measurement, jump and cursor position) settings for.

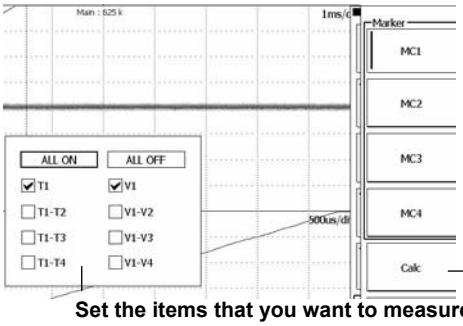
Set the waveform to measure (CH1–CH4, M1–M4).

Press to specify where to make the cursors jump to (Zoom1, Zoom2).

Set the cursor position.

Setting Measurement Items (Item)

Press the **Item** soft key to display the following screen.



For each marker, specify the basic measurement items whose values you want to display.

See page 10-1.

Set the items that you want to measure.

CURSOR Serial Menu

Press the **CURSOR** key, the **Type** soft key, and then the **Serial** soft key to display the following menu.

Turns cursor measurement on and off

Set the cursor type to Serial.

Set the cursor that you want to configure (SC1, SC2).

Press to configure the SC1 or SC2 cursor.

Set the tracking mode (OFF, Zoom1, Zoom2).

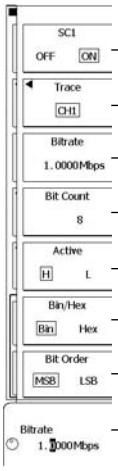
Moves the cursor to the left by the specified number of bits.

Moves the cursor to the right by the specified number of bits.

Set the cursor position.

Setting the SC1 or SC2 Cursor (Setup)

Press the Setup soft key to display the following menu.



Turns the SC1 cursor on and off

Set the waveform to measure.

Set the bitrate (using the jog shuttle).

Set the bit count (using the jog shuttle).

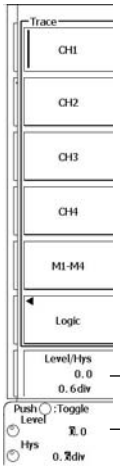
Set whether to make the high (H) or low (L) signals ones.

Set the format (Bin, Hex).

Set the bit order (MSB, LSB).

Set the bitrate and bit count.

Setting the Source Waveform (Trace)



Set the waveform to measure.

* When you set Trace to Logic, you can select one of the following bits to measure:
A0 to A7, B0 to B7, C0 to C7, and D0 to D7.
(On 16-bit models, you can select from bits A0 to A7 and C0 to C7.)

Switches the value that the jog shuttle adjusts (Level, Hys)

Set the threshold level and the hysteresis.

Explanation

Source Waveform

You can set the source waveform to a channel from CH1 to CH4 or M1 to M4 or to a logic signal bit from A0 to D7. (On 16-bit models, you can choose a logic signal bit from A0 to A7 or C0 to C7.) However, you cannot measure snapshot waveforms or accumulated waveforms other than the most recent one.

On a logic signal, you can only use the VT cursor.

Cursor Types and Measured Items

ΔT Cursors

You can use the ΔT cursors to measure the time values at the cursor locations.

T1	Time value at Cursor1
T2	Time value at Cursor2
ΔT	Time difference between Cursor1 and Cursor2
1/ΔT	Inverse of the time difference between Cursor1 and Cursor2

ΔV Cursors

You can use the ΔV cursors to measure the vertical values at the cursor locations.

V1	Vertical value at Cursor1
V2	Vertical value at Cursor2
ΔV	Difference between the vertical values of Cursor1 and Cursor2

ΔT&ΔV Cursors

You can use the ΔT andΔV cursors to measure the time values and vertical values at the cursor locations.

Time axis

T1	Time value at Cursor1
T2	Time value at Cursor2
ΔT	Time difference between Cursor1 and Cursor2
1/ΔT	Inverse of the time difference between Cursor1 and Cursor2

Vertical axis

V1	Vertical value at Cursor1
V2	Vertical value at Cursor2
ΔV	Difference between the vertical values of Cursor1 and Cursor2

VT Cursor

You can measure the time difference between the trigger position and the VT cursor position and measure the selected waveform values at the VT cursor position.

- CH1 to CH4

V(CH1)	Vertical value of CH1
V(CH2)	Vertical value of CH2
V(CH3)	Vertical value of CH3
V(CH4)	Vertical value of CH4
V(M1)	Vertical value of M1
V(M2)	Vertical value of M2
V(M3)	Vertical value of M3
V(M4)	Vertical value of M4
T	Time value

- Logic A0 to D7 (A0 to A7 and C0 to C7 On 16-bit models)

V(LG1)	Vertical value of Group 1
V(LG2)	Vertical value of Group 2
V(LG3)	Vertical value of Group 3
V(LG4)	Vertical value of Group 4
V(LG5)	Vertical value of Group 5
T	Time value

Marker Cursors

Marker cursors move on the waveform data points. You can measure the values at the specified cursor locations. You can position the marker cursors (MC1 to MC4) on different waveforms.

T1	Time value at MC1
T1-T2	Time difference between MC1 and MC2
T1-T3	Time difference between MC1 and MC3
T1-T4	Time difference between MC1 and MC4
V1	Vertical value at MC1
V1-V2	Difference between the vertical values of MC1 and MC2
V1-V3	Difference between the vertical values of MC1 and MC3
V1-V4	Difference between the vertical values of MC1 and MC4

Serial Cursors

Using the serial cursor position as the reference point, you can search serial patterns (ones and zeros) in the waveform at the specified bitrate. You can search the entire displayed waveform (10 divisions). You can specify the threshold value used to separate ones from zeros and specify whether to associate ones with high or low levels. There are two serial cursors: SC1 and SC2. You cannot display both cursors simultaneously, but you can display serial patterns simultaneously.

Calculations (Calc)

In all types of cursor measurement other than serial cursor measurement, you can specify calculations to be made using the measured cursor values and display the results of those calculations. For information about the types of functions (operators) that you can use in calculations, see section 9.10. For information about the items that can be measured, see section 10.2.

Cursor Range

ΔV Cursors (When the cursor type is ΔV or ΔT&ΔV)

Taking the center of the waveform area to be 0 divisions, you can move the cursors within the range of –4 to +4 divisions in 0.01-division steps.

ΔT Cursors (When the cursor type is ΔT&ΔV, ΔT, Marker, VT, or Serial)

Taking the center of the waveform area to be 0 divisions, you can move the cursors within the range of –5 to +5 divisions in 0.01-division steps. If a zoom window is displayed and a cursor moves into the zoom window, you can move the cursor in steps of 0.01 divisions of the zoom window.

Serial Cursor Display Formats

When you measure using serial cursors, you can configure the following settings.

Selecting a Measured Cursor Value Display Format

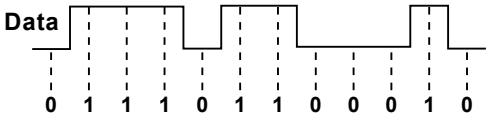
You can select the format that you want to use to display the measured cursor values.

Bin	The values are displayed in binary format.
Hex	The values are displayed in hexadecimal format.

Bit Order

You can select a bit order that is appropriate for the data stream.

MSB	Select this option when the data stream starts with the MSB.
LSB	Select this option when the data stream starts with the LSB.



When Bit Order is set to MSB, the value is 762.
When Bit Order is set to LSB, the value is 46E.

How Hidden Bits Are Handled

- In binary, a hidden bit is indicated with an x.
- In hexadecimal, hidden bits are ignored when values are determined.

Serial Cursor Tracking Mode

You can specify what action to take when the cursor leaves a zoom area.

OFF	Nothing happens when the cursor leaves a zoom area.
Zoom1 or Zoom2	When the cursor leaves the Zoom1 or Zoom2 area, the area is repositioned so that it is centered around the cursor.

Cursor Jump

You can make a cursor jump to the middle of a zoom window by selecting one of the jump methods listed below.

When the Cursor Type Is ΔT, ΔV, ΔT&ΔV, VT, or Marker

To Zoom1	The selected cursor jumps to the center of the Zoom1 window.
To Zoom2	The selected cursor jumps to the center of the Zoom2 window.

* When the cursor type is ΔT, ΔV, or ΔT&ΔV and the jog shuttle is set to adjust both Cursor1 and Cursor2, you can make Cursor 1 jump to the center of the specified zoom window while maintaining the same space between the two cursors.

When the Cursor Type Is Serial

←/→	You can jump in the selected direction by the distance specified by the Bit Count setting.

Notes about Cursor Measurement

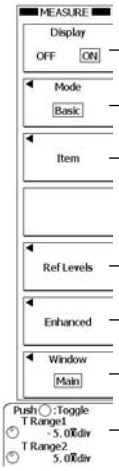
- The measured time values are based on the trigger position.
- The measured value for data that cannot be measured appears as "***."
- In the main, ZOOM1, and ZOOM2 windows, when the display record length is less than 10 kpoints (except for 4 and 5 kpoints) and Dot Connect is set to an option other than OFF, the DL6000/DLM6000 interpolates between sampled data. Therefore, it is possible for the cursor to be in a position where there is no sampled data.
  Because marker cursors move on the sampled data, they are always located in places where there is sampled data.
- If the serial cursor sample rate (S/s) or bitrate (bit/s) exceeds 1 M, all the bits of the measured result are Xs.

10.2 Automatically Measuring Waveform Parameters

Procedure

MEASURE Menu

Press **MEASURE** to display the following menu.



Turns automated measurement on and off

Set the measurement mode to Basic.

Press to set the source waveform and measurement items.

Press to configure the time measurement reference levels.

Press to configure the enhanced features.

Set the measurement source window (Main, Zoom1, Zoom2).

Set the upper and lower limits of the measurement time range (T Range1 and T Range2).

Setting the Source Waveform and the Measurement Items (Item)

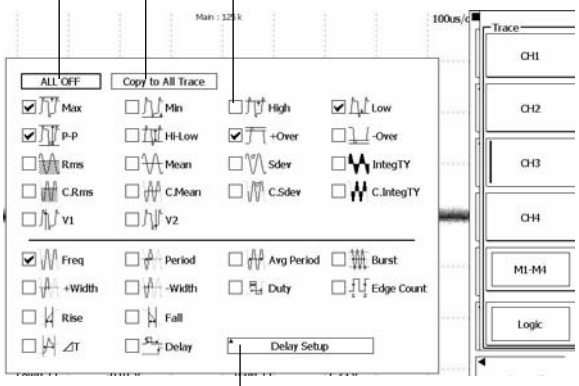
Press the **Item** soft key to display the following menu.

When the Source Waveform Is a Channel from CH1 to CH4 or M1 to M4

Clears all check boxes

Copies the settings on this screen to all channels

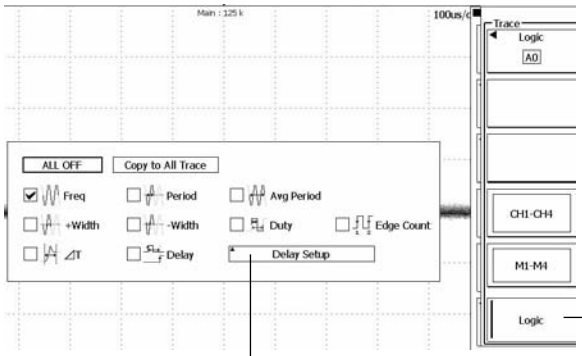
Set the items that you want to measure.



Set the waveform whose settings you want to configure.

Press to configure the measurement of delay between waveforms.

When the Source Waveform Is a Logic Signal

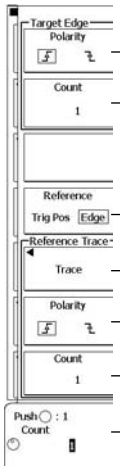


Select Logic.

Press to configure the measurement of delay between waveforms.

Configuring the Measurement of the Delay between Waveforms (Delay Setup)

Press the **Delay Setup** soft key to display the following menu.



- **Set the edge slope to detect.**
- **Set the edge that you want to detect (using the jog shuttle).**
- **Set the reference point (Trig Pos, Edge).**
- **Set the reference waveform (CH1–CH4, M1–M4, Logic).***
- **Set the slope of the edge of the reference waveform.**
- **Set the edge that you want to use as the reference point (using the jog shuttle).**

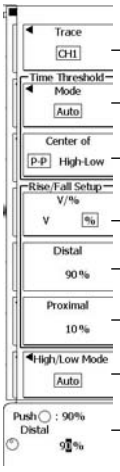
Only when Reference is set to Edge

- **Set the edge that you want to detect and the edge that you want to use as the reference point.**

* You can set the reference waveform to a bit from A0 to A7, B0 to B7, C0 to C7, or D0 to D7. (On 16-bit models, you can select from bits A0 to A7 and C0 to C7.)

Setting the Reference Levels for Time Measurements (Ref Levels)

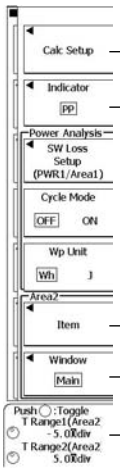
Press the **Ref/Levels** soft key to display the following menu.



- **Select the waveform to set the reference level for (CH1–CH4, M1–M4).**
- **Set the threshold mode (Auto, Level/Hys, Upper/Lower).**
- **Auto: Set Center of (P-P, High-Low).**
  Level/Hys or Upper/Lower: Set the threshold for Level/Hys or Upper/Lower (using the jog shuttle).
- **Set the unit used in the measurement of the Rise and Fall items (V, %).**
- **Set the distal value (using the jog shuttle).**
- **Set the proximal value (using the jog shuttle).**
- **Set the mode for determining high and low levels (Auto, Histogram, Max-Min).**
- **Set the distal and proximal values and the Level/Hys or Upper/Lower threshold.**

Configuring Enhanced Features (Enhanced)

Press the **Enhanced** soft key to display the following menu.



Press to configure expressions.

Press to set the indicator feature.

Configure the optional power supply analysis feature. ► IM DLM6054-61EN manual*

*** Only when the power supply analysis feature is enabled on a model with the power supply analysis option installed**

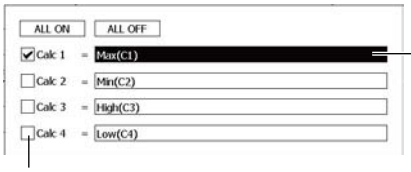
Press to set the source waveform and items to measure for area 2.

Set the measurement source window for area 2 (Main, Zoom1, Zoom2).

Set the upper and lower limits of the measurement time range of area 2 (T Range1(Area2) and T Range2(Area2)).

Configuring Calculations (Calc Setup)

Press the **Calc Setup** soft key to display the following menu.

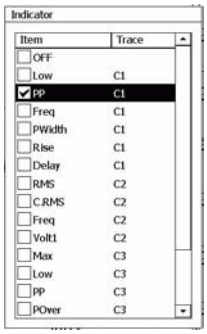


Define expressions using functions, arithmetic operators, and measurement items.

Set the expressions that you want to use.

Configuring the Indicator Feature (Indicator)

Press the **Indicator** soft key to display the following menu.



Select the measurement item whose location you want to indicate. (Select OFF to disable this feature.)

Explanation

Measurement Source Waveform (Trace)

You can set the source waveform to a channel from CH1 to CH4 or M1 to M4 or to a logic signal bit from A0 to D7. (On 16-bit models, you can choose a logic signal bit from A0 to A7 or C0 to C7.)However, you cannot measure snapshot waveforms or accumulated waveforms other than the most recent one.

Measurement Items (Item)

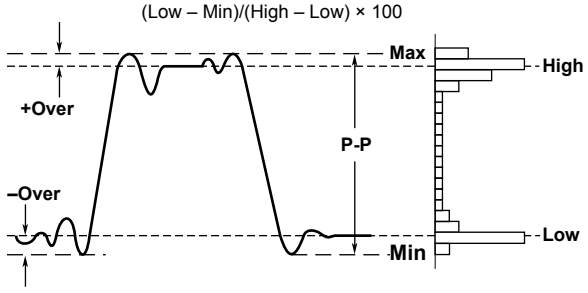
You can choose from the 30 measurement items and delay measurement items listed below. (The characters in parentheses indicate how an item is displayed on the screen.)

- The DL6000/DLM6000 can store a total of up to 100000 data values for all areas and traces (CH1 to CH4, M1 to M4, and Logic).
- A total of up to 16 measurement items can be displayed on the screen.
- The measurement items that you can select when the source waveform is a logic signal are Freq, Period, Avg Period, +Width, -Width, Duty, Edge Count, ΔT, and Delay.

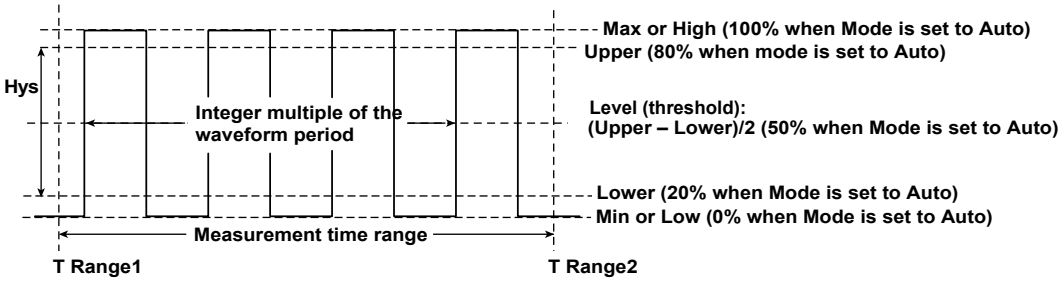
Voltage Measurement Items

Max (Max): Maximum voltage [V]
Min (Min): Minimum 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): The high voltage value minus the low voltage value
+Over (+Over): Overshoot [%]
(Max – High)/(High – Low) × 100
–Over (–Over): Undershoot [%]
(Low – Min)/(High – Low) × 100

Rms (Rms): Rms voltage [V] $(1/\sqrt{n})(\Sigma(xI^2))^{1/2}$
Mean (Mean): Mean voltage [V] $(1/n)\ \Sigma xI$
Sdev (Sdev): Standard deviation [V] $((\Sigma xI^2 - (\Sigma xI)2/n)/n)^{1/2}$
IntegTY (ITY): Sum of the positive and negative areas under the curve [Vs]



C.Rms (CRms): The rms value over an integer multiple of the waveform period within the measurement time range [V]
C.Mean (CMean): The mean voltage over an integer multiple of the waveform period within the measurement time range [V]
C.Sdev (CSdev): The standard deviation over an integer multiple of the waveform period within the measurement time range [V]
C.IntegTY (CITY): The average of the areas of the positive and negative amplitudes in each period [Vs]



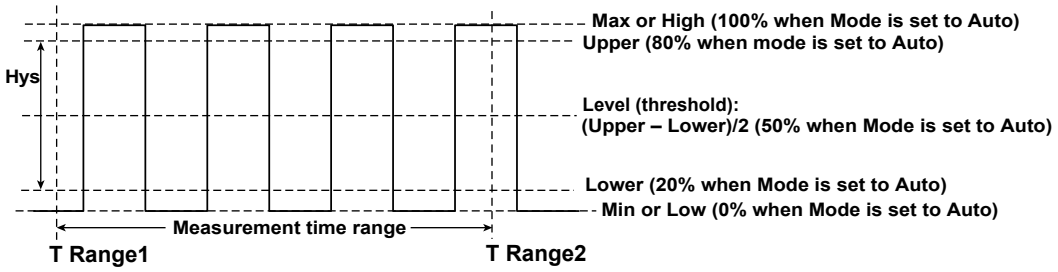
V1 (V1(x)): The voltages where each trace intersects T-Range1 (the cursor on the left that determines the measurement time range)
V2 (V2(x)): The voltages where each trace intersects T-Range2 (the cursor on the right that determines the measurement time range)
ΔT (ΔT(x)): The time difference between T-Range1 and T-Range2

* The name of the trace goes in the area marked an x. For example, for CH1, C1 would appear instead of x; for M1, M1 would appear; and for logic signal A0, LA0 would appear.

Time Measurement Items

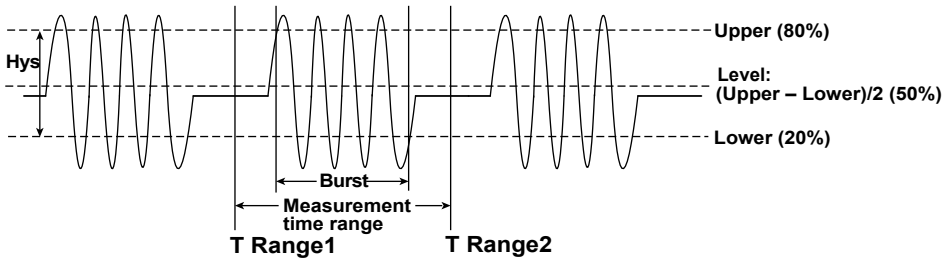
Freq (Freq): Frequency [Hz]
Avg Period (Avg Period): Average period in the measurement time range [s]
Edge Count (Edge): Edge count [no unit]

When Count = 4

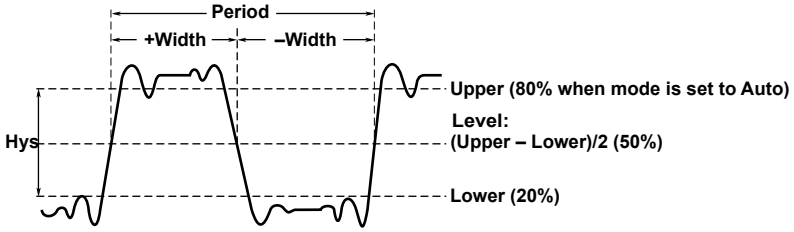


Burst (Burst): Burst period [s]

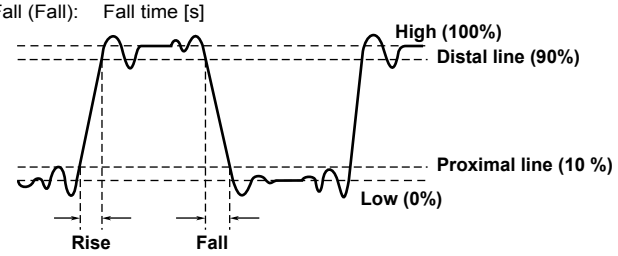
Set the measurement time range appropriately for the burst period that you want to measure.



+Width (+Width): Duration for which the waveform is above the reference line [s]
-Width (-Width): Duration for which the waveform is below the reference line [s]
Period (Period): Period [s]
Duty (Duty): Duty cycle (+Width/Period × 100) [%]



Rise (Rise): Rise time [s]
Fall (Fall): Fall time [s]



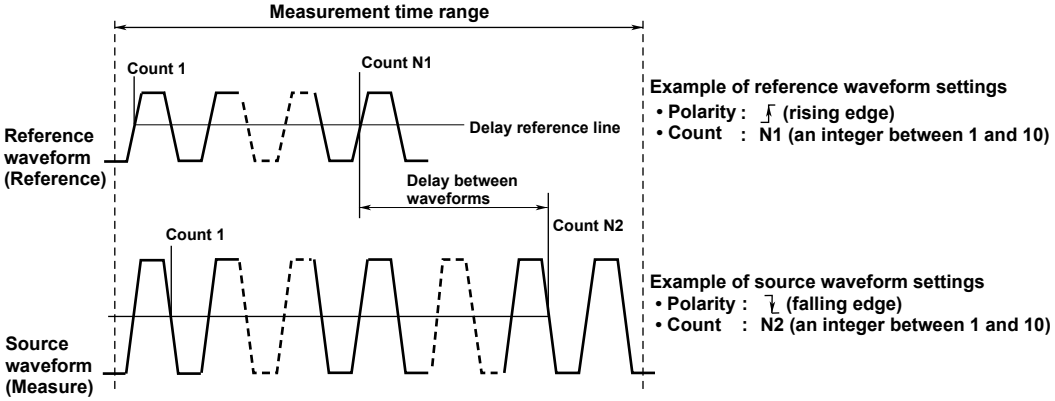
Other Measurement Items

Delay (Dly): The delay time in seconds

Configuring Delay Measurement (Delay Setup)

You can measure the delay between trace waveforms or the time difference from the trigger point to a rising or falling edge.

The following example shows delay measurement using a rising edge (when Reference is set to Edge).



- The reference position for measuring the delay between waveforms changes according to the Reference setting.

Edge	The specified edge of the reference waveform is the reference point.
Trig Pos	The trigger position is the reference point.

- Use the Edge Polarity setting to choose whether to detect rising or falling edges. Rising edges are detected by default.
- Use the Count setting to specify which edge to make the reference or measurement point. You can select a value from 1 to 10. The default setting is 1.
- The measurement point is detected on the voltage of the delay reference line.
- The voltage of the delay reference line is determined by the threshold mode as indicated below.

Auto	The line is 50% of the P-P or Hi-Lo value.
Level/Hys	The line is the specified threshold value.
Upper/Lower	The line is (Upper – Lower)/2.

- The name of the measurement item that the delay value is displayed next to is “Dly.”

High and Low Levels (High/Low Mode)

You can select the method for determining the 100% (high) and 0% (low) levels used in the measurement of the High, Low, Hi-Low, Rise, and Fall measurement items.

Auto
The DL6000/DLM6000 sets the high value to the high amplitude level and the low value to the low amplitude level based on the voltage level frequency of the source waveform in the measurement time range while taking into account the effects of ringing, spikes, etc. This method is suitable for measuring square waves and pulse waves.

Histogram
The DL6000/DLM6000 sets the level with the highest frequency on the histogram with the highest amplitude to high, and the level with the highest frequency on the histogram with the lowest level to low. This method is suitable for waveforms, such as rectangular waveforms, whose highest-frequency levels have much higher frequencies than the frequencies of other levels.

MAX-MIN
The DL6000/DLM6000 sets the high and low values to the maximum and minimum values in the measurement time range. This method is suitable for measuring sinusoidal and saw waves. It is not suitable for waveforms that have ringing and spikes.

Measurement Time Range (T Range1 and T Range2)

Taking the center of the waveform area to be 0 divisions, you can set the ends of the measurement time range to values within the range of ±5 divisions in 0.01-division steps.

Threshold (Mode)

You can set the method for determining the threshold used in the measurement of the time axis measurement items (except for Rise and Fall) to one of the options listed below.

Auto	The DL6000/DLM6000 determines the threshold automatically using P-P or High-Low.
Level/Hys	You can set the threshold using the jog shuttle.
Upper/Lower	You can set the threshold using the jog shuttle.

* You can apply the threshold to a channel from CH1 to CH4 or from M1 to M4.

Enhanced Features (Enhanced)

Measurement Areas (Area1 and Area2)

You can perform automated measurement of waveform parameters on two areas. You can also perform calculations using the measured waveform parameters.

Calculations (Calc Setup)

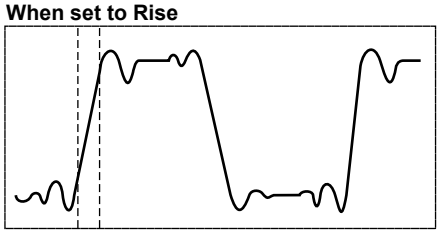
You can specify calculations to be made using the results of automated measurement and display the results of those calculations. For information about the types of functions (operators) that you can use in calculations, see section 9.10. For information about the items that can be measured, see section 10.2.

Indicator Feature (Indicator)

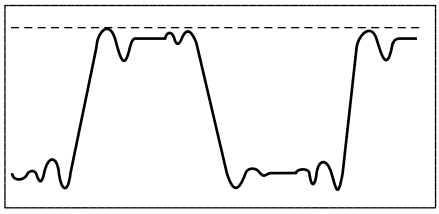
You can indicate the location of a specified measurement item using cursors. The measurement items whose locations you can indicate are listed below.

Max, Min, High, Low, P-P, HiLow, + Over (POver), –Over (MOver), Rms, Mean, C.Rms, C.Mean, Avg Period, Freq, Burst, Period, + Width (PWidth), –Width (MWidth), Period, Duty, Rise, Fall, Delay, V1 (Volt1), and V2 (Volt2)

When set to Rise



When set to Max



Note

If the statistical processing mode is set to Cycle or History, the measurement location cannot be displayed.

Notes about Automated Measurement of Waveform Parameters

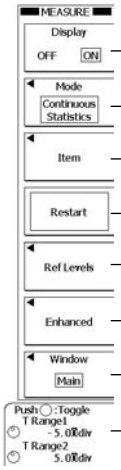
- If measurement is not possible, the measured value appears as “*****.”
- The DL6000/DLM6000 may not measure correctly if the waveform amplitude is small.
- If there are two or more waveform periods within the measurement time range, the time-axis parameters (+Width, –Width, Period, and Duty) are measured on the first period.
- To cancel automatic measurement, set Mode to OFF. Measurement will stop immediately.

10.3 Performing Statistical Processing on Measured Waveform Parameter Values

Procedure

MEASURE Continuous Statistics Menu

Press **MEASURE**, and then the **Continuous Statistics** soft key to display the following menu.



Turns automated measurement on and off

Set the measurement mode to Continuous Statistics.

Press to set the source waveform and measurement items. ► section 10.2

Restarts statistical processing

Press to configure the time measurement reference levels. ► section 10.2

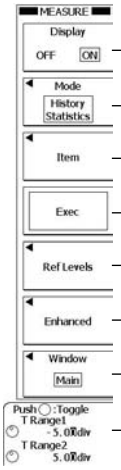
Press to configure the enhanced features. ► section 10.2

Set the measurement source window (Main, Zoom1, Zoom2). ► section 10.2

Set the upper and lower limits of the measurement time range (T Range1 and T Range2). ► section 10.2

MEASURE History Statistics Menu

Press **MEASURE**, and then the **History Statistics** soft key to display the following menu.



Turns automated measurement on and off

Set the measurement mode to History Statistics.

Press to set the source waveform and measurement items. ► section 10.2

Executes statistical processing

Press to configure the time measurement reference levels. ► section 10.2

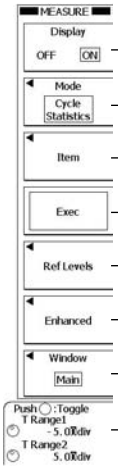
Press to configure the enhanced features. ► section 10.2

Set the measurement source window (Main, Zoom1, Zoom2). ► section 10.2

Set the upper and lower limits of the measurement time range (T Range1 and T Range2). ► section 10.2

MEASURE Cycle Statistics Menu

Press **MEASURE**, and then the **Cycle Statistics** soft key to display the following menu.



Turns automated measurement on and off

Set the measurement mode to Cycle Statistics.

Press to set the source waveform and measurement items. ► section 10.2

Executes statistical processing

Press to configure the time measurement reference levels. ► section 10.2

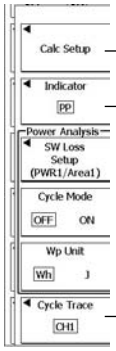
Press to configure the enhanced features.

Set the measurement source window (Main, Zoom1, Zoom2). ► section 10.2

Set the upper and lower limits of the measurement time range (T Range1 and T Range2). ► section 10.2

Configuring Enhanced Features (Enhanced)

Press the **Enhanced** soft key to display the following menu.



Press to configure expressions. ► section 10.2

Press to configure the indicator feature. ► section 10.2

Configure the optional power supply analysis feature. ► IM DLM6054-61EN manual*

*** Only when the power supply analysis feature is enabled on a model with the power supply analysis option installed**

Set the source waveform to use to determine the period (CH1–CH4, M1–M4, Logic).*

* You can set the reference waveform to a bit from A0 to A7, B0 to B7, C0 to C7, or D0 to D7. (On 16-bit models, you can select from bits A0 to A7 and C0 to C7.)

Explanation

There are three types of statistical processing: normal statistical processing, cyclic statistical processing, and history data statistical processing.
You can perform statistical processing on the automated measurements of waveform parameters listed section 10.2. The five statistical processing results listed below are displayed for the values of the selected automated measurement items. For example, if you select CH1 P-P as the automated measurement item, statistics such as the maximum, minimum, mean, and standard deviation values as well as the number of measured values used to calculate the statistics appear at the bottom of the screen.

Max	Maximum value
Min	Minimum value
Mean	Mean value
σ	Standard deviation
Cnt	The number of measured values that statistics were calculated for

The DL6000/DLM6000 can display the statistical results of two automatically measured items. If three or more automated measurement items are selected, the DL6000/DLM6000 displays the first two items ordered by ascending channel number and the order that the items appear in the automated measurement item selection menu (Max, Min, ..., DT, and Delay).

Example 1:	When the following statistical values are specified: Max and High for CH1, Max and Min for CH2, and Max and Min for CH3, the DL6000/DLM6000 displays Max and High for CH1.
Example 2:	When the following statistical values are specified: Max for CH1, Max and Min for CH2, and Max and Min for CH3, the DL6000/DLM6000 displays Max for CH1 and Max for CH2.

You can view undisplayed statistical analysis results by:

- Transferring them to a PC using the communication feature.
- Saving them as automated measurements of waveform parameters (see section 13.10 for details) and loading them onto a PC.

Normal Statistical Processing

While acquiring signals, the DL6000/DLM6000 calculates the statistics of the signals that it has acquired so far. The number of measured values that statistics were calculated for, expressed as Cnt, corresponds to the number of signals that the DL6000/DLM6000 has acquired up to that point. If you apply statistical processing to an additional automated measurement item, the Cnt value is reset to 1 regardless of whether or not the DL6000/DLM6000 is acquiring signals.
You can press the Restart soft key to start statistical processing over.

Cyclic Statistical Processing

The DL6000/DLM6000 determines periods in order from the oldest data of the displayed waveform, measures the selected automated measurement items within each period, and performs statistical processing on the results of automated measurement. The method used to determine the period in cyclic statistical processing is the same as the method used to determine the Period waveform parameter. The period of the specified waveform is applied to all measurement source waveforms.
The following parameters cannot be selected as measurement items.

Avg Period, Edge Count, ΔT, and Delay

History Data Statistical Processing

In history statistical processing, the DL6000/DLM6000 measures automated measurement items on the acquired waveform using the history feature. The DL6000/DLM6000 performs statistical processing starting from the oldest waveform. The statistics of the waveforms in the history waveform list display are calculated.

Notes about Statistical Processing

All soft keys except the Abort soft key are disabled during cyclic and history data statistical processing.
In normal statistical processing, press the RUN/STOP key to start waveform acquisition and perform statistical processing for the number of times specified by Count.

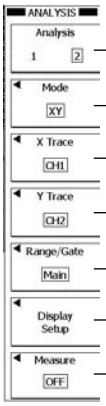
10.4 Viewing the Phase between Measured Waveforms on the XY Display

You can specify up to two XY waveforms (Analysis1 and Analysis2) and display them in the Analysis window.

Procedure

ANALYSIS XY Menu

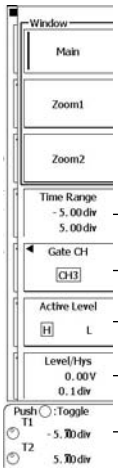
Press **SHIFT+DISPLAY** (XY) to display the following menu.
You can also display the following menu by pressing **ANALYSIS** and then pressing the **Mode** soft key to select **XY**.



- **Set the analysis number (1, 2).**
- **The analysis type is XY.**
- **Set the X-axis waveform.**
- **Set the Y-axis waveform.**
- **Press to set the time range and the gate channel.**
- **Press to turn the VT waveform display on or off.**
- **Set the analysis feature (OFF, Cursor, Integ XY).**

Setting the Time Range and the Gate Channel (Range/Gate)

Press the **Range/Gate** soft key to display the following menu.



- **Select the window within which you want to set the time range.**
- **Set the start (T1) and stop (T2) points (using the jog shuttle).**
- **Set the gate channel (CH1–CH4, M1–M4).**
- **Set the active level (H, L).**
- **Set the reference level and the hysteresis (using the jog shuttle).**
- **Set the start point, stop point, reference level, and hysteresis.**

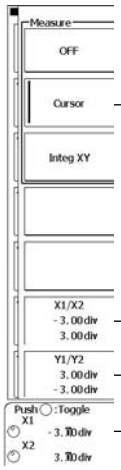
Note

When you press **SHIFT+DISPLAY** (XY) to display the ANALYSIS XY menu, the menu for Analysis 2 appears.

Configuring Analysis (Measure)

Press the **Measure** soft key to display the following menu. Analysis is not performed if you select **OFF**.

When Performing Cursor Analysis



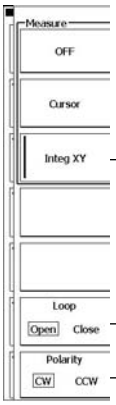
Select Cursor.

Set the X1 and X2 cursors (using the jog shuttle).

Set the Y1 and Y2 cursors (using the jog shuttle).

Set the X1, X2, Y1, and Y2 cursors.

When Measuring Area



Select Integ XY.

Set the method for determining the area (Open, Close).

Set the direction to make positive (CW, CCW).

Explanation

X-Axis and Y-Axis Waveforms (X Trace/Y Trace)

Select a waveform from CH1 to CH4 or M1 to M4.

Time Range (Range/Gate)

You can set the source window to main, Zoom1, or Zoom2.

Set the time range within the selected window.

You can set the time range to an area within ±5.00 divisions.

Gate Channel (Range/Gate)

The DL6000/DLM6000 displays an XY waveform when the selected gate channel signal is greater than or equal to the reference level or when it is less than or equal to the reference level.

Active Level (Active Level)

Select whether to display an XY waveform when the signal is greater than or equal to or less than or equal to the reference level.

H	Greater than or equal to the reference level
L	Less than or equal to the reference level

Reference Level and Hysteresis (Level/Hys)

Set the hysteresis and the reference level used to determine the signal state.

Analysis (Measure)

OFF

Analysis is disabled.

Cursor

The two time cursors and the two vertical cursors can be used at the same time.

X1/X2: You can measure the time values at cursor locations X1 and X2. You can move the cursors within the range of ±4 divisions in 0.01-division steps.

Y1/Y2: You can measure the vertical values at cursor locations Y1 and Y2. You can move the cursors within the range of ±4 divisions in 0.01-division steps.

Integ XY

You can determine the total area of the XY waveform. For details, see appendix 1.

Loop: Sets the method of determining the area to Open (total trapezoidal area) or Close (total triangular area).

Polarity: Select which direction to make positive: CW (clockwise) or CCW (counterclockwise).

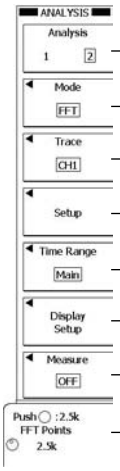
10.5 Performing FFT Analysis

You can analyze the power spectrums of up to two input waveforms (Analysis1 and Analysis2).
On models with the user-defined feature (optional), the DL6000/DLM6000 can determine the linear spectrum, rms power spectrum, power spectrum density, cross spectrum, transfer function, and coherence function.
FFT waveforms appear in the Analysis window.

Procedure

ANALYSIS FFT Menu

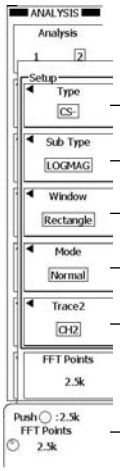
Press **SHIFT+MATH/REF** (FFT) to display the following menu.
You can also display the following menu by pressing **ANALYSIS** and then pressing the **Mode** soft key to select **FFT**.



