DL750/DL750P
ScopeCorder

USER'S MANUAL

Part 1 **Part 2**

GiGAZoom
E N G I N E ™

Thank you for purchasing the DL750/DL750P ScopeCorder.
This user's manual contains useful information about the instrument's functions and operating procedures and lists the handling precautions of the DL750/DL750P. It mainly focuses on the DL750. The user's manual is divided into two parts, Part 1 and Part 2. For details on the information covered in Part 1 and Part 2 as well as other DL750/DL750P manuals, see "Manuals That Come with the DL750/DL750P" on the next page. To ensure correct use, please read this manual thoroughly before beginning operation. After reading the manual, keep it in a convenient location for quick reference whenever a question arises during operation.

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from those that actually appear on your screen.
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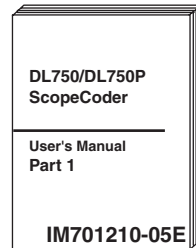
Revisions

- 1st Edition: February 2005
- 2nd Edition: May 2005
- 3rd Edition: December 2005

Manuals That Come with the DL750/DL750P

DL750/DL750P Manuals

The following manuals are provided for the DL750/DL750P. Use them according to your application.

User's Manual Part 1

DL750/DL750P ScopeCoder

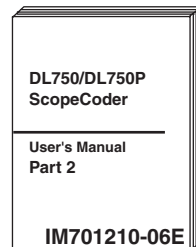**User's Manual Part 1**

IM701210-05E

This manual. Contains chapters 1 to 9 of the DL750/DL750P User's Manual. Mainly describes the basic operations of the DL750/DL750P up to waveform acquisition.

[Contents]
- **Chapter 1 Names and Functions of Parts**
- **Chapter 2 Explanation of Functions**
- **Chapter 3 Making Preparations for Measurements**
- **Chapter 4 Common Operations**
  Operations and functions of keys and the jog shuttle, entering values and strings, operations on the USB keyboard/USB mouse, initializing settings, auto setup, calibration, and help function
- **Chapter 5 Horizontal and Vertical Axes**
- **Chapter 6 Triggering**
- **Chapter 7 Acquisition and Display**
  Record length, acquisition mode, sequential store, dual capture, realtime recording to the internal hard disk, voice memo, and acquisition memory backup
- **Chapter 8 Waveform Display and Information Display**
- **Chapter 9 Recording in Recorder Mode (Realtime Recording) (DL750P Only)**
- **Index** Common to Part 1 and Part 2.

User's Manual Part 2

DL750/DL750P ScopeCoder

**User's Manual Part 2**

IM701210-06E

Contains chapters 10 to 19 and appendix of the DL750/DL750P User's Manual. Mainly describes operations after waveform acquisition and optional functions.

[Contents]
- **Chapter 10 Waveform Computation**
- **Chapter 11 Waveform Analysis/Search**
  Displaying of history waveforms, history search, search & zoom, cursor measurements, automated measurement of waveform parameters, statistical processing, and GO/NO-GO determination
- **Chapter 12 Printing the Screen Image Data**
- **Chapter 13 Saving and Loading Data**
- **Chapter 14 External Trigger I/O, External Clock Input, and Video Signal Input**
- **Chapter 15 Using the DSP Channel (Optional)**
- **Chapter 16 Ethernet Interface (Optional)**
- **Chapter 17 Other Operations**
  Changing the menu/message language, turning the click sound ON/OFF, changing the USB keyboard language, checking the USB keyboard, setting the screen color/brightness, setting the backlight, and locking the keys
- **Chapter 18 Troubleshooting, Maintenance, and Inspection**
- **Chapter 19 Specifications**
- **Appendix**
- **Index** Common to Part 1 and Part 2.

Operation Guide

DL750/DL750P
ScopeCoder

Operation Guide

IM701210-07E
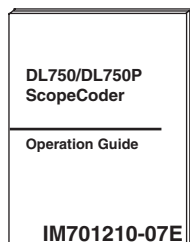
Familiarizes the first-time user with the basic operations of the DL750/DL750P.
Latter half of the guide summarizes key points of each setup menu. Use this as a guide when setting up the DL750/DL750P.