Set the analysis number (1, 2).
The analysis type is FFT.
Set the waveform to analyze (CH1–CH4, M1–M4).
Press to configure the FFT conditions.
Set the analysis range (Main, Zoom1, Zoom2).
Press to set the vertical and horizontal scale values.
Press to configure FFT waveform measurement.
Set the number of FFT points.

Configuring FFT Conditions (Setup)

Press the **Setup** soft key to display the following menu.



Set the spectrum type (LS, RS, PS, PSD, CS, TF, CH).*
Set the spectrum sub type (MAG, LOGMAG, PHASE, REAL, IMAG).*
Set the time window (Rectangle, Hanning, Flattop).
Set the waveform display method (Normal, Max Hold, Average).
Set the second waveform to be analyzed (only when Type is set to CS, TF, or CH).
Set the number of FFT points.

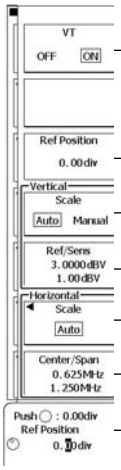
*** Only available on models with the user-defined computation option**

Note

When you press **SHIFT+MATH/REF** (FFT) to display the ANALYSIS FFT menu, the menu for Analysis 2 appears.

Setting the Vertical and Horizontal Scale Values (Display Setup)

Press the **Display Setup** soft key to display the following menu.



Turns the source waveform display on and off

Set the vertical-axis reference position (using the jog shuttle).

Set the vertical-axis scale (Auto, Manual).

Manually set the vertical-axis scale value (using the jog shuttle).

Set the horizontal-axis scale (Auto, Center/Span, Left/Right).

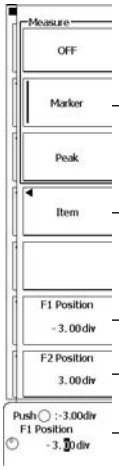
Manually set the horizontal-axis scale value (using the jog shuttle).

Set the vertical-axis reference position, the vertical-axis scale value, and the horizontal-axis scale value.

Configuring FFT Waveform Measurement (Measure)

Press the **Measure** soft key. The menu that appears varies according to the cursor type.

Marker Cursors (Marker)



Select Marker.

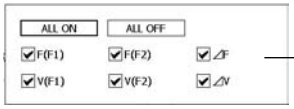
Press to set measurement items.

Set the F1 cursor position (using the jog shuttle).

Set the F2 cursor position (using the jog shuttle).

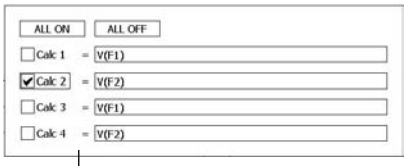
Set the F1 and F2 cursor positions.

When You Press Basic



Set the items that you want to measure.

When You Press Calc



See section 10.1.

Peak Cursors (Peak)

Select Peak.

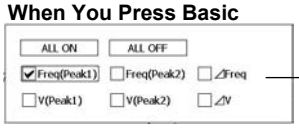
Press to set measurement items.

Set the measurement time range for Peak1 (using the jog shuttle).

Set the measurement time range for Peak2 (using the jog shuttle).

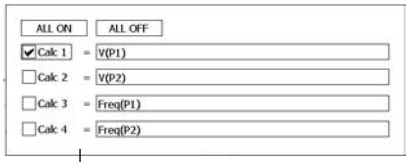
Set upper and lower limits (T1 and T2) for the measurement time ranges of Peak1 and Peak2.

When You Press Basic



Set the items that you want to measure.

When You Press Calc



See section 10.1.

Explanation

Analysis Source Waveform (Trace)

Select the analysis source waveform from the options indicated below. The available waveforms vary depending on the model.
CH1 to CH4 and M1 to M4.

FFT Conditions (Setup)

You can configure the time window and how to display FFT waveforms (normal, peak hold, or average).
On models with user-defined computation (optional), you can also select the spectrum to analyze.

Spectrum Type (Type/Sub Type)

On models with user-defined computation (optional), you can select the spectrum to analyze from the following options:

Spectrum	Description
LS-MAG	Magnitude of the specified waveform's linear spectrum
LS-LOGMAG	Logarithmic magnitude of the specified waveform's linear spectrum
LS-PHASE	Phase of the specified waveform's linear spectrum
LS-REAL	Real part of the specified waveform's linear spectrum
LS-IMAG	Imaginary part of the specified waveform's linear spectrum
RS-MAG	Rms power spectrum magnitude
RS-LOGMAG	Rms power spectrum logarithmic magnitude
PS-MAG	Magnitude of the specified waveform's power spectrum
PS-LOGMAG	Logarithmic magnitude of the specified waveform's power spectrum
PSD-MAG	Magnitude of the specified waveform's power spectrum density
PSD-LOGMAG	Logarithmic magnitude of the specified waveform's power spectrum density
CS-MAG	Magnitude of the cross spectrum of the specified two waveforms
CS-LOGMAG	Logarithmic magnitude of the cross spectrum of the specified two waveforms
CS-PHASE	Phase of the cross spectrum of the specified two waveforms
CS-REAL	Real part of the cross spectrum of the specified two waveforms
CS-IMAG	Imaginary part of the cross spectrum of the specified two waveforms
TF-MAG	Magnitude of the transfer function of the specified two waveforms
TF-LOGMAG	Logarithmic magnitude of the transfer function of the specified two waveforms
TF-PHASE	Phase of the transfer function of the specified two waveforms
TF-REAL	Real part of the transfer function of the specified two waveforms
TF-IMAG	Imaginary part of the transfer function of the specified two waveforms
CH-MAG	Magnitude of the coherence function of the specified two waveforms

Time Window (Window)

Select the time window that you want to use from the options listed below.

- Rectangle (rectangular window)
- Hanning (Hanning window)
- Flattop (flattop window)

Waveform Display Mode (Mode)

Set the FFT waveform display mode to one of the options listed below.

- Normal: The DL6000/DLM6000 displays FFT waveforms for each acquisition.
- Max Hold: For each frequency, the DL6000/DLM6000 holds the maximum value among the values acquired from the start of analysis up to the current acquisition and displays it.
- Average: For each frequency, the DL6000/DLM6000 displays the average of the values acquired from the start of analysis up to the current point.

Analysis Source Waveform (Trace2)

When the spectrum type is CS, TF, or CH, you can choose from the following options.
CH1 to CH4 and M1 to M4.

Number of FFT Points (FFT Point)

You can select one of the following options.
2.5k, 6.25k, 12.5k, 25k, 62.5k, 125k, or 250k

Note

Relationship between the Number of FFT Points and the Number of Displayed Points (Display Record Length)

Depending on the number of displayed points in the window that you select using the analysis range (Time Range) setting, the actual number of FFT points may be different from the number of FFT points that you selected.

If the number of FFT points is less than the number of displayed points, the displayed points are sampled to match the number of FFT points. The FFT may not cover the entire display range.

If the number of FFT points is greater than the number of displayed points, the number of FFT points is adjusted to an appropriate number that is less than or equal to the number of displayed points.

Analysis Range (Time Range)

Select the analysis range from the options listed below.

- Main: The range of the entire main window
- Zoom1: The range of the entire Zoom1 window
- Zoom2: The range of the entire Zoom2 window

Scale Value (Display Setup)

Set the vertical and horizontal scale values.

Displaying the Source Waveform (VT Display)

Select whether or not to display the FFT source waveform.

- ON: The source waveform is displayed.
- OFF: The source waveform is not displayed.

Reference Position (Ref Position)

Set the reference position on the vertical axis to a value within ±4.00 divisions.

Vertical Scale (Vertical Scale)

You can select one of the following options.

- Auto: The vertical scale values are set automatically.
- Manual: Set the center (Ref Level) of the vertical axis and the value per division (Sensitivity).

Horizontal Scale (Horizontal Scale)

You can select one of the following options.

- Auto: The center point and span are set automatically.
- Center/Span: Set the center point and span manually.
- Left/Right: Set the left and right ends of the scale manually.

Performing Measurements on FFT Waveforms (Measure)

You can analyze values on an FFT waveform using marker cursors and peak cursors.

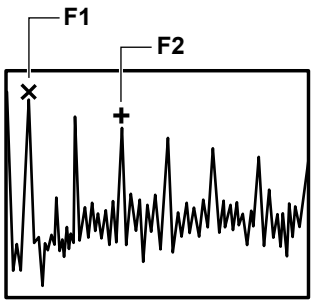
Cursor Type (Mode)

Set the cursor that you want to use for analysis to one of the options listed below.

- Marker: Using two marker cursors, you can display frequencies, levels, and the difference between the markers.
- Peak: Using two peak cursors, you can display peak values (Peak1 and Peak2) and the difference between the peaks.
- OFF: Cursor measurement is disabled.

Marker Cursors (Marker)

The DL6000/DLM6000 displays the frequencies and levels at the two marker cursors (F1 and F2). It can also display the difference between the cursors. Marker cursors move on the waveform data points.



Measurement Items (Item)

Set the measurement item to one of the settings below.

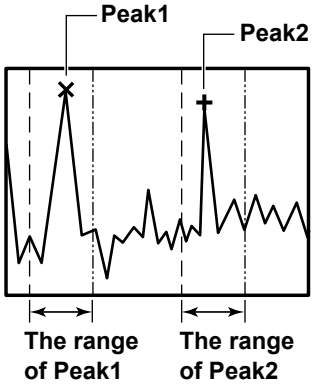
F1: The F1 frequency
F2: The F2 frequency
ΔF: The frequency difference between F1 and F2
V1: The F1 level
V2: The F2 level
ΔV: The difference between the F1 and F2 levels

- **Marker Cursor Positions (F1 Position and F2 Position)**

  You can set the F1 and F2 positions.
  Range: ±5.00 divisions

Peak Cursors (Peak)

Within each of the two frequency ranges (Peak1 T1 to T2 and Peak2 T1 to T2) that you specify, the DL6000/DLM6000 determines the peak (Peak1 and Peak2) and displays the frequencies, levels, and the difference between the peak values.



- **Measurement Item (Item)**

  Set the measurement item to one of the settings below.

  Freq(Peak1): The Peak1 frequency
  Freq(Peak2): The Peak2 frequency
  ∆Freq: The frequency difference between Peak1 and Peak2
  V(Peak1): The Peak1 level
  V(Peak2): The Peak2 level
  ∆V: The level difference between Peak1 and Peak2

- **Measurement Time Range (Peak1 T1 and T2 and Peak2 T1 and T2)**

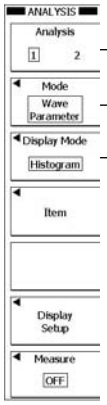
  Peak1 T1 and T2: Set the Peak1 measurement time range.
  Peak2 T1 and T2: Set the Peak2 measurement time range.
  Range: ±5.00 divisions

10.6 Displaying Histograms, Trends, and Lists of Automated Measurements of Waveform Parameters

Procedure

ANALYSIS Wave Parameter Menu

Press **ANALYSIS** to display the following menu.

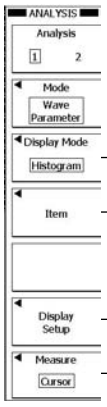


Set the analysis number (1, 2).

Set the analysis type to waveform parameter.

Set the display mode (Histogram, Trend, List).

Configuring the Histogram Display (Histogram)



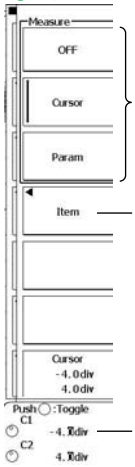
Set the display mode to Histogram.

Press to set the measurement item to display a histogram for.

Press to turn the VT waveform display on or off.

Set the analysis feature (OFF, Cursor, Param).

➡

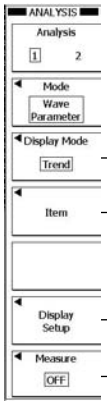


Select an analysis option.

Press to set the item to analyze.

Set the C1 and C2 cursor positions (only when Measure is set to Cursor).

Configuring the Trend Display (Trend)



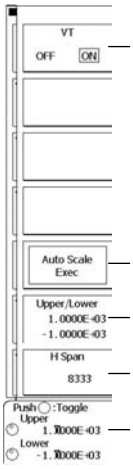
Set the display mode to Trend.

Press to set the measurement item whose trend you want to display.

Press to turn the VT waveform display on or off and to configure the display range.

Set the analysis feature (OFF, Cursor).
► figure shown above.

➡



Press to turn the VT waveform display on or off.

Executes auto scaling.

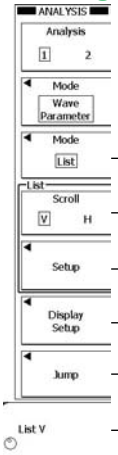
Set the vertical-axis scale value manually.

Set the horizontal-axis scale value manually.*

Set the vertical-axis (Upper/Lower) and horizontal-axis (H-Span) scale values.

* **When Mode in the MEASURE menu is set to Cycle Statistics, set H Range (Main, Zoom1, Zoom2).**

Configuring the List Display (List)



Set the display mode to List.

Set the direction to scroll in (V for vertical or H for horizontal).

Press to set the list type (Trend, Statistics) and the scroll amount (1, 10, 100, 1000, 10000).

Press to turn the VT waveform display on or off.

Move to a specific location (Latest, Oldest, Max, Min).

Scroll the list up, down, left, or right.

Explanation

Display Mode (Display Mode)

You can select one of the following options.

Histogram	A histogram of the results is displayed.
Trend	A trend of the results is displayed.
List	A list of the results is displayed. All the results for the selected automated waveform parameter measurement items are displayed.

Measurement Item to Display (Item)

You can select one automated waveform parameter measurement item and display its histogram or trend.

The measurement items that you can select vary as indicated below depending on the measurement mode that you select in the MEASURE menu.

- **When the Mode Is Basic, Continuous Statistics, or History Statistics**
  Area/Calc: You can select a measurement item from Area1, Area2, or Calc.
  Trace: You can set the measurement source waveform to a channel from CH1 to CH4, M1 to M4, or Logic.
- **When the Mode Is Cycle Statistics**
  Select: You can select a measurement item from Basic or Calc.
  Trace: You can set the measurement source waveform to a channel from CH1 to CH4, M1 to M4, or Logic.

Displayed Trend Points (H Span)

You can set the number of trend points to show in the trend display. The trend of the specified number of measured values starting from the latest measured result is displayed. The maximum number of displayable trend points is 100,000 (when a single item is selected).

Executing Auto Scale (Auto Scale Exec)

When you are displaying a trend, you can execute Auto Scale to adjust Upper, Lower, and H Span in the manner described below.

Upper and Lower	Upper and lower are set so that the difference between the maximum and minimum values of the waveform parameter is 80% of the waveform area.
H Span	H Span is set so that all the waveform parameter values that were measured before Auto Scale was executed are displayed. If the automated waveform parameter measurement mode is Basic or Continuous Statistics and the number of waveform parameters that had been measured is less than or equal to 100, H-Span is set to 100.

Displayed Waveform Area (H Range)

When you are displaying a trend and the automated waveform parameter measurement mode is Cycle Statistics, you can choose to display the main, Zoom1, or Zoom2 waveform area.

Analysis (Measure)

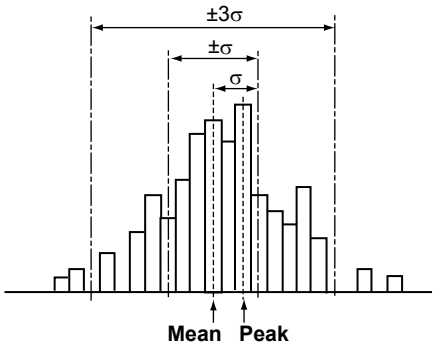
OFF

Analysis is disabled.

Param

You can select parameters.

Mean	Mean value
σ	Standard deviation of the histogram
Peak	Peak value of the histogram
Integ±σ	Percentage of measured values that fall within ±σ (%)
Integ±3σ	Percentage of measured values that fall within ±3σ (%)



Cursor (When the display mode is histogram or trend)

C1	The measured value at cursor C1 is displayed.
C2	The measured value at cursor C2 is displayed.
ΔC	The difference between the measured values of cursors C1 and C2 is displayed.

Configuring the List Display (Setup)

List Type (Mode)

There are two types of lists that can be displayed.

- **Trend**

  The results of automated measurement from the start of measurement to the present are all displayed in a list. The measurement items that are displayed are those that have been enabled in the MEASURE menu.

- **Statistics**

  Statistical processing is performed on the results of automated measurement from the start of measurement to the present, and the statistical values that are listed below are displayed for each measurement item. The measurement items that are displayed are those that have been enabled in the MEASURE menu.

  Current (current value), Max (maximum value), Min (minimum value), Mean (mean value), σ (standard deviation), and Cnt (number of processed values)

Scroll Amount

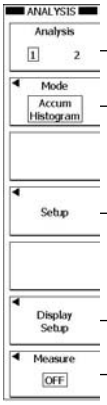
You can set the number of vertical list entries to scroll through at a time to a value from 1 to 10000.

10.7 Displaying the Frequency Distribution of a Specified Area (Accum Histogram)

Procedure

ANALYSIS Accum Histogram Menu

Press **ANALYSIS** to display the following menu.



Set the analysis number (1, 2).

Set the analysis type to Accum Histogram.

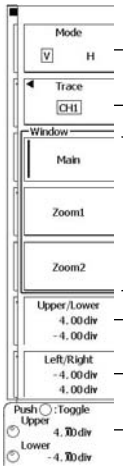
Press to configure the axis and the area.

Press to turn the VT waveform display on or off.

Set the analysis feature (OFF, Cursor, Param).

Setting the Axis and the Area (Setup)

Press the **Setup** soft key to display the following menu.



Set the axis (V, H).

Set the waveform to display (CH1–CH4, M1–M4).

Set the source window.

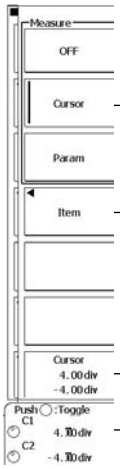
Set the upper and lower limits of the range (using the jog shuttle).

Set the left and right limits of the range (using the jog shuttle).

Set the upper, lower, left, and right limits of the range.

Configuring Cursors (Cursor)

Press the **Measure** soft key and then the **Cursor** soft key to display the following menu.



Select Cursor.

Press to set the item to analyze (Basic, Calc).

Switches the value that the jog shuttle adjusts (C1, C2)

Set the cursor positions (C1 and C2).

Configuring Parameters (Param)

Press the **Measure** soft key and then the **Param** soft key to display the following menu.

Select Param.

Press to set the item to analyze (Area1, Area2, Calc item).

Set the range of Area1 (using the jog shuttle).

Set the range of Area2 (using the jog shuttle).

Set the upper and lower limits (T1 and T2) of the Area1 and Area2 ranges.

Explanation

Axis (Mode)

Select the histogram axis.

V	Vertical
H	Horizontal

Waveform to Display (Trace)

Select a waveform from CH1 to CH4 or M1 to M4.

Source Window (Window)

You can set the source window to main, Zoom1, or Zoom2.

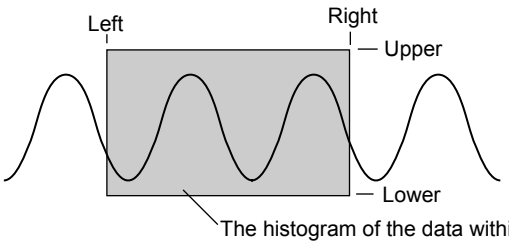
Source Area (Upper/Lower and Left/Right)

Upper/Lower

You can set the horizontal range of the area that you want to use to create a histogram to an area within ±4 divisions.

Left/Right

You can set the vertical range of the area that you want to use to create a histogram to an area within ±4 divisions.



Analysis (Measure)

OFF

Analysis is disabled.

Cursor

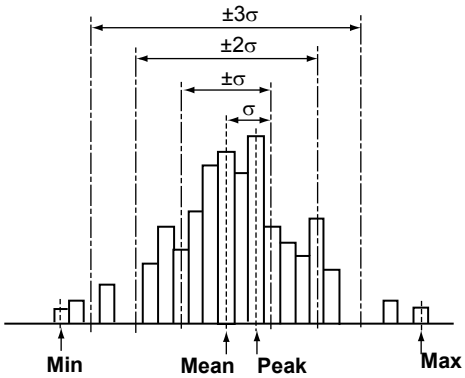
C1	The measured value at cursor C1 is displayed.*
C2	The measured value at cursor C2 is displayed.*
ΔC	The difference between the measured values of cursors C1 and C2 is displayed.
Calc1 to Calc4	The value that results from the specified calculation is displayed.

* When the axis is set to H, you can move two vertical cursors and measure their vertical values.
When the axis is set to V, you can move two horizontal cursors and measure their horizontal-axis values.

Param

You can display the following parameter values for histograms of the two specified areas (Area1 and Area2).

Peak Point	Peak value
Max Point	Maximum value
Min Point	Minimum value
Median	Median*
Mean	Mean value
σ	Standard deviation of the histogram
Rms	Rms value
Integ±σ	Percentage of values that fall within ±σ
Integ±2σ	Percentage of values that fall within ±2σ
Integ±3σ	Percentage of values that fall within ±3σ
Calc1 to Calc4	The value that results from the specified calculation



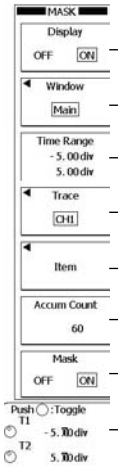
* The sampled points are sorted from the minimum to the maximum value, and the middle number is determined.

10.8 Performing a Mask Test

Procedure

MASK Menu

Press **SHIFT+MEASURE** (MASK) to display the following menu.



Switches mask testing on and off

Set the measurement source window (Main, Zoom1, Zoom2).

Set the upper and lower limits (T1 and T2) of the measurement time range (using the jog shuttle).

Set the waveform to measure (CH1–CH4, M1–M4).

Press to set measurement items.

Set the accumulation count (using the jog shuttle).

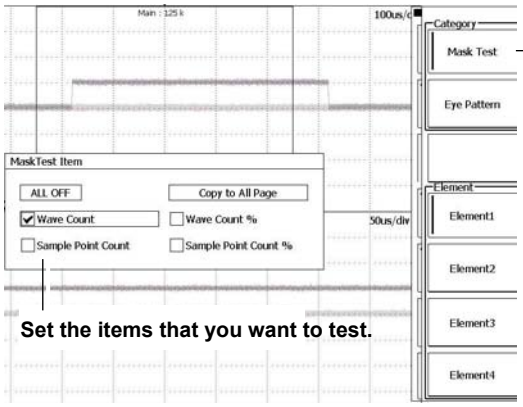
Switches mask display on and off

Set the measurement time range and the accumulation count.

Setting Measurement Items (Item)

Press the **Item** soft key and then the **Mask Test** or **Eye Pattern** soft key.

When You Press Mask Test

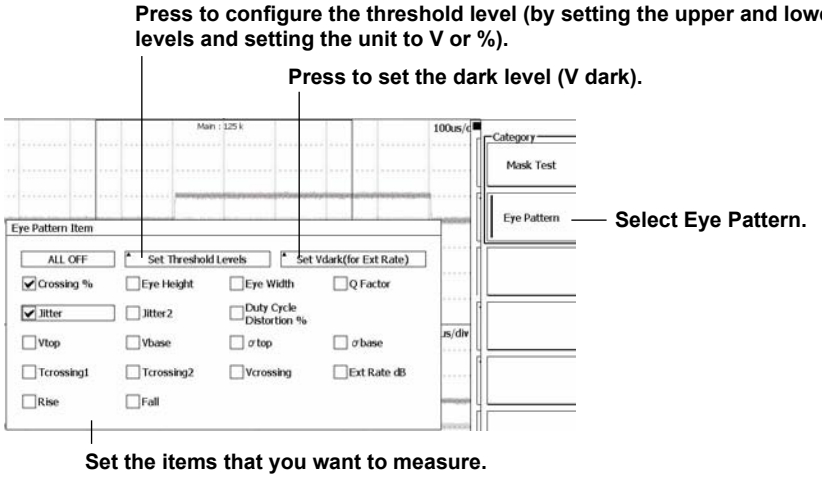


Select Mask Test.

Select an element.

Set the items that you want to test.

When You Press Eye Pattern



Explanation

You can execute a mask test (mask test and eye pattern measurement) and display the results. The mask test detects an error if the source trace enters any one of four masks (elements). You can create the masks on a PC. For information about how to load the mask patterns that you create, see section 13.7.

Measurement Source Waveform (Trace)

Select a waveform from CH1 to CH4 or M1 to M4.

Measurement Source Window (Window)

Select Main, Z1, or Z2.

Measurement Time Range (Time Range)

Taking the center of the waveform area to be 0 divisions, you can set the ends of the measurement time range to values within the range of ±5 divisions in 0.01-division steps.

Measurement Items (Item)

You can select the following measurement items.

Mask Test		
	Wave Count	Acquisition error count
	Wave Count %	Acquisition error rate (%)
	Sample Point Count	Sampling error count/total data count
	Sample Point Count %	Sampling error rate (%)
Eye Pattern Measurement		For definitions of measurement items and their formulas, see “Mask Test” in section 2.9.
	Crossing %	Level where the rising edge and the falling edge of the eye pattern intersect, expressed as a percentage with respect to the difference between Vtop and Vbase
	Eye Height	Height of the eye
	Eye Width	Width of the eye
	Q Factor	Quality factor of the eye diagram expressed as a ratio of the eye height with respect to the noise at both the high and low voltage levels
	Jitter	Magnitude of the time fluctuation of the first crossing point (crossing1)
	Jitter2	Magnitude of the time fluctuation of the second crossing point (crossing2)
	Duty Cycle Distortion %	Time difference between the falling edge intermediate point and the rising edge intermediate point as determined by the intermediate threshold level expressed as a percentage with respect to the full bit width
	Vtop	Average top peak voltage of the vertical histogram
	Vbase	Average bottom peak voltage of the vertical histogram
	σ top	Standard deviation of the top peak voltage of the vertical histogram
	σ base	Standard deviation of the bottom peak voltage of the vertical histogram
	Tcrossing1	Average time of the first crossing point
	Tcrossing2	Average time of the second crossing point
	Vcrossing	Voltage at the point where the rising edge and the falling edge cross
	Ext Rate dB	Extinction rate in dB
	Rise	Rise time between the specified lower and upper threshold levels
	Fall	Fall time between the specified upper and lower threshold levels

Threshold Levels (Set Threshold Levels)

You can specify the threshold levels using percentages or physical values. The threshold levels are used to measure the eye pattern Rise (the time it takes to go from Lower to Upper) and Fall (the time it takes to go form Upper to Lower) items.

V	You can set the level to a value within ±10 divisions. The unit changes depending on the set conditions.
%	You can set the level to a percentage from 0 to 100%. The difference between Vtop and Vbase is taken to be 100%.

Dark Level (Set Vdark)

Set the dark level (zero light level). The dark level is used to measure Ext Rate dB (the eye pattern extinction rate in dB).

You can set the level to a value within ±10 divisions. The unit changes depending on the set conditions.

Accumulation Count (Accum Count)

Set how many acquired signals to accumulate. For details on the accumulation feature, see section 8.2.

Mask Display (Mask)

You can select whether or not to display the mask images that have been created on a PC.

Notes about Mask Tests

- When you execute a mask test, all waveforms other than the source waveform are displayed as described below.
- They are not displayed when Dot Connect is set to OFF (see section 8.1 for details).
- They are displayed at low intensity when Dot Connect is set to an option other than OFF.
- You cannot execute a mask test when GO/NOGO determination or history searching is in progress.
- Accumulation turns on when you turn mask testing on (open the setup menu). The accumulation mode is set to Count.

Note

Because the sample point count is calculated using interpolated data, the value returned for it may not correspond to the record length.

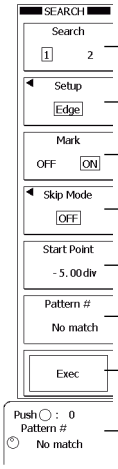
10.9 Searching Waveforms

You can search the displayed waveforms for locations that match the specified conditions. You can specify up to two search conditions (Search1 and Search2).

Procedure

SEARCH Menu

Press **SEARCH** to display the following menu.



Set the search condition number (1, 2).

Configure the search conditions.

Turns the display of detected point markers on and off

Set the skip mode (OFF, Hold Off, Decimation).

Set the search start point (using the jog shuttle).

Specify the detected point that you want to display (using the jog shuttle).

Executes a search

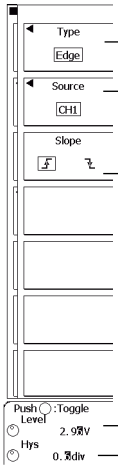
Set the detected point number and the search start point.

Configuring Search Conditions (Setup)

Searching for Edges

Press the **Setup** soft key, the **Type** soft key, the **Edge/State** soft key, and then the **Edge** soft key to display the following menu.

When the waveform to search is a channel CH1–CH4, M1–M4.



Set the search type to Edge.

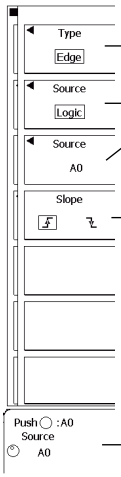
Set the waveform to search (CH1–CH4, M1–M4). or M1 to M4).

Set the slope (,). ► section 6.3

Set the level.

Set the hysteresis.

When the Waveform to Search Is a Logic Signal



Set the search type to Edge.

Set the waveform to search (Logic).

Press to set the source (A0–D7). This is the same as the setting using the jog shuttle.

Set the slope (,). ► section 6.3

Set the source (A0–D7).

Using Qualifications to Limit an Edge Search (Edge Qualified)

Press the **Setup** soft key, the **Type** soft key, the **Edge/State** soft key, and then the **Edge Qualified** soft key to display the following menu.

Set the search type to Edge Qualified.

Set the waveform to search (CH1–CH4, M1–M4).

Set the slope (,).

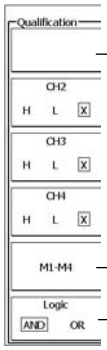
Press to configure the qualifications.
► section 6.4

Press to set the level and hysteresis.

Set the level of the source.

Set the hysteresis of the source.

Level and Hysteresis Settings



You cannot set a qualification for the waveform that will be searched.

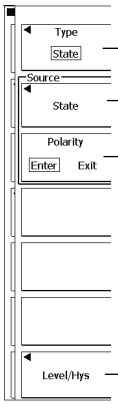
Set the qualification for each channel (H, L, X).

Press to open the setup menu for M1 to M4.

Set the logic for the qualifications.

Searching for State Conditions (State)

Press the **Setup** soft key, the **Type** soft key, the **Edge/State** soft key, and then the **State** soft key to display the following menu.



Set the search type to State.

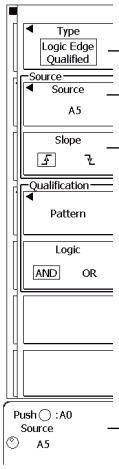
Press to set the state conditions.
► section 6.6

Set the location to be searched (Enter, Exit).

Press to set the level and hysteresis.
► "Searching for Edge Using Conditions"

Using Qualifications to Limit an Edge Search on a Logic Signal (Logic Edge Qualified)

Press the **Setup** soft key, the **Type** soft key, the **Edge/State** soft key, and then the **Logic Edge Qualified** soft key to display the following menu.



Set the search type to Logic Edge Qualified.

Press to set the waveform to search (this is the s as the setting using the jog shuttle). ► section 6.

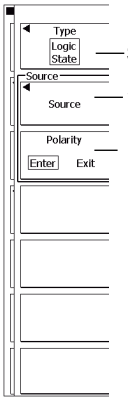
Set the slope (,).

Press to configure the qualifications. ► section 6.4

Set the waveform to search.

Searching for State Conditions on a Logic Signal (Logic State)

Press the **Setup** soft key, the **Type** soft key, the **Edge/State** soft key, and then the **Logic State** soft key to display the following menu.



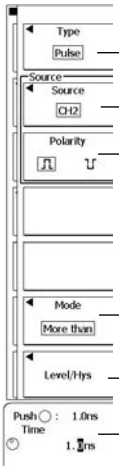
Set the search type to Logic State.

Set the waveform to search (A0–D7). ► section 6.6

Set the polarity (Enter, Exit). ► section 6.6

Searching for Pulse Widths (Pulse)

Press the **Setup** soft key, the **Type** soft key, the **Width** soft key, and then the **Pulse** soft key to display the following menu.



Set the search type to Pulse.

Set the search source waveform (CH1–CH4, M1–M4). ► section 6.7

Set the kind of pulse to compare to the specified time (,). ► section 6.7

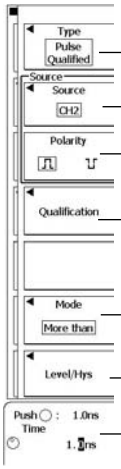
Set the time width mode. ► section 6.7

Press to set the level and hysteresis. ► "Searching for Edge Using Conditions"

Set the reference time.

Using Qualifications to Limit a Pulse Width Search (Pulse Qualified)

Press the **Setup** soft key, the **Type** soft key, the **Width** soft key, and then the **Pulse Qualified** soft key to display the following menu.



Set the search type to Pulse Qualified.

Set the search source waveform (CH1–CH4, M1–M4).
► section 6.8

Set the kind of pulse to compare to the specified time (⎍, ⎎).
► section 6.8

Press to configure the qualifications.
► section 6.8

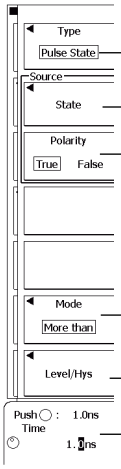
Set the time width mode.
► section 6.8

Press to set the level and hysteresis.
► "Searching for Edge Using Conditions"

Set the reference time.

Searching for State Widths (Pulse State)

Press the **Setup** soft key, the **Type** soft key, the **Width** soft key, and then the **Pulse State** soft key to display the following menu.



Set the search type to Pulse State.

Press to configure the state conditions.
► section 6.9

Set the comparison method.
True: The time for which the state conditions are met is compared with the reference time.
False: The time for which the state conditions are not met is compared with the reference time.
► section 6.9

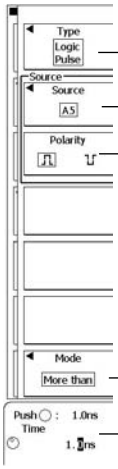
Set the time width mode.
► section 6.9

Press to set the level and hysteresis.
► "Searching for Edge Using Conditions"

Set the reference time.

Searching for Pulse Widths on a Logic Signal (Logic Pulse)

Press the **Setup** soft key, the **Type** soft key, the **Width** soft key, and then the **Logic Pulse** soft key to display the following menu.



Set the search type to Logic Pulse.

Set the waveform to search (A0–D7).
► section 6.7

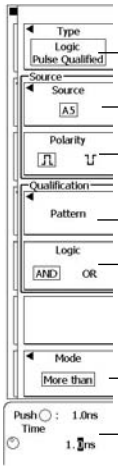
Set the kind of pulse to compare to the specified time (⎍ , ⎎).
► section 6.7

Set the time width mode.
► section 6.7

Set the reference time.

Using Conditions to Limit a Pulse Width Search on a Logic Signal (Logic Pulse Qualified)

Press the **Setup** soft key, the **Type** soft key, the **Width** soft key, and then the **Logic Pulse Qualified** soft key to display the following menu.



Set the search type to Logic Pulse Qualified.

Set the waveform to search (A0–D7).

Set the kind of pulse to compare to the specified time (⎍ , ⎎).

Press to configure the qualifications.

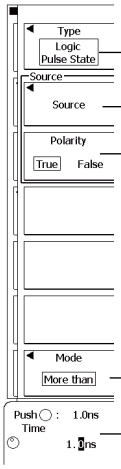
Set the logic (AND, OR).

Set the time width mode.
► section 6.8

Set the reference time.

Searching for State Widths on a Logic Signal (Logic Pulse State)

Press the **Setup** soft key, the **Type** soft key, the **Width** soft key, and then the **Logic Pulse State** soft key to display the following menu.



Set the search type to Logic Pulse State.

Press to configure the state conditions.
► section 6.9

Set the comparison method.
True: The time for which the state conditions are met is compared with the reference time.
False: The time for which the state conditions are not met is compared with the reference time.
► section 6.9

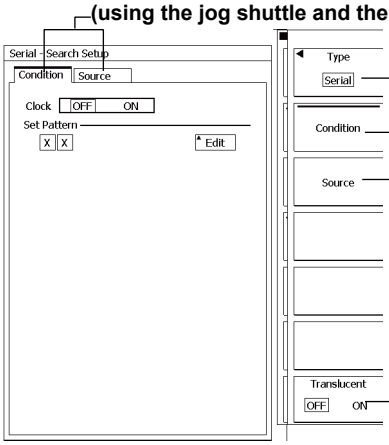
Set the time width mode.
► section 6.9

Set the reference time.

Searching on a Serial Bus Signal (Serial)

Press the **Setup** soft key, the **Type** soft key, the **Width** soft key, and then the **Serial** soft key to display the following menu.

Switch between configuring the search conditions and the waveform to search (using the jog shuttle and the SET key).



Set the search type to Serial.

Press to configure the search conditions.

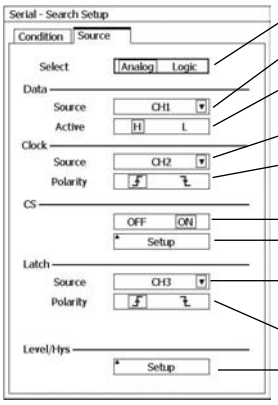
Press to configure the waveform to search.

Turns translucent dialog box display on and off

Setting Search Conditions (Condition Setup)

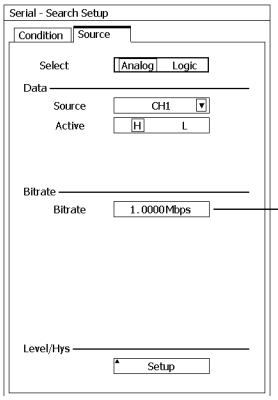
When Searching on Analog Waveforms

When Clock Is Set to ON



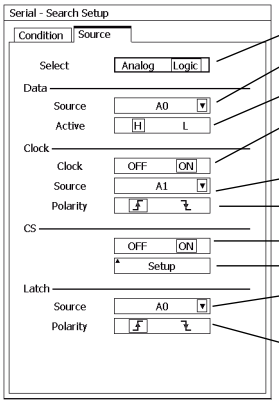
Set the type of waveform to search (only on the DLM6000).
Set the data source (CH1–CH4, M1–M4).
Set the active state.
Set the clock source.
Select rising or falling.
Turns chip select on and off
Set the chip select state conditions (when CS is set to ON).
Set the latch source (to X to not specify a latch source or CH1–CH4, M1–M4).
Select rising or falling.
Press to configure the levels and hysteresis for the data, clock, CS, and latch sources.

When Clock Is Set to OFF



Set the bitrate.

When Searching on Logic Signals



Set the type of waveform to search.
Set the data source (A0–D7).
Set the active state (H, L).
Turns the clock on and off
(the same as the Clock setting in the Condition tab)
Set the clock source (when clock is set to ON).
Select rising or falling (when Clock is set to ON).
Turns chip select on and off
Set the chip select state conditions (when CS is set to ON).
Set the latch source
(to X to not specify a latch source or to A0–D7).
Select rising or falling.

Explanation

You can search the displayed waveforms for locations that match the specified conditions. You can zoom-in on the detected locations. You can search through up to up to 5000 points within the specified search range.

Search Condition Number (Search)

You can specify two search conditions. You can configure a search condition by setting Search to the number of the condition that you want to configure.

Search Conditions (Setup)

Configure the search conditions.

Search Type (Type)

You can select the search type from the options listed below. The various search types are the same as the trigger conditions with the same names. For details about a search type (except for Logic Pulse Qualified), see the explanation for its corresponding trigger condition.

Edge

- Edge (Edge)
  You can search for the edges of the search source waveform. You can set the search source waveform to Logic or a channel from CH1 to CH4 or M1 to M4. For details, see section 6.3.
- Qualified Edge (Edge Qualified)
  You can search for the edge of the search source waveform where the waveform levels meet the specified qualifications. You can set the search source waveform to a channel from CH1 to CH4 or M1 to M4. For details, see section 6.4.
- State Condition (State)
  The DL6000/DLM6000 searches for points where the result of comparing each waveform state to the specified state condition changes from met to not met or from not met to met. If you specify a clock source, the DL6000/DLM6000 samples the comparison results using the clock and detects the point of change in sync with the clock. You can set the search source waveform to a channel from CH1 to CH4 or M1 to M4. For details, see section 6.6.
- Qualified Logic Edge (Logic Edge Qualified)
  You can search a logic waveform. You can search for the edge of a square waveform where the waveform levels meet the specified qualifications. For details, see section 6.4.
- Logic State Condition (State)
  You can search a logic waveform. The DL6000/DLM6000 searches for points where the result of comparing each logic signal state to the specified state condition changes from met to not met or from not met to met. If you specify a clock source, the DL6000/DLM6000 samples the comparison results using the clock and detects the point of change in sync with the clock. For details, see section 6.6.

Width

- Pulse Width (Pulse)
  You can search for pulses of a specified width on the search source waveform. You can set the search source waveform to channel from CH1 to CH4 or M1 to M4. For details, see section 6.7.
- Qualified Pulse Width (Pulse Qualified)
  You can search on the search source waveform for pulses of a specified length where the waveform levels meet the specified qualifications. You can set the search source waveform to a channel from CH1 to CH4 or M1 to M4. For details, see section 6.8.
- State Condition Width (Pulse State)
  The DL6000/DLM6000 searches for points where the result of comparing each waveform state to the specified state condition is met or not met for a specified period of time. If you specify a clock source, the DL6000/DLM6000 samples the comparison results using the clock and detects the points of change in sync with the clock. You can set the search source waveform to a channel from CH1 to CH4 or M1 to M4. For details, see section 6.9.
- Logic Signal Pulse Width (Logic Pulse)
  You can search a logic signal for pulses of a specified width. For details, see section 6.7.

- Qualified Logic Signal Pulse Width (Logic Pulse Qualified)
  You can search a logic waveform. You can search for the pulse of a specified length on the search source waveform where the logic signal waveform levels meet the specified qualifications. You can set the search source signal to a bit from A0 to A7, B0 to B7, C0 to C7, or D0 to D7. (On 16-bit models, you can select a bit from A0 to A7 or C0 to C7.)
- Logic Signal State Condition Width (Logic Pulse State)
  You can search a logic waveform. The DL6000/DLM6000 searches for points where the result of comparing each logic signal state to the specified state condition is met or not met for a specified period of time. If you specify a clock source, the DL6000/DLM6000 samples the comparison results using the clock and detects the points of change in sync with the clock. For details, see section 6.9.

Serial

You can search a serial pattern signal. The DL6000/DLM6000 searches for locations where the data pattern of the search source waveform matches the data pattern that you have specified.

Note

When you want to search I2C, CAN, LIN, SPI, or UART signals, see the IM DLM6054-51EN option manual.

Level (Level)

Specify the level used to detect edges and conditions.
If you are setting the level for a logic signal, set the threshold level.
Taking the vertical position to be 0 divisions, you can set the level to a value within the range of ±10 divisions in 0.01-division steps. For example, when the voltage scale is 2 V/division, you can set the threshold in 0.02 V steps.

Hysteresis (Hysteresis)

You can set the hysteresis that is applied to the level value.
You can set the hysteresis to a value from 0.0 to 4.0 divisions in 0.1-division steps.

About Qualified Logic Signal Pulse Width Searches (Logic Pulse Qualified)

Search Source Waveform (Source)

The DL6000/DLM6000 compares the pulse width of the specified bit to the specified time and searches for locations where the conditions are met.
You can set the search source signal to a bit from A0 to A7, B0 to B7, C0 to C7, or D0 to D7. (On 16-bit models, you can select a bit from A0 to A7 or C0 to C7.)

Polarity (Polarity)

You can select which trigger source polarity will cause the DL6000/DLM6000 to compare the pulse width to the reference times. The trigger source polarity is based on the trigger level.

Pos	The signal level must be high.
Neg	The signal level must be low.

Pattern

For each signal, you can set the condition that must be met for the DL6000/DLM6000 to trigger to H, L, or X.

H	The signal level must be high.
L	The signal level must be low.
X	No conditions have to be met (“don’t care”).

Logic (Logic)

You can set the logic for all the conditions to AND or OR.

AND	The DL6000/DLM6000 triggers when all the specified conditions are met.
OR	The DL6000/DLM6000 triggers when any of the specified conditions is met.

Note

You cannot specify qualifications for the trigger source signal.

Detected Point Mark (Mark)

Select whether or not to display marks on the detected points. When this feature is turned on, detected point marks appear at the top section of the main window.

ON: Marks are displayed.

OFF: Marks are not displayed.

Skip Mode (Skip Mode)

After a point is detected in a search, you can skip the detection of search conditions for the specified amount of time or the specified number of counts.

OFF	All points are searched.
Hold Off	You can skip the detection of search conditions for a specified amount of time. You can set the amount of time to a value from 0.1 ns to 1.00000 s (six significant digits) in 0.1 ns steps.
Decimation	You can skip the detection of search conditions for a specified number of counts. You can set the number of counts to a value from 1 to 9999.

Search Start Point (Start Point)

You can set the search start point to a value in the range of ±5.00 divisions in 0.01-division steps.

Search Result Display (Pattern#)

Detected points are numbered in order. The first detected point is zero.

You can specify the number of a detected point to display the point in the zoom waveform area.

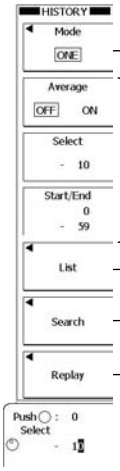
The maximum detected point number is 4999.

11.1 Displaying History Waveforms

Procedure

HISTORY Menu

Press **HISTORY** (∿🕒∿) to display the following menu.



Set the display mode (ONE, All Half Tone, Accumulate).

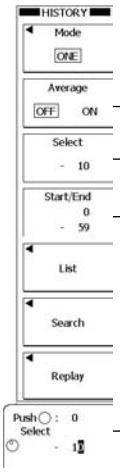
The setup menu varies depending on the display mode.

Shows a list of timestamps

► sections 11.2 and 11.3

Replay (unless Average is set to ON)

When the Display Mode is One or All Half Tone



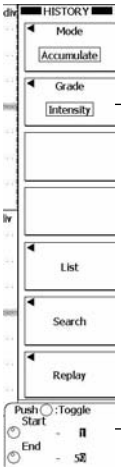
Turns averaging on or off

Set the highlighting (using the jog shuttle; only when Average is set to OFF).

Set the display range (using the jog shuttle).

Set the display range or the highlighting.

When the Display Mode Is Accumulate

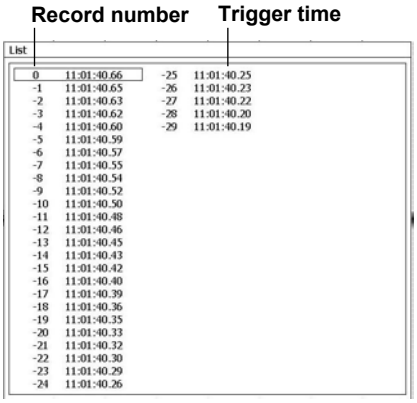


Set the gradation mode (Intensity, Color).

Set the start and end of the display range.

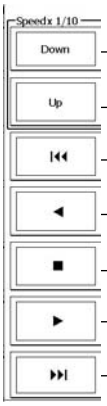
Displaying a List of Timestamps (List)

Press the **List** soft key to display the following screen.



Replay (Replay)

Press the **Replay** soft key to display the following menu.



- **Decreases the replay speed by one level**
- **Increases the replay speed by one level**
- **Displays the oldest history waveform**
- **Replays waveforms toward older waveforms**
- **Stops replay**
- **Replays waveforms toward newer waveforms**
- **Displays the most recent history waveform**

Note

You cannot use the replay feature for waveforms acquired in Average mode.

Explanation

You can display history waveforms and a list of all the history waveform timestamps.

Display Mode (Mode)

You can select how to display history waveforms from the following options.

- One: Only the waveform of the selected record number is displayed.
- All Half Tone: All selected waveforms are overlaid. All waveforms except the highlighted waveform are displayed in an intermediate color.
- Accumulate: All selected waveforms are overlaid. The frequency of data occurrence is represented by intensity (Intensity) or by color (Color).

Average (Average)

Highlights the waveform obtained by taking the linear average of the history waveforms in the range specified by Start No and End No. When the display mode is set to All Half Tone, all history waveforms that had been averaged are overlaid and displayed in an intermediate color.

Highlighting (Select No.)

The latest history waveform is assigned the record number zero, and older waveforms are assigned numbers in descending order (-1, -2, -3, and so on).
The waveform and timestamp of the record number you specify here are highlighted.
Settable range: 0 to –(the number of waveform acquisitions – 1)

Maximum Number of Waveform Acquisitions

(The maximum number of history waveforms that can be stored in the acquisition memory)

The number of history waveforms that can be stored varies depending on the selected record length as indicated below:

Record Length	Number of Waveforms
2.5 kpoints	2000
6.25 kpoints	1000
12.5 kpoints	500
25 kpoints	250
62.5 kpoints	120
125 kpoints	60
250 kpoints	30
625 kpoints	10
1.25 Mpoints	5
2.5 Mpoints	2
6.25 Mpoints	1

* The number of waveforms is not affected by interleaving or high resolution mode.

Display Range (Start/End)

When the display mode is set to All Half Tone or Accumulate, you can use record numbers to set the range of history waveforms to display.
Settable range: 0 to –(the number of waveform acquisitions – 1)

List of Timestamps (List)

- You can display a list of the record numbers and trigger times of the acquired waveforms in the acquisition memory.
- You can display 75 items of data on the screen. You can scroll through the displayed data using the jog shuttle.

Replay (Replay)

You can display the specified waveform first and then the older or newer data in order.

Note

Notes about Configuring the History Feature

- In Averaging mode, Roll mode, and Repetitive Sampling mode, the DL6000/DLM6000 acquires waveforms at each display update interval.
- When Averaging mode and Repetitive Sampling mode are selected and you acquire a waveform by pressing SINGLE, the DL6000/DLM6000 acquires multiple waveforms and uses them to produce a complete final waveform, but only the complete final waveform is saved in the acquisition memory.
- If you restart waveform acquisition by using the RUN/STOP key, all history waveforms that had been stored up to that point are cleared. However, if the trigger mode is set to Single (using the SINGLE key), the waveforms that had been stored using the SINGLE key remain in the acquisition memory as a history waveforms unless you change the waveform acquisition conditions.
- If you stop waveform acquisition, the DL6000/DLM6000 only displays waveforms that have been acquired completely.
- If you change the waveform acquisition conditions and start waveform acquisition, the past data stored in the acquisition memory is cleared.
  For details about waveform acquisition conditions, see section 7.2.

Notes about Recalling Data Using the History Feature

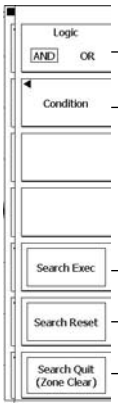
- Waveform acquisition stops when you press HISTORY. You cannot display history waveforms while waveform acquisition is in progress.
- You can start waveform acquisition when the HISTORY menu is displayed, but you cannot change the history settings during waveform acquisition.
- The settings are restricted so that the following relationship is retained: Last record (End) ≤ Select ≤ First record (Start).
- When you load waveform data from the specified storage medium, history waveforms up to that point are cleared. The loaded waveform data is placed in record number zero. If you load a file containing multiple waveforms, the most recent waveform is placed in zero, and other waveforms are placed in order in record numbers –1, –2, and so on.
- Computations and automated measurements of waveform parameters are performed on the waveform of the record number specified by Select. You can analyze old data as long as you do not overwrite the acquisition memory contents by restarting waveform acquisition. If Average is set to ON, analysis is performed on the averaged waveform.
- History waveforms are cleared when you turn the power off.

11.2 Searching for History Waveforms by Zone

Procedure

HISTORY Search Menu

Press **HISTORY** (∿◷∿) and then the **Search** soft key to display the following menu.



Set the search logic (AND, OR).

Configure the search conditions.

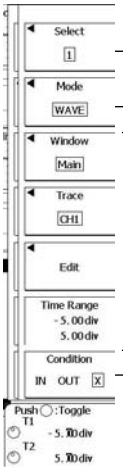
Executes a search

Ends the search

Clears the search zones

Setting Search Conditions (Condition Setup)

Press the **Condition** soft key to display the following menu.



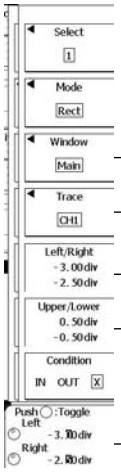
Set the search condition number.

Set the search mode (Rect, WAVE, Polygon, Parameter).*
*** See section 11.3 for details.**

The setup menu varies depending on the search mode.

Set the search criterion (IN, OUT, X).

Searching by Rectangular Zone (Rect)



Set the search source window (Main, Zoom1, Zoom2, XY1, XY2).

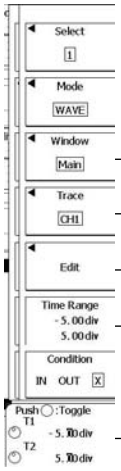
Set the search source waveform (CH1–CH4, M1–M4).

Set the left and right limits of the rectangular zone (using the jog shuttle).

Set the upper and lower limits of the rectangular zone (using the jog shuttle).

Set the left, right, upper, and lower limits of the rectangular zone (using the jog shuttle).

Searching by Waveform Zone (WAVE)



Set the search source window (Main, Zoom1, Zoom2).

Set the search source waveform (CH1–CH4, M1–M4).

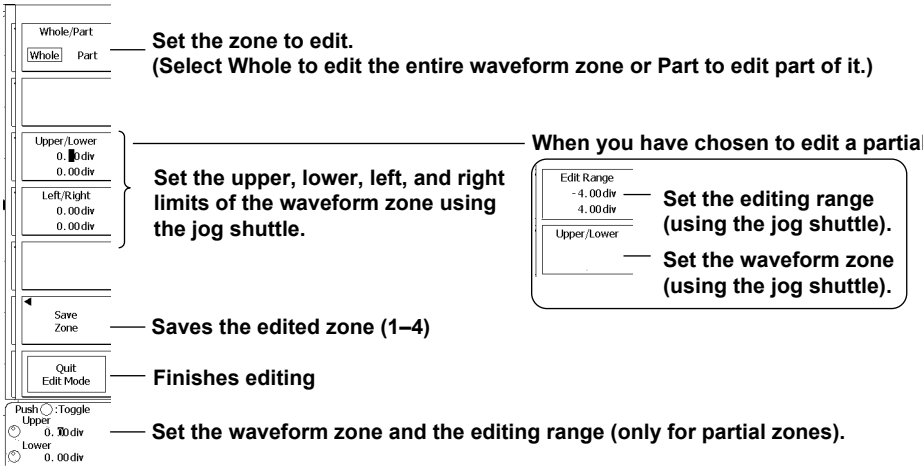
Edit the waveform zone.

Switches the item that the jog shuttle adjusts (T1, T2).

Set the search time range (T1, T2).

Creating a New Waveform Zone (New REF Trace)

Press the **Edit** soft key, the **New REF Trace** soft key, and then a soft key from **CH1** to **CH4** or **M1** to **M4** to display the following menu.



Set the zone to edit.
(Select Whole to edit the entire waveform zone or Part to edit part of it.)

When you have chosen to edit a partial zone (Part)

Set the upper, lower, left, and right limits of the waveform zone using the jog shuttle.

Set the editing range (using the jog shuttle).

Set the waveform zone (using the jog shuttle).

Saves the edited zone (1–4)

Finishes editing

Set the waveform zone and the editing range (only for partial zones).

Creating a New Zone from a Previously Saved Zone (Load Zone)

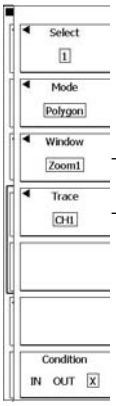
Press the **Edit** soft key, the **Load Zone** soft key, and then a soft key from **#1** to **#4**. The zone that you specified is loaded.

Editing Zones (Modify Zone)

Press the **Edit** soft key and then the **Modify Zone** soft key to display the waveform zone edit menu.

Searching by Polygonal Zone (Polygon)

Using the FILE menu, load a polygon image into the specified zone (Zone1 to Zone4).



Set the search source window (Main, Zoom1, Zoom2, XY1, XY2).

Set the search source waveform (CH1–CH4, M1–M4).

Note

You can create polygon images on a PC by using the Mask Editor Software.

Explanation

You can search through the history waveforms for waveforms that meet the specified conditions, display the detected history waveforms, and list their timestamps.
You can specify up to four search conditions. You can set the search logic for each of the search conditions to AND or OR.
You can use the following types of zones as search conditions.
Rectangular, waveform, and polygonal zones.

Search Logic (Logic)

You can set the search logic for each of the search condition numbers from 1 to 4.

- AND: The DL6000/DLM6000 searches for history waveforms that meet all search conditions.
- OR: The DL6000/DLM6000 searches for history waveforms that meet any of the search conditions.

Search Condition Numbers (Select)

For search conditions 1 to 4, set the source waveform, search range (the waveform zone upper and lower limits), and the search criterion.

Search Criterion (Condition)

Select whether to detect waveforms that are in or out of the search range.

- IN: Waveforms that are inside of the search range are detected.
- OUT: Waveforms that are outside of the search range are detected.
- X: The DL6000/DLM6000 does not search for waveforms.

Search Mode (Mode)

You can select the search mode from the following options.

- Rect: You can create a rectangular zone by specifying upper, lower, left, and right limit values and search for either all waveforms that enter or all waveforms that do not enter the zone.
- WAVE: You can create a zone based on a reference waveform and search for either all waveforms that enter or all waveforms that do not enter the zone.
- Polygon: You can load a polygonal zone that you have created on a PC and search for either all waveforms that enter or all waveforms that do not enter the zone. (See section 6.19 for details.)
- Parameter: See section 11.3 for details.

Search Source Window (Window)

You can select the search source window from the following options. However, you cannot set the search source window to XY1 or XY2 when you search using a waveform zone.

- Main: The waveforms in the main window are searched.
- Zoom1: The waveforms in the Zoom1 window are searched.
- Zoom2: The waveforms in the Zoom2 window are searched.
- XY1: The waveforms in the XY1 window are searched.
- XY2: The waveforms in the XY2 window are searched.

Source Waveform (Trace)

Select a waveform from CH1 to CH4 or M1 to M4.

Search Zone (Edit)

- Rectangular zone: You can create a rectangular zone by specifying upper, lower, left, and right limit values.
- Waveform zone: You can create a zone based on a reference waveform.

For details about creating rectangular and waveform zones, see section 6.19.

Search Time Range (Time Range)

You can specify the time axis search range for waveform zones. The default setting is ±5 divisions on the time axis in the display area.

Executing a Search (Exec)

You can search for waveforms that meet the specified search conditions and display only the waveforms and timestamps that are detected.

Ending the Search (Search Reset)

You can clear the history waveforms that were detected and display all history waveforms.

Clearing Search Zones (Search Quit)

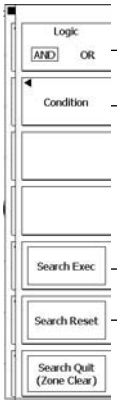
You can clear all search zones (rectangular, waveform, and polygonal) and return to the top of the HISTORY menu.

11.3 Searching for History Waveforms Using Parameters

Procedure

HISTORY Search Menu

Press **HISTORY** (∿◷∿) and then the **Search** soft key to display the following menu.



Set the search logic (AND, OR).

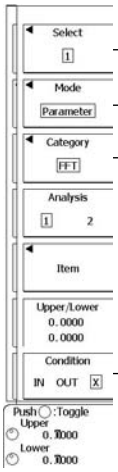
Configure the search conditions.

Executes a search

Ends the search

Setting Search Conditions (Condition Setup)

Press the **Condition** soft key to display the following menu.



Set the search condition number.

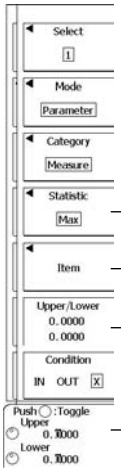
Set the search mode to Parameter.

Set the category (Measure, FFT, XY).

The setup menu varies depending on the category.

Set the search criterion (IN, OUT, X).

Searching for Waveform Parameters (Measure)



Set the item to perform statistical analysis on (Max, Min, Mean, s).*
*** Only when the waveform mode is Cycle Statistics**

Set which parameters to search for.

Switches the item that the jog shuttle adjusts (Upper, Lower)

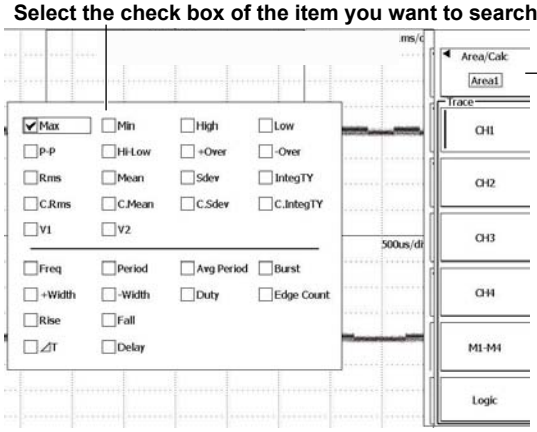
Set the upper and lower limits of the search range.

Setting Which Parameters to Search For (Item)

Press the **Item** soft key to display the following menu.

When Mode in the MEASURE Menu Is Set to Basic, Continuous Statistics, or History Statistics

Select the check box of the item you want to search for.



Set the item to search for (Area1, Area2, Calc).*

Set the source waveform (CH1–CH4, M1–M4, LOGIC).

*** When the waveform mode is Cycle Statistics, this becomes the Select soft key (Basic/Calc).**

Searching for FFT Parameters

Set the search source FFT waveform (1, 2).

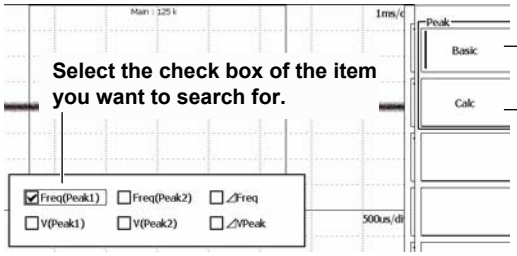
Set which FFT parameters to search for.

Switches the item that the jog shuttle adjusts (Upper, Lower)

Set the upper and lower limits of the search range.

Setting Which Parameters to Search For (Item)

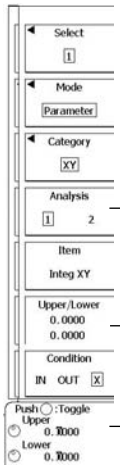
Press the **Item** soft key to display the following menu.



Select if you want to search for a standard analysis item (Peak).

Select if you want to search for a registered expression.

Searching for an XY Parameter



Set the search source XY waveform (1, 2).

Switches the item that the jog shuttle adjusts (Upper, Lower)

Set the upper and lower limits of the search range.

Explanation

You can search through the history waveforms for waveforms that meet the specified conditions, display the detected history waveforms, and list their timestamps.
You can specify up to four search conditions. You can set the search logic for each of the search conditions to AND or OR.
You can use the following types of parameters as search conditions.
Waveform parameter values, FFT analysis items, and XY waveform areas

Search Logic (Logic)

You can set the search logic for each of the search condition numbers from 1 to 4.

- AND: The DL6000/DLM6000 searches for history waveforms that meet all search conditions.
- OR: The DL6000/DLM6000 searches for history waveforms that meet any of the search conditions.

Search Condition Numbers (Select)

For search conditions 1 to 4, set the search mode, search range (the waveform parameter upper and lower limits), and the search criterion.

Search Criterion (Condition)

Select whether to detect waveforms that are in or out of the search range.

- IN: Waveforms that are inside of the search range are detected.
- OUT: Waveforms that are outside of the search range are detected.
- X: The DL6000/DLM6000 does not search for waveforms.

Search Mode (Mode)

You can select the method for specifying the search range from the following options.

- Rect (see section 11.2 for details)
- WAVE (see section 11.2 for details)
- Polygon (see section 11.2 for details)
- Parameter: You can search for the following types of parameters.
  - Measure: You can search for the values of a particular measurement item that fall within specified upper and lower limits.
  - FFT: You can search for the values of a particular FFT analysis result that fall within specified upper and lower limits.
  - XY: You can search for XY waveform areas that fall within specified upper and lower limits.

Search Source (Analysis)

When the search mode is FFT or XY, you can specify the search source.

- 1: The FFT or XY waveform of Analysis 1 in the ANALYSIS menu.
- 2: The FFT or XY waveform of Analysis 2 in the ANALYSIS menu.

Parameter (Item)

When Searching for Waveform Parameters (Measure)

Selecting the Item That You Want to Search For (Area, Calc, or Select)

- Area1 or Area2: You can select items from the standard waveform parameters. You can select whether to use the standard waveform parameters in Area1 or Area2.
- Calc: You can select an item from the expression values registered in the MEASURE menu.
- Basic: You can select an item from the standard waveform parameters. You can select this option when the Mode item in the MEASURE menu is set to Cycle Statistics.

Search Source Waveform

You can select the search source waveform from the following options.
LOGIC or a channel from CH1 to CH4 or M1 to M4

When Searching for FFT Parameters

Selecting Which Item to Search For (Peak)

- Basic: You can select from the standard FFT analysis items (Peak).
- Calc: You can select from the expressions that have been registered in the FFT menu (which you can open by pressing SHIFT+MATH/REF).

When Searching for XY Waveform Parameters

You can search through the area values that have been determined using Loop and Polarity according to the settings in the XY menu (which you can open by pressing SHIFT+DISPLAY).

Upper and Lower Parameter Limits (Upper/Lower)

Settable range for upper and lower limits: –1.0E + 31 to 1.0E + 31

Executing a Search (Exec)

You can search for waveforms that meet the specified search conditions and display only the waveforms and timestamps that are detected.

Ending the Search (Search Reset)

You can clear the history waveforms that were detected and display all history waveforms.

12.1 Loading Roll Paper into the Built-In Printer (Optional)

Appropriate Roll Paper for the Printer

Only use roll paper made for the printer by YOKOGAWA. The DL6000/DLM6000 comes with one set of roll paper included. Use this when you first load roll paper into the built-in printer. When you need a new supply of roll paper, please contact your nearest YOKOGAWA dealer.

Paper for the DL6000 Series

Part Number: B9988AE
Specifications: Heat sensitive paper, 10 m
Minimum Quantity: 10 rolls

Paper for the DLM6000 Series

Part Number: B9850NX
Specifications: Heat sensitive paper, 30 m
Minimum Quantity: 5 rolls

Handling Roll Paper

The roll paper is made of thermochemically colored heat sensitive paper. Please read the following information carefully.

Storage Precautions

When in use, the heat-sensitive paper changes color gradually at temperatures of approximately 70° C or higher. The paper can be affected by heat, humidity, or chemicals, whether something has been recorded on it or not. As such, please follow the guidelines listed below.

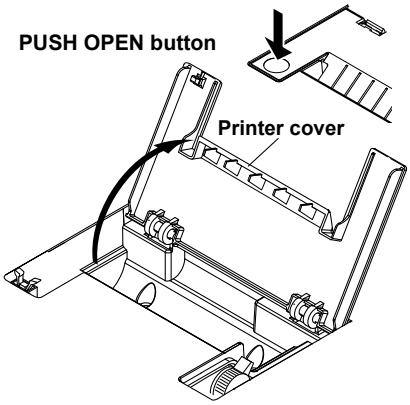
- Store the paper in a cool, dry, and dark place.
- Use the paper as quickly as possible after you break its protective seal.
- If you attach a plastic film that contains plasticizing material such as vinyl chloride film or cellophane tape to the paper for a long time, the recorded sections will fade due to the effect of the plasticizing material. Use a holder made of polypropylene to store the roll paper.
- When starching the record paper, do not use starches containing organic solvents such as alcohol or ether. Doing so will change the paper's color.
- We recommend that you make copies of the recordings if you intend to store them for a long period of time. Because of the nature of heat-sensitive paper, the recorded sections may fade.

Operating Precautions

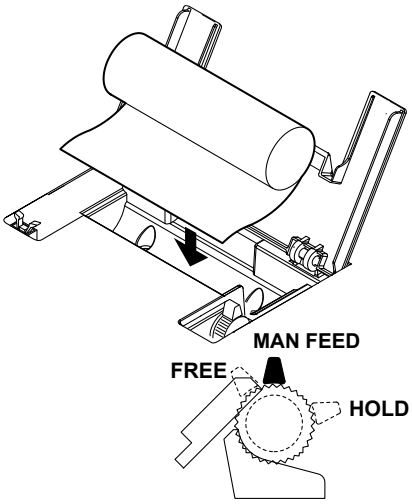
- Only use genuine, YOKOGAWA-supplied roll paper.
- If you touch the roll paper with sweaty hands, there is a chance that you will leave fingerprints on the paper, thereby blurring the recorded sections.
- If you rub the surface of the roll paper against something hard, there is a chance that the paper will change color due to frictional heat.
- If the roll paper comes into contact with products such as chemicals or oil, there is a chance that the paper will change color or that the recorded sections will disappear.

Attaching the Roll Paper (DL6000)

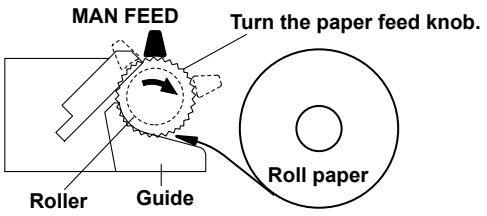
1. Press the PUSH OPEN button to release the printer cover lock. Lift the handle on the right of the printer cover to open it.



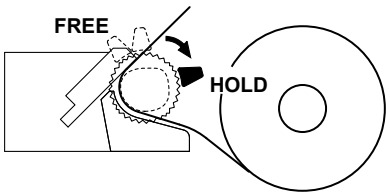
2. Move the release arm in the front right of the printer to the MAN FEED position. Hold the roll paper so that the inside (the unglossed side) is facing up, and put it into the holder.



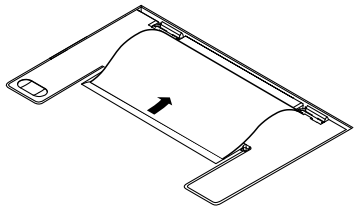
3. Insert the edge of the roll paper evenly into the space between the roller and the black guide, and then turn the paper feed knob clockwise (in the direction of the roll paper) so that the roll paper sticks out from the roller by about 10 cm.



4. Move the release arm to the FREE position, adjust any bends or distortions in the roll paper, and then move the release arm to the HOLD position. If you leave the release arm in the FREE or MAN FEED position and you try to print, the print operation will fail, and an error message will occur.



5. Close the printer cover by pulling it towards you, making sure that the edge of the roll paper sticks out of the printer cover paper slit. When you close the cover, push down on it until you hear a click.

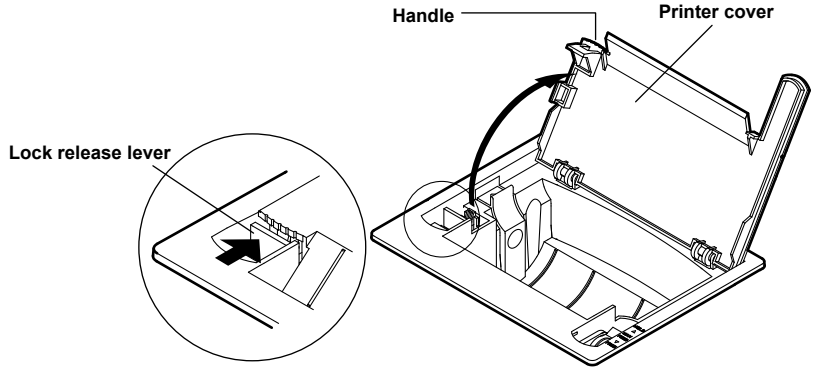


Note

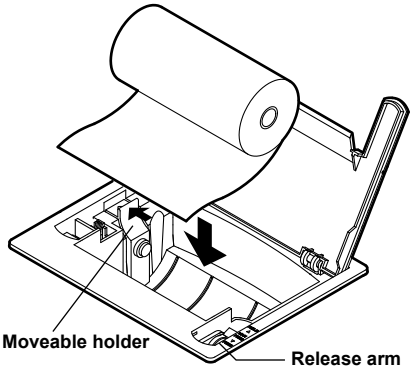
When you close the printer cover, make sure that the release arm is in the HOLD position.

Attaching the Roll Paper (DLM6000)

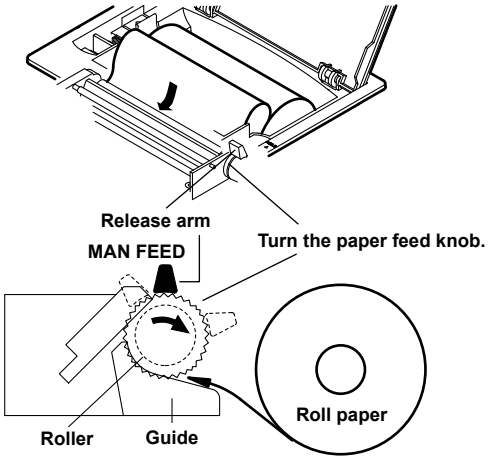
1. Push the lock release lever in the direction of the OPEN arrow. Then, lift the handle on the left of the printer cover to open it.



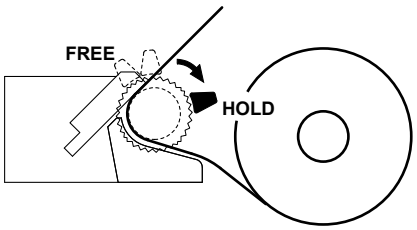
2. Move the release arm in the front right of the printer to the MAN FEED position. While holding the roll paper so that the inside (the unglossed side) is facing up and pushing the moveable holder on the left side of the roll paper storage space further to the left, attach the core of the roll paper to the holder on the right side. Then, release the moveable holder.



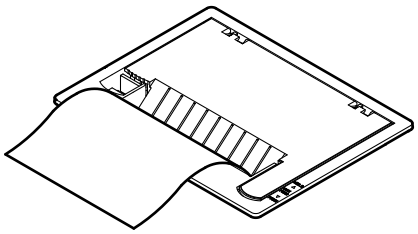
3. Insert the edge of the roll paper evenly into the space between the roller and the black guide, and then turn the paper feed knob clockwise (in the direction of the back of the printer) so that the roll paper sticks out from the roller by about 10 cm.



4. Move the release arm to the FREE position, adjust any bends or distortions in the roll paper, and then move the release arm to the HOLD position. If you leave the release arm in the FREE or MAN FEED position and you try to print, the print operation will fail, and an error message will occur.



5. Close the printer cover by pulling it towards you, making sure that the edge of the roll paper sticks out of the printer cover paper slit. When you close the cover, push down on it until you hear a click.



Note

When you close the printer cover, make sure that the release arm is in the HOLD position.

12.2 Printing Using the Built-in Printer (Optional)

Procedure

PRINT Built-in Printer Menu

1. Press **SHIFT+PRINT** (MENU).
2. Press the **Print to** soft key to select **Built-in Printer**.
3. Press the **High Resolution** soft key to select **ON** or **OFF**.

Printing

4. Press **PRINT**.

Explanation

High Resolution (High Resolution)

Depending on what option you select for the High Resolution setting, you can print at one of the following resolutions.

ON: 2048 × 768 monochrome printing

OFF: 1024 × 768 (XGA) monochrome printing

The High Resolution setting does not affect the print size. When you set High Resolution to ON, the horizontal resolution is doubled.

12.3 Printing Using a USB Printer

Procedure

1. Use a USB cable to connect the DL6000/DLM6000 to a USB printer.

PRINT USB Printer Menu

2. Press **SHIFT+PRINT** (MENU).
3. Press the **Print to** soft key to select **USB Printer**.
4. Press the **Printer** soft key to select **EPSON Inkjet** or **HP Inkjet**.
5. Press the **Color** soft key to select **ON** or **OFF**.

Printing

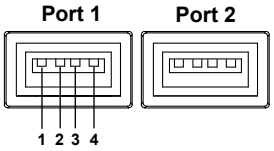
6. Press **PRINT**.

Explanation

You can use the USB interface to print a screen capture on a USB printer.

USB Ports for Peripherals

To connect the DL6000/DLM6000 to a USB printer, connect a USB cable to the one of the two USB ports for peripherals.



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

Usable Printers

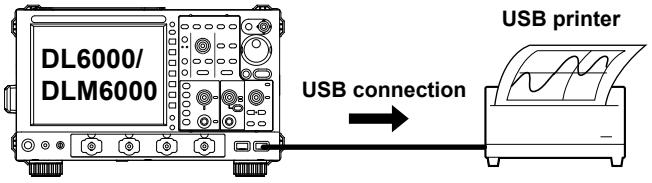
You can use USB printers that are compatible with USB Printer Class Ver. 1.0.

Note

- Do not connect incompatible printers.
- For USB printers that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

Connection Procedure

Connect a USB printer directly to the DL6000/DLM6000 using a USB cable as shown in the figure below. You can connect or remove the USB cable regardless of whether or not the DL6000/DLM6000 power switch is turned on (hot-plugging is supported). Connect the type A connector of the USB cable to the DL6000/DLM6000, and connect the type B connector to the printer. If you connect a printer when the power switch is on, the printer becomes available for use after the DL6000/DLM6000 identifies the printer.



Note

- Connect to the printer directly, not through a hub.
- Only connect a compatible USB keyboard, mouse, printer, or storage device to a USB port for peripherals.
- Do not connect multiple printers to the USB ports for peripherals.
- Never turn off the printer or remove the USB cable while printing is in progress.
- Do not connect or remove USB cables from the time when the DL6000/DLM6000 is turned on until key operation becomes available (approximately 20 to 30 seconds).

Color (Color)

You can select one of the following options.

ON: The DL6000/DLM6000 prints using the same colors as the screen, excluding the background color. The grid and some other items are printed in black.

OFF: The DL6000/DLM6000 prints in the same way that it prints from the built-in printer.