[Contents]
- **Flow of DL750/DL750P Operation**
- **Front Panel Controls**
- **Parts of the Screen**
- **Basic Key & Jog Shuttle Operations**
- **Main Functions of the DL750/DL750P**
- **Operating the DL750/DL750P**
  Making preparations before observation, displaying waveforms, changing the waveform display conditions, changing the trigger settings, measuring waveforms, zooming the waveform along the time axis, and printing/saving waveforms
- **Setup Menu Items**

Communication Interface User's Manual

DL750/DL750P
ScopeCorder

B8023YZ
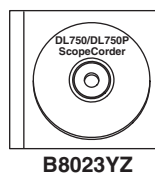
A manual in PDF format that is stored in the accompanying CD-ROM. Describes the functions of each communication interface on the DL750/DL750P and commands.

[Contents]
- **Chapter 1   Overview of the GP-IB Interface**
- **Chapter 2   Overview of the Serial (RS-232) Interface**
- **Chapter 3   Overview of the USB Interface**
- **Chapter 4   Overview of the Ethernet Interface (Optional)**
- **Chapter 5   Before Programming**
- **Chapter 6   Commands**
- **Chapter 7   Status Reports**
- **Chapter 8   Sample Programs**
- **Appendix**
- **Index**

User's
Manual

IM701210-71E
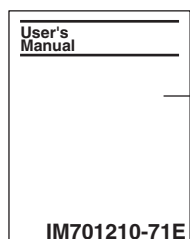
Handling of the Communication Interface User's Manual CD-ROM

Describes the handling precautions of the Communication Interface User's Manual CD-ROM.

Functions Described in This Manual and the DL750/ DL750P Version

The contents of this manual describe the DL750/DL750P version 6.20 or later. The table below shows the relationship between the DL750/DL750P versions and the new functions and supported modules. If the DL750/DL750P is not of the newest version, you will not be able to use all the functions covered in this manual. Check the DL750/DL750P version by referring to Soft Version on the overview screen that appears by selecting the MISC key > Overview soft key. For details on the procedure, see section 18.4 in the User's Manual Part 2. For up-to-date information about the DL750/DL750P versions and the procedure for upgrading your DL750/DL750P, check the following Web page.
http://www.yokogawa.com/tm/DL750/

DL750/DL750P Versions and New Functions

Version	Suffix Code	New Functions	Reference Page/ Section/Chapter
1.09 or later	Standard	• Voice memo and voice comment	*Pages 2-36* and *2-64, sections 7.9* and *13.19*
2.02 or later	Standard	• Wave window trigger • Cycle statistical processing • Chinese menu and message support	*Page 2-26* and *section 6.17* *Page 2-57* and *section 11.7* *Section 17.1*
	/G3	• DSP channels	*Page 2-50, chapter 15,* and *appendix 6*
3.01 or later	Standard	• Numeric monitor display • Added exponential window to FFT computation/increased number of points in FFT computation (up to 100 kpoints). • Normal statistical processing/statistical processing of history memory • Increased the number of parameters for automated measurement/statistical processing of waveform parameters (Up to 24000 increased to up to 48000) • Added waveform data save formats for action-on-trigger and GO/NO-GO determination (select from binary, ASCII, and floating) • Support for inverted display on the strain module • Support for current probe (701931)	*Page 2-39* and *section 8.13* *Page 2-47, section 10.5, page app-21* *Page 2-57* and *section 11.7* *Sections 11.6* and *11.7* *Pages 2-29* and *2-58,* and *Section 13.7* *Page 2-14* and *section 5.12* *Page 2-9* and *section 3.6*
	/G3	• Support for enhanced trigger (OR trigger and window trigger) on DSP channels • Knocking filter	*Pages 2-22* and *2-26, chapter 15* *Section 15.6*
3.10 or later	Standard	• Added Korean to the menu languages. Added Korean, German, French, and Italian to message languages.	*Section 17.1*
4.01 or later	Standard	• Changed the number of screens that can be captured on the dual capture function • Selection of the traces to be displayed on the dual capture function • Mail transmission using the dual capture trigger function • Automated measurement of waveform parameters on the dual capture function • Added the action on stop function. • Parameter search of the history memory function • Added H&V cursor measurement to T-Y waveforms	*Page 2-34* and *section 7.6* *section 7.6* *section 7.6* *section 11.6* *section 7.8* *section 11.3* *section 11.5*
	Standard, /G3 /C10	• Filter Hz display • SNTP function • WebDAV server function • Mail attachment function of image data	*Sections 10.5* and *15.3* *Sections 3.5* and *16.8* *Section 16.11* *Section 16.5*
	/DC	• Added the DC power supply option (DL750 only)	*Section 3.4*
4.02 or later	Standard	• START/STOP key response time	*Section 7.1*
5.01 or later	Standard	• Recording in recorder mode (DL750P only) • Connection of USB storage device to the USB PERIPHERAL interface (DL750P only) • Creation of PDF files of the printed image (DL750P only) • Support for current probe (701933) • Added 16 divided windows to the display format • Added the output format to the built-in printer (Zoom Print) and changed the name of the function Long copy to Fine print • Added the linear scaling display format	*Chapter 9* *Section 13.3* *Section 13.13* *Page 2-9* and *section 3.6* *Section 8.1* *Section 12.2* *Section 5.11*
6.01 or later	Standard	• Creation of PDF files of the reprint image in X-Y Recorder Mode (DL750P only) • Creation of PDF files of the printed image (X-Y waveform) (DL750P only)	*Section 9.9* *Section 13.3*
	Standard, /G2	• Overall value display of the power spectrum computation (FFT)	*Section 10.3, 10.5, 11.6, and page App-19*