Notes about Printing Using a USB Printer

- Screen captures may not be printed properly on some printers. Use a USB printer that has been tested for compatibility.
- You can also print from a USB printer that is connected to a PC. You can save a screen capture to a storage medium by following the procedure in section 13.6, load the screen capture onto a PC, and then print it.

Note

- The DL6000/DLM6000 may not detect when a USB printer has run out of paper or has encountered an error. If an error occurs, press PRINT again to stop printing.

12.4 Printing on a Network Printer (Optional)

Procedure

1. Connect the DL6000/DLM6000 to the network. For details about connecting to a network, see chapter 14.

PRINT Network Printer Menu

2. Press **SHIFT+PRINT (MENU)**.
3. Press the **Print to** soft key to select **Network Printer**.
4. Press the **Printer** soft key to select **HP Inkjet** or **HP Laser(Monochrome)**.
5. If you select HP Inkjet, press the **Color** soft key to select **ON** or **OFF**.

Printing

6. Press **PRINT**.

Explanation

You can print from a network printer on models that are equipped with the network option (/C9 or /C12).
You can use a network printer to print screen captures.

Connecting to a Network Printer

You must configure the network printer in advance by following the instructions in section 14.8.

Usable Printers

You can connect to the following printers.

HP inkjet printers
HP laser printers (monochrome)

13.1 About ATA Flash Memory Cards

Procedure

Usable PC Cards

The DL6000/DLM6000 can use ATA flash memory cards (PC Card Type II) and compact flash cards (with a PC Card Type II adapter). It can also use some ATA flash card hard drives.
For more detailed information, contact your nearest YOKOGAWA dealer.

Note

When using a PC card with a PC, make sure that the PC is compatible with the PC card. Also, depending on the type of PC, some of the cards listed above may not function properly. Make sure that the card that you intend to use is compatible with your PC.

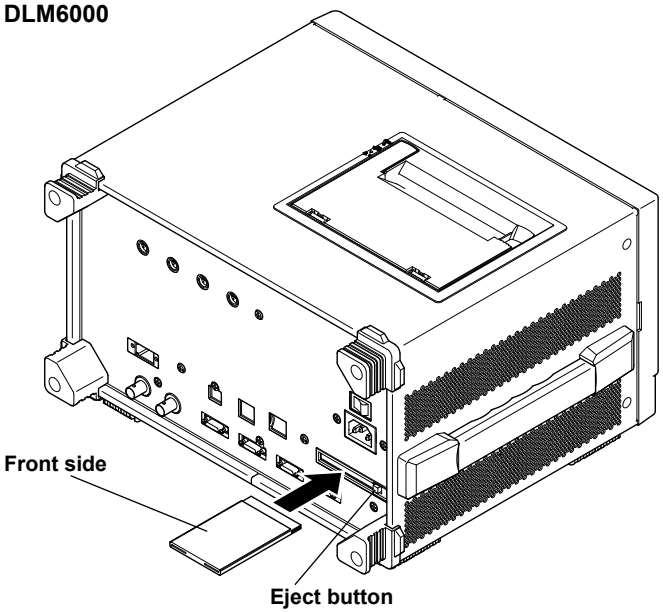
Inserting a PC Card

Insert the PC card into the PC card drive with the front side facing up.
The PC card drive is located on the rear panel of the DL6000/DLM6000.

Removing the PC Card

Make sure that the DL6000/DLM6000 is not accessing the PC card, and then press the PC card eject button next to the PC card drive.

DLM6000



CAUTION

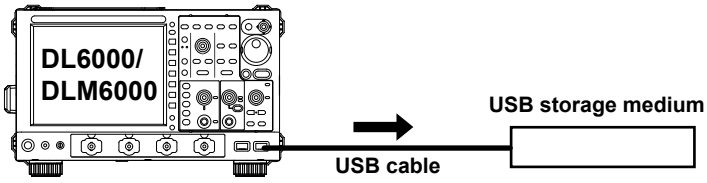
- Inserting and removing the PC card quickly (within the span of a second) may damage the DL6000/DLM6000.
- If you remove the PC card while the DL6000/DLM6000 is accessing it, the data on the PC card may be corrupted.

General PC Card Handling Precautions

Follow the general handling precautions that are included with your PC card.

13.2 Connecting a USB Storage Device to a USB Port

When connecting a USB storage device to a DL6000/DLM6000 USB port, connect the USB cable directly as shown in the figure below. You can connect or disconnect a USB cable at any time regardless of whether the DL6000/DLM6000 is on or off (hot-plugging is supported). Connect the type A connector of the USB cable to the DL6000/DLM6000, and connect the type B connector to the USB storage device. If you connect a USB storage device when the power switch is on, the device becomes available for use after the DL6000/DLM6000 identifies it.



Note

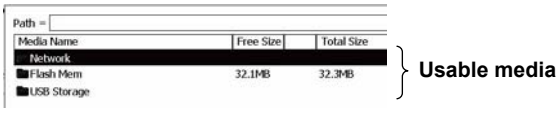
- Connect USB storage devices directly, not through a USB hub.
- Only connect a compatible USB keyboard, mouse, printer, or storage device to a USB port for peripherals.
- Do not connect and disconnect multiple USB devices repetitively. Leave a 10-second interval between removal and connection.
- Do not connect or remove USB cables from the time when the DL6000/DLM6000 is turned on until key operation becomes available (approximately 20 to 30 seconds).
- You can use USB storage devices that are compatible with USB Mass Storage Class Ver. 1.1.
- The total number of storage devices that you can connect to the DL6000/DLM6000, including both PC cards and USB storage devices, is four. If the connected medium is partitioned, the DL6000/DLM6000 treats each partition as a separate storage medium. As such, the DL6000/DLM6000 can handle up to four partitions.

Confirming What Connected USB Storage Devices Can Be Used

Press **FILE** and then the **Utility** soft key to display a list of files.

Follow the procedure in section 13.10 to make the current folder the highest level in the folder hierarchy.

The devices that can be used appear.



13.3 Connecting to a Network Drive

You can connect the DL6000/DLM6000 to a network drive and save and load setup, measurement, analysis, screen image, and other data.
For details about connecting to a network drive, see chapter 14.3.

13.4 Saving Measured Data

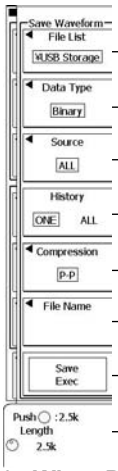
CAUTION

Do not remove the storage medium or turn off the power when the file icon ( ) in the bottom left of the screen is blinking. Doing so may damage the storage medium and corrupt its data.

Procedure

File Waveform (Save) Menu

Press **File** and then the **Waveform**(Save) soft key to display the following menu.



Set the save destination.

Set the data format (Binary, ASCII, Float).

Set the waveforms to save (CH1–CH4, M1–M4, LOGIC, ALL).

Set how much history data to save (ONE, ALL).

Set the data compression type (OFF, P-P, Decim) and the save range (Main, Z1, Z2).*

Set the file name.

Saves measured data

Set the size of the compressed file (when Compression is set to P-P or Decim).

* **When Data Type is set to ASCII, set the Compression and Range settings.**

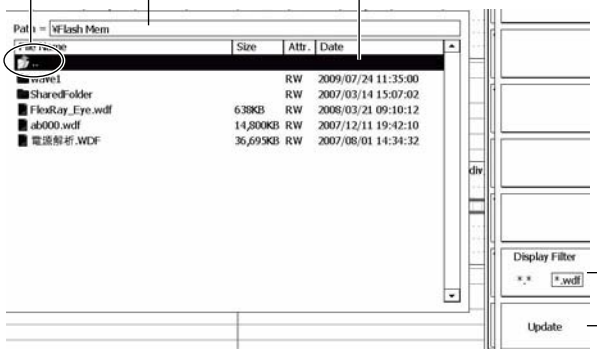
Setting the Save Destination (File List)

Press the **File List** soft key to display the following screen.

To move to the folder that contains the current folder, move the cursor to this line and press SET.

Folder to save to

Set the folder to save to.
Move the cursor to a folder by using the jog shuttle or the SET key (by moving it up, down, left, or right), and press SET.

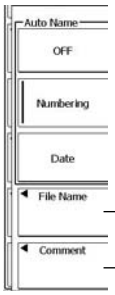


Set which files to display in the File List window (*.wdf, *.*).

Updates the File List with the most recent information

Assigning File Names (File Name)

Press the **File Name** soft key to display the following menu.



Set the auto naming method (OFF, Numbering, Date).

Set the file name.

Set the comment.

Explanation

Data Type (Data Type)

Binary

- The sampled data stored in the acquisition memory is saved to a file in binary format.
- You can load the data into the DL6000/DLM6000, display the waveform of the data, and view the values that it contains.
- You can use YOKOGAWA's Xviewer software application to analyze waveforms on your PC. For details, contact your nearest YOKOGAWA dealer. You can download a trial version from the YOKOGAWA website.
- The extension is .wdf.

ASCII

- The sampled data stored in the acquisition memory is converted using the specified range and saved to a file in ASCII format. You can use the file to analyze waveforms on your PC.
- You cannot load the data using the DL6000/DLM6000.
- The extension is .csv.

Float

- The sampled data stored in the acquisition memory is converted using the specified range and saved to a file in 32-bit IEEE floating format. You can use the file to analyze waveforms on your PC.
- The data notation is little-endian (Intel format).
- You cannot load the data using the DL6000/DLM6000.
- The extension is .fld.

Data Size

The data sizes indicated below are for when the record length is 125 kpoints and you save the measured data from CH1 to CH4 and LOGIC with one history waveform.

Data Format	Extension	Size (In bytes)
Binary	.wdf	Approx. 1.5 to 2 M. (125 kpoints + 12) × 4 channels × the number of history waveforms × 2 + 150 K + the data size of LOGIC* * (125 kpoints + 12) × 2 when the state (see section 5.2 for details) is off and (125 kpoints + 12) × 4 when the state is on.
ASCII	.csv	15 to 20 M
Float	.fld	Approx. 2M. (125 kpoints + 12) × the number of history waveforms × 4

Waveforms to Save (Source)

You can select which waveforms to save from the options listed below.
CH1 to CH4, M1 to M4, LOGIC, and ALL (all waveforms)

- You can only save LOGIC waveforms when the data format is Binary or ASCII.
- The vertical-axis, horizontal-axis, and trigger settings are also saved along with the waveforms.
- If you select ALL, only the displayed waveforms are saved. In Interleave mode, computed waveforms whose source is set to CH2 or CH4 cannot be saved.

History Data (History)

You can choose how much history data you want to save.
ALL: All history data is saved.
ONE: Only the currently displayed waveform is saved.
You can also only save the history data that has been found through a search. For information about searching for history data, see chapter 11.

Data Compression (Compression)

You can select the data compression method. You cannot load compressed data into the DL6000/DLM6000 acquisition memory.
OFF: Data is saved without compression.
P-P: Data is P-P compressed and saved.
Decim:* Data is sampled and saved.

* This compression method cannot be used on the measured data from the LOGIC channel. When you set the Source setting to ALL, the LOGIC channel measured data is P-P compressed.

File Size after Compression (Length)

When you select P-P or Decim, you can select the size that the file will be compressed to from the options below.
2.5k, 6.25k, 12.5k, 62.5k, 125k, 250k, 625k, 1.25M, 2.5M, and 6.25M.
When the record length and the compressed size are the same, the saved file is not compressed.

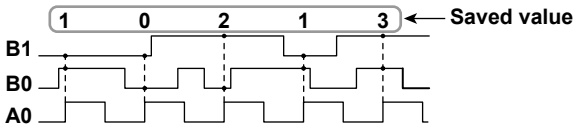
Save Range (Range)

When the data format is ASCII, you can select the range of data to save from the options below.
Main (the main window), Z1 (the Zoom1 window), and Z2 (the Zoom2 window)

Logic Signal State Data

When the waveform to save is a logic signal and the data format is ASCII, you can save the logic signal states that have been acquired at the edges of a specified clock signal.

Example when the clock is A0, the polarity is ↓, and the data for B0 and B1 is saved.



Storage Media and Folders (Directories)

The media that you can save to appear in the File List window.

Storage Media Indication Examples

[Storage Card]:	PC card
[Network]:	Network drive (on models that are equipped with the Ethernet interface option)
[Flash Mem]:	Flash memory
[USB Storage]:	USB storage

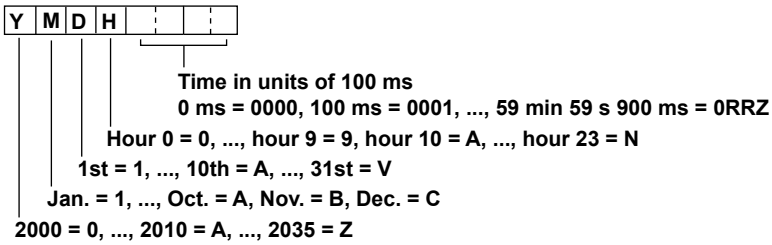
Auto Naming (Auto Name)

You can select the auto naming method from the following three options.

OFF: The name that you specify using the File Name setting is used.

Numbering: When the DL6000/DLM6000 saves files, it automatically adds a three-digit number from 000 to 999 after the common name specified using the File Name setting (up to five characters).

Date: The DL6000/DLM6000 names files by creating an 8-character file name from the date and time using base 36 numbers (0 to 9 and A to Z). The file name specified using the File Name setting is not used.



File Name (File Name)

The maximum number of characters that you can use for file names and folder names is 64. The following restrictions apply.

- The following types of characters can be used: 0 to 9, A to Z, a to z, _, –, =, (,), {, }, [,], #, $, %, &, ~, !, `,and @.

* @ cannot be entered consecutively.

- The following character strings cannot be used due to MS-DOS limitations.
  AUX, CON, PRN, NUL, CLOCK, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, and COM9
- Make sure that the full file path (absolute path from the root folder) is less than or equal to 260 characters in length. If it exceeds 260 characters, an error occurs when you perform a file operation (such as saving, copying, renaming, or creating a folder).
  Full file path: When an operation is being performed on a folder, the full path is up to the name of the folder.
  When an operation is being performed on a file, the full path is up to the name of the file.
- The input box in the keyboard that appears in the screen can display up to 36 characters.

The following additional restrictions apply when you use the auto file naming feature.

- If you set auto naming to Numbering, file names will be eight characters long. A file name will consist of the five characters that you entered for the file name and a three-character sequence number.
- If you set auto naming to Date (date and time), the characters that you entered for the file name will not be used. File names will only consist of the date information.

Comment (Comment)

You can add a comment that consists of up to 160 characters when you save a file. You do not have to enter a comment. All characters, including spaces, can be used in comments.

Specifying Which Files to Display in the File List Window (Display Filter)

You can select which types of files to display in the File List window.

*.set: Only setup data files are displayed.
*.wdf: Only waveform files (binary) are displayed.
*.csv: Only CSV files are displayed.
*.bmp: Only BMP files are displayed.
User Def: You can specify what types of files to display.
You can use the "*" and "?" wildcards.
.: All files in all media and folders are displayed.

Note

- Pressing any key other than Abort during a load or save operation will result in an error.
  The accumulate setting is always off while measured data is loaded.
- If you change the extension of the saved data file, by using a PC or some other device, the DL6000/DLM6000 will no longer be able to load it.
- Up to 2500 files and folders can be displayed in the file list. If there are more than a total of 2500 files and folders in a given folder, the file list for that folder will only display 2500 files and folders. There is no way to set which files and folders are displayed.

Data Format for Saving Multiple Records

The DL6000/DLM6000 saves data that contains multiple records, such as history data, in the following data format.

ASCII format: CR+LF is inserted between records.

<Header>
CH1 measured data 1-1, CH2 measured data 1-1, CH3 measured data 1-1, ..., [CR+LF]
CH1 measured data 1-2, CH2 measured data 1-2, CH3 measured data 1-2, ..., [CR+LF]
⋮
CH1 measured data 1-m, CH2 measured data 1-m, CH3 measured data 1-m, ..., [CR+LF] — **Record 1**
[CR+LF]
CH1 measured data 2-1, CH2 measured data 2-1, CH3 measured data 2-1, ..., [CR+LF]
CH1 measured data 2-2, CH2 measured data 2-2, CH3 measured data 2-2, ..., [CR+LF]
⋮
CH1 measured data 2-n, CH2 measured data 2-n, CH3 measured data 2-n, ..., [CR+LF] — **Record 2**
[CR+LF]
⋮

Float format: Data is saved separately by channel.

Measured data for CH1 on record 1
Measured data for CH1 on record 2
⋮
Measured data for CH1 on record N
Measured data for CH2 on record 1
Measured data for CH2 on record 2
⋮
Measured data for CH2 on record N
⋮

13.5 Saving Setup Data

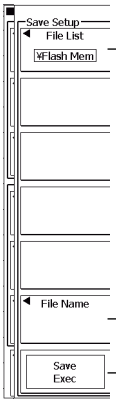
CAUTION

Do not remove the storage medium or turn off the power when the file icon ( ) in the bottom left of the screen is blinking. Doing so may damage the storage medium and corrupt its data.

Procedure

File Setup (Save) Menu

Press **File** and then the **Setup**(Save) soft key to display the following menu.



Set the save destination. See section 13.4.

Set the file name. See section 13.4.

Saves setup data

Explanation

Setup Information That Is Saved

The setup information for the settings at the time of the save operation is saved. However, the date, time, and communication setup information is not saved.

Bytes Used When Saving Setup Information

Approx. 64 KB

Notes about Saving Data

Up to 2500 files and folders can be displayed in the file list. If there are more than a total of 2500 files and folders in a given folder, the file list for that folder will only display 2500 files and folders. There is no way to set which files and folders are displayed.

File Extensions for Setup Information

Setup information files are saved with a .set extension.

Note

- Pressing any key other than Abort during a load or save operation will result in an error.
- You cannot save or load while data is being acquired.
- If you change file name extensions through a PC or some other means, the DL6000/DLM6000 will not be able to load the files.
- File paths of up to 36 characters in length can be displayed under “Path.”
- When setup information is loaded from a file, the settings of each key are changed to match the loaded settings, and they cannot be changed back. We recommend that you save the current settings before loading different setup information.
- Data and time, communication, menu language, message language, and USB keyboard language setup information is not saved. So even if you load setup information from a file, the settings listed above will not change.

13.6 Saving Other Types of Data

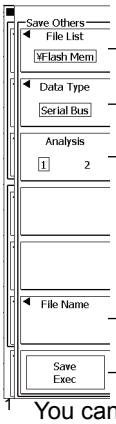
CAUTION

Do not remove the storage medium or turn off the power when the file icon ( ) in the bottom left of the screen is blinking. Doing so may damage the storage medium and corrupt its data.

Procedure

File Others (Save) Menu

Press **FILE** and then the **Others**(Save) soft key to display the following menu.



Set the save destination. See section 13.4.

Set the data format (FFT, Harmonics, Wave Parameter, Accum Histogram, Serial Bus, Wave-Zone, Snap).[1, 2]

Set the data to save (analysis 1 and 2, zones 1–4).[3]

Set the file name. See section 13.4.

Saves the data

1 You can only select Harmonics when the power supply analysis option is installed.

2 You can only select Serial Bus when the serial bus option is installed.

3 When Data Type is set to FFT, Accum Histogram, Harmonics, or Serial Bus, you can select 1 or 2. When Data Type is set to Wave-Zone, you can select an option from Zone1 to Zone4.

Explanation

You can save the following data to the specified storage medium.

- FFT results
- Automated measurements of waveform parameters (Wave Parameter)
- The frequency distribution of the specified area (Accum Histogram)
- Waveform zones (Wave-Zone)
- Snapshot waveforms (Snap)
- Power supply analysis results (Harmonics; optional)
- Serial bus frame lists (Serial Bus; optional)

FFT

You can save up to 250 Kpoints of data in CSV format.

Data Size

Data size in bytes = The number of data points × 15

Output Example

Analysis Type	FFT
Model Name	DLM6000
Model Version	*.**
Data Points	1251
HResolution	5.00E+02
HUnit	Hz
-3.10E+01	
-5.43E+01	
-4.16E+01	
-6.69E+01	
-4.80E+01	
-5.26E+01	
-6.39E+01	
-5.11E+01	
-5.17E+01	
-5.87E+01	

Data to Save (Source)

You can save the data from Analysis 1 or 2.

Power Supply Analysis Results (Harmonics)

On models with the power supply analysis option, you can save power supply analysis results in CSV format. For details, see the separate user's manual, *IM DLM6054-61EN*.

Automated Measurements of Waveform Parameters (Wave Parameter)

You can save automated measurements of waveform parameters in CSV format. The maximum number of previous values that you can save is equal to 100000/the number of items that are turned on.

Data Size

Data size in bytes = The number of measured items × 15 × the number of history waveforms

Output Example

Analysis Type	WaveParameter								
Model Name	DLM6000								
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

Histogram (Accum Histogram)

In Horizontal mode, you can save up to 640 items of data in CSV format, and in Vertical mode, up to 800.

Data Size

Data size in bytes = The number of data points × 15

Output Example

Analysis Type	AccumHistogram
Model Name	DLM6000
Model Version	*.**
8	
150	
9	
154	
6	
154	
8	
156	
9	
153	

Data to Save (Source)

You can save the data from Analysis 1 or 2.

Serial Bus Frame List (Serial Bus)

On models with the serial bus trigger and analysis option, you can save serial bus frame lists in CSV format. For details, see the separate user's manual, *IM DLM6054-51EN*.

Waveform Zones (Wave-Zone)

You can save the waveform zones used in GO/NO-GO determination, history waveform searches, and waveform searches. The extension is .zwf.

Zone to Save (Zone)

You can save a waveform zone from Zone1 to Zone4.

Note

An error will occur if you press Abort while the DL6000/DLM6000 is saving data.

Snapshot Waveforms (Snap)

You can save snapshot waveforms. The extension is .snp.

13.7 Loading Measured Data

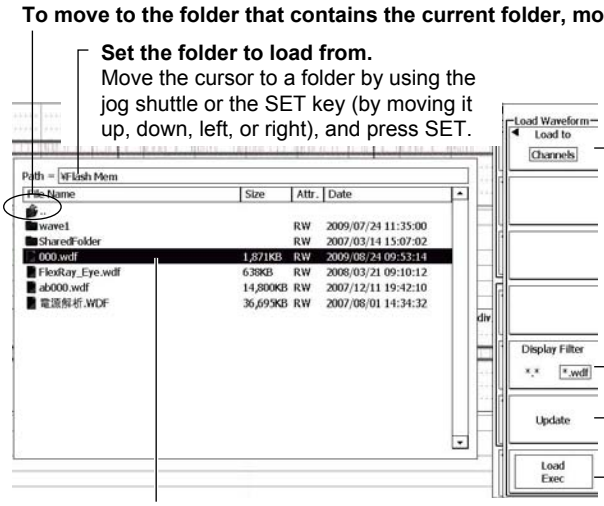
CAUTION

Do not remove the storage medium or turn off the power when the file icon ( ) in the bottom left of the screen is blinking. Doing so may damage the storage medium and corrupt its data.

Procedure

FILE Waveform (Load) Menu

Press **FILE** and then the **Waveform**(Load) soft key to display the following menu.



Set the location to which you want to load the data

Set which files to display in the File List window (*.wdf, *.*).

Updates the File List with the most recent information

Loads measured data

Explanation

You can load and display measured data that has been saved to a storage medium. You can load the measured data into a reference waveform or the acquisition memory. Data saved with Source set to ALL or LOGIC cannot be loaded into a reference waveform. Also, compressed data cannot be loaded into the acquisition memory.

Data that has been loaded into the acquisition memory is overwritten when you start waveform acquisition.

Data to Load (Load to)

You can select the data to load from the following options.

Channels: All the saved data is loaded into the acquisition memory. The saved setup data is also loaded.

REF1 to REF4: The data is loaded into the reference waveform that corresponds to the number that you specify. Setup data is not loaded.

13.8 Loading Setup Data

CAUTION

Do not remove the storage medium or turn off the power when the file icon ( ) in the bottom left of the screen is blinking. Doing so may damage the storage medium and corrupt its data.

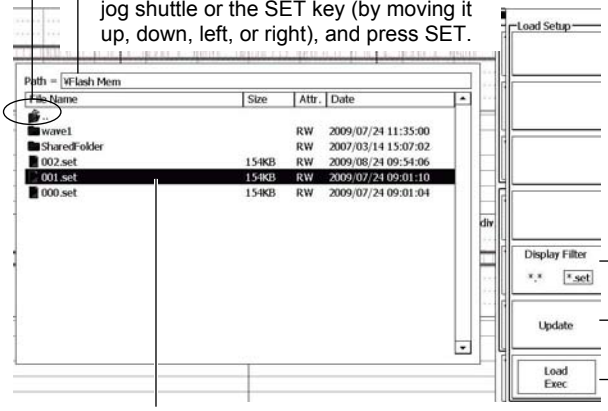
Procedure

FILE Setup (Load) Menu

Press **FILE** and then the **Setup**(Load) soft key to display the following menu.

To move to the folder that contains the current folder, move the cursor to this line and press SET.

Set the folder to load from.
Move the cursor to a folder by using the jog shuttle or the SET key (by moving it up, down, left, or right), and press SET.



Set which files to display in the File List window (*.set, *.*).

Updates the File List with the most recent information

Loads the setup data

Move the cursor to the file that you want to load by using the jog shuttle or the SET key (by moving it up, down, left, or right).

Explanation

You can load setup data that has been saved to a storage medium.

13.9 Loading Other Types of Data

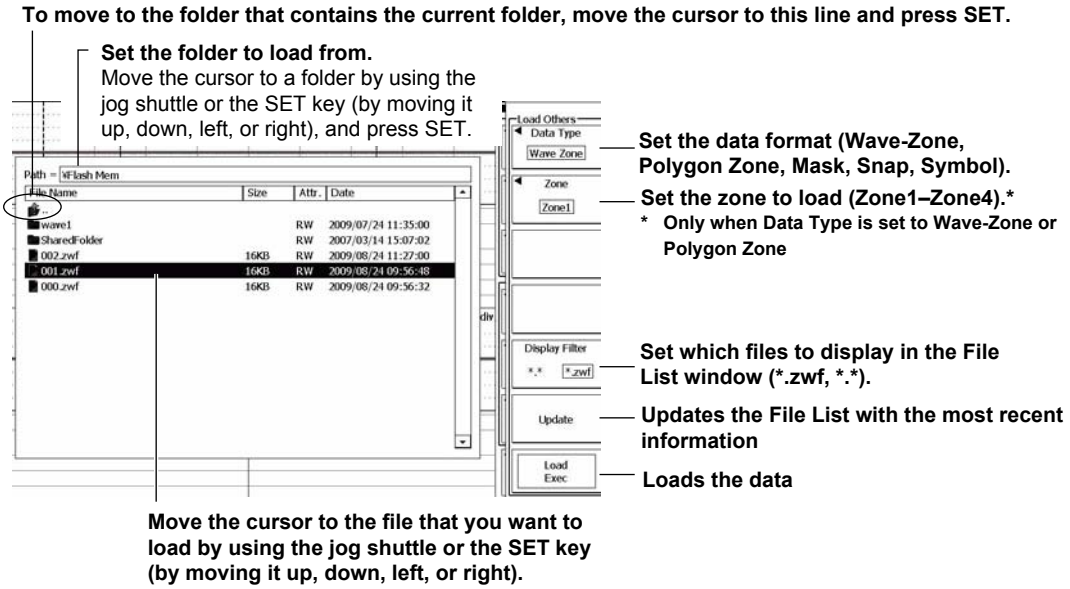
CAUTION

Do not remove the storage medium or turn off the power when the file icon ( ) in the bottom left of the screen is blinking. Doing so may damage the storage medium and corrupt its data.

Procedure

FILE Others (Load) Menu

Press **FILE** and then the **Others**(Load) soft key to display the following menu.



Explanation

You can load the following data from the specified storage medium.

- Waveform zones (.zwf), polygonal zones (.msk), and mask patterns (.msk)
- Snapshot waveforms (.snp)
- Symbol files (.sbl)*

  * Symbol files are definition files (with .sbl extensions) for converting logic signal patterns into symbols. You can edit them by using YOKOGAWA's free Symbol Editor software. You can obtain Symbol Editor from the YOKOGAWA website (http://www.yokogawa.com/tm/).

13.10 File Operations

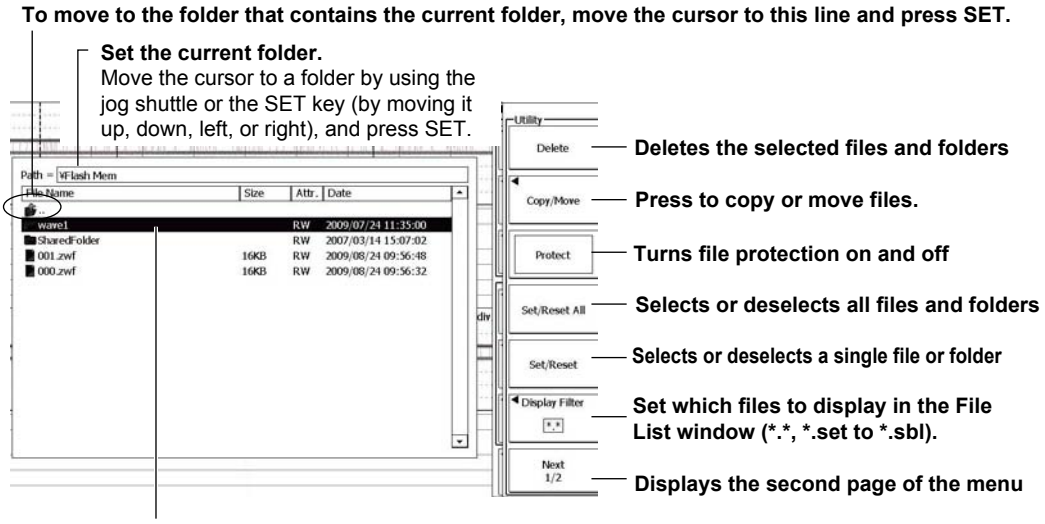
CAUTION

Do not remove the storage medium or turn off the power when the file icon ( ) in the bottom left of the screen is blinking. Doing so may damage the storage medium and corrupt its data.

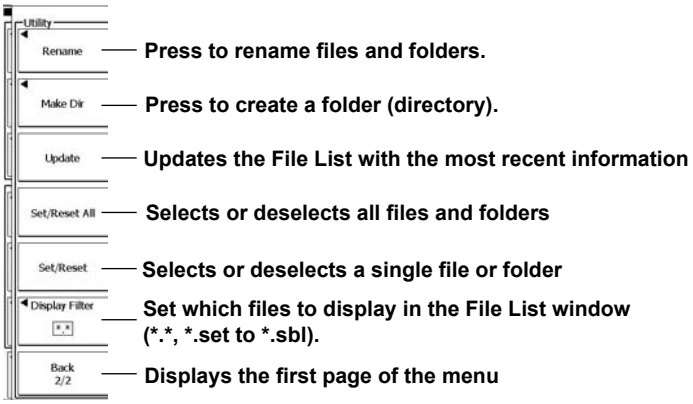
Procedure

FILE Utility Menu

Press **FILE** and then the **Utility** soft key to display the first page of the following two-page menu.



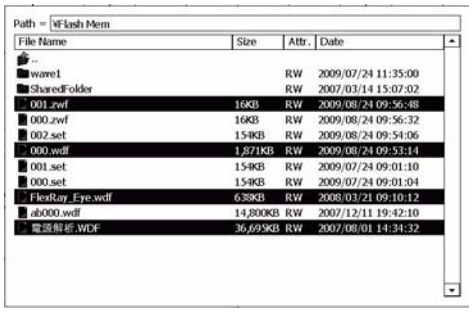
Press the **Next** soft key to display the second page of the menu.



Selecting Files and Folders Using the SET Key

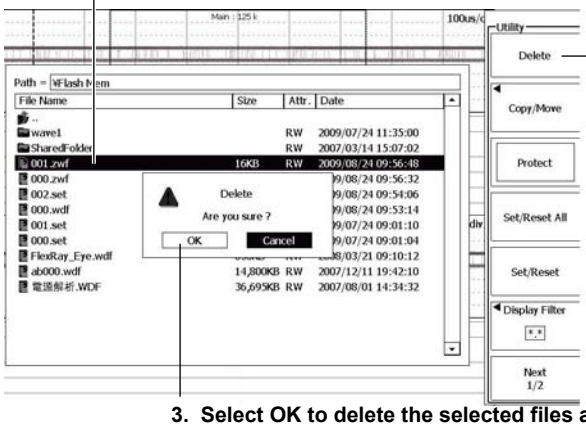
Move the cursor to the file or folder that you want to select, and then press the **SET** key. Press the **Set/Reset** soft key to deselect a file or folder.

Example of Multiple File Selection (Highlighted files)



Deleting Files and Folders (Delete)

1. **Move the cursor to the file or folder that you want to delete (you can select multiple files and folders).**



2. **Execute the delete operation.**

3. **Select OK to delete the selected files and folders.**

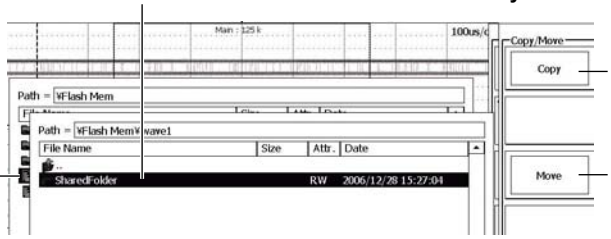
Copying and Moving Files (Copy and Move)

Move the cursor to the file that you cant to copy or move.

Press the **Copy or Move** soft key to display the following screen.

1. **Move the cursor to the file that you want to copy or move (you can select multiple files).**

2. **Move the cursor to the folder that you want to copy or move to.**



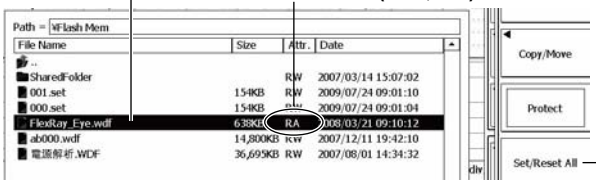
3. **Execute the copy operation.**

3. **Execute the move operation.**

Changing File Attributes (Protect)

Move the cursor to the file whose attribute you want to change.

Attribute (R/W, RA)



Changes the attributes (ON: RA, OFF: R/W)

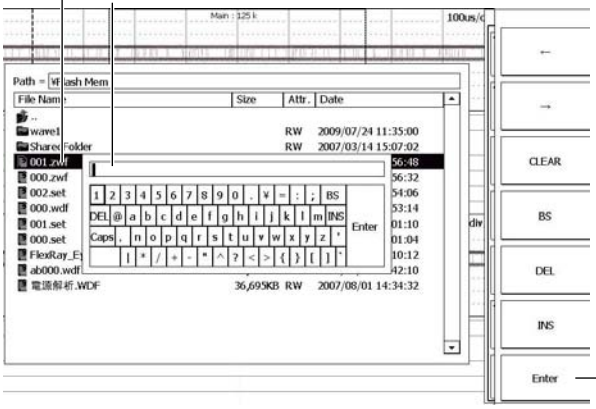
Renaming Files and Folders (Rename)

Move the cursor to the file or folder that you want to rename.

Press the **Rename** soft key on the second page of the menu to display a keyboard.

Move the cursor to the file or folder that you want to rename.

Enter the new name.



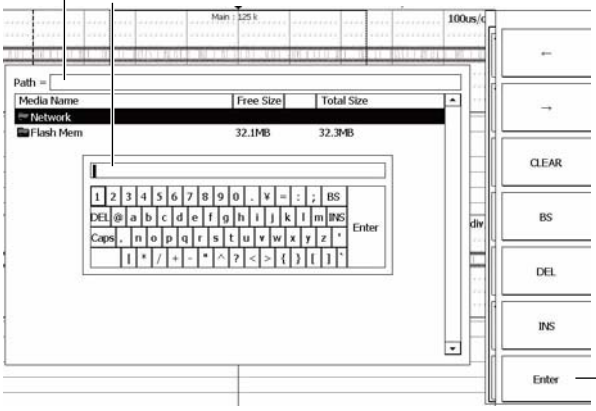
Press the Enter soft key or Enter on the keyboard to change the name.

Making Folders (Make Dir)

Press the **Make Dir** soft key on the second page of the menu to display a keyboard.

Current folder

Enter the new folder name.



Press the Enter soft key or Enter on the keyboard to change the name.

Explanation

Renaming Files and Folders (Rename)

You can change the name of the selected file or folder.

Selecting Files and Folders (SET key, Set/Reset All, and Set/Reset)

You can use the following methods to select files and folders.

- **Selecting Files One at a Time (By pressing SET or the Set/Reset soft key)**
  Press **SET** to select a file. Or press the **Set/Reset** soft key to select and deselect files.
- **Selecting all Files or Folders (By pressing the Set/Reset All soft key)**
  Each time you press the **Set/Reset All** soft key, all the files and folders in the current folder are selected or deselected.

Copying and Moving Files (Copy and Move)

You can copy or move all the selected (highlighted) files.

Note

- Copying or moving will stop if an error occurs while the DL6000/DLM6000 is copying or moving files.
- You cannot copy or move a file to a destination if there is already a file with the same name in that destination.
- After executing a copy or move operation, you cannot simply change the destination directory and then copy or move the same files that you copied before. You have to reselect the files that you want to copy or move.
- Up to 2500 files and folders can be displayed in the file list. If there are more than a total of 2500 files and folders in a given folder, the file list for that folder will only display 2500 files and folders. There is no way to set which files and folders are displayed.

File Attributes (Protect)

You can change the attributes of the selected files (unless they are located on a network drive). The file attributes appear under Attr in the file list.

RW	The file can be read and written to.
RA	The file can only be read. It cannot be written to or deleted.

Note

- You cannot change folder attributes.

Deleting Files and Folders (Delete)

You can delete all the selected (highlighted) files.

Note

- Deleted data cannot be recovered. Be careful not to delete the wrong files.
- Deletion will stop if an error occurs while the DL6000/DLM6000 is deleting files.

Making Folders (Make Dir)

You can create a new folder in the current folder of the selected storage medium.

Note

- You cannot change the name of a file if a file with the same name already exists in the same folder.
- You cannot create a folder if a folder with the same name already exists in the same folder.
- The DL6000/DLM6000 can recognize up to 26 different storage media.

13.11 Saving Screen Capture Data

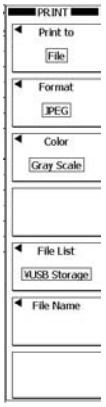
CAUTION

Do not remove the storage medium or turn off the power when the file icon ( ) in the bottom left of the screen is blinking. Doing so may damage the storage medium and corrupt its data.

Procedure

PRINT File Menu

Press **SHIFT+PRINT** (MENU) to display the following menu.



Set the save destination to File.

Set the data format (BMP, PNG, JPG).

Set the color mode (True Color, True Color(Reverse), Gray Scale).

Set the save destination.

Set the file name.

Saving

Press **PRINT** while the screen that you want to save is displayed.

Explanation

You can save screen capture data to the specified storage medium.
The storage media that you can save to are PC cards, external USB devices, flash memory devices, and network drives (on models that are equipped with the Ethernet interface option). For details about saving to a network drive, see chapter 14.3.

Data Formats and Extensions

You can save the following types of files to the specified storage medium. The table below lists the automatically attached extensions and their corresponding file sizes (representative values).

File Format	Extension	File Size[1]
BMP	.bmp	Approx. 100 KB (approx. 1.6 MB)[2]
PNG	.png	Approx. 11 KB (approx. 52 KB)[2]
JPG	.jpg	Approx. 255 KB[3]

1 When the color mode is set to Monochrome.
2 The file sizes in parentheses indicate the file size when the color mode is set to True Color.
3 All files saved in JPG format have approximately the same file size.

Color Mode

You can set the color mode to one of the following options.

True Color	An image is produced with a 65536-color palette.
True Color(Reverse)	The screen background is not produced in color.
Gray Scale	An image is produced with a 32-color grayscale palette.
Monochrome	A black-and-white image is produced. You cannot select this mode when Format is set to JPG.

Save Destination

The media that you can save to appear in the File List window. The window is the same as that explained in “Storage Media and Folders” in section 13.4.

File Name

See the explanation for “File Name” in section 13.4.

Note

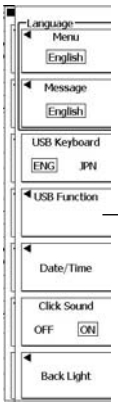
Up to 2500 files and folders can be displayed in the file list. If there are more than a total of 2500 files and folders in a given folder, the file list for that folder will only display 2500 files and folders. There is no way to set which files and folders are displayed.

13.12 Connecting to a PC through a USB Port

Procedure

UTILITY System Configuration Menu

Press **UTILITY** and then the **System Configuration** soft key to display the following menu.



Step 1 Set the USB communication mode (USB TMC, Mass Storage).

Step 2 To activate the settings, restart the DL6000/DLM6000.
(Turn it off, wait at least 10 seconds, and then turn it on.)

Explanation

You can use a USB port to connect the DL6000/DLM6000 to a PC, and you can control the DL6000/DLM6000 from the PC.

USB Communication

USB TMC

- You can communicate with the PC using USB TMC (Test and Measurement Class).
- To use USB TMC, you must install the USB TMC driver provided by YOKOGAWA on the PC.
- Do not use USB TMC drivers (or software) supplied by other companies.

Mass Storage

- The connected PC can use the DL6000/DLM6000 as a USB storage device.
- You do not have to install the USB TMC driver on the PC.

Note

- For information about how to obtain the YOKOGAWA USB TMC driver, contact your nearest YOKOGAWA dealer. You can also access the YOKOGAWA USB driver download webpage and download the driver.
  http://tmi.yokogawa.com/
- To activate the TMC and Mass Storage settings, restart the DL6000/DLM6000. Turn off the DL6000/DLM6000 power switch, wait at least 10 seconds, and then turn on the switch.
- To remotely control the DL6000/DLM6000 using communication commands through the USB port, enable the TMC setting. To enable remote control through the USB port, see the instructions in the *DL6000/DLM6000 Communication Interface User's Manual, IM DLM6054-17EN*.
- You cannot use keys to perform file operations when a PC is connected to the DL6000/DLM6000 and the Mass Storage setting is enabled. You cannot use communication commands to perform file operations either. To perform file operations, you must restart the DL6000/DLM6000 after disconnecting the PC or enabling the TMC setting.

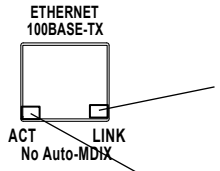
14.1 Connecting the DL6000/DLM6000 to a Network

Optional Ethernet Interface Specifications

There is a 100BASE-TX port located on the rear panel of the DL6000/DLM6000.

Item	Specification
Ports	1
Electrical and mechanical specifications	IEEE802.3
Transmission system	Ethernet (100BASE-TX/10BASE-T)
Transfer rate	100 Mbps max.
Communication protocol	TCP/IP
Supported services	DHCP, DNS, and Microsoft network file sharing client/server
Connector type	RJ-45

100BASE-TX Ethernet port



LINK LED
Illuminates when a link is established between the DL6000/DLM6000 and another device and the devices are capable of communicating with each other

ACT LED
Blinks when packets are being sent and received normally

Items Required to Connect the DL6000/DLM6000 to a Network Cable

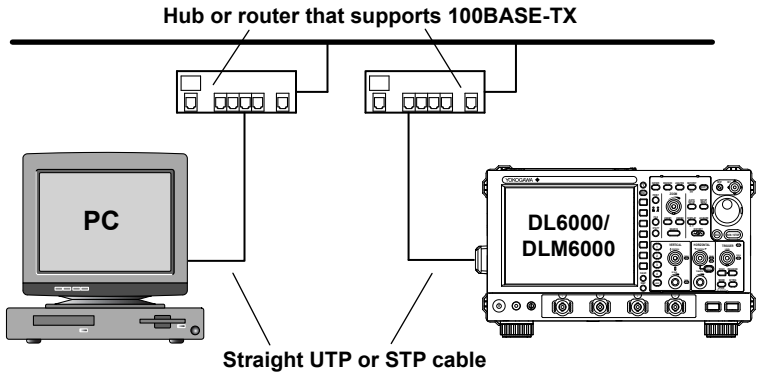
When connecting the DL6000/DLM6000, be sure to use one of the following cables.

- A UTP (unshielded twisted pair) cable (category 5 or better)
- An STP (shielded twisted pair) cable (category 5 or better)

Connection Procedure

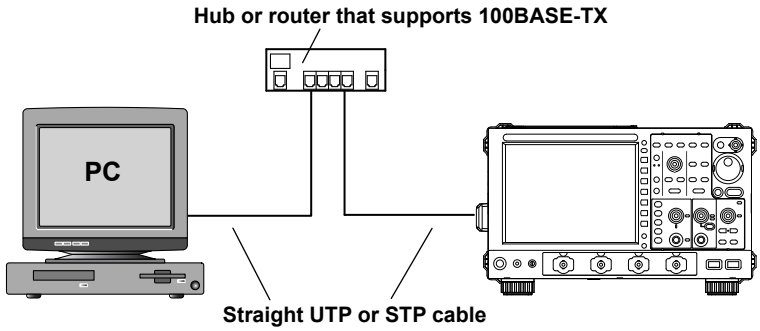
To Connect to a PC over a Network

1. Turn off the DL6000/DLM6000.
2. Connect one end of a UTP (or STP) cable to the ETHERNET 100BASE-TX port on the rear panel.
3. Connect the other end of the UTP (or STP) cable to a hub or router.
4. Turn on the DL6000/DLM6000.



To Connect to a PC through a Hub or Router

1. Turn off the DL6000/DLM6000 and the PC.
2. Connect one end of a UTP (or STP) cable to the ETHERNET 100BASE-TX port on the rear panel.
3. Connect the other end of the UTP (or STP) cable to a hub or router.
4. Connect the PC to the hub or router in the same way.
5. Turn on the DL6000/DLM6000.



Note

- When you connect a PC to the DL6000/DLM6000 through a hub or router, the PC must have an auto switching 10BASE-T/100BASE-TX network card.
- Use straight UTP or STP cables that are category 5 or better.
- Do not connect the DL6000/DLM6000 to a PC directly. Direct communication without a hub or router is not guaranteed to work.

14.2 Configuring TCP/IP Settings

Procedure

UTILITY Network Menu

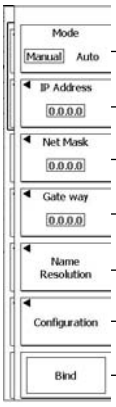
Press **UTILITY** and then the **Network** soft key to display the following menu.

Configure TCP/IP settings.

Check TCP/IP settings.

TCP/IP Settings (Setup)

Press the **Setup** soft key to display the following menu.



Set the network setup mode (Manual, Auto).

Set the IP address.

Set the subnet mask.

Set the default gateway.

Specify these settings when the network setup mode is Manual.

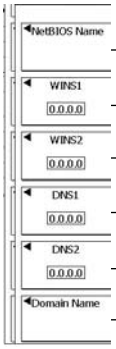
Configure DNS and WINS settings.

Check TCP/IP settings.

Applies the settings

DNS and WINS Settings (Name Resolution)

Press the **Name Resolution** soft key to display the following menu.



Set the NetBIOS name.

Set the primary WINS server address.

Set the secondary WINS server address.

Set the primary DNS server address.

Set the secondary DNS server address.

Set the domain name (DNS).

Explanation

Network Setup Mode (Mode)

The following TCP/IP settings are configured automatically when you set the mode to Auto.

- IP address
- Subnet mask
- Default gateway

DHCP

DHCP is a protocol that temporarily allocates necessary information to a computer so that it can connect to the Internet.

The DL6000/DLM6000 can only use DHCP if there is a DHCP server on the network. Ask your network administrator whether or not DHCP is available.

The following information is assigned automatically when you set the network setup mode to Auto.

- IP address
- Subnet mask
- Default gateway
- DNS
- WINS
- Domain name

When you set the network setup mode to Auto, different information may be assigned to the DL6000/DLM6000 each time it is turned on or bound to a server. When you connect a PC to the DL6000/DLM6000, you must check the IP address and other network settings on the PC each time you turn the DL6000/DLM6000 on or bind it to a server.

IP Address (IP Address)

You can set the IP address assigned to the DL6000/DLM6000. The default setting is 0.0.0.0.

The IP address is an ID that is assigned to each device on an IP network (the Internet or an intranet). The ID is a 32-bit value that is expressed using four octets. Each octet is separated by a period and has a value from 0 to 255, as in “192.168.111.24.”

Obtain an IP address from your network administrator. In a network that supports DHCP, this parameter can be set automatically.

Subnet Mask (Net Mask)

You can set the mask value used to determine 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 subnetworks. The subnet mask is a 32-bit value that specifies the number of bits of the IP address that are used to identify the network address. The remaining portion of the network address is the host address that identifies individual computers on the network.

Consult your network administrator for the subnet mask value. In a network that supports DHCP, this parameter can be set automatically.

Default Gateway (Gate Way)

You can set the IP address of the default gateway (which is a gateway used to communicate with other networks). The default setting is 0.0.0.0.

The default gateway handles data exchange between multiple networks so that data transmission proceeds smoothly.

Consult your network administrator for the default gateway value. In a network that supports DHCP, this parameter can be set automatically.

DNS and WINS (Name Resolution)

DNS is a system that correlates combinations of host names and domain names to IP addresses. Given AAA.BBBBB.com, AAA is the host name and BBBBB.com is the domain name. You can use a host name and domain name to access the network instead of a numeric IP address.
The DL6000/DLM6000 allows you to specify the host by name, instead of by IP address.
WINS is a service that allows you to associate a PC's NetBIOS name and its IP address on a Windows network. You can use WINS to connect to different subnetworks.
Set the domain name or the NetBios name and the IP address of the DNS or WINS server (the default IP address is 0.0.0.0). For details, consult your network administrator.

DNS Server (DNS1 and DNS2)

You can specify up to two DNS server addresses: one primary and one secondary. If querying to the primary DNS server fails, the DL6000/DLM6000 automatically switches to the secondary DNS server to find the mapping of the host name and domain name to the IP address.

Domain Name (DomainName)

Specify the information to attach to the host name when querying the DNS server.

WINS (WINS1 and WINS2)

You can specify up to two WINS server addresses: one primary and one secondary. If querying to the primary WINS server fails, the DL6000/DLM6000 automatically switches to the secondary WINS server to find the mapping of the NetBIOS name to the IP address.

NetBIOS Name (NetBIOS Name)

Specify the NetBIOS name to use when querying the WINS server.

Applying the Settings (Bind)

Execute Bind after you have changed the Ethernet settings.

Note

PC TCP/IP Settings

To connect a PC to the DL6000/DLM6000, you must configure PC communication settings, such as the IP address. Configure communication settings for each NIC that is installed in the PC. This section explains the NIC settings that must be made to connect the DL6000/DLM6000 to a PC.
To use a DHCP server to automatically obtain the IP address and other network information automatically, select "Obtain an IP address automatically" under the "IP Address" tab of the "TCP/IP Properties" dialog box.
When you connect a PC to the DL6000/DLM6000 through a hub or router, you might configure the settings as shown in the figure below.
For details about the settings, consult your system or network administrator.

Setting	Value	Notes
IP address	Example: 192.168.0.128	PC IP Address
Subnet mask	Example: 255.255.255.0	Set to the same value as the DL6000/DLM6000 subnet mask.
Gateway	0.0.0.0 (default value)	
DNS	Disable	
WINS	Disable	

MAC Address

A MAC address is a unique fixed preset address assigned to each Ethernet device. MAC addresses are used to physically distinguish between Ethernet devices and are necessary for data transfer between nodes.

14.3 Saving and Loading Measurement, Setup, and Image Data on a Network Drive

Procedure

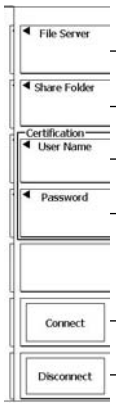
UTILITY Network Menu

Press **UTILITY**, the **Network** soft key, and then the **Client Setup** soft key to display the following menu.

Configure network drive settings.

Network Drive Settings (Net Drive)

Press the **Net Drive** soft key to display the following menu.



Set the name of the file server.

Set the name of the shared folder.

Set the user name.

Set the password.

Connect to the network drive.

Disconnect from the network drive.

Saving a Screen Capture

Press **SHIFT+PRINT** (MENU) to select the network drive that you want to save to (**Network Printer**), and then save the screen capture. For details about saving screen captures, see chapter 12.

Loading and Saving Measured Data and Setup Data

In the FILE menu, set the current folder to the network drive (**Network**), and then perform the save or load operation. For details about loading and saving, see chapter 13.

Explanation

Just as you can with a PC card drive, you can save screen capture data, measured data, and setup data to a network drive over an Ethernet connection.

File Server (File Server)

Specify the host name of the network file server (the PC with file server capabilities) on which you want to save the measurement or setup data. You cannot specify an IP address.

Shared Folder (Share Folder)

Specify the name of the shared folder using up to 30 characters.

User Name (UserName)

Specify a user name using up to 30 characters.
You can use any of the ASCII characters on the keyboard to enter the user name.

Password (Password)

Using up to 30 characters, specify the password for the user name that you entered.
You can use any of the ASCII characters on the keyboard to enter the password.

Note

- You must enable sharing on the PC that you intend to connect to.
- Before using this feature, configure the TCP/IP settings described in section 14.2.
- The connection to the file server is restored when you turn the power on.

14.4 Configuring E-mail Transmission (SMTP client function)

Procedure

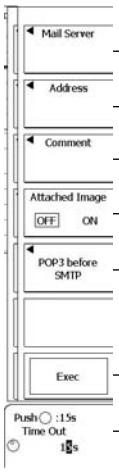
UTILITY Network Menu

Press **UTILITY**, the **Network** soft key, and then the **Client Setup** soft key to display the following menu.

— **Configure e-mail transmission.**

E-mail Transmission Settings (E-Mail Setup)

Press the **E-Mail Setup** soft key to display the following menu.



— **Set the mail server.**

— **Set the e-mail address.**

— **Set the comment.**

— **Turns screen capture attachment on and off**

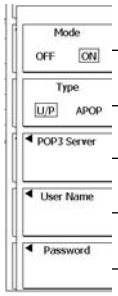
— **Configure authentication settings.**

— **Sends an e-mail**

— **Set the timeout value.**

User Authentication Settings (POP3 before SMTP)

Press the **POP3 before SMTP** soft key to display the following menu.



— **Set the mode to ON or OFF.**

— **Set the encryption type (U/P, APOP).**

— **Set the name of the POP3 server.**

— **Set the user name.**

— **Set the password.**

Explanation

One of the actions that you can select in the action-on-trigger and GO/NO-GO determination features is the transmission of e-mails containing trigger times and other information to a specific e-mail address.

Mail Server (Mail Server)

Specify the IP address of the network e-mail server. In a network with a WINS or DNS server, you can specify the NetBIOS name or the host name and domain name instead of the IP address.

E-mail Address (Address)

To Address: Using up to 100 characters, you can specify multiple addresses on the network to send e-mails to. Separate the addresses with commas.

From Address: You can specify the address of the sender using up to 40 characters. If you do not specify a From Address, the To Address is used.

Comment (Comment)

The first line of the e-mail that will be sent. Use this setting as necessary. You can enter up to 100 characters.

Attaching Screen Captures (Attached Image)

You can attach a capture of the screen that is displayed at the time the e-mail is sent.

- File format: PNG
- File name: DL_image[date and time].png (Example: DL Image0802171158.png is the file name that would be created on 2008/2/17 at 11:58.)
- Resolution: XGA (1024 × 768 dots)
- Approximate file size
  - Normal screen: Approx. 50 KB
  - Maximum: Approx. 1.6 MB*

    * For screen captures that contain a large amount of color information.

User Authentication (POP3 before SMTP)

Before you send an e-mail, POP3 user authentication is performed.

- Mode
  ON: Authentication is performed before e-mails are sent.
  OFF: Authentication is not performed before e-mails are sent.
- Encryption type
  U/P: The authentication data is sent in plaintext.
  APOP: The authentication data is encrypted before it is sent.
- Server name
  Using up to 30 characters, enter the POP3 server host name or IP address.
- User name
  Using up to 30 characters, enter the user name that the DL6000/DLM6000 will need to access the POP3 server.
- Password
  Using up to 30 characters, enter the password that the DL6000/DLM6000 will need to access the POP3 server.

Timeout (Time Out)

Specify the timeout period for sending and receiving. You can set the timeout to a value between 1 and 60 s in 1 s steps. The default value is 15 s.

E-mail Transmission (Exec)

You can send an e-mail to the specified e-mail addresses (Address). When Attached Image is set to ON, a screen capture taken at the time you selected Exec is attached to the e-mail.

Note

- Before using the e-mail transmission feature, configure the TCP/IP settings described in section 14.2.
- The DL6000/DLM6000 supports plaintext (U/P) and encrypted (APOP) POP3 user authentication.*

* APOP uses the MD5 algorithm (Message-Digest Algorithm 5 by RSA Data Security, Inc.).

14.5 Using SNTP to Set the Date and Time

Procedure

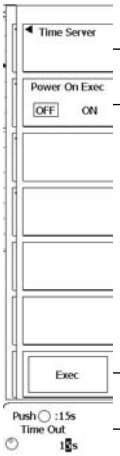
UTILITY Network Menu

Press **UTILITY**, the **Network** soft key, and then the **Client Setup** soft key to display the following menu.

Set the date and time.

Date and Time Settings (Net Time Adjust Setup)

Press the **Net Time Adjust Setup** soft key to display the following menu.



Specify the host name or IP address of the NTP or SNTP server.

Turns date and time information retrieval on and off

Sets the date and time.
(Retrieves information from an NTP or SNTP server and use it to set the date and time.)

Set the timeout value.

Explanation

You can acquire time information from a NTP or SNTP server connected to the network and use it to set the date and time on the DL6000/DLM6000.

When Power On Exec is set to ON and you turn on the DL6000/DLM6000, it automatically acquires date and time information from the NTP or SNTP server connected to the network.

Note

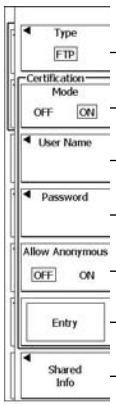
You must properly set the time difference between the region where you are using the DL6000/DLM6000 and Greenwich Mean Time.

14.6 Accessing the DL6000/DLM6000 from a PC (File Server)

Procedure

UTILITY Network Menu

Press **UTILITY**, the **Network** soft key, and then the **Server Setup** soft key to display the following menu.



Set the file server feature to Microsoft Network, FTP, or Web (see section 14.7).

Turns authentication on and off

Set the user name.

Set the password.

Enables or disables anonymous access (only for FTP)

Applies the settings

Check the shared folder.

Explanation

You can access the DL6000/DLM6000 flash memory from a PC connected over an Ethernet network.

File Server Type (Type)

You can select one of the following options.

- Microsoft Network: Select this option if the PC will use the Microsoft network protocol to access the DL6000/DLM6000 flash memory.
- FTP: Select this option if you will use an FTP client software application to access the DL6000/DLM6000 flash memory from a PC.

Turning Authentication On and Off (Mode)

You can select whether or not to perform authentication when a PC connects to the DL6000/DLM6000. If you select OFF, you can access the DL6000/DLM6000 without entering a user name or password.

User Name (UserName)

Using up to 30 characters, set the user name that will be necessary to access the DL6000/DLM6000 from a PC. You can use any of the ASCII characters on the keyboard to enter the user name.

Password (Password)

Using up to 15 characters, set the password that will be necessary to access the DL6000/DLM6000 from a PC. You can use any of the ASCII characters on the keyboard to enter the password.

Enabling or Disabling Anonymous Access (Allow Anonymous)

This setting is only available when you set the file server type to FTP. You can select whether or not to allow anonymous users to login to the DL6000/DLM6000.

- ON: Anonymous users can login to the DL6000/DLM6000. Only read operations are allowed.
- OFF: Anonymous users cannot login to the DL6000/DLM6000.

The following table shows the login requirements for different file server types.

Setup Item						
File server type	Microsoft Network		FTP			
Authentication on/off	Disable	Enable	Disable		Enable	
User name and password	Not necessary	Necessary	Not necessary		Necessary	
Anonymous login permission	—	—	No	Yes	No	Yes
Login permission						
User login permission	Yes	Yes	Yes	Yes	Yes	Yes
Anonymous login permission	Yes	No	No	Yes	No	Yes
Anonymous login permission only (All other user names are rejected.)	No	No	No	No	No	Yes*

* Access is only restricted to anonymous logins when no user name or password has been set.

Applying the Settings (Entry)

If you do not press Entry, the settings that you specified will not be applied.

Shared Folder (Shared Info)

The DL6000/DLM6000 offers the same shared folder for both Microsoft network and FTP access.

Note

- To access the DL6000/DLM6000 using its Microsoft network server feature, your PC must have Microsoft Windows XP Home Edition or Professional installed.
  However, the following security update (MS05-011) may cause problems. For example, it may take time to display file lists and copy the DL6000/DLM6000 files to a PC.
  Patch: Security Update for Windows XP (KB885250)
  Date published: 2005/2/7. Version: 885250
  To avoid the problems caused by this security update, contact the Microsoft customer service center and download the following hotfix.
  Hotfix
  Document number: 895900. Last update: 2005/6/1. Revision: 2.0.
  The above issue does not pertain to FTP.
- The DL6000/DLM6000 FTP server feature supports plaintext and encoded authentication. For encoded authentication, the DL6000/DLM6000 uses OTP (one time password).*

* The DL6000/DLM6000 OTP uses the MD5 algorithm (Message-Digest Algorithm 5 by RSA Data Security, Inc.)

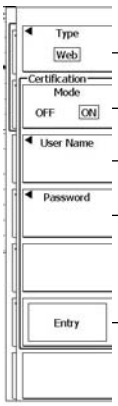
- The DL6000/DLM6000 can connect to up to three clients as an FTP or Microsoft network server.

14.7 Using a PC to Monitor the DL6000/DLM6000 and Change Its Settings (Web Server)

Procedure

UTILITY Network Menu

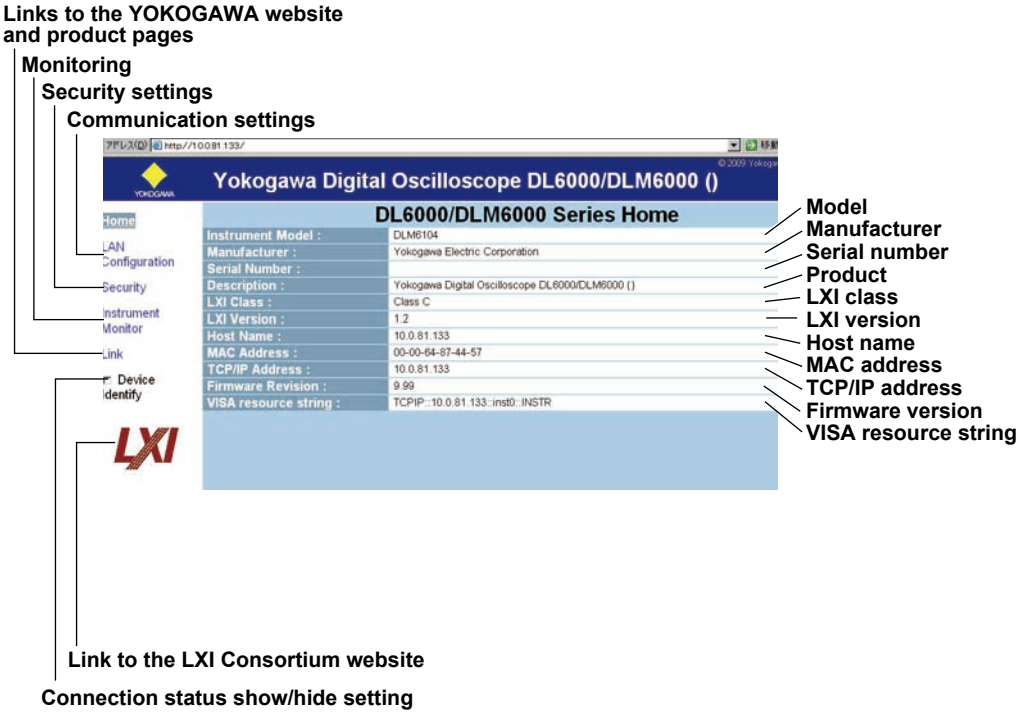
Press **UTILITY**, the **Network** soft key, and then the **Server Setup** soft key to display the following menu.



Set the file server feature to Web.
Turns authentication on and off
Set the user name.
Set the password.
Applies the settings

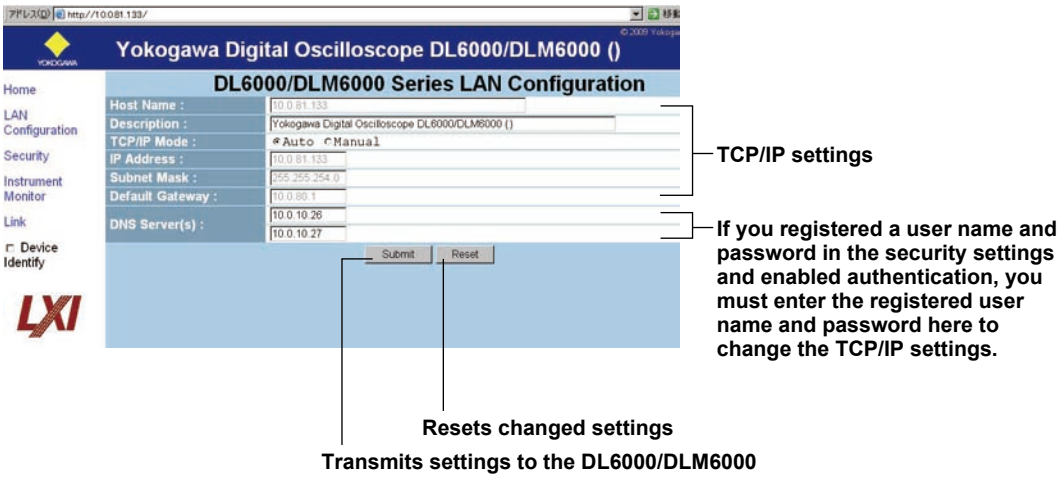
Connecting a PC to the DL6000/DLM6000

Open a Web browser on a PC that is connected to the network.
In the browser's address bar, enter "http://," followed by the IP address of the DL6000/DLM6000.
If authentication has been enabled on the DL6000/DLM6000, a dialog box for entering the user name and password appears. Enter the user name and password that you specified in the above menu.
If the PC connects to the DL6000/DLM6000 Web server successfully, the following top page will appear.



TCP/IP Settings

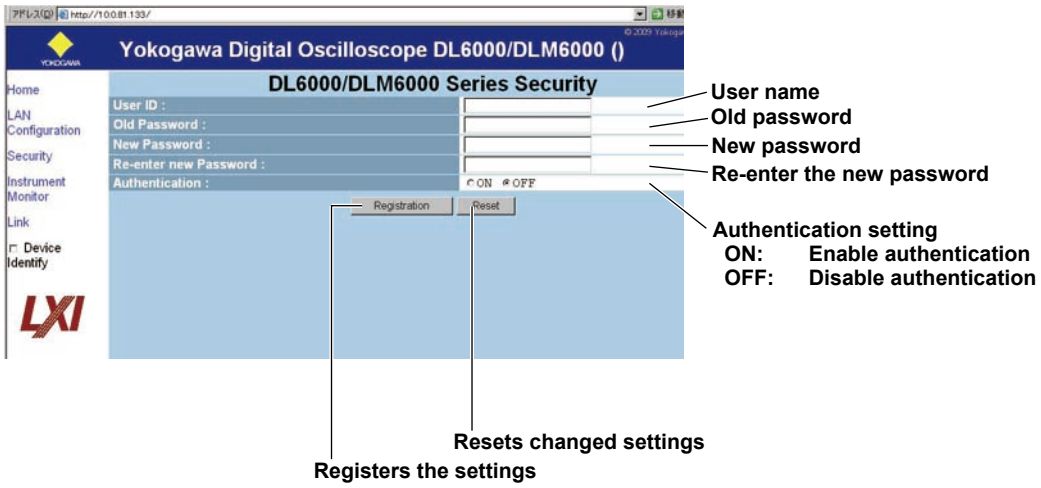
On the DL6000/DLM6000 Web page, click LAN Configuration to display the TCP/IP setup page.



The current TCP/IP settings appear inside the browser window. You can change the settings in the window. After you change the settings, click Submit to transmit them to the DL6000/DLM6000. Click Reset to undo the changes that you made.

Security Settings

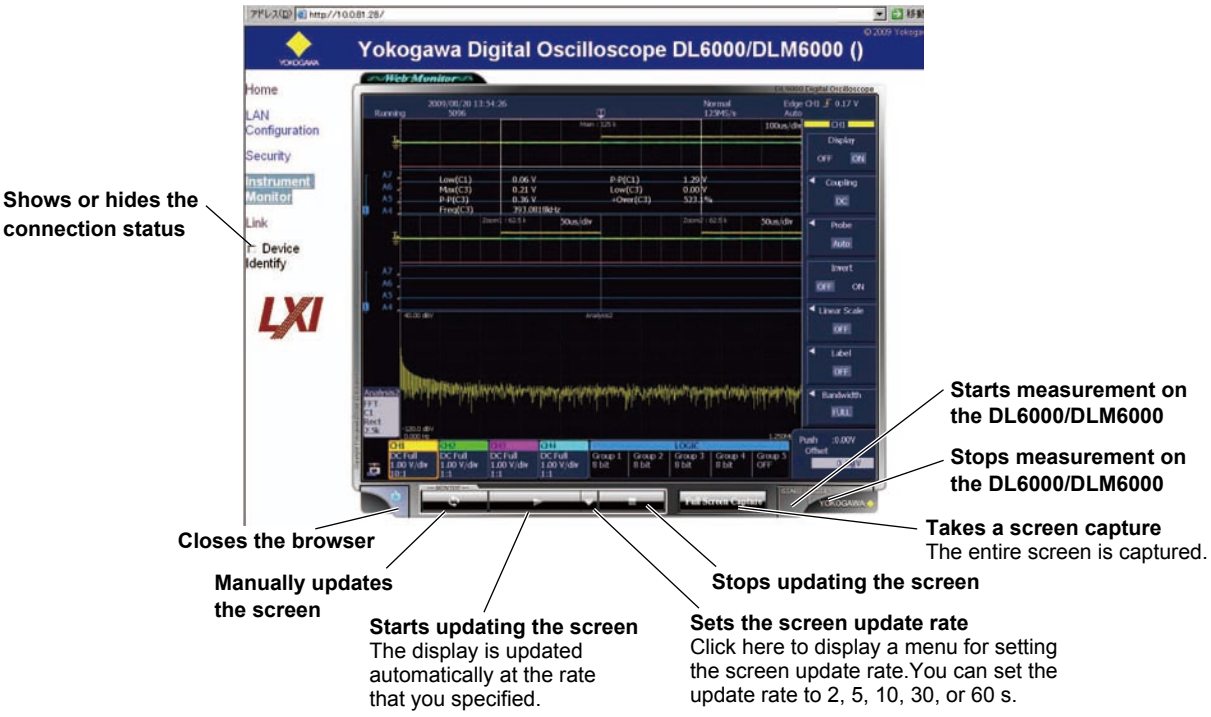
On the DL6000/DLM6000 Web page, click Security to display the security setup page.



The current security settings appear inside the browser window. You can change the settings in the window. After you change the settings, click Registration to transmit them to the DL6000/DLM6000. Click Reset to undo the changes that you made.

Monitoring

On the DL6000/DLM6000 Web page, click Instrument Monitor to monitor the DL6000/DLM6000.



Showing and Hiding the Connection Status

If you select the Device Identify check box, an icon that indicates the connection status blinks in yellow on the DL6000/DLM6000 screen.

When the Device Identify check box is cleared

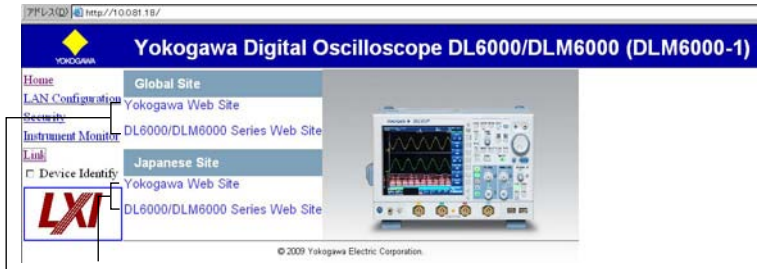
This icon indicates the connection status.

When the Device Identify check box is selected

Blinks in yellow

Links

On the DL6000/DLM6000 Web page, click Link to display links to the YOKOGAWA website and product pages.



Links to pages on the YOKOGAWA Japanese site

Links to pages on the YOKOGAWA global site (English)

Explanation

From a PC connected to an Ethernet network, you can display the DL6000/DLM6000 screen and start and stop measurement. You can also update the DL6000/DLM6000 screen that is displayed on the PC and take screen captures.

Turning Authentication On and Off (Mode)

You can select whether or not to perform authentication when a PC connects to the DL6000/DLM6000. If you select OFF, you can access the DL6000/DLM6000 without entering a user name or password.

User Name (UserName)

Using up to 30 characters, set the user name that will be necessary to access the DL6000/DLM6000 from a PC. You can use any of the ASCII characters on the keyboard to enter the user name.

Password (Password)

Using up to 15 characters, set the password that will be necessary to access the DL6000/DLM6000 from a PC. You can use any of the ASCII characters on the keyboard to enter the password.

Applying the Settings (Entry)

If you do not press Entry, the settings that you specified will not be applied.

Recommended Operating Systems and Browsers

OS	Web Browsers
Windows XP Professional	Internet Explorer 6.0 or Firefox 2.0
Windows 2000	Internet Explorer 6.0 or Firefox 2.0
Macintosh OS/X (10.4.8)	Safari (2.0.4)
Windows Vista Enterprise	Internet Explorer 7.0

Connecting from a PC

To use the Web server feature to connect to the DL6000/DLM6000 from a PC, use a hub or router, and connect to a network. Do not connect a PC directly to the DL6000/DLM6000.

Note

- You need Adobe Flash® Player (version 8 or later) to use the Web server feature.
  Your browser will automatically download the most recent version of Flash Player when you access the DL6000/DLM6000 website.
  If the download does not begin automatically, download the latest version of Flash Player from the Adobe website.
- To use the full screen capture feature, disable your browser's popup blocker.
- You cannot use the Web server feature when the DL6000/DLM6000 is printing or handling files.
- You cannot use the Web server feature when a PC is connected to the DL6000/DLM6000 and the Mass Storage setting is enabled.
  To use the Web server feature, you must restart the DL6000/DLM6000 after disconnecting the PC or enabling the TMC setting.

14.8 Configuring a Network Printer

Procedure

UTILITY Network Menu

Press **UTILITY**, the **Network** soft key, and then the **Client Setup** soft key to display the following menu.

— **Configure network printer settings.**

Network Printer Settings (Net Print Setup)

Press the **Net Print Setup** soft key to display the following menu.

— **Set the name of the printer server.**

— **Set the name of the shared printer.**

— **Set the user name.**

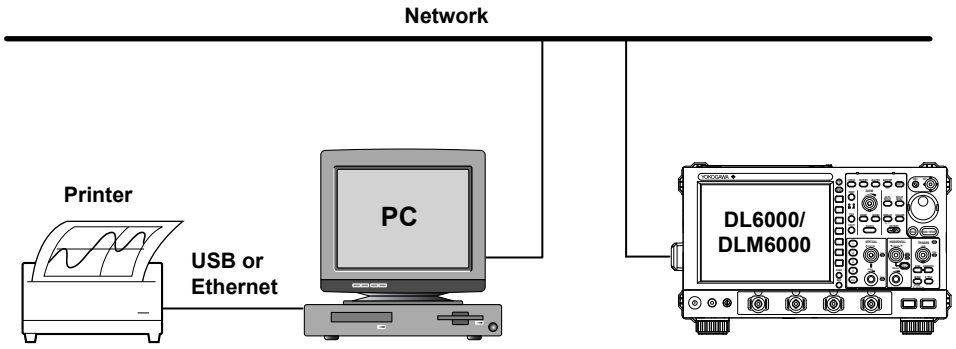
— **Set the password.**

Note

For details about printing screen captures, see chapter 12.

Explanation

The DL6000/DLM6000 can connect to a PC running a Windows OS and use a shared network printer. A connection example is shown below.



We recommend that you use a PC with one of the following operating systems.

Windows 2000
Windows XP Professional

Note

To use a network printer, you must configure it as a shared printer on the PC.

The following example explains how to configure a printer as a shared printer on Windows XP Professional.

- On the taskbar, click Start, and then click Printers and Faxes.
- Right-click the printer that you want to share, and then click Sharing.

The DL6000/DLM6000 can print to the following printers.

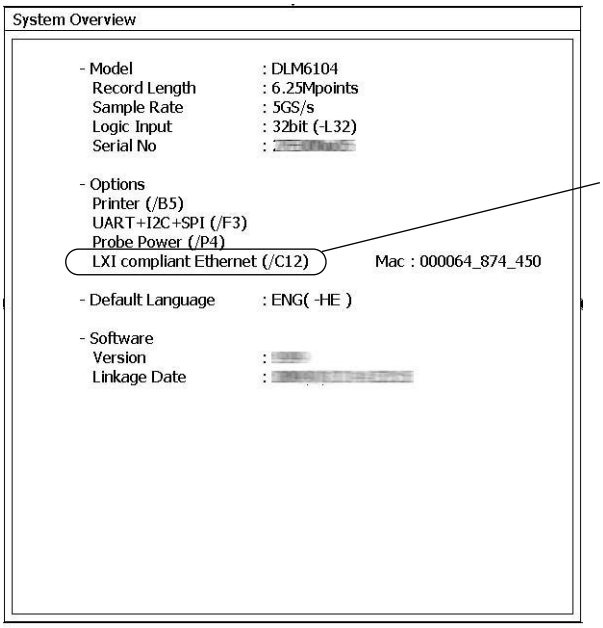
HP inkjet printers
HP laser printers (monochrome)

14.9 Checking Whether or Not the DL6000/DLM6000 Has an Ethernet Interface

Procedure

UTILITY Overview Menu

Press **UTILITY** and then the **Overview** soft key to display the following menu.