Version	Suffix Code	New Functions	Reference Page/ Section/Chapter
6.02 or later	Standard	• Connection of USB storage device to the USB PERIPHERAL interface (DL750)*	*Section 13.3*
6.20 or later	Standard	• Added waveform icons to the title of the CH/DSP/LOGIC/EVENT setup menus.	*Section 5.1*
		• Added All ON of Variable (Var.) to the all channel setup menu.	*Section 5.13 (section 5.9)*
		• Added ACQ Count to the action-on-trigger/action-on-stop setup menu.	*Sections 6.18 and 7.8*
		• Added bandwidth limit to the channel information during temperature/strain measurement.	*Section 8.13*
		[Recording in recorder mode (DL750P only)] • Added an Extra Area ON/OFF function when the format is set to Dual, Triad, or Quad in the print settings of Chart Recorder mode.	*Section 9.4*
		• Added the Fine setting to Gauge in the print settings of Chart Recorder mode.	*Section 9.4*
		• Added A4 print to the print length during reprint in Chart Recorder mode.	*Section 9.8*
		• Selection of the print font size (Print Font) in the print settings of X-Y Recorder mode.	*Section 9.7*
		• Support for phase shift even when external clock is selected.	*Section 10.4*
		[Printing on the built-in printer (DL750P only)] • Added A4 print to the output format.	*Section 12.2*
		• Added an Extra Area ON/OFF function when the format is set to Dual, Triad, or Quad in the print settings of fine print, zoom print, and A4 print.	*Section 12.2*
		• Added the Fine setting to Gauge in the print settings of fine print, zoom print, and A4 print.	*Section 12.2*
		• Creation of PDF files of the print image when all waveform display (Display Mode: All) is selected in the history memory function (DL750P only).	*Section 13.13 (section 11.1)*
		• Added a function for switching the screen display font size (large or small).	*Chapter 17*
	/G2	• Added DUTYH and DUTYL to the user-defined computation.	*Section 10.5*