Equipped with an Ethernet interface

Explanation

Checking for an Ethernet Interface

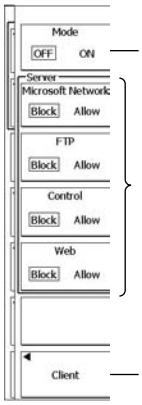
If the DL6000/DLM6000 has an Ethernet interface, the indication “LXI compliant Ethernet (/C12)” or “Storage+LXI compliant Ethernet (/C9)” will appear in the system overview.

14.10 Configuring the Firewall

Procedure

UTILITY Network Menu

Press **UTILITY**, the **Network** soft key, and then the **Firewall Setup** soft key to display the following menu.



Turns the firewall on and off

Choose to allow or block each server feature (Microsoft Network, FTP, Control, and Web).

Choose to allow or block each client feature (E-mail, Net Drive/Print, and Net Time Adjust).

Explanation

You can block network access to and from the DL6000/DLM6000.

Turning the Firewall On and Off

ON: The firewall blocks access to and from the features that correspond to the menu items that are set to Block. It also blocks pinging and ICMP messages.

OFF: All access is allowed, regardless of the menu items that are set to Block. The following ports are used.

Used Ports

Port	Service	Service Type (Client/Server)
21/tcp	File Transfer [Control]	Client and server
25/tcp	Simple Mail Transfer	Client
53/udp	Domain Name Server	Client
67/udp	Bootstrap Protocol Server	Client
80/tcp	World Wide Web HTTP Server	Server
110/tcp	Post Office Protocol Version3	Client
111/tcp	VXI-11 RPC	Server
111/udp	VXI-11 RPC	Server
123/udp	Network Time Protocol	Client
137/udp	NETBIOS Name Service	Client and server
138/udp	NETBIOS Datagram Service	Client and server
139/tcp	NETBIOS Session Service	Client
445/tcp	Microsoft-DS	Server
10001/tcp	Control Server	Server
10240/tcp	VXI-11 Core Port	Server
10250/tcp	VXI-11 Abort Port	Server

Item Permissions (Allow/Block)

You can choose whether or not to apply the firewall to each of the Ethernet features that the DL6000/DLM6000 uses.

- Microsoft Network
  You can choose to allow or block Microsoft network client access to the DL6000/DLM6000.
- FTP
  You can choose to allow or block FTP client access to the DL6000/DLM6000.
- Control (When Device is set to Network or VXI-11)
  You can choose to allow or block remote control client access to the DL6000/DLM6000.
- Web
  You can choose to allow or block Web client access to the DL6000/DLM6000.
- Net Drive/Print
  You can choose to allow or block access by the DL6000/DLM6000 network drive to a Microsoft network server.
- Net Time Adjust
  You can choose to allow or block access by the DL6000/DLM6000 to an NTP or SNTP server.
- E-Mail
  You can choose to allow or block access by the DL6000/DLM6000 to an SMTP or POP server.

Note

Limitation to the FTP "Allow" Option

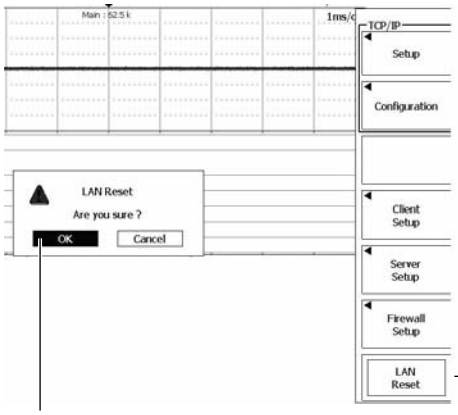
Clients cannot connect to the DL6000/DLM6000 using passive mode FTP.

14.11 Initializing All Ethernet Interface Settings

Procedure

UTILITY Network Menu

Press **UTILITY** and then the **Network** soft key to display the following menu.



1. Initialize the network settings.

2. Select OK, and then press SET to execute initialization.

Explanation

Default Values

Setting				Default Value
TCP/IP-Setup				
	Mode			Auto
	Name Resolution			
		NetBIOS Name		tmmachine
		WINS1		0.0.0.0
		WINS2		0.0.0.0
		DNS1		0.0.0.0
		DNS2		0.0.0.0
Client Setup				
	E-Mail Setup			
		Mail Server		blank
		Address		blank
		Comment		blank
		Attached Image		OFF
		POP3 before SMTP		
			Mode	OFF
		Time Out		15s
	Net Drive Setup			
		File Server		blank
		Share Folder		blank
		User Name		blank
		Password		blank
	Net Print Setup			
		Print Server		blank
		Share Name		blank
		User Name		blank
		Password		blank
	Net Time Adjust Setup			
		Time Server		blank
		Power On Exec		OFF
		Time Out		15s
Server Setup				
	Type			Microsoft Network
	Microsoft Network			
		Mode		ON
		User Name		blank
		Password		blank
	FTP			
		Mode		ON
		User Name		blank
		Password		blank
		Allow Anonymous		OFF
	Web			
		Mode		OFF
		User Name		blank
		Password		blank
Firewall Setup				
	Mode			OFF
	Microsoft Network			Block
	FTP			Block
	Control			Block
	Web			Block

15.1 External Trigger Input (TRIG IN)

CAUTION

Only apply signals that meet the following specifications. Signals that do not meet the specifications, such as those with excessive voltage, may damage the DL6000/DLM6000.

External Trigger Input Terminal

This terminal is used when an external signal is used as the trigger source (see section 6.3 for details).

Item	Specifications
Connector type	BNC
Maximum input voltage	±40 V (DC + ACpeak) or 28 Vrms when the frequency is 10 kHz or less
Input frequency bandwidth	DC to 100 MHz
Input impedance	Approx. 1 MΩ, approx. 18 pF
Trigger sensitivity	0.1 VP-P
Trigger level	± 2 V (resolution: 5 mV)

15.2 Trigger Output (TRIG OUT)

CAUTION

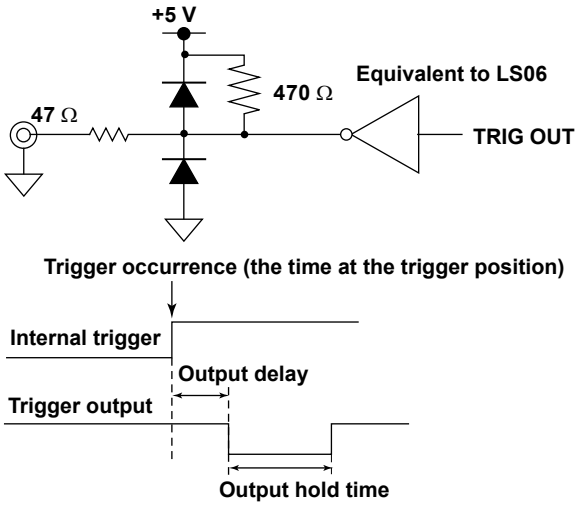
Do not apply external voltage to the TRIG OUT terminal. Doing so may damage the DL6000/DLM6000.

External Trigger Output Terminal

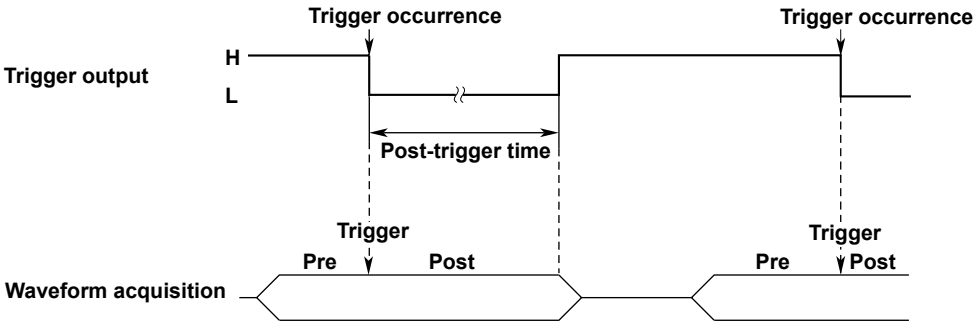
When a trigger occurs, the DL6000/DLM6000 produces a TTL level signal. The signal level is normally high. It becomes low when a trigger occurs.

Item	Specifications
Connector type	BNC
Output level	5 V TTL
Logic	Low when a trigger occurs and high after acquisition is completed
Output delay	50 ns or less
Output hold time	Low level: 50 ns minimum. High level: 50 ns minimum.

Trigger Output Circuit Diagram and Timing Chart



Low Level and High Level Hold Times



15.3 RGB Video Signal Output (RGB VIDEO OUT)

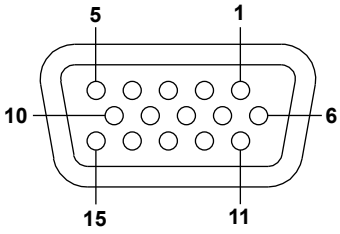
CAUTION

- Only connect the DL6000/DLM6000 to a monitor after turning both the DL6000/DLM6000 and the monitor off.
- Do not short the VIDEO OUT terminal or apply external voltage to it. Doing so may damage the DL6000/DLM6000.

Video Signal Output Terminal

You can connect an external monitor to the video signal output terminal and use it to view the DL6000/DLM6000 display. Any multisync monitor that supports XGA can be connected.

Item	Specifications
Connector type	D-Sub 15-pin
Output format	Analog RGB output
Output resolution	1024 × 768 dots, 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	—	

Connecting to a Monitor

1. Turn off the DL6000/DLM6000 and the monitor.
2. Use an RGB cable to connect the DLM2000 to the monitor.
3. Turn on the DL6000/DLM6000 and the monitor.

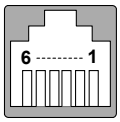
15.4 GO/NO-GO Signal Output

You can transmit the results of GO/NO-GO determination to an external device.

Output Terminal

The connector uses an RJ-12 modular jack. Connect the separately sold 366973 cable to the connector.

GO/NO-GO



Connector on the DL6000/DLM6000

Pin No.	Signal Name
1	NC (no connection)
2	NC (no connection)
3	GO OUT (negative logic)
4	NO-GO OUT (negative logic)
5	GND
6	NC (no connection)

Input level: TTL (0 to 5 V)

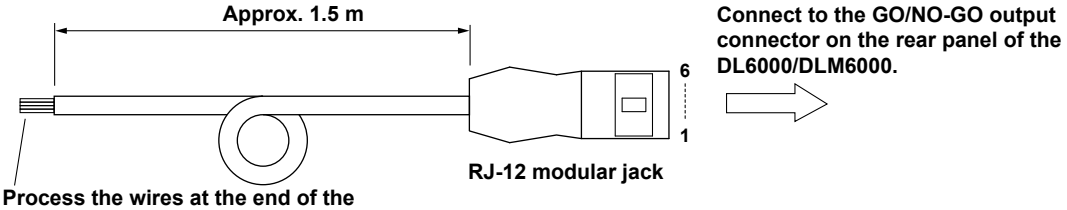
Connecting to Other Instruments

CAUTION

- Do not apply external voltage to the NO-GO OUT and GO OUT output pins. Doing so may damage the DL6000/DLM6000.
- When connecting the GO/NO-GO determination signal output to another device, do not connect the wrong signal pin. Doing so may damage the DL6000/DLM6000 or the connected device.
- Do not connect a USB cable to the GO/NO-GO output terminal. Doing so may damage the DL6000/DLM6000.

When connecting to an external device, use a cable designed for GO/NO-GO determination, such as optional accessory 366973.
Do not use this cable for any purpose other than transmitting GO/NO-GO determination signals from the DL6000/DLM6000.

Specifications of the GO/NO-GO Cable (Optional accessory 366973)



Wire color	Pin No.	Signal Name	Logic
White	3	GO OUT	Negative logic
Green	4	NO-GO OUT	Negative logic
Blue	5	GND	

GO/NO-GO Output Signal

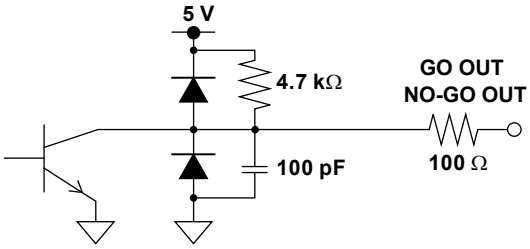
NO-GO OUT Signal

When the determination result is NO-GO, the output signal level (the TTL level) temporarily changes from high (H) to low (L).

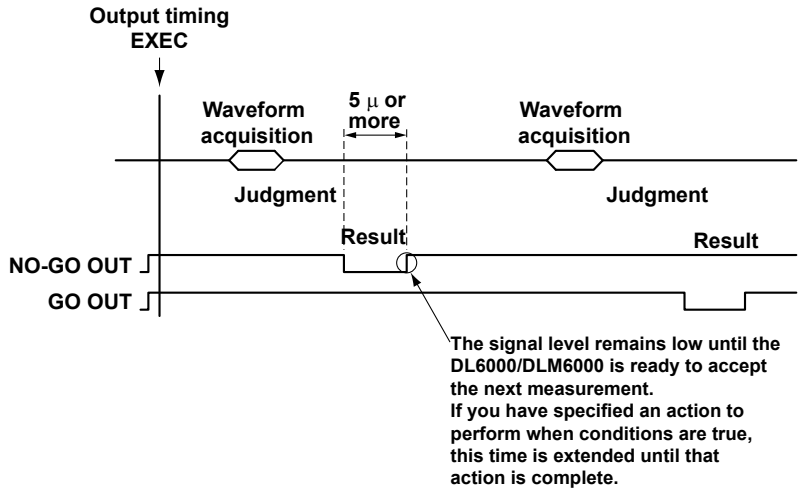
GO OUT Signal

When the determination result is GO, the output signal level (the TTL level) temporarily changes from high (H) to low (L).

Signal Output Circuit Diagram



GO/NO-GO Output Timing

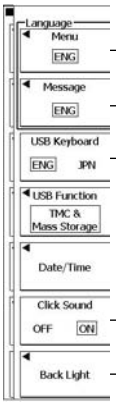


16.1 Changing the Message Language, Menu Language, and USB Keyboard Language, and Turning the Click Sound On and Off

Procedure

UTILITY System Configuration Menu

Press **UTILITY**, and then the **System Configuration** soft key to display the following menu.



Set the menu language.

Set the message language.

Set the USB keyboard language (ENG, JPN).

Turns the click sound on and off

► section 16.4

Explanation

Menu Language (Menu)

You can select the menu language from the following options.
English, Japanese, Chinese, Korean, Italian, French, German, and Spanish

Message Language (Message)

Messages appear when errors occur or when you press HELP. You can select the message language from the following options.
English, Japanese, Chinese, and Korean
For details about messages, see section 17.2.

Click Sound (Click Sound)

You can choose whether or not to make a click sound when you turn the jog shuttle. The default setting is ON.

USB Keyboard Language (USB Keyboard)

Sets the USB keyboard language to English (ENG) or Japanese (JPN). The USB keyboard can be used to enter file names, comments, etc.
You can use the following keyboards conforming to USB Human Interface Devices (HID) Class Ver. 1.1.

- When the USB keyboard language is English: 104 keyboard
- When the USB keyboard language is Japanese: 109 keyboard

For details on how the DL6000/DLM6000 keys are mapped to the keys on a 104 keyboard, see appendix 3.

16.2 Viewing Setup Information

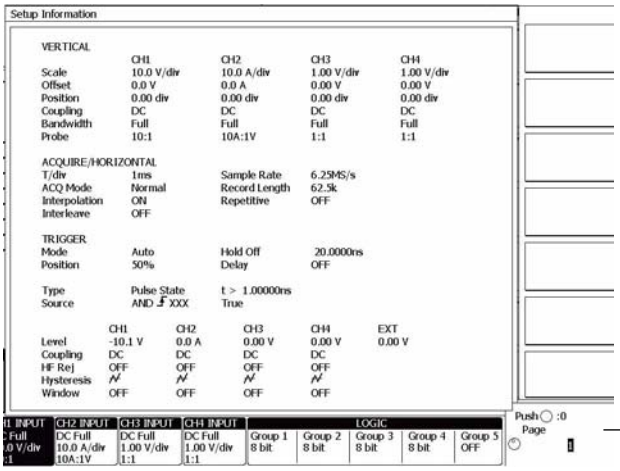
Procedure

UTILITY Setup Information Menu

Press **UTILITY** and then the **Next** soft key to display the following menu.

Displays setup information

Setup Information Display Example



Set which page to show on the screen.

Explanation

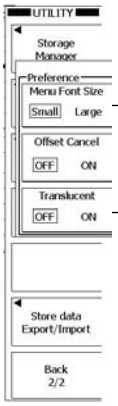
You can view a list of setup information. The list contains multiple pages. You can select and view one page at a time.

16.3 Enabling Translucent Display and Changing the Font Size

Procedure

UTILITY Preference Menu

Press **UTILITY**, the **Next** soft key, and then the **Preference** soft key to display the following menu.



Set the font size (Small, Large).

Turns translucent display on and off

Explanation

Font Size

You can set the size of the alphanumeric characters in menus to Small or Large. You can change the size of alphanumeric characters even when the display language is set to a language other than English.

Translucent Display

When you enable translucent display, the dialog boxes that appear when you configure settings are translucent so that you can see what is displayed below them.

16.4 Adjusting the Backlight

Procedure

UTILITY System Configuration Menu

Press **UTILITY**, **System Configuration**, and then the **Back Light** soft key to display the following menu.

Enables or disables Auto OFF

Turns off the backlight

Set the backlight brightness.

Explanation

Backlight Auto OFF

The backlight turns off automatically when there are no key operations for the specified time period. The backlight turns back on when you press a key.

Backlight Brightness

You can change the backlight brightness. You can set the brightness to a value between 1 (dark) and 8 (bright). You can prolong the backlight service life by decreasing the backlight brightness and turning off the backlight when you do not need to view the screen.

LCD OFF

You can turn off the backlight. When the backlight is off, you can turn the backlight back on by pressing a key.

17.1 If a Problem Occurs

Dealing with Unusual Circumstances

- If a message appears on the screen, see the following pages for reference.
- If servicing is necessary or the instrument does not operate properly even after you have attempted to deal with the problem according to the instructions in this section, contact your nearest YOKOGAWA dealer.

Description	Probable Cause	Solution	Reference Section
The instrument does not power 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.	16.4
	The screen is displayed with inappropriate colors.	Turn the power off, and then turn the power on again while holding down RESET.	4.4
The display is odd.	The system is not operating properly.	Turn off the instrument, and then turn it back on.	3.3
Keys do not work.	The keys are malfunctioning.	Perform a key test. If the test fails, servicing is required.	17.3
Triggering does not work.	The trigger settings are not appropriate.	Set the trigger conditions correctly.	Chapter 6
The measured values are not correct.	Insufficient warm-up.	Warm up the instrument for 30 minutes after turning on the power.	—
	The instrument has not been calibrated.	Calibrate the instrument.	4.7
	The probe's phase has not been corrected.	Perform phase correction properly.	3.5
	The probe attenuation is not correct.	Set an appropriate value.	5.1
	Offset voltage is applied.	Set the offset voltage to 0 V.	5.1
	Other causes.	Calibrate the instrument. If the measured values are still not correct, servicing is required.	4.7
Cannot print to the built-in printer.	The printer head is damaged or worn out.	Servicing is required.	—
Cannot save to the specified storage medium.	The storage medium is not formatted.	Format the storage medium.	17.6
	No more free space on the storage medium.	Delete unneeded files or use another storage medium.	—
Unable to configure or control the instrument through the communication interface.	The instrument address used by the program is different from the specified address.	Match the address used in the program to the instrument's address.	*Communication Interface User's Manual IM DLM6054-17EN*
	The interface is not used in a way that conforms to the electrical or mechanical specifications.	Use the interface in a way that conforms to the specifications.	

17.2 Messages and Corrective Actions

Messages

Messages may appear on the screen during operation. This section explains the meanings of the error messages and how to respond to them. You can display the error messages in English or Japanese (see section 16.1 for details). If servicing is necessary to solve the problem indicated by a message, contact your nearest YOKOGAWA dealer.

In addition to the following error messages, there are also communication error messages. These messages are explained in the *Communication Interface User's Manual (IM DLM6054-17EN)*.

Information

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.	6.14
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
62	The corresponding field was not found.	—
63	Action-on-trigger is completed.	16.4
64	The instrument is set to remote mode by the communication control. Press the CLEAR key tochange to local mode.	—
65	Local lockout is set by the communication control. To operate using the keys, release the lockout using the communication control.	—
66	Firmware will be updated. Do you want to proceed? Note: It will take approx. 5 minutes. Please DO NOT power off the unit until the completion. Once the procedure is completed, the unit will reboot itself. We recommend you to save the setups before updating the firmware.	—
67	Updating Firmware. Note: Please DO NOT power off the unit. Once the procedure is completed, the unit will reboot itself.	
68	Firmware is updated. Will be rebooted.	—
69	Any serial bus signal can not be detected.	Separate manual*
70	Serial bus automatic setting was aborted.	Separate manual*
71	The symbol/physical value file(.sbl) has not been loaded.	13.9
72	A contradiction in bit numbers of logic setting and symbol definition was detected. Check the symbol/ physical value file(.sbl).	—
73	Check the input voltage level and attenuation ratio.	5.1
74	Screen will be cleared. Press CLEAR again to proceed. Press ESC to abort.	8.3

* IM DLM6054-51EN

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

Code	Message and Corrective Action	Section
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 14
509	Access denied.	Chapter 13
510	File system error. Service is required.	—
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	Ilegal 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 the file. Another process may be using the file. Please wait and try again. If the process still fails, servicing is required.	—
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 connections.	Chapter 15
534	The file does not exist. Check the network setting and connections.	Chapter 15
535	Access was blocked. Check the network setting and connections.	Chapter 15
539	Unable to load a logic waveform to the reference waveform.	14.2

Code	Message and Corrective Action	Section
540	Unable to load a file containing logic waveforms.	13.5
541	Unable to load that file. Its extention is invalid.	13.5

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 iii
557	Image creation failure. Working memory space may be insufficient. Maintenance service is required.	—

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.	4.7
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.	10.10
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
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 the RUN/STOP key or wait until the process is completed.	Chapter 6

Code	Message and Corrective Action	Section
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.	—
669	Sending E-Mail. Wait until it is completed.	—
670	The corresponding field was not found.	—
674	Cannnot store because the data is locked. Release the lock through Store Detail.	4.6
675	Serial bus automatic setting is in progress. Please wait.	Separate manual*

* IM DLM6054-51EN

Setting Errors

Code	Message and Corrective Action	Section
800	Improper Date/Time setting.	3.7
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 Mask test mode. Turn off the Mask test mode.	10.8
806	Invalid bit assignment in the logic group.	5.2
807	Unable to enable the trigger conditions. Set the clock source to another group or assign bits to the group.	5.2, 6.6, 6.9

System Errors

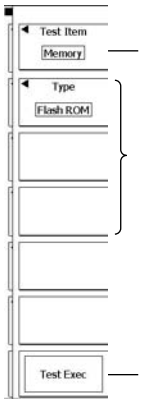
Code	Message and Corrective Action	Section
900	Failed to backup setup data. Initializing will be executed. Backup battery may be low. Maintenance service is required to replace the back-up battery.	17.7
901	Fan stopped. Power off immediately. Maintenance service is required.	17.7
902	Backup battery is low. Maintenance service is required to replace the back-up battery.	17.7
903	Calibration failure. Disconnect the input and execute again. If it fails again, service is necessary.	—
904	Invalid Command.	—

17.3 Carrying Out Self-Tests (Self Test)

Procedure

UTILITY Self Test Menu

Press **UTILITY** and then the **Self Test** soft key to display the following menu.



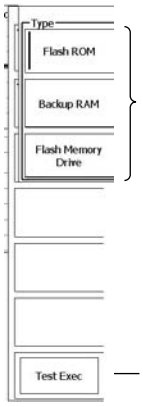
Set the test to perform (Memory, Printer, PC Card, Key Board, Accuracy).

The settings vary depending on the test that you select.

Performs a self test

Executing a Memory Test

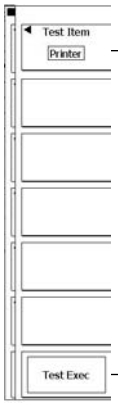
Press the **Test Item** soft key, the **Memory** soft key, and then the **Type** soft key to display the following menu.



Select a medium that you want to test.

Executes a memory test

Executing a Printer, PC Card, or Accuracy Test



Set the test to perform (Printer, PC Card, Accuracy).

Performs the test that you selected

Executing a Key or Soft Key Test

Set the test to Key Board.

Executes a soft key test

Executes a panel key test

Note

The Accuracy test item is for servicing.

Explanation

Memory Test (Memory)

A test to determine whether or not the internal CPU board RAM and ROM are operating properly. If they are operating properly, “Success” appears.
If an error occurs, “Fail” appears.

Printer Test (Printer)

A test to determine whether or not the optional built-in printer is operating properly. The built-in printer is operating properly if the print density is correct. The built-in printer does not print properly if there is an error.

PC Card Test (PC Card)

A test to determine whether or not the PC card slot is operating properly. If an error occurs, “Fail” appears.

Key Test (Key Board)

A test to determine whether or not the front-panel keys are operating properly. If the name of the key that you press is highlighted, the key is operating properly.

Soft Key Test (Key Board)

A test to determine whether or not the soft keyboard input is correct. The soft keyboard is operating properly if you can enter the specified characters.

Accuracy Test (Accuracy)

The results of the system’s automatic calibration appear. If an error occurs, “Fail” appears.

If an Error Occurs during a Self-Test

If an error occurs even after you carry out the following procedure, contact your nearest YOKOGAWA dealer.

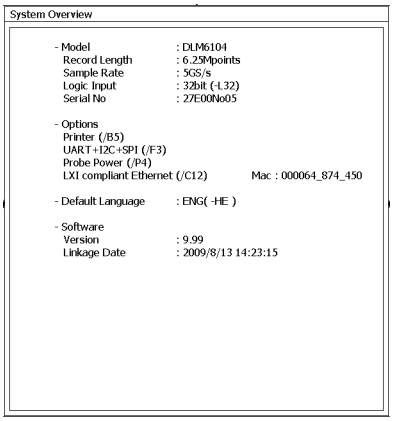
- Execute the self-test again several times.
- Check whether or not the media being tested is properly inserted.
- Check that the paper is set properly in the built-in printer and that paper is not jammed (see section 12.1 for details).

17.4 Viewing System Information (Overview)

Procedure

UTILITY Overview Menu

Press **UTILITY** and then the **Overview** soft key to display the following screen.



Explanation

You can view the following information in the screen that appears when you follow the procedure.

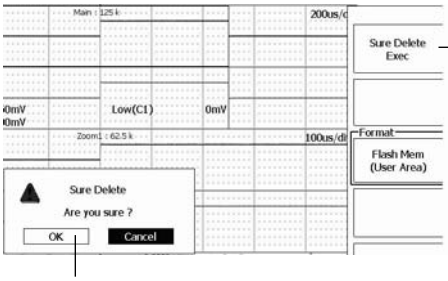
Model	Model
Record Length	Record length
Logic Input	Number of bits in the DLM6000 logic input
Sample Rate	Maximum sample rate
Serial No.	Serial number
Option	Optional features installed in the DL6000/DLM6000
Default Language	Default language
Software Version	Firmware version number
Linkage Date	Firmware version date

17.5 Deleting All Data in the Internal and Flash Memory

Procedure

UTILITY Storage Manager Menu

Press **UTILITY**, the **Next** soft key, and then the **Storage Manager** soft key to display the following menu.



1. Deletes all data
(A confirmation dialog box appears.)

2. Select OK, and then press SET to delete all data.

Explanation

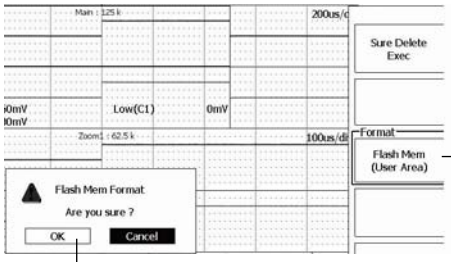
You can use this feature to delete all the data in the internal and flash (User Area) memory. Save the data that you want to keep to a PC or other device.

17.6 Formatting Flash Memory

Procedure

UTILITY Storage Manager Menu

Press **UTILITY**, the **Next** soft key, and then the **Storage Manager** soft key to display the following menu.



1. **Formats the flash memory**
   (A confirmation dialog box appears.)
2. **Select OK, and then press SET to begin formatting.**

Explanation

You can format flash memory. Save the data that you want to keep to a PC or other device.

17.7 Recommended Replacement Parts

YOKOGAWA guarantees the DL6000/DLM6000 for the period and under the conditions of the product warranty.
Under the conditions of the three-year warranty, the following parts are excluded. For part replacement, contact your nearest YOKOGAWA dealer.

Part Name	Operating Life
Built-in printer	Under normal conditions of use, the period it takes to use 120 rolls of printer paper (part number: B9850NX)
LCD backlight	Under normal conditions of use, approximately 25,000 hours

The following are consumable parts. We recommend replacing them at the intervals listed below. For part replacement, contact your nearest YOKOGAWA dealer.

Part Name	Recommended Replacement Interval
Cooling fan	3 years
Backup battery (lithium battery)	5 years

18.1 Signal Input Section

Analog Signal Input

Item	Specifications			
Number of input channels	4(CH1 to CH4)			
Input coupling settings	AC1 MΩ, DC1 MΩ, DC50 Ω, and GND			
Input connector	BNC connector			
Input impedance	1 MΩ±1.0%, approx. 20 pF 50 Ω±1.5%			
Selectable voltage sensitivity range	1 MΩ input: 50 Ω input:	2 mV/div to 5 V/div(in 1-2-5 steps) 2 mV/div to 500 V/div(in 1-2-5 steps)		
Maximum input voltage	1 MΩ input: 50 Ω input:	150 Vrms CAT I (At 100 kHz and higher) 5 Vrms or less and 10 Vpeak or less		
Selectable maximum DC offset range (When the probe attenuation is set to 1:1)	1 MΩ input: 2 mV/div to 50 mV/div: 100 mV/div to 500 mV/div: 1V/div to 5V/div: 50 Ω input: 2 mV/div to 50 mV/div: 100 mV/div to 500 mV/div:	 ±1 V ±10 V ±100 V ±1 V ±5 V		
Vertical-axis (voltage-axis) accuracy DC accuracy[1] Offset voltage accuracy[1]	 2 mV/div to 50 mV/div: 100 mV/div to 500 mV/div: 1 V/div to 5 V/div:	 ±(1.5% of 8 divisions + offset voltage accuracy) ±(1% of set value + 0.2 mV) ±(1% of set value + 2 mV) ±(1% of set value + 20 mV)		
Voltage standing wave ratio (VSWR)	Less than 1.5 within the frequency band (typical value)[4]			
Frequency Bandwidth (≥ 3dB)[1, 2] (When sine wave with amplitude ±3 div_{P-P} equivalent is input)	1 MΩ input (measured from the probe tip when using the supplied 10:1 probe (10:1 conversion))	DL6054/DLM6054	DL6104/DLM6104	DL6154
	50V/div to 100mV/div:	DC to 500MHz	DC to 500MHz	DC to 500MHz
	50mV/div to 20mV/div:	DC to 400MHz	DC to 400MHz	DC to 400MHz
	50 Ω input			
	500mV/div to 10mV/div:	DC to 500MHz	DC to 1.0GHz	DC to 1.5GHz
	5mV/div:	DC to 400MHz	DC to 750MHz	DC to 1.0GHz
	2mV/div:	DC to 400MHz	DC to 600MHz	DC to 750MHz
–3 dB point for AC coupling	10 Hz or less (1 Hz or less when using the supplied 10:1 probe)			
Skew between channels (when channels are set to the same conditions)	1 ns or less			
Residual noise level[3]	0.4 mVrms or 0.05 divisions rms, whichever is greater (typical value[4])			
Isolation between channels (when set to the same voltage sensitivity)		DL6054/DLM6054	DL6104/DLM6104	DL6154
	Maximum bandwidth:	–34 dB (typical value[4])	–30 dB (typical value[4])	–30 dB (typical value[4])
A/D converter resolution	8 bit(25 LSB/div) 12 bits maximum (during high-resolution mode)			
Probe attenuation settings	Voltage probe: Current probe:	Auto, 1:1, 2:1, 5:1, 10:1, 20:1, 50:1, 100:1, 200:1, 500:1, 1000:1 Auto, 1A:1V, 10A:1V, 100A:1V		
Bandwidth limit	For each channel, can be set to FULL, 200 MHz, 20 MHz, 8 MHz, 4 MHz, 2 MHz, 1 MHz, 500 kHz, 250 kHz, 125k Hz, 62.5 kHz, 32 kHz, 16 kHz, or 8 kHz Accomplished through the combination of an analog (200 and 20 MHz) and digital (IIR + FIR) filter.			
Maximum sample rate	Real-time sampling mode. Values inside parentheses are for high resolution mode.	DL6054/DLM6054	DL6104/DLM6104	DL6154
	When interleave mode is on:	5 GS/s(2.5GS/s)	5 GS/s(2.5GS/s)	10 GS/s(5GS/s)
	When interleave mode is off:	2.5 GS/s(1.25GS/s)	2.5 GS/s(1.25GS/s)	5 GS/s(2.5GS/s)
	Repetitive sampling mode:	2.5 TS/s	2.5 TS/s	2.5 TS/s
	Interpolation sampling mode:	2.5 TS/s	2.5 TS/s	2.5 TS/s

Item	Specifications	
Maximum record length	6.25 M Points	Stays the same whether interleave mode is on or off
Maximum acquisition rate	1.25M Points	60 waveform/s/channel
	12.5k Pokints	9000 waveform/s/channel
	2.5k Points	25000 waveform/s/channel
Dead time in N Single mode[5]	400 ns or less (equivalent to 2.5 million waveforms per second)	

1 Values measured under standard operating conditions (see section 18.11 for details) after a 30-minute warm-up and calibration.
2 Values for repeating phenomena.
The single-shot frequency bandwidth is from DC to the sampling frequency/2.5 or is the frequency bandwidth of the repeating phenomena, whichever is less.
3 Values when the input section is shorted, the acquisition mode is set to Normal, accumulation is set to off, and the probe attenuation is set to 1:1.
4 ypical values represent typical or average values. They are not strictly warranted.
5 The number of inputs does not affect the acquisition rate.

Logic Signal Input (DLM6000)

Item	Specifications			
Usable probes	701980, 701981, 701988, 701989 (8-bit input))			
Number of inputs	16 (on 16-bit models with 2 logic probe IFs using 2 logic probes) Pod A(0 to 7), Pod C(0 to 7) 32(on 32-bit models with 4 logic probe IFs using 4 logic probes) Pod A(0 to 7), Pod B(0 to 7), Pod C(0 to 7), Pod D(0 to 7)			
Nondestructive maximum input voltage	701980, 701981, 701989: ±40V(DC + ACpeak) or 28Vrms 701988: ±42V(DC + ACpeak) or 29Vrms For information about derating based on frequency, see the respective logic probe user's manual.			
	When using the 701980	When using the 701981	When using the 701988	When using the 701989
Input range	±40V	±10V	±40V	Threshold level ±6V
Minimum input voltage	500mV$_{P-P}$	500mV$_{P-P}$	500mV$_{P-P}$	300mV$_{P-P}$
Maximum toggle frequency[1]	100MHz	250MHz	100MHz	250MHz
Input impedance (typical value[3])	1MΩ/10pF	10kΩ/9pF	1MΩ/10pF	100kΩ/3pF
Threshold level setting	Same value for all 8 bits	Same value for all 8 bits	Same value for all 8 bits	Same value for all 8 bits
Variable threshold level range	±40V	±10V	±40V	±6V
Threshold level resolution	0.1V	0.1V	0.05V	0.05V
Threshold level accuracy[1]	±(0.1 V + 3% of setting)	±(0.1 V + 3% of setting)	±(0.1 V + 3% of setting)	±(0.1 V + 3% of setting)
Hysteresis voltage (typical value[3])	80mV	50mV	100mV	HFrejection OFF: 100mV ON: 250mV
Minimum pulse width	5ns	2ns	5ns	2ns
Logic channel threshold level preset	You can choose from the following preset threshold level settings. COMS(5V)=2.50V, CMOS(3.3V)=1.66V, CMOS(2.5V)=1.25V, CMOS(1.8V)=0.90V, ECL=-1.30V			
Maximum sample rate	Real-time sampling mode. Values inside parentheses are for high resolution mode[2] When interleave mode is on: 5GS/s(2.5GS/s) When interleave mode is off: 2.5GS/s(1.25GS/s) Repetitive sampling mode: 2.5TS/s→2.5GS/s(1.25GS/s)+, through pulse interpolation Interpolation sampling mode: 2.5TS/s→2.5GS/s(1.25GS/s)+, through pulse interpolation			
Maximum record length[4]	6.25M Points (stays the same whether interleave mode is on or off)			
Maximum acquisition rate[4]	1.25M Points	60 waveforms per second per channel		
	12.5K Points	9,000 waveforms per second per channel		
	2.5K Points	25,000 waveforms per second per channel		
Dead time in N Single mode[4]	400 ns or less (equivalent to 2.5 million waveforms per second)			

1 Under standard operating conditions (see section 18.11 for details) after a 30-minute warm-up.
2 Resolution only improves for analog waveforms.
3 Typical values represent typical or average values. They are not strictly warranted.
4 The number of inputs does not affect the acquisition rate.

18.2 Triggering Section

Item	Specifications				
Trigger modes	Auto, Auto Level, Normal, Single, N Single The DL6000/DLM6000 measures in Single mode when you start acquisition by pressing the SINGLE key.				
Trigger sources	CH1 to CH4:		Signals received through input terminals		
	LINE:		The connected commercial power supply signal (only Edge trigger can be used)		
	EXT:		The signal received through the TRIG IN terminal		
	PodA to PodD[3](Logic):		Signals received through the logic signal input port terminals		
Trigger coupling	CH1 to CH4:		DC/AC		
	EXT:		DC		
HF rejection	Trigger source bandwidth limit can be specified separately for CH1 to CH4				
	OFF:		No bandwidth limit		
	15kHz:		DC to approximately 15 kHz		
	20MHz:		DC to approximately 20 MHz		
Trigger hysteresis	Trigger level hysteresis can be selected for CH1 to CH4 separately. Trigger level hysteresis cannot be specified on channels set to TV trigger.				
	High:		Apply a hysteresis of approx. 1.0 division around the trigger level		
	Low:		Apply a hysteresis of approx. 0.3 division around the trigger level		
Selectable trigger level range	CH1 to CH4:		±4 divisions from the screen center		
	EXT:		±2 V(with a 1:1 probe), **±20 V(with a 10:1 probe)**		
	PodA to PodD[3](Logic):		Determined by the threshold levels		
Trigger level resolution	CH1 to CH4:		0.01 divisions (0.1 divisions for TV triggers)		
	EXT:		5 mV(with a 1:1 probe), **50 mV(with a 10:1 probe)**		
Trigger level accuracy	CH1 to CH4[1]:		±(0.2 divisions + 10% of the trigger level)		
	EXT[2]:		±(50 mV + 10% of the trigger level)		
Window comparator setting	Window comparator can be turned on or off for CH1 to CH41 separately				
	OFF:		Normal comparator Edge polarities: Rise and Fall. Qualifications: H, L, and X.		
	ON:		Window comparator Edge polarities: Enter and Exit. Qualifications: IN, OUT, and X.		
Selectable window trigger level range	Can be set separately for CH1 to CH4				
	Center:		±4 divisions from the screen center		
	Width:		±4 divisions around the center		
Window trigger level accuracy	The following trigger level accuracy applies to the upper and lower limits of the window that are specified using the Center and Width settings. The upper and lower limits are set separately for CH1 to CH4 ±(0.2 divisions + 10% of the trigger level) However, the accuracy does not apply to an upper or lower limit that falls outside ±4 divisions from the screen center.				
External trigger probe attenuation setting	1:**1, 10:1**				
Trigger sensitivity[1]			DL6054/DLM6054	DL6104/DLM6104	DL6154
	CH1 to CH4:	1div$_{P-P}$	DC to 500MHz[4]	DC to 1GHz[4]	DC to 1GHz[4]
	EXT:	100mV$_{P-P}$	DC to 100MHz	DC to 100MHz	DC to 100MHz
	Edge OR:	1div$_{P-P}$	DC to 50MHz	DC to 50MHz	DC to 50MHz
Trigger position	Can be set as a percentage of the display record length in 0.1% steps				
Selectable trigger delay range	-(Time length of the post-trigger section) to 10 s **Resolution:(1/sample rate)×100**				
Selectable hold-off time range	20 ns to 10 s , Resolution: **5ns**				

Item	Specifications		
Trigger type (A trigger)	Edge:	Triggers on the edge of a single trigger source	
		The source can be set to a signal from CH1 to CH4, PodA(0 to 7) to PodD (0 to 7)[3], EXT, or LINE	
	Edge OR:	Triggers when any of the edge trigger conditions of multiple trigger sources is met	
		The source can be set to a signal from CH1 to CH4 (Max.50 MHz)	
	Edge Qualified:	Triggers on the edge of a single trigger source while qualifications are met	
		The source can be set to a signal from CH1 to CH4, or EXT. Qualifications can be specified for CH1 to CH4.	
	Logic Edge Qualified:	An edge qualified trigger based on the logic signal	
		The sources for edge detection and the qualifications can be selected from PodA (0 to 7) to PodD (0 to 7)[3]	
	State:	Triggers when the state condition changes from met to not met or from not met to met	
		State conditions can be applied to all sources using AND or OR.	
		A clock channel can be specified that is used to determine the met or not met state condition. No clock can also be selected.	
		The source and state clock can be set to a signal from CH1 to CH4.	
	Logic State:	A state trigger based on the logic signal	
		The source and state clock can be set to a signal from PodA(0 to 7) to PodD (0 to 7)[3]	
	Pulse Width:	Triggers on the width of a single trigger source	
		The source can be set to a signal from CH1 to CH4, or EXT.	
		More than:	Triggers when the time length during which the condition is met is longer than Time1, and the condition changes to not met
		Less than:	Triggers when the time length during which the condition is met is shorter than Time1, and the condition changes to not met
		Between:	Triggers when the time length during which the condition is met is longer than Time1 but shorter than Time2 and the condition changes to not met
		Out of Range:	Triggers when the time length during which the condition is met is shorter than Time1 or longer than Time2 and the condition changes to not met
		Time Out:	Triggers when the time length during which the condition is met exceeds Time1
		Time:	Time1 and Time2: 1.5 ns to 10 s in 0.5 ns steps. Minimum spacing between Time1 and Time2: 2ns
		Time accuracy[2]	±(0.2% of setting + 1 ns)
		Minimum time detection width:	2ns(Typical value[5])
	Logic Pulse Width:	A pulse width trigger based on the logic signal	
		The source and state clock can be selected from PodA (0 to 7) to PodD (0 to 7)[3]	
	Pulse Qualified:	Triggers on the pulse width of a single trigger source while qualifications are met	
		The source can be set to EXT or a signal from CH1 to CH4. Qualifications can be specified for CH1 to CH4.	
		For details on the time settings, see “Pulse Width.”	
	Pulse State:	Triggers on the time-duration for which the state condition is met or not met	
		For a description of the state conditions, see “State Pattern.”	
		The sources and state clock can be selected from CH1 to CH4.	
		For details on the time settings, see “Pulse Width.”	
	Logic Pulse State:	A pulse state trigger based on the logic signal	
		The sources and state clock can be selected from PodA (0 to 7) to PodD (0 to 7).[3]	

Item	Specifications		
	Event Cycle:	Triggers when the interval between two events meets the specified time conditions	
		More than:	Triggers at the end of an interval that is longer than Time1
		Less than:	Triggers at the end of an interval that is shorter than Time1
		Between:	Triggers at the end of an interval that is longer than Time1 and shorter than Time2
		Out of Range:	Triggers at the end of an interval that is shorter than Time1 or longer than Time2
		Time Out:	Triggers when Time1 is exceeded
		Time:	Time1 and Time2: 1.5 ns to 10 s in 0.5 ns steps The minimum spacing between Time1 and Time2: 2 ns
		Event:	Edge/Edge Qualified/Logic Edge Qualified /State/Logic State/ Pulse Width/Logic Pulse Width/Pulse Qualified/Pulse_State/ Logic Pulse State/CAN[6]/LIN[6]/I2C[6]/SPI[6]/Serial pattern (TV, Edge OR, and UART[4] cannot be chosen as events.)
	Event Delay:	Triggers when the interval between event 1 and event 2 meets the specified time conditions	
		More than:	Triggers on the occurrence of event 2 when the time between the occurrence of event 1 and the occurrence of event 2 is longer than Time1
		Less than:	Triggers on the occurrence of event 2 when the time between the occurrence of event 1 and the occurrence of event 2 is shorter than Time1
		Between:	Triggers on the occurrence of event 2 when the time between the occurrence of event 1 and the occurrence of event 2 is longer than Time1 and shorter than Time2
		Out of Range:	Triggers on the occurrence of event 2 when the time between the occurrence of event 1 and the occurrence of event 2 is shorter than Time1 or longer than Time2
		Time Out:	Triggers when the time between the occurrence of event 1 and the occurrence of event 2 exceeds Time1
		Time:	Time1 and Time2: 1.5 ns to 10 s in 0.5 ns steps The minimum spacing between Time1 and Time2: 2 ns
		For details on Event, see Event Cycle.	
	Event Sequence:	Activate a trigger when the first event 2 occurs within the specified time range after the event 1 occurrence	
		For details on time settings, see Event Delay	
		For details on Event, see Event Cycle	
	CAN[6]:	Triggers on a CAN (Controller Area Network) bus signal The source can be set to a signal from CH1 to CH4.	
		Mode:	SOF, Error Frame, ID Std/Data, ID Ext/Data, ID/Data OR, Msg/Signal
		BitRate:	1M, 500k, 250k, 125k, 83.3k, 33.3kbps, User Define (For User Define, you can set a value from 1 M to 100 kbps in 0.1kbps steps)
	LIN[6]:	Triggers on a LIN (Local Interconnect Network) bus signal The source can be set to a signal from CH1 to CH4, or from logic bits PodA(0 to 7), PodD(0 to 7)[3]	
		Mode:	Break
		BitRate:	1200, 2400, 4800, 9600, 19200bps, User Define (For User Define, you can set a value from 1 k to 20 kbps in 0.01kbps steps)
	UART[6]:	Triggers on a UART (RS232) signal The source can be set to a signal from CH1 to CH4 or from logic bits PodA(0 to 7), PodD(0 to 7)[3]	
		Mode:	Every Data
		Format:	8-bit data (no parity bit), 7-bit data + parity bit, 8-bit data + parity bit
		BitRate:	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200bps, User Define (For User Define, you can set a value from 1 k to 200 kbps in 0.1kbps steps)

18.2 Triggering Section

Item	Specifications			
	I2C[6]:	Triggers on an I²C bus signal. The source can be set to a signal from CH1 to CH4 or from logic bits PodA(0 to 7), PodD(0 to 7)[3]		
		Mode:	Every Start, Adr Data, NON ACK, General Call, Start byte/HS Mode	
	SPI[6]:	Triggers on an SPI (Serial Peripheral Interface) bus signal The source can be set to a signal from CH1 to CH4 or from logic bits PodA(0 to 7), PodD(0 to 7)[3]		
		Mode:	3wire, 4wire	
	Serial:	Triggers on a general-purpose serial communication signal The source can be selected from PodA (0 to 7) to PodD (0 to 7).[2] Data channel, chip select channel, clock channel, and latch channel can be specified.		
		Bitrate:	1 k to 50 Mbps (without clock)	
		Bit length:	1 to 128bits	
	TV	Triggers on the specified field number, line number, or polarity in video signals of various broadcasting formats. The source can be set to a channel from CH1 to CH4.		
		Mode:	NTSC:	Triggers on an NTSC (525/60/2) signa
			PAL:	Triggers on a PAL (625/50/2) signal
			SDTV:	SDTV(480/60p) signal
			HDTV:	Triggers on an SDTV (480/60p) signal 1080/60p, 1080/60i, 1080/50i, 1080/25p, 1080/24p, 1080/24sF, 720/60p, 1125/60/2
			User def TV:	You can trigger on any TV signal by selecting standard or high definition, setting the H sync period, and setting the sync guard. Sync guard can be set to a value from 60 to 90% of the H sync value in 1% steps.
		Porality:	Pos, Neg	
		HF Rej:	NTSC/PAL:	300 kHz
			SDTV/HDTV:	OFF
			User Def:	Select from OFF or 300 kHz
		Line:	5 to 1054(NTSC), 2 to 1251(PAL), 8 to 2251(SDTV), 2 to 2251(HDTV), 2 to 2251(User def TV)	
		Field:	1, 2, X	
		Frame Skip:	1, 2, 4, 8	
AB trigger	Able to trigger on the combination of triggers A and B Trigger B can only be set to an Edge trigger. (see Trigger Type (A trigger))			
	OFF:	Triggers only on the trigger A conditions (the trigger B conditions are not used).		
	A Delay B:	After the trigger A conditions are met and the specified amount of time elapses, the DL6000/DLM6000 triggers when the trigger B conditions are met.		
		Delay value:	10ns to 10s	
	A to B(N):	After the trigger A conditions are met, the DL6000/DLM6000 triggers when the trigger B conditions are met N times.		
		N value:	1 to 10^9	

1 Values measured under standard operating conditions (see section 18.11 for details) after a 30-minute warm-up and calibration.
2 Values measured under standard operating conditions (see section 18.11 for details) after a 30-minute warm-up.
3 16 bits model: PodA0 to 7, PodC0 to 7
32 bits model: PodA0 to 7, PodB0 to 7, PodC0 to 7, PodD0 to 7
4 When HF Rejection is set to OFF.
5 Typical values represent typical or average values. They are not strictly warranted.
6 CAN, LIN, I2C, SPI, and UART are options.

18.3 Time Axis

Item	Specifications
Selectable time scale range	500ps/division to 50 s/division (in 1-2-5 steps)
Timebase accuracy[1]	±0.001%
Time measurement accuracy[1]	±(0.001% 10ps + 1 sample period)

1 Values measured under standard operating conditions (see section 18.11 for details) after a 30-minute warm-up.

18.4 Display

Item	Specifications
Display	8.4-inch (21.3-cm) color TFT LCD
Display screen size	170.5 mm (horizontal) × 127.9 mm (vertical)
Resolution of the entire screen[1]	1024 × 768 (XGA)
Resolution of the waveform display	800 × 640

1 The LCD may include a few defective pixels (within 4 ppm over the total number of pixels including RGB).
The LCD may contain some pixels that are always lighted or that never light. Please be aware that these are not defects.

18.5 Features

Vertical and Horizontal Control

Item	Specifications
Channel on/off	Channel on/off CH1 to CH41 and LOGIC can be turned on and off separately. When interleave mode is on, all even-numbered channels (including LOGIC2) are automatically are turned off. With logic waveforms,[1] all 32 bits (16 bits on 16-bit models) can be displayed regardless of interleave mode.
Logic waveform bus display[1]	You can divide logic waveforms into five groups and view them in a bus display. The bus display shows the logic signal according to the specified format (Format) and bit order (Bit Order).
Logic waveform status display[1]	A clock bit can be used to display states at a specified edge (⤴ / ⤵ / ⤴⤵).
Vertical position setting	Analog waveforms: Waveforms can be moved in the range of ±4 divisions from the center of the waveform display frame. Logic waveforms[1]: The center of logic waveforms can be moved in the range of ±4 divisions from the center of the waveform display frame. Press the vertical position knob to reset the position to its default value (0 divisions).
Vertical scale settings	The vertical scale knob allows you to set the vertical scale. Press the knob to switch between coarse and fine. For the selectable range when using Coarse adjustment, see "Analog Input Section" in section 18.1, "Signal Input Section." Fine vertical sensitivity is achieved through digital zooming. If you change the scale while the DL6000/DLM600 is stopped, you can vertically expand or reduce waveforms. Logic waveforms[1] can be expanded to five different display-size levels.
Input filtering	Bandwidth limit can be specified for CH1 to CH4 separately. For the available filter types, see "Bandwidth limit" in section 18.1, "Signal Input Section."
Offset cancelling	Can be set to on or off for CH1 through CH4 OFF: Does not apply the specified offset to the result of cursor measurements, computations, and automated measurement of waveform parameters. ON: Applies the specified offset to the result of cursor measurements, computations, and automated measurement of waveform parameters.
Inverted display	Waveforms can be inverted around the vertical position for CH1 to CH41 separately. Configuration and measurement are executed on the waveforms before the inversion.
Linear scaling	Scaling coefficient, offset value, and unit can be specified for CH1 to CH4 separately.
Deskewing	The waveform display position can be adjusted for CH1 to CH4 separately. Trigger skew cannot be adjusted. Logic waveforms[1] can be adjusted at the pod (8-bit) level. Adjustment at the bit level is not possible. The adjustable range is ±80 ns in 0.01 ns steps.
Horizontal position setting	Horizontal position knob can be used to set the trigger position and trigger delay. What the knob controls is indicated by the DELAY key LED. LED off: Trigger position LED on: Trigger delay For trigger position and trigger delay specification details, see "Trigger position" or "Selectable trigger delay range" in section 18.2, "Triggering Section."
Time scale setting	The TIME/DIV knob can be used to set the time scale. For the selectable range, see "Selectable time scale range" in section 18.3, "Time Axis." If you change the time scale while the DL6000/DLM6000 is stopped, you can expand or reduce waveforms along the time axis.
Roll mode	The DL6000/DLM6000 switches to roll mode display when the trigger mode is set to Auto, Auto Level, or Single for the following time scale ranges. For details on the trigger modes, see "Trigger modes" in section 18.2, "Triggering Section." 100 ms/division to 50 s/division

1 Logic only available on the DLM6000.

Signal Acquisition and Screen Display

Item	Specifications
Acquisition modes	Serectable from Normal, Envelope, and Averaging. Normal: Normal sampling without special processing. Envelope: From the data sampled at the maximum real-time sample rate, the DL6000/DLM6000 acquires the maximum and minimum values for each memory acquisition interval. Average: Averages normally sampled data over multiple acquisitions. Exponential averaging is performed when the trigger mode is set to Auto, Auto Level, or Normal, and linear averaging is performed when the trigger mode is set to Single. The trigger mode is set to Normal for N Single. The attenuation constant for exponential averaging and the linear average count can be set to a value from 2 to 1024 in 2n steps. Averaging cannot be used on logic waveforms. For details on the trigger modes, see "Trigger modes" in section 18.2, "Triggering Section."
Sampling modes	You can select real-time, interpolation, or repetitive sampling mode. When you use a short time scale that would cause the sample rate to exceed the real-time sampling maximum sample rate with the specified record length kept constant, the DL6000/DLM6000 operates as follows: For the maximum sample rates, see "Maximum sample rate" in section 18.1, "Signal Input Section." RealTime: Achieves the desired time scale by reducing the display record length. Interpolation: Performs interpolation sampling. If you decrease the time scale further and the upper limit of the interpolation sampling rate is exceeded, the DL6000/DLM6000 reduces the display record length to achieve the desired time scale. Repetitive: Performs repetitive sampling. If you decrease the time scale further and the upper limit of the repetitive sampling rate is exceeded, the DL6000/DLM6000 reduces the display record length to achieve the desired time scale.
High resolution mode	Improves the analog waveform S/N ratio by combining the high resolution mode and the digital filter. Improves the vertical resolution up to 12 bits.
Interleave mode	Analog signal input: The DL6000/DLM6000 can double its maximum real-time sampling rate by sampling using two A/D converters (even-numbered channels are turned off). Logic signal input: (DLM6000) The DL6000/DLM6000 can double its maximum real-time sampling rate by sampling a single input signal with two logic signal converters.
Record lengths	2.5k Points/6.25k Points/12.5k Points/25k Points/62.5k Points/125k Points/250k Points/625k Points/1.25M Points/2.5M Points/6.25M Points
History feature	Automatically saves history waveforms (past waveforms that have been acquired using the same acquisition conditions). The maximum number of acquisitions that can be held is as follows: 2500 acquisitions (when the record length is set to 2.5 k points) 1600 acquisitions (when the record length is set to 2.5 k points, the trigger mode is set to N-Single) Replay: History waveforms are replayed automatically. History accumulation (half tone, intensity, color grade) History averaging: Acquired history waveforms are linearly averaged and displayed.

Item	Specifications
Zoom	xpands waveforms vertically (analog waveforms only) and horizontally (along the time axis). Two locations, Zoom1 and Zoom2, can be expanded. Separate magnification settings can be specified for each location. Auto scrolling and searching are available as supplementary features of the zoom feature. For details, see "Computation, Analysis, and Searching" in section 18.5, "Features." Vertical zoom Zoom source waveform: CH1 to CH4, M1 to M4 Zoom position: The center position to zoom in on on the zoom source waveform can be specified. Selectable range: ±4 divisions Zoom factor: The selectable range is 1 to 10. Time axis zoom Zoom position The center position to zoom in on on the main waveform can be specified. Selectable range: ±5 divisions Zoom factor: Can be set using the time scale magnification knob. The magnification can be set in 1-2-5 steps between 2 or 2.5× and the magnification that corresponds to 2.5 or 3.125 points/10 divisions. If the record length or time axis is changed, the DL6000/DLM6000 retains the zoom factor as much as possible. Auto scroll feature: Automatically moves the zoom position in the specified direction.
Display format	The display can be divided into 1, 2, 3, or 4 areas. The zoom windows can be divided into 1, 2, 3, or 4 areas or can be set to follow the main window setting. The analog:logic display ratio can be set to 1:3, 1:1, or 3:1.
Display interpolation	Sampled points can be displayed by using the dot display, sine interpolation display, linear interpolation display, or pulse interpolation display.
Graticule	The graticule can be set to one the following four grid types: dot grid, line grid, frame, and crosshair.
Auxiliary display on and off	Turn ON/OFF the scale values, waveform labels, and trigger marks
Scale values and waveform labels can be turned on and off.	The LCD backlight can be turned off manually or automatically (automatically turns off when a specified time elapses with no key activity), and the brightness can be adjusted. If the backlight is off, pressing any key turns on the backlight. The brightness level can be adjusted in the range of 1 to 8 (eight levels).
X-Y display	Two X-Y waveforms, XY1 and XY2, can be displayed. X-Y waveforms are displayed in their dedicated window and can be displayed simultaneously with T-Y waveforms. Specify the X-Trace, Y-Trace, and the X-Y display time range. X-Trace: CH1 to CH4, MATH1 to MATH4 Y-Trace: CH1 to CH4, MATH1 to MATH4 Time range: –5 divisions to +5 divisions on the main screen
Accumulation	The selectable modes are count mode and time mode. Count: Accumulates the specified number of history waveforms Time: Accumulates waveforms with gradually decreasing intensity for the specified amount of time The accumulation time can be set to a value from 100 ms to 100s or to infinite. Intensity and color modes can be selected. Intensity: Accumulates waveforms using separate channel colors with gradually decreasing intensity. Color: Displays the intensity that appears in intensity mode using different colors. Accumulates waveforms can be saved and loaded.
Snapshot	The currently displayed waveforms can be retained on the screen as snapshot waveforms. Snapshot waveforms can be saved and loaded.
Clear trace	Displayed waveforms can be cleared.

Computation, Analysis, and Searching

Item	Specifications	
Computation	Four computations can be performed, using MATH1 to MATH4	
	Available source channels are as follows:	
	MATH1:	CH1 to CH4
	MATH2 to MATH4:	CH1 to CH4, MATH1(REF1)[1]
	The following computation types are available.	
	Standard model:	Operators: +, -, ×, FILTER(Delay/Movin Avg/Low Pass/High Pass), INTEG, COUNT(EDGE/ROTARY), Logic DA(DLM6000)
	User-defined computation (optional):	Expressions can be created by combining the following operators and constants. Operators: +, -, ×, /, ABS, SQRT, LOG, LN, EXP, P2, SIN, ASIN, COS, ACOS, TAN, ATAN, PH, DIFF, INTEG, FILT1, FILT2, HLBT, MEAN, DELAY, BIN, PWHH, PWHL, PWLH, PWLL, PWXX, FV, DUTYH, DUTYL Constants: K1 to K4, 0 to 9, PI, e, fs, 1/fs, Exp, Measure
	Power supply analysis (Option):	Standard computations, Power, Z, I^2t, and user computations are available.
FFT	Two FFT (Fast Fourier Transform) waveforms, FFT1 and FFT2, can be displayed	
	Sources:	CH1 to CH4, M1 to M4
	Ranges:	Main, Zoom1, Zoom2
	FFT Points:	2.5k, 6.25k, 12.5k, 25k, 62.5k, 125k, 250k points (samples the waveform in the above range using the specified number of FFT points)
	Window:	Rectangular, Hanning, and flattop
	Mode:	Normal, Max Hold, Average
	On models with the user-defined computation option, the FFT's Type and Sub type settings can be set as follows:	
	Type:	LS, RS, PS, PSD, CS, TF, CH
	Sub type:	MAG, LOGMAG, PHASE, REAL, IMAG
Reference waveforms	Four reference waveforms, REF1 to REF4, can be displayed Saved waveforms and channel waveforms can be loaded into REF1 to REF4. REF and MATH cannot be used simultaneously.	
Serial bus signal analysis[2]	CAN, LIN, UART, I^2C, SPI, and user-defined serial bus data can be analyzed and displayed. The DL6000/DLM6000 can decode frames, fields, and other information from the waveform displayed on the screen. Then, it can display the decoded results along with the waveform on the screen or display a list of detailed decoded results. By setting search conditions and performing a search, you can display an expanded waveform with the detected frame's or field's first data byte at the center of the window. The DL6000/DLM6000 can analyze and search the waveforms of up to two serial bus signals (S.Bus1 and S.Bus2).	
History waveform searching	ou can search for waveforms that meet specified conditions, display detected history waveforms, and list the timestamps of the waveforms. You can set up to four search conditions and combine them using AND or OR logic. Search criterion can be set to whether the source waveform enters the search range (IN), moves outside the search range (OUT), or don't care (X). The following four search range types are available.	
	Rect-Zone:	Rectangular zone. FFT waveforms cannot be used.
	Wave-Zone:	Waveform zone. XY and FFT waveforms cannot be used.
	Polygon-Zone:	Polygonal zone. FFT waveforms cannot be used.
	Parameter:	Zone between the upper and lower limits of one waveform parameter.
Waveform searching (search and zoom)	Searches the displayed waveform for locations that meet the specified conditions and displays the waveform expanded around the detected points.	
	Search feature:	Searches for a particular section after a particular time (Start Point) on the currently displayed waveform and displays the section in the zoom window. Selectable Start Point range is ±5 divisions.
	Search Type:	Edge, Edge Qualified, Logic Edge Qualified, State, Logic State, Pulse, Logic Pulse, Pulse Qualified, Pulse State, Logic Pulse State, Serial Pattern, I2C[1], CAN[1], LIN[1], SPI[1], UART[1]

1 During user-defined computation, you can use MATH1 and 2 in MATH3 and MATH1 to 3 in MATH4.
The results of user-defined computation can only be used in a user-defined computation source.

2 CAN, LIN, UART, I2C, and SPI are options.

Item	Specifications
Cursor measurement	he following cursors are selectable. ΔT, ΔV, ΔT & ΔV, VT, Marker, Serial
Automated measurement of waveform parameters	The following waveform parameters can be automatically measured. Items that are measured over the entire specified range of data and are irrelevant to the period. Max, Min, High, Low, P-P, High-Low, +Over, -Over, Rms, Mean, Sdev, IntegTY, Edge Count Items that are measured in the first period in the specified range. Freq, Period, Burst, +Width, -Width, Duty, Rise, Fall, Delay Items that are measured over all periods in the specified range. AvgPeriod, C. Rms, C. Mean, C. Sdev, C. IntegTY ΔT & ΔV cursor value V1, V2, ΔT For logic signal, only the following items are selectable. Freq, AvgPeriod, Edge Count, +Width, -Width, Period, Duty, ΔT, Delay The maximum total number of items that can be displayed in Area1 and Area2 on the screen is 16.
Statistical processing of waveform parameters	he following three types of statistical processing are available. Continuous: Calculates statistics on normal measurement that is performed multiple times. Cycle: Calculates statistics on the measurement of each period of the displayed waveform. History: Calculates statistics on the measurements of multiple history waveforms. The calculated statistics are as follows: Statistical items: Max, Min, Mean, Sdev, Count The maximum number of items that can be displayed on the screen is two.
Trend display and histogram display of waveform parameters	Up to two trends or histograms of the specified measurement items can be displayed. The maximum number of items that can be displayed on the screen is 16.
Expanded waveform parameter measurement	Automated measurement of waveform parameters can be performed on two areas. Calculations can be performed using the automated measurement values of waveform parameters. In addition to the normal waveform measurement range (Area1), you can specify another measurement range (Area2). The same parameter measurement as Area1 can be performed in Area2. The maximum total number of items that can be displayed in Area1 and Area2 on the screen is 16.
Frequency distribution analysis	Counts the frequency of data occurrence in a specified area and displays the values in a histogram. You can select whether to count the voltage data frequency or the time data frequency. The mean, standard deviation, maximum value, minimum value, peak value, median, etc., can be measured on the histogram. You can set up to two histogram source waveforms.
Action-on-trigger	A specific action can be executed when the DL6000/DLM6000 triggers. You can set the number of times to execute the action in terms of the number of waveform acquisitions or the number of determinations. Actions: Beeping, screen capture data printing or saving, waveform data saving, mail transmission[2]
GO/NO-GO determination	A specific action can be executed when the GO/NO-GO result is NO-GO. You can set the number of times to execute the action in terms of the number of waveform acquisitions or the number of determinations. Up to four conditions can be set, and the four4 conditions can be combined using AND or OR logic to perform determination. Reference condition can be set to whether the source waveform enters the reference range (IN), moves outside the search range (OUT), or don't care (X). The following four reference range types are available. Rect-Zone: Rectangular zone. FFT waveforms cannot be used. Wave-Zone: Waveform zone. XY and FFT waveforms cannot be used. Polygon-Zone: Polygonal zone. FFT waveforms cannot be used. Parameter: Zone between the upper and lower limits of one waveform parameter. Actions: Beeping, screen capture data printing or saving, waveform data saving, mail transmission[1]

1 CAN, LIN, UART, I^2C, and SPI are options.
2 On models with the Ethernet option.

Item	Specifications	
Mask test	Performs mask test and eye pattern measurement	
	Mask Test Item:	Wave Count/Wave Count%/Sample Point Count/Sample Point Count%
	Eye pattern Item:	Crossing%/Eye Height/Eye Width/Q Factor/Jitter/Jitter2/Duty Cycle Distortion%/Vtop/Vbase/σtop/σbase/Tcrossing1/Tcrossing2/ Vcrossing/Ext Rate dB/Rise/Fall
Power supply analysis feature (optional)	Two power supplies, PWR1 and PWR2, can be analyzed.	
	Voltage channel	U+pk, U-pk, Up-p, Urms, Udc, Uac, Umn, Urmn, S, P, Q, Z,λ, Wp, Wp+, Wp-, Abs.Wp
	Current channel	I+pk, I-pk, Ip-p, Irms, Idc, Iac, Imn, Irmn, q, q+, q-, Abs.q, I2t
	Common	High, Low, Hi-Low, +Over, -Over, IntegTY, C.IntegTY, V1, V2, Freq, Period, AvgPeriod, Burst, +Width, -Width, Duty, EdgeCount, Rise, Fall, ΔT, Delay
	Items that are measured over the entire measurement range U+pk, U-pk, U_{P-P}, I+pk, I-pk, I_{P-P}, I2t	
	Items that are measured within a period extracted from the measurement range Udc, Urms, Uac, Umn, Urmn, Idc, Irms, Iac, Imn, Irmn	
	Items whose measurement range changes depending on the cycle mode (CycleMode)2[2] Wp, Wp+, Wp-, Abs.Wp, q, +q, -q, Abs.q, P, S, Q, Z, λ	
	Switching loss analysis (SW.Loss):	
	Switching loss analysis (SW.Loss):	The total loss and the switching loss can be measured. Items such as power waveforms and measured values can be displayed, and statistics can be computed. The items whose switching losses can be measured automatically are listed below. Wp, Wp+, Wp-, Abs.Wp, P, P+, P-, Abs.P, and Z
	Safe Operating Area (SOA):	An X-Y display can be created with voltage input plotted on the X-axis and current input plotted on the Y-axis.
	Harmonic Analysis (Harmonics):	Simple comparisons can be made between the harmonics and the following limits. IEC 61000-3-2 Ed. 2.2, “Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)” EN61000-3-2(2000) IEC 61000-4-7 Ed. 2
	Joule Integral (I^2t):	Items such as Joule integral waveforms and measured values can be displayed, and statistics can be computed. The items whose Joule integral can be measured automatically are listed below. I^2t
	Trend display::	The change over time of the measured waveform parameters in each period can be displayed in trends.
	History search:	You can search through the history for the power supply analysis items just as you can for the standard measurement items.
	Saving results of harmonic computations:: The results of harmonic computations can be saved to CSV files.	
	Also, during power supply analysis, the time difference between the voltage and current waveforms can be automatically deskewed. For automatic deskewing to be performed, the voltage and current signals of the deskew signal source (701935; sold separately) must be connected through probes to CH1 and CH2 (or CH3 and CH4), respectively. For information about the deskew range, see “Deskewing” in this section.	

1 On models with the Ethernet option.

2 Measured over the entire measurement range when the cycle mode is set to OFF, measured within a period extracted from the measurement range when the cycle mode is set to ON.

Screen Capture Data Printing and Saving

Item	Specifications
Built-in printer (optional)	Prints a monochrome copy of the displayed screen at a resolution of 1024 × 768 (XGA) High Resolution: The horizontal resolution is doubled (2048 × 768; the print size does not change).
USB printer	Prints screen captures on an external printer via USB. Color can be turned on or off. Supports Epson inkjet printers and HP inkjet printers.
Network printer	Prints screen captures on an external printer via Ethernet.[1]Color can be turned on or off. Supports Epson inkjet printers, HP inkjet printers, and HP laser printers.
File	Saves screen capture data to the specified storage medium using one of the following save modes. The storage medium can be set to internal memory or USB storage. Output data format can be set to PNG or JPEG. Available color settings are OFF, ON, ON (Rev), and ON (Gray).

1 On models with the Ethernet option.

Data Storage

Item	Specifications
Waveform data	Saves waveform data (including history waveforms) to the specified storage medium.[1] The saved data can be loaded into the DL6000/DLM6000. Available data formats are binary (.wdf), ASCII (.csv), and float (flt). Only binary (.wdf) files can be loaded into the DL6000/DLM6000. Waveform data is saved by specifying the data format, the waveform to save, the range to save (Main, Zoom1, or Zoom2), and the compression method (OFF, P-P, or Decimation). Waveform data is loaded by setting the load destination to ACQ memory, REF1 (MATH1), or REF2 (MATH2). If waveform data is loaded into the ACQ memory, the data is cleared when you start waveform acquisition.
Setup data	Setup data can be saved to the specified storage medium.1 The saved data can be loaded into the DL6000/DLM6000.
Other types of data	Waveform zones can be saved and loaded. Polygonal zones can be loaded. Snapshot waveforms can be saved and loaded. Automatically measured waveform parameters can be saved. Serial bus frame lists can be saved. FFT waveform data can be saved. Histogram data can be saved and loaded.

1 The storage medium can be set to internal memory or USB storage.

Other Features

Item	Specifications
Default setup	Resets the DL6000/DLM6000 to its factory default settings. The following settings are not reset: date and time settings, communication interface settings, settings stored to the internal memory, and language settings. The Undo command can be used to revert to the previous settings.
Auto setup	Automatically sets the voltage scale, time scale, trigger, and other settings to the most suitable values for the input signals. The Undo command can be used to revert to the previous settings.
Serial bus auto setup[1]	The DL6000/DLM6000 can automatically set the serial bus type (CAN, LIN, UART, I2C, or SPI) as well as the trigger source bit rate and source level and trigger based on those settings.
Calibration	Auto calibration and manual calibration are available.
Setup data (storage and recall)	Up to twelve sets of setup data can be stored and loaded from the internal memory.
Environment settings	The date, time, and message language can be specified. The click sound can be turned on and off.
Probe compensation signal output	Transmits signals from the front-panel probe compensation signal output terminals (approx. 1 V_{P-P} and approx. 1 kHz rectangular wave).
Overview	Allows you to view the DL6000/DLM6000 system status.
Self-tests	Memory, accuracy, and printer tests are available.
Menu language setting	The menu language can be switched.
Help feature	Displays a description of the settings.

1 On models with the serial bus option.

18.6 Built-in Printer (/B5 Option)

Item	Specifications
Print system	Thermal line dot system
Dot density	8 dots/mm
Sheet width	112mm
Resolution in the paper feed direction	Normal printing: 8 dots/mm. High-resolution printing: 16 dots/mm.

18.7 Storage

Internal Memory

Item	Specifications
Media type	CF memory card
Memory size	Standard model: Approx. 390 MB, /C9 Option: Approx. 3.7GB

USB Storage Device

Item	Specifications
Compatible USB storage devices	Mass storage device compatible with USB Mass Storage Class Ver. 1.1

See section 8.8, "USB for Peripherals."

18.8 USB for Peripherals

Item	Specifications
Connector type	USB type A (receptacle)
Electrical and mechanical specifications	USB Rev. 2.0 compliant
Supported transfer modes	LS (Low Speed; 1.5 Mbps), FS (Full Speed; 12 Mbps)
Ports	2
Power supply	5 V, 500 mA (for each port)
Compatible devices	USB HID Class Ver. 1.1 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
No. of connectable devices	Mouse, keyboard, and printer: 1 each Mass storage devices: 2 Up to two devices can be connected.

18.9 Auxiliary I/O Section

External Trigger Input (TRIG IN)

Item	Specifications
Connector type	BNC
Input bandwidth[1]	DC to 100MHz
Input impedance	Approx. 1 MΩ, approx. 18 pF
Maximum input voltage	±40 V (DC + ACpeak) or 28 Vrms, when the frequency is less than or equal to 10 KHzr
Input range	±2V
Trigger level	±2V, The resolution is 5 mV

1 Values measured under standard operating conditions (see section 18.11 for details) after a 30-minute warm-up.

Trigger Output (TRIG OUT)

Item	Specifications
Connector type	BNC
Output level	5V TTL
Output logic	Negative logic
Output delay	50ns Max
Output hold time	Negative logic: Low level: 50 ns min. High level: 50 ns min.

Video Signal Output (VIDEO OUT)

Item	Specifications
Connector type	D-sub 15 pin (receptacle)
Output type	Analog RGB output
Output resolution	XGA-compliant output, 1024 × 768 dots, approx. 60-Hz Vsync (62.5-MHz dot clock frequency)

GO/NO-GO Output (GO OUT, NO-GO OUT)

tem	Specifications
Connector type	RJ-12 modular jack
Output signal	GO OUT, NO-GO OUT
Output level	TTL compatible
Compliant cable	Four-wire modular cable

Probe Interface Terminal

tem	Specifications
Output terminals	4
Output voltage	±12 V (up to 1.2 A in combination with the rear-panel probe power terminal), ±5 V (up to 800 mA total)
Usable probes	Active probes (701912, 701913, 701914), differential probes (701923, 701924), urrent probes (701928, 701929)

Probe Power Terminal (/P4 Option)

tem	Specifications
Output terminals	2(DL6000) 4(DLM6000)
Output voltage	±12 V (up to 1.2 A in combination with the probe interface terminal)
Usable probes and deskew signal sources	FET probe (700939), current probe (701930, 701931, 701932, 701933), differential probes (700924, 700925, 701920, 701921, 701922, 701926), deskew signal source (701935)

18.10 Computer Interface

PC Card Interface

Item	Specifications	
Number of ports	1	
Compatible cards[1]	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

1 For details on compatible devices, contact your nearest YOKOGAWA dealer.

USB-PC Connection

Item	Specifications
Connector type	USB type B connector (receptacle)
Electrical and mechanical specifications	USB Rev. 2.0 compliant
Supported transfer standards	FS (Full Speed) mode (12 Mbps) and HS (High Speed) mode (480 Mbps)
Number of ports	1
Supported protocols	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 Strage Class Ver.1.1 Access from a PC to the internal memory, PC card,[2,3] USB mass-storage device is possible (reading and writing). However, formatting is not possible.
Compatible PC systems	A PC running Windows XP/2000 English/Japanese version, equipped with a USB port.

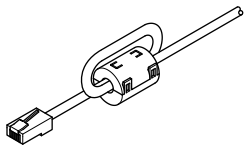
1 A separate driver is required.
2 No drivers are required.
3 For details on compatible devices, contact your nearest YOKOGAWA dealer.