* Applicable to DL750s on which "USB Storage: Yes" is displayed on the overview screen that appears when you press the MISC key followed by the Overview soft key.
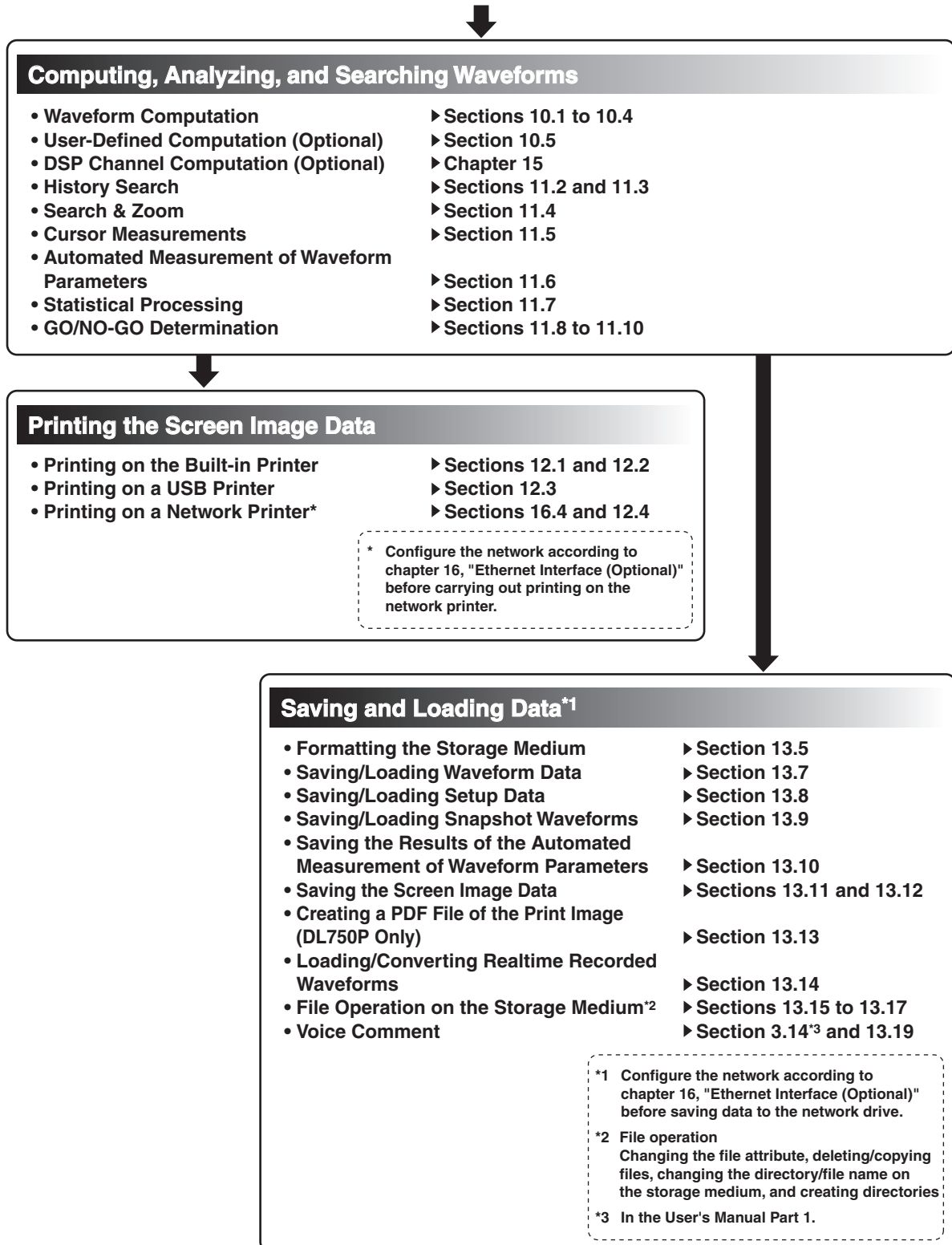
DL750/DL750P Versions and Supported Modules

Version	Supported Modules Reference Page Vertical Axis Settings	Specifications Concerning Horizontal/	Reference Section
1.07 or later	701250 High-Speed 10 MS/s, 12-Bit Isolation Module	*Page 19-18*	*Sections 5.1 to 5.15*
	701251 High-Speed High-Resolution 1 MS/s, 16-Bit Isolation Module	*Page 19-20*	*Sections 5.1 to 5.15*
	701265 Temperature, High Precision Voltage Isolation Module	*Page 19-29*	*Sections 5.1, 5.2, 5.5, 5.7, 5.13, 5.14, and 5.16*
2.02 or later	701255 High-Speed 10 MS/s, 12-Bit Non-Isolation Module	*Page 19-22*	*Sections 5.1 to 5.15*
	701260 High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS)	*Page 19-24*	*Sections 5.1 to 5.15*
	701270 Strain Module (NDIS)	*Page 19-31*	*Sections 5.1, 5.2, 5.7, 5.11 to 5.14, and 5.17*
	701271 Strain Module (DSUB, Shunt-Cal)	*Page 19-33*	*Sections 5.1, 5.2, 5.7, 5.11 to 5.14, and 5.17*
3.01 or later	701275 Acceleration/Voltage Module (with AAF)	*Page 19-35*	*Sections 5.1, 5.2, 5.4, 5.5, 5.7 to 5.9, 5.13, 5.14, and 5.18**
	701280 Frequency Module	*Page 19-37*	*Sections 5.19, 5.1, 5.2, 5.4, 5.8 to 5.11, 5.13, and 5.14*
5.01 or later	701261 Universal (Voltage/Temp.) Module	*Page 19-26*	*Sections 5.1, 5.2, 5.4, 5.5, 5.7 to 5.9, 5.13, and 5.14*
	701262 Universal (Voltage/Temp.) Module (with AAF)	*Page 19-26*	*Sections 5.1, 5.2, 5.4, 5.5, 5.7 to 5.9, 5.13, and 5.14*

* Reference section for acceleration measurement.