LXI Interface (/C9 or /C12 Option)

Item	Specifications
Connector type	RJ-45 connector
Ports	1
Electrical and mechanical specifications	IEEE 802.3 compliant
Transmission system	Ethernet(1000BASE-T/100BASE-TX/10BASE-T)
Communication protocol	TCP/IP
Supported services	DHCP, DNS, Microsoft network file sharing server and client, SMTP client, SNTP client, FTP server, Web server, network printer, and firewall
LED indicators	Two indicators: Link, which illuminates in yellow when a link is established, and Activity, which illuminates in green when packets are being transmitted or received
Compliant standard	LXI Standard, Revision 1.2
Functional class	Class C

18.11 General Specifications

Item	Specifications	
Standard operating conditions	Ambient temperature::	23 ± 5°C
	Ambient humidity:	55 ± 10% RH
	Supply voltage and frequency errors:	Within 1% of rating
Warm-up time	At least 30 minutes	
Storage environment	Temperature:	–20 to 60°C
	Humidity:	20 to 80%RH (no condensation)
	Altitude:	3000 m or less
Operating environment	Temperature:	5 to 40°C
	Humidity:	20 to 80%RH (when the printer is not used; no condensation) 35 to 80%RH (when the printer is used; no condensation)
	Altitude:	2000 m or less
Recommended calibration period	One year	
Rated supply voltage	100 to 120 VAC/220 to 240 VAC(automatic switching)	
Permitted supply voltage range	90 to 132 VAC/198 to 264 VAC	
Rated supply frequency	50/60 Hz	
Permitted supply voltage frequency range	48 to 63 Hz	
Power fuse	Built in (not replaceable)	
Maximum power consumption	300 VA	
Withstand voltage (between the power supply and case)	1.5 kVAC for 1 minute	
Insulation resistance (between the power supply and case)	500 VDC, 10 MΩ or more	
External dimensions	DL6000 350 mm (W)×200 mm (H)×181 mm (D) when the printer cover is closed; excluding protrusions DLM6000 350 mm (W)×200 mm (H)×288 mm (D) when the printer cover is closed; excluding protrusions	
Weight	DL6000: Approx. 6.5 kg (Not including options, only the instrument. However, the printer is included.) DLM6000: Approx. 7.7 kg (Not including options, only the instrument. However, the printer is included.)	
Instrument cooling method	Forced air cooling; side ventilation	
Installation position	Horizontal (However, can be installed on a slope using stand and handle,) Do not install vertically or stack..	
Battery backup	The clock is backed up with the internal lithium battery. Battery life: Approx. five years (at an ambient temperature of 25°C)	
Environmental protection	Uses lead-free soldering	
Safety standard	Compliant standard EN61010-1 Overvoltage Category II[1] Measurement Category I[2] Pollution degree 2[3]	

Item	Specifications
Emissions	Compliant standard EN61326-1 Class A EN61326-2-1 EN55011 Class A Group1 C-Tick EN55011 Class A Group1 (Applicable to the DL6054, DL6104, DL6154, DLM6054, DLM6104, 701939, 701912, 01913, 701914, 701923, 701974 with 701975, 701980[4], 701981[4], 701935[5]) EN61000-3-2 EN61000-3-3 This is a class A instrument designed for an industrial environment. Operation of this equipment in a residential area may cause radio interference, in which case users will be required to correct the interference. Cable conditions Logic signal input port[4] 701981 Attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) to one end (DL6000/DLM6000 end) of the logic probe cable. 701980 Attach ferrite cores (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) to the both end of logic probe cables. External trigger input (TRIG IN) terminal Use a BNC cable[6] and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (DL6000/DLM6000 end). Trigger output (TRIG OUT) terminal Same as the external trigger input terminal above. Video signal output (VIDEO OUT) terminal Use a 15-pin D-Sub VGA shielded cable[6] and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end ((DL6000/DLM6000 end). Probe power terminal[7] Attach a ferrite core (TDK: ZCAT1325-0530A, YOKOGAWA: A1181MN) to one end (DL6000/DLM6000 end) of the power supply cable. USB connector for connecting peripheral devices Attach a ferrite core (TDK: ZCAT1325-0530A, YOKOGAWA: A1181MN) to one end (DL6000/DLM6000 end) of the USB cable.[6] USB connector for connecting to a PC Attach a ferrite core (TDK: ZCAT1325-0530A, YOKOGAWA: A1181MN) to one end (DL6000/DLM6000 end) of the USB cable.[6] GO/NO-GO output terminal Use a GO/NO-GO cable (YOKOGAWA model 366973, sold separately) and wind the cable twice around the ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (DL6000/DLM6000 end). See the figure below. Ethernet interface connector Use a Ethernet interface cable4 and wind the cable twice around the ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (DL6000/DLM6000 end). See the figure below. 

1 The overvoltage category(installation category) is a value used to define the transient overvoltage condition and includes the rated impulse withstand voltage. The overvoltage category II applies to electrical equipment that is powered through a fixed installation, such as a switchboard.
2 Measurement category (CAT I) applies to measurement of circuits that are not directly connected to a main power source. For example, this category applies to measurement of secondary electric circuits in equipment across a transformer. The estimated transient overvoltage for the DLM2000 is 1500 V.
3 The pollution degree refers 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).
4 Logic only available on the DLM6000.
5 The 701935 is YOKOGAWA's Deskew Correction Signal Source.
6 Use cables of length 3 m or less.
7 Only connect to evaluate the DLM6000. Do not use with the DL6000.

Item	Specifications	
Immunity	Compliant standard	
	EN61326-1 Table2(for industrial environment)	
	Applicable to the DL6054, DL6104, DL6154, DLM6054, DLM6104, 701939, 701912, 01913, 701914, 701923, 701974 with 701975, 701980[1], 701981[1], 701935[2]	
	EN61326-2-1	
	Influence in the immunity testing environment (criteria A)	
	Noise increase:	Within ±200 mV (when using the 701939 or 701974 with 701975)
		Within ±2 V (when using the 701913 or 701923)
		Logic signal polarity inversion does not occur (when using the 701980 or 701981)[1]
	Test conditions:	2.5 GS/s, envelope mode, 20 MHz BWL (10:1 probe attenuation setting), and , probe tip terminated at 50 Ω.
		Logic threshold: CMOS5V(2.5V), probe tip terminated at 50 Ω[1]
	Cable conditions:	Same as the emission cable conditions.
	Test items:	1. Static discharge: EN61000-4-2 Air discharge: ±8 kV. Contact discharge: ±4 kV. Criteria B. 2. Radiated immunity: EN61000-4-3 80 M to 1 GHz, 10 V/m, 1.4 to 2 GHz, 3 V/m, 2.0 to 2.7 GHz, 3 V/m, criteria A 3. Conducted immunity: EN61000-4-6 3 V, criteria A 4. EFT/Burst: EN61000-4-4 Power line: ±2 kV. Signal line: ±1 kV, criteria B 5. Power frequency magnetic fields: EN61000-4-8 330 A/m, 50 Hz, criteria A 6. Surge immunity: EN61000-4-5 ±1 kV between lines, ±2 kV common, criteria B 7. Voltage dip and interruptions: EN61000-4-11 1 cycle, both polarities, 100%, criteria B Other tests, criteria C Definitions of criteria A, B, and C Criteria A: During testing, "influence in the immunity testing environment" described above is met. Criteria B: The instrument continues to function and is controllable throughout testing. The instrument does not change operation modes, and data changes do not persist. Criteria C: During testing, temporary degradation of performance or loss of functionality occurred, the correction of which required user operation or system reset.

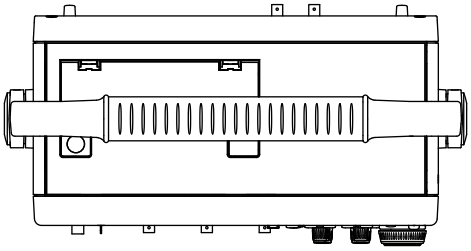
1 Logic only available on the DLM6000.
2 The 701935 is YOKOGAWA's Deskew Correction Signal Source.

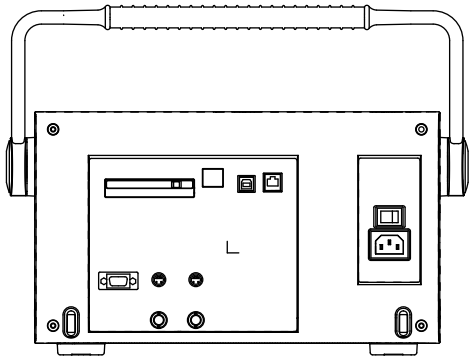
18.12 External Dimensions

DL6000(DL6054, DL6104, DL6154)

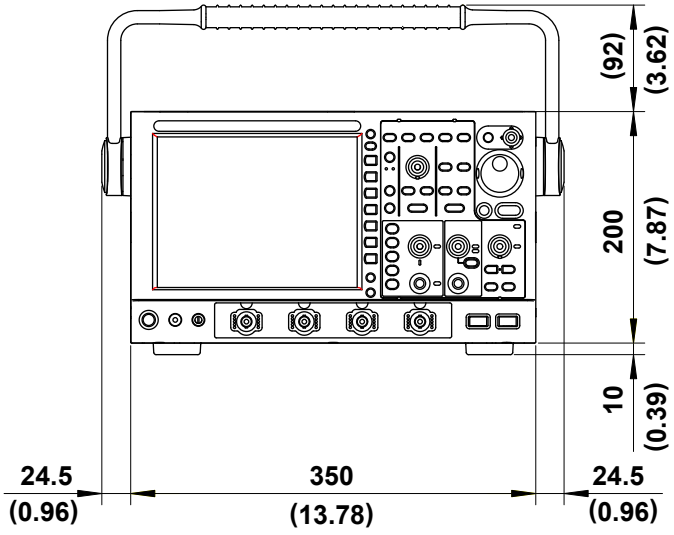
Unit: mm

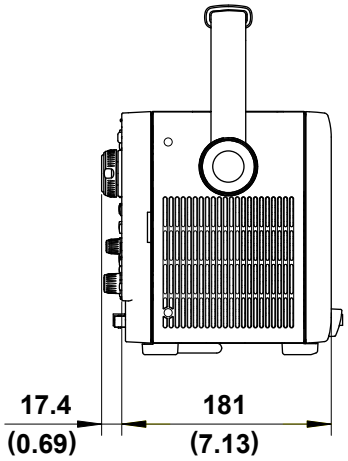
Unless otherwise specified, tolerance is ±3% (however, tolerance is ±0.3 mm when below 10 mm).





REAR VIEW

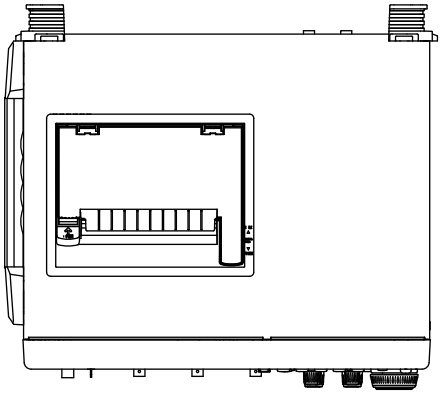


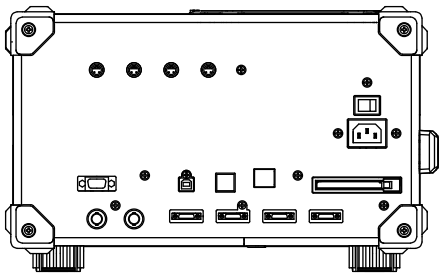


DLM6000(DLM6054, DLM6104)

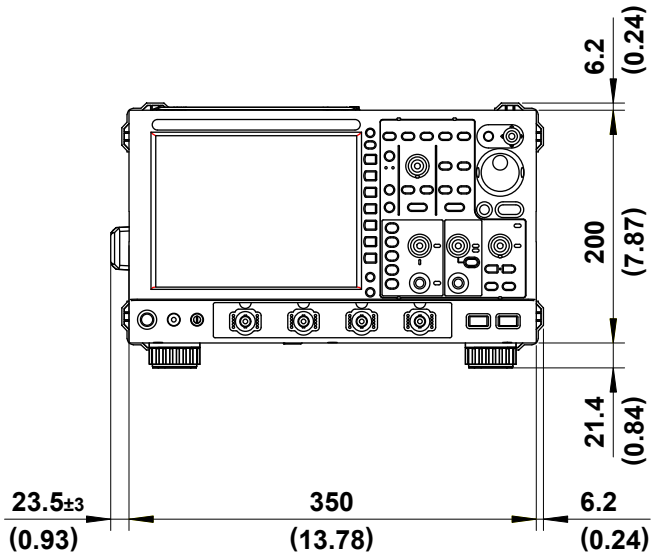
Unit: mm

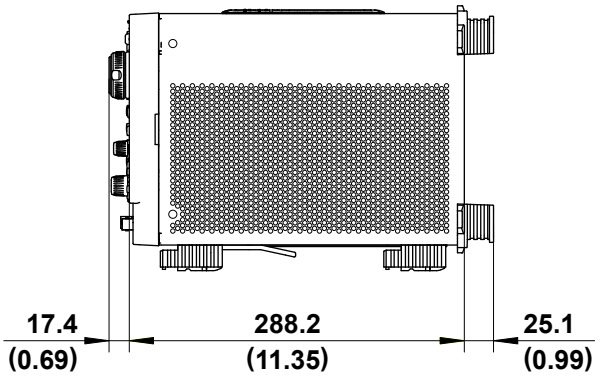
Unless otherwise specified, tolerance is ±3% (however, tolerance is ±0.3 mm when below 10 mm).





REAR VIEW

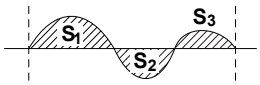




Appendix 1 How Waveform Areas Are Calculated

IntegTY

Sum of the positive and negative curve areas: $S^1 + S^3 – S^2$

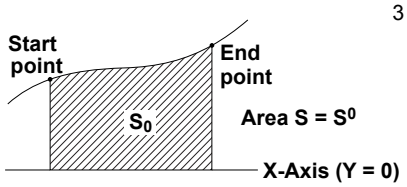


IntegXY for XY Display

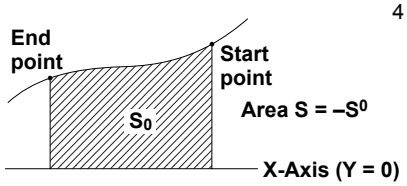
Open

(1) When Each Y Data Point Corresponds to a Single X Data Point

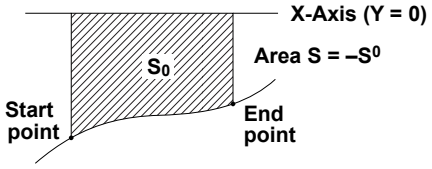
1



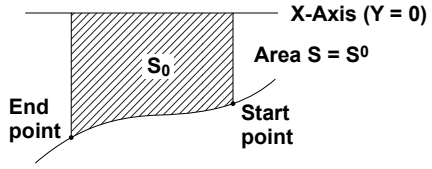
2



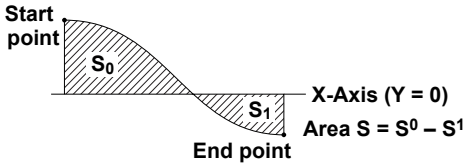
3



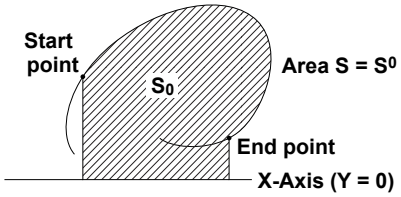
4

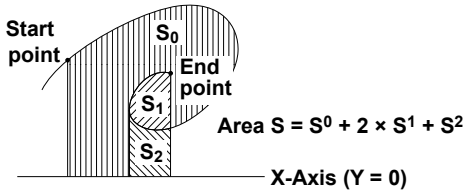


(2) When the Waveform Extends into the Negative Side



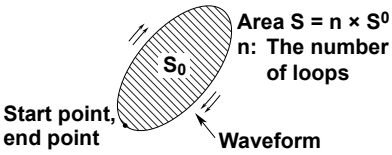
(3) When There Are Multiple Y Data Points That Correspond to an X Data Point



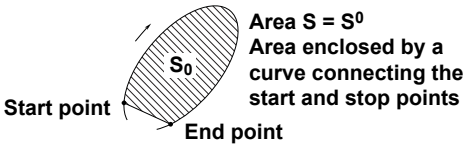


Close

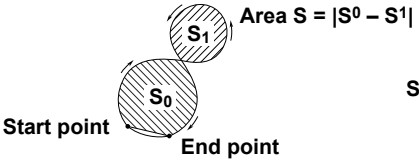
(1) Multiple Loops



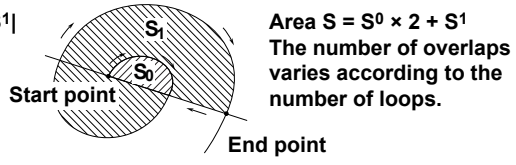
(2) Non-Closed Curve



(3) Loop Tracing a Figure-Eight



(4) Loop Tracing a Spiral



Appendix 2 104 USB Keyboard Key Assignments

Panel Key	USB Keyboard
CH1	Ctl-1
CH2	Ctl-2
CH3	Ctl-3
CH4	Ctl-4
LOGIC	Ctl-l
MATH/REF	Ctl-b
MODE	Ctl-t
EDGE	Ctl-w
ENHANCED	Ctl-e
B TRIG	Ctl-y
“ACTION/GONOGO	
(SHIFT-MODE)”	Ctl-Shift-t
RUN/STOP	F12
SINGLE	F11
ACQUIRE	Ctl-a
DELAY	F9
CURSOR	Ctl-n
MEASURE	Ctl-m
ANALYSIS	Ctl-k
SEARCH	Ctl-o
“XY	
(SHIFT-DISPLAY)”	Ctl-Shift-d
“FFT	
(SHIFT-MATH/REF)”	Ctl-Shift-b
“TELECOM TEST	
(SHIFT-MEASURE)”	Ctl-Shift-m
DISPLAY	Ctl-d
ZOOM1	Ctl-z
ZOOM2	Ctl-x
SETUP	Ctl-s
AUTO SETUP	Ctl-i
HELP	Ctl-/
HISTORY	Ctl-h
CLEAR TRACE	Ctl-q
SNAP SHOT	Pause
PRINT	Print
“PRINT MENU	
(SHIFT-PRINT)”	Shift-Print
FILE	Ctl-f
UTILITY	Ctl-u
ESC	ESC
F1	F1
F2	F2
F3	F3
F4	F4
F5	F5
F6	F6
F7	F7
SET	Ctl-Return
RESET	Ctl-r
↑ (moving the SET key up)	↑
↓ (moving the SET key down)	↓
← (moving the SET key to the left)	←
→ (moving the SET key to the right)	→

Panel Key	USB Keyboard
Knob	
V SCALE R (zoom in)	End
V SCALE L (zoom out)	Home
V SCALE PUSH(Fine)	F10
V POS R(Up)	Ctl-End
V POS L(Down)	Ctl-Home
V POS PUSH(RESET)	Ctl-v
TRIG LEV R(Up)	Ctl-↑
TRIG LEV L(Down)	Ctl-↓
TRIG LEV PUSH(Auto)	Ctl-p
H SCALE R (zoom in)	PageDown
H SCALE L (zoom out)	PageUp
H POS R	Ctl-PageUp
H POS L	Ctl-PageDown
H POS PUSH(Reset)	F8
MAG R (zoom out)	Ctl-Del
MAG L (zoom in)	Ctl-Ins
JOG R(Up)	Ctl-→
JOG L(Down)	Ctl-←

Appendix 3 Integration and Differentiation of Waveform Parameters

Differentiation and Integration

The computation of the derivative value uses the 5th order Lagrange interpolation formula to derive a point of data from the five points of data before and after the target point.
The following equations use data f_0 to f_n and I_0 to I_n with respect to sampling time x_0 to x_n. The derivative and integrated values corresponding to these data points are computed as follows:

Differentiation (DIFF)

Point x_k $\quad f_k' = \frac{1}{12h}[f_{k-2} - 8f_{k-1} + 8f_{k+1} - f_{k+2}]$

h = Δx is the sampling interval (sec) (example h = 200×10^{-6} at 5 kHz)

Integration (INTEG)

Point x_0 $\quad I_0 = 0$

Point x_1 $\quad I_1 = \frac{1}{2}(f_0 + f_1)h$

Point x_2 $\quad I_2 = \frac{1}{2}(f_0 + f_1)h + \frac{1}{2}(f_1 + f_2)h = I_1 + \frac{1}{2}(f_1 + f_2)h$

Point x_n $\quad I_n = I_{n-1} + \frac{1}{2}(f_{n-1} + f_n)h$

Appendix 4 ASCII Data File Format

The format of the file that is produced when analog and logic signal data is saved in ASCII format is indicated below.

	A	B	C	D	E	F	G	H	I	J
1	Header Size	15								
2	Model Name	DLM6000								
3	Comment									
4	BlockNumber	1	1	1	1	1	1	1	1	1
5	TraceName	CH1	CH2	CH3	CH4	Group1	Group2	Group3	Group4	Group5
6	BlockSize	2500	2500	2500	2500	2500	2500	2500	2500	2500
7	VUnit	V	V	V	V					
8	SampleRate	250000	250000	250000	250000	250000	250000	250000	250000	250000
9	HResolution	4.00E-06	4.00E-06	4.00E-06	4.00E-06	4.00E-06	4.00E-06	4.00E-06	4.00E-06	4.00E-06
10	HOffset	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03
11	HUnit	s	s	s	s	s	s	s	s	s
12	DisplayBlockSize	2500	2500	2500	2500	2500	2500	2500	2500	2500
13	DisplayPointNo.	0	0	0	0	0	0	0	0	0
14	Date	2007/1/26	2007/1/26	2007/1/26	2007/1/26	2007/1/26	2007/1/26	2007/1/26	2007/1/26	2007/1/26
15	Time	41:25.6	41:25.6	41:25.6	41:25.6	41:25.6	41:25.6	41:25.6	41:25.6	41:25.6
16										
17		-1.00E-02	2.00E-02	2.00E-02	2.00E-02	78	133	199	12	0
18		4.00E-02	4.00E-02	4.00E-02	3.00E-02	78	149	199	12	0
19		5.00E-02	1.00E-02	1.00E-02	-1.00E-02	78	133	199	12	0
20	Data	3.00E-02	-2.00E-02	-3.00E-02	0.00E+00	78	133	199	12	0
21	↓	4.00E-02	1.00E-02	5.00E-02	9.00E-02	78	133	199	12	0
22		-1.00E-02	5.00E-02	2.00E-02	2.00E-02	78	133	199	12	0
23		4.00E-02	2.00E-02	-4.00E-02	-4.00E-02	78	133	199	12	0
24		8.00E-02	3.00E-02	6.00E-02	9.00E-02	78	133	199	12	0
25		-4.00E-02	8.00E-02	4.00E-02	6.00E-02	78	133	199	12	0
26		5.00E-02	0.00E+00	1.00E-02	2.00E-02	94	149	199	12	0

Header Size	The number of header lines
Model Name	The name of the instrument
Comment	A comment attached at the time the data file was saved
BlockNumber	The number of blocks for this group The maximum block number when the number of blocks varies depending on the waveform
TraceName	The names of each of the waveforms
BlockSize	The number of data points in a single block of a waveform
VUnit	Each waveform's Y-axis unit (has no effect on the data)
Sample Rate	The sample rate used for waveform acquisition
HResolution	Each waveform's X-axis conversion coefficient, HResolution X-axis value = HResolution × (Data No. – 1) + HOffset
HOffset	Each waveform's X-axis conversion offset, HOffset X-axis value = HResolution × (Data No. – 1) + HOffset
HUnit	Each waveform's X-axis unit (this has no effect on the data).
DisplayBlockSize	The length of the data displayed on the screen (the display record length)
DisplayPointNo.	This number shows what point in memory is on the leftmost side of the display record length
Date	Date when waveform acquisition was completed
Time	Time when waveform acquisition was completed

Index

A

Page

Accum Histogram 10-31
Accumulate 11-1, 11-3
Accumulated Display 2-22
Accumulated Histogram Display 2-32
Accumulated Waveform Display 8-5
ACQ Count 6-61
ACQUIRE Key 1-5
Acquisition Mode 2-15, 7-2
Acquisition Mode Displays 1-8
Action 6-62
Action-On-Trigger 6-52
Action-on-Trigger 2-18
ACTION GO/NO-GO key 1-5
Action Mode 6-53
Action on TRIG 6-59
Action on Trig 6-52
Addition, Subtraction, and Multiplication 2-24
All Half Tone 11-1, 11-3
Analysis (accum histogram) 10-33
Analysis (FFT) 10-30
Analysis (XY) 10-21
ANALYSIS Key 1-6
Analysis Results Screen 1-9
ASCII 13-5
A Trigger 6-46
Attaching the Roll Paper (DL6000) 12-2
Attaching the Roll Paper (DLM6000) 12-4
Auto(Trigger mode) 6-2
Auto Level 6-2
Auto Level Mode 2-6
Automated Measurement of Waveform Parameters 2-28
Automatically Measuring Waveform Parameters 10-10
Automatic Zero Adjustment 5-4
Auto Mode 2-6
Auto Naming 13-7
Auto Ranging Exec 9-11
Auto Scale Exec 10-29
Auto Scroll 8-10
Auto Setup 4-12
AUTO SETUP Key 1-5
Average Mode 2-15
Averaging Mode 7-2

B

Page

Backlight Auto OFF 16-4
Bandwidth 5-5
Bandwidth Limit 2-4
Binary 13-5
Binary Format 9-11
Bind 14-5
B TRIG 6-44
B Trigger 2-11, 6-46
B TRIG Key 1-5
Bundle 5-10
Bus Display 2-14, 5-10
Buzzer 6-53

C

Page

Calc 10-8
Calculations 10-8
calibration 4-17
CH1 to CH4 Keys 1-4
Changing File Attributes 13-19
Checking for an Ethernet Interface 14-21
Clearing Search Zones 11-9
Clear Trace 8-7
Click Sound 16-1
Clock 6-49
Clock Source 6-17
Combination 2-11, 6-46
Combination Triggers 6-44
Compensating the Probe 3-12
Computation Mode 9-1
Computation on History Waveforms 9-19
Computation Source Waveforms 9-2, 9-17
Computed Data Averaging 9-19
Configuring TCP/IP Settings 14-3
Connecting Logic Probes 3-14
Connecting the DL6000/DLM6000 to a Network 14-1
Connecting the Power Cord 3-6
Connecting the Probe 3-9
Constant Definitions 9-18
Consumables v
Continuous Statistics Menu 10-17
Converting the Scale of a Computed Waveform 2-25
Copying Files 13-18
Counting Edges 9-6
Count Start Point 9-7, 9-9
Coupling 6-7
CS 6-50
Current-to-Voltage Conversion Ratio 2-3
Current Probes 5-4
CURSOR Key 1-6
Cursor Measurement 2-27
Cursor Measurements 10-1
Cycle Statistics Menu 10-18
Cyclic Statistical Processing 10-19

D

Page

D/A Conversion 2-25, 9-11
D/A Conversion on History Waveforms 9-11
Dark Level 10-36
Data Compression 13-6
Data Size 13-5
Data Type 13-5
Date and Time 3-16
Dealing with Unusual Circumstances 17-1
Default Settings 4-11
Default Setup 4-11
DELAY Key 1-4
Delay Setup 10-11, 10-15
Deleting Files and Folders 13-18
Deskewing (logic) 2-14, 5-12
Determination Zone 6-60
Dialog Box Operation 4-4
Digital Filter 9-18
Display Filter 13-8
Display Format 2-22, 8-2, 9-11
display history waveforms 11-3
Displaying Computed Waveforms 2-24
Displaying Logic Signals 2-14
Displaying Reference Waveforms 2-24
Displaying Scale Values 2-23
Display Interpolation 2-22, 8-2

DISPLAY Key 1-5
Display Mod 11-3
Display Mode 10-29
Display Record Length 2-5
Display Size (logic) 5-12
Dot Connect 8-2
DT&DV Cursors 10-3, 10-7
DT Cursors 10-1, 10-7
DV Cursors 10-2, 10-7

E

Page
E-mail Transmission 14-8
Edge Condition 6-10
Edge Count 2-24
edge count 9-7
EDGE Key 1-5
Edge OR 6-14
Edge OR Trigger 2-7
Edge Qualified 6-10
Edge Qualified Trigger 2-6
Edge State 6-15
Edge Trigger 2-6, 6-5
Effective Data Range 2-2
Enhanced Features 10-12
ENHANCED Key 1-5
Entering Values 4-5
Envelope Mode 2-15, 7-2
ESC key 1-1
Event Cycle 2-10, 6-39
Event Delay 2-11, 6-40, 6-41
Event Interval 6-41
Event Interval Trigger 2-10
Event Reference Time 6-43
Event Sequence 2-11, 6-40, 6-42
Examples of Expressions 9-20
Expressions 9-17
External Trigger Input 15-1
eye pattern measurement 10-35
Eye Patterns 6-70

F

Page
FFT Analysis 2-31, 10-22
FFT key 1-6
FFT Parameter 6-69
FFT Parameters for Determination 6-67
Field Number 6-36
File Extensions for Setup Information 13-10
FILE Key 1-7
File Name 13-7
File Operations 13-17
File Server Type 14-12
Filter1/Filter2 9-18
Filter Order 9-4
Filter Type 9-4
Float 13-5
Font Size 16-3
Frame Skip 6-38
FTP 14-12

G

Page
Gate Channel 10-21
GO/NO-GO Determination 2-18, 6-56, 6-65
GO/NO-GO Signal Output 15-4
Gradation Mode 8-5
Grade 8-5
Graticule 8-3
Grid/Cursor 8-4
Grouping 2-14, 5-9, 5-11

H

Page
Handling Roll Paper 12-1
HDTV 6-35
Help key 1-1
HF Rejection 2-13, 6-8
High and Low Levels 10-15
High Resolution 12-6
High Resolution Mode 2-16, 7-3
Histogram Display 10-28
Histograms (wave parameter) 10-28
History Data 13-6
History Data Statistical Processing 10-19
History Feature 2-19, 11-4
HISTORY key 1-5
History Search 2-20
History Statistics Menu 10-17
Hold-off Time 6-2
Horizontal Axis 2-4
How Waveform Areas Are Calculated App-1
H Range 10-29
H Span 10-29
Hysteresis 6-8

I

Page
IIR Filter 2-24, 9-4
Indicator Feature 10-12, 10-16
Initial Computation Point 9-5
Initializing All Ethernet Interface Settings 14-24
Initializing the Vertical Zoom 8-11
Input Coupling 2-3, 5-3
Installation Conditions 3-3
Integration 2-24, 9-5
Intensity 8-4
Interleave Mode 2-16, 7-3
Interpolation Mode 2-17, 7-4
Inverted Waveform Display 2-4, 5-4

J

Page
Jog Shuttle Adjusts 4-2

K

Page
Key Operations 4-1
Key Test 17-7

L

Page
Labels 5-5
Labels and Units 9-14
Latch 6-50
Level/Hys 10-16
LEVEL Knob 1-5
Linear Scaling 5-5
Line Number 6-36
List Display (FFT) 10-29, 10-30
Lists (wave parameter) 10-28
Loading Measured Data 13-14
Loading Other Types of Data 13-16
Loading Reference Waveforms 9-12
Loading Setup Data 13-15
Load Zone 11-7
Logic Edge Qualified 6-11
Logic Edge Qualified Trigger 2-6
LOGIC Keys 1-4
Logic Pulse 6-21
Logic Pulse State 6-29

Logic Pulse State Trigger 2-9
Logic Pulse Trigger 2-8
Logic Signal(trigger) 6-13, 6-18, 6-23, 6-31
Logic Signal Bit Order 10-4
Logic Signal Format 10-4
Logic Signal State Data 13-6
Logic State 6-16
Logic State Trigger 2-7

M

Page
MAC Address 14-5
Mail-Mode 6-53
Mail Transmission 6-54
Making Folders 13-19
Mapping 5-11
Marker Cursors 10-5, 10-8
MASK key 1-6
Mask Test 2-29, 10-34
Mask Tests 6-70
Mass Storage 13-23
MATH/REF Key 1-6
MATH/REF Menu 9-1
Math on History 9-19
Math on History Exec 9-11
Measure (accum histogram) 10-33
Measure (FFT) 10-26, 10-30
Measure (XY) 10-21
MEASURE Key 1-6
Measurement Items 10-13
Measurement of the Delay between Waveforms 10-11
Measurement Resolution 2-2
Measurements on FFT Waveforms 10-26
Memory Test 17-7
MENU key 1-7
Menu Language 16-1
Message Language 16-1
Messages 17-2
Microsoft Network 14-12
MODE key 1-5
model iii
Modify Zone 11-7
Monitoring 14-16
Monitor the DL6000/DLM6000 14-14
Moving Files 13-18

N

Page
Network Drive 13-3
Network Printer 14-19
New REF Trace 11-6
Nogo Count 6-61
Normal 6-2
Normal Mode (acquisition) 2-15, 7-2
Normal Mode (trigger) 2-6
N Single: 6-2
N Single Mode 2-6
NTSC 6-33

O

Page
Offset Cancelling 5-6
Offset Voltage 2-4, 5-6
One 11-1, 11-3
Operators 9-17
Order 5-10
Overview 17-8

P

Page
PAL 6-34
PC Card 13-1
PC Card Test 17-7
Peak Cursors 10-26
Performing Rotary Counting 9-8
Phase Correction of the Probe 3-13
Phases A and B 9-9
Phase Shift 9-4
Phase shift 2-24
Polarity 2-12, 6-7
Polygonal Zone 6-58, 6-61
POSITION Knob 1-4
power cord 3-6
Power Switch 3-7
power switch 1-1
Print 6-53
Printer Test 17-7
Printing on a Network Printer 12-9
Printing Using a USB Printer 12-7
Printing Using the Built-in Printer 12-6
PRINT Key 1-7
Probe Attenuation 2-3, 5-4
probe power terminal 3-10
Protect 13-19
Pulse 6-20
Pulse Qualified 6-25
Pulse Qualified Trigger 2-8
Pulse State 6-28
Pulse State Trigger 2-9
Pulse Trigger 2-8

Q

Page
Qualification 6-25
Qualification(Edge) 6-12

R

Page
Ranging 9-2
Ratio 5-12
Real-time Sampling Mode 2-17, 7-4
Realtime 2-17
Rear Panel (DL6000) 1-2
Rear Panel (DLM6000) 1-3
Recalling Setup Information 4-16
Recommended Replacement Parts 17-11
Record Length 2-16, 7-1
Rectangular Zone 6-57, 6-60
Reference Levels for Time Measurements 10-11
Reference Times 6-22
Reference Waveforms 9-12
reference waveforms 2-24
Renaming Files 13-19
Renaming Folders 13-19
Repetitive Sampling Mode 2-17, 7-4
Replay 11-2
RESET key 1-7, 4-3
Roll Mode 5-13
Roll Mode Display 2-5
Rotary Count 2-25
Rubber Feet 3-5
RUN/STOP Key 1-7
RUN and STOP 7-5

S

Page
Sample Rate 2-16
Sampling Mode 2-16, 7-3
Save to File 6-53
Saving and Loading Data on a Network Drive 14-6
saving FFT data 13-12

Saving Histogram 13-13
Saving Measured Data 13-4
Saving Multiple Records 13-8
Saving Power Supply Analysis Results 13-12
Saving Serial Bus Frame List 13-13
Saving Setup Data 13-9
Saving Snapshot Waveforms 13-13
Saving Waveform Parameters 13-12
Saving Waveform Zones 13-13
SCALE Knob 1-4
Scale Value Display 8-3
Scaling Coefficient 5-5
SDTV 6-34
Search Conditions 10-38
Searching by Polygonal Zone 11-7
Searching by Rectangular Zone 11-6
Searching by Waveform Zone 11-6
Searching for an XY Parameter 11-12
Searching for Edges 10-38
Searching for FFT Parameters 11-12
Searching for History Waveforms by Zone 11-5
Searching for History Waveforms Using Parameters 11-10
Searching for Pulse Widths on a Logic Signal 10-42
Searching for State Conditions 10-39
Searching for State Conditions on a Logic Signal 10-40
Searching for State Widths 10-41
Searching for State Widths on a Logic Signal 10-43
Searching for Waveform Parameters 11-11
Searching on a Serial Bus Signal 10-43
Searching Waveforms 10-38
SEARCH Key 1-6
Search Source 11-13
Selecting Files and Folders 13-18
Select No. 11-3
Self-Tests 17-6
Serial Cursors 10-6, 10-8
Serial Pattern 6-47
Serial Trigger 2-10
SET key 1-7, 4-3
Set the Date and Time (SNTP) 14-11
SETUP MENU Key 1-5
Setup Trace 9-1
SHIFT Key 1-6
Signal acquisition state 1-8
Simultaneous Analog Waveform Display 5-12
Sine Interpolation 2-22
SINGLE 7-5
SINGLE Key 1-7
Single Mode 2-6, 6-2
Slope 6-7
Smoothing 2-24, 9-4
Snapshot 2-23, 8-7
soft keys 1-1
Soft Key Test 17-7
Specified Record Length 2-5
Spectrum Type 10-24
Splitting the Screen 2-22
Start/End 11-3
State Condition 6-16, 6-17
State Display 2-14, 5-9, 5-11
State Trigger 2-7
Statistical Processing 2-28, 10-19
Statistical Processing on Measured Waveform Parameter Values 10-17
Storage Media Indication Examples 13-7
Storing Setup Information 4-16
suffix code iii
Sync Signal Guard Frequency 6-36
System Information 17-8

T

Page

Threshold Level (logic) 2-14
Threshold Levels (logic) 5-9, 5-12
Time/div 5-13
TIME/DIV Knob 1-4
Time Axis 2-4
Time Axis Setting 2-5, 2-16
time difference 3-16
Timestamps 11-2
Time Width Mode 6-22, 6-31
Time Width Modes 6-42
Trace Number 9-1
Tracking Mode 10-9
Translucent 2-23
Translucent Display 16-3
Trend Display 10-28
Trends (wave parameter) 10-28
Trigger Coupling 2-13, 6-7
Trigger Delay 2-12, 6-3, 6-4
Trigger Holdoff 2-12
Trigger Hysteresis 2-13
Trigger Level 6-9
Trigger level 2-12
Trigger Mode 6-2
Trigger Modes 2-6
Trigger Output 15-2
Trigger Position 2-12, 6-3, 6-4
Trigger Slope 2-12, 6-7
Trigger Source 2-12, 6-7
Trigger Type 2-6
Turning the Firewall 14-22
TV Trigger 2-10, 6-33

U

Page

Unit 9-14
Upper/Lower 10-16
USB Keyboard 4-7
USB Keyboard Language 16-1
USB Mouse 4-9
USB Storage Devices 13-2
USB TMC 13-23
User-Defined Computation 2-25
UserdefTV 6-35
Using Conditions to Limit a Pulse Width Search on a Logic Signal 10-42
Using Qualifications to Limit an Edge Search 10-39
Using Qualifications to Limit an Edge Search on a Logic Signal .. 10-40
Using Qualifications to Limit a Pulse Width Search 10-41
Using the Handle (DL6000) 3-2
UTILITY Key 1-7

V

Page

Vertical Display Range (logic) 5-10
Vertical Position 5-2, 5-7
Vertical Position (logic) 5-10, 5-12
Vertical Positions of Waveforms 2-2
Vertical Scale 5-2, 5-6
Vertical Scale Setting 2-2
Video Signal Output 15-3
Viewing Setup Information 16-2
VT Cursor 10-4, 10-7

W

Page

Waveform Acquisition 7-5
Waveform Display 5-3
Waveform Display Color 8-3

waveform display range 9-2
Waveform Mapping 2-22, 8-3
Waveform Parameter 6-69
Waveform Parameter Search 2-20
Waveform Parameters for Determination 6-66
Waveforms to Save 13-6
Waveform Zone 6-57, 6-60
Waveform Zoom 2-21
Window Comparator 2-13, 6-8

X

Page

X-Y Analysis 2-30
XY key 1-5
XY Parameters for Determination 6-67
XY Waveform Parameter 6-69
XY waveforms analysis 10-20

Z

Page

Zone Search 2-20
Zoomed Waveform 8-11
Zoomed Waveforms 8-10
Zoom Factor 8-10, 8-11
ZOOM key 1-6
ZOOM Knob 1-6
Zoom Link 8-9
Zoom Position 8-10, 8-11
zoom screen 1-9
Zoom Windows On and Off 8-9