Flow of Operation

The figure below provides an overview of the flow of operations described in this manual. For a description of each item, see the relevant chapter or section.

From "Waveform Acquisition" of User's Manual Part 1 (see page Part 1:xv)

Computing, Analyzing, and Searching Waveforms

• Waveform Computation	▶ Sections 10.1 to 10.4
• User-Defined Computation (Optional)	▶ Section 10.5
• DSP Channel Computation (Optional)	▶ Chapter 15
• History Search	▶ Sections 11.2 and 11.3
• Search & Zoom	▶ Section 11.4
• Cursor Measurements	▶ Section 11.5
• Automated Measurement of Waveform Parameters	▶ Section 11.6
• Statistical Processing	▶ Section 11.7
• GO/NO-GO Determination	▶ Sections 11.8 to 11.10

Printing the Screen Image Data

• Printing on the Built-in Printer	▶ Sections 12.1 and 12.2
• Printing on a USB Printer	▶ Section 12.3
• Printing on a Network Printer*	▶ Sections 16.4 and 12.4

> * Configure the network according to chapter 16, "Ethernet Interface (Optional)" before carrying out printing on the network printer.

Saving and Loading Data[1]

• Formatting the Storage Medium	▶ Section 13.5
• Saving/Loading Waveform Data	▶ Section 13.7
• Saving/Loading Setup Data	▶ Section 13.8
• Saving/Loading Snapshot Waveforms	▶ Section 13.9
• Saving the Results of the Automated Measurement of Waveform Parameters	▶ Section 13.10
• Saving the Screen Image Data	▶ Sections 13.11 and 13.12
• Creating a PDF File of the Print Image (DL750P Only)	▶ Section 13.13
• Loading/Converting Realtime Recorded Waveforms	▶ Section 13.14
• File Operation on the Storage Medium[2]	▶ Sections 13.15 to 13.17
• Voice Comment	▶ Section 3.14[3] and 13.19

> [1] Configure the network according to chapter 16, "Ethernet Interface (Optional)" before saving data to the network drive.
>
> [2] File operation
> Changing the file attribute, deleting/copying files, changing the directory/file name on the storage medium, and creating directories
>
> [3] In the User's Manual Part 1.

Ethernet interface and other operations do not have to be configured in order from previous chapter. They can be configured independently.

Ethernet Interface (Optional)

• Connecting the DL750/DL750P to the PC* ▶Section 16.1

• Setting TCP/IP ▶Section 16.2

• Saving/Loading data on a network drive
  (FTP client function) ▶Section 16.3
• Transmitting E-mail messages ▶Section 16.5
• Accessing the DL750/DL750P from the PC*
  (FTP server function) ▶Section 16.6
• Web server function ▶Section 16.7
• Using as a Windows network drive ▶Section 16.11

* PC or workstation

Other Operations

• Setting the menu/message language ▶Section 17.1
• Turning click sound ON/OFF ▶Section 17.1
• etting the USB keyboard language ▶Section 17.3
• Setting the screen color and intensity ▶Section 17.4
• Setting the backlight ▶Section 17.5
• Locking the keys ▶Section 17.6

The functions below that are not covered in the flow of operations in this section are not explained in this manual. For their descriptions, see the User's Manual Part 1 (IM701210-05E).

- Making preparations for measurements
- Displaying waveforms on the screen
- Setting the horizontal and vertical axes
- Setting the trigger
- Acquiring waveforms
- Displaying waveforms and information
- Recording in recorder mode (DL750P only)

Contents

Appendix

Index

User's Manual Part 1 (See IM701210-05E for the chapters listed below.)

Chapter 4   Common Operations

Chapter 5   Horizontal and Vertical Axes

Voltage Measurement (On the 701250, 701251, 701255, 701260, 701261, 701262, 701265, or 701275)

Temperature Measurement (On the 701261, 701262, or 701265)

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App

Index

10.1 Adding, Subtracting, Multiplying, and Dividing Waveforms

<For a description of this function, refer to page 2-47.>

Procedure
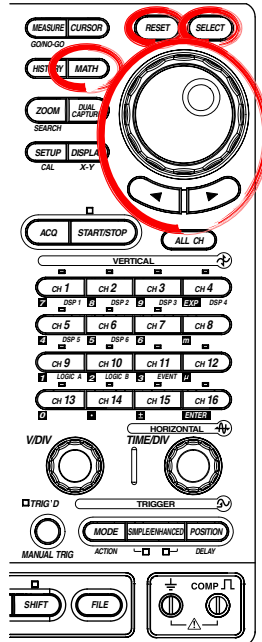
1. Press **MATH**.
2. Press the **Mode** soft key to select ON.

Setting the Computation Start and End Points

3. Press the **Start Point/End Point** soft key to set the jog shuttle control to Start Point.
4. Turn the **jog shuttle** to set the computation start point.
5. Likewise, set the End Point.

Setting the Computation

6. Press the **Setup** soft key. The Math1 to Math8 setup dialog boxes appear.
7. Use the **jog shuttle** and **SELECT** to select the Math waveform you wish to set. The corresponding Math waveform setup dialog box appears.

Setting the Computing Operation

8. Use the **jog shuttle** and **SELECT** to set Operation to S1+S2, S1–S2, S1*S2, or S1/S2.

Selecting the Channel on Which to Perform Computation

9. Use the **jog shuttle** and **SELECT** to select Source1.
10. Likewise, select Source2.

Setting the Scaling

11. Use the **jog shuttle** and **SELECT** to set Scale to Auto or Manual.
    If you select Manual, proceed to step 9; if you select Auto, proceed to step 11.

Above is the menu when the user-defined computation option is installed.
The menu on models without the option is as follows:*1: Phase Shift, *2: Threshold, *3: Start Point/End Point, *4: Exec

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Waveform Computation

Setting the Upper and Lower Limits of Waveform Display

(When Scale Is Set to Manual)

12. Use the **jog shuttle** and **SELECT** to set Upper.
13. Likewise, set Lower.

Note

> If you select Auto, you cannot set Upper and Lower.

Setting the Unit

14. Use the **jog shuttle** and **SELECT** to set the Unit using up to four characters according to the procedure given in section 4.2.

Setting the Label

15. Use the **jog shuttle** and **SELECT** to enter the Label according to the procedure given in section 4.2. For a description of the Label display, see section 8.10, "Setting Waveform Labels."

Turning ON/OFF the Math Waveform Display

16. Use the **jog shuttle** and **SELECT** to set Display to ON or OFF.

As necessary, set Math2 to Math8 in a similar fashion.

Executing the Computation

17. Press the **Exec** soft key.
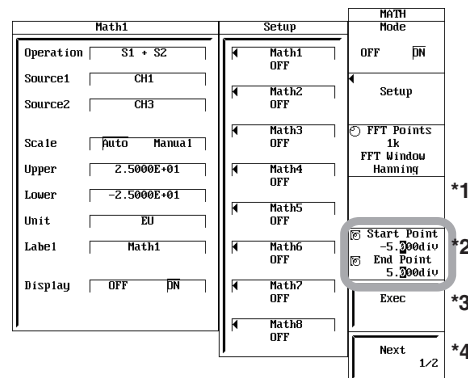
```
                                              MATH
            Math1                Setup         Mode

 Operation    S1 + S2        ◄    Math1      OFF    ON
                                  OFF
 Source1        CH1          ◄
                                  Math2          Setup
 Source2        CH3          ◄    OFF

                             ◄    Math3    ⟳ FFT Points
 Scale     Auto   Manual          OFF            1k
                             ◄    Math4       FFT Window
 Upper     2.5000E+01             OFF           Hanning      *1
 Lower    -2.5000E+01        ◄    Math5
                                  OFF
 Unit          EU            ◄    Math6      ⌧ Start Point
                                  OFF          -5.000div    *2
 Label        Math1                          ⌧ End Point
                             ◄    Math7          5.000div
                                  OFF
 Display   OFF     ON                            Exec        *3
                             ◄    Math8
                                  OFF
                                                 Next        *4
                                                 1/2
```

Above is the menu when the user-defined computation option is installed.
The menu on models without the option is as follows:
*1: Phase Shift, *2: Threshold, *3: Start Point/End Point, *4: Exec

Explanation

Addition, subtraction, multiplication, and division can be performed between channels.

Computation Target Channel

CH1 to CH16, DSP1 to DSP6 (optional), and Math1 to Math8

Setting the Computation Range: Start Point/End Point

By default, the measurement range is ±5 divisions of the display frame on the time axis. You can limit this range.

The concept of the computation range is analogous to the concept of the selectable range of cursor display position in cursor measurement.

For details, see section 11.5, "Selectable Range of Cursor Position."

Setting the Scaling

Set the upper and lower limits of the math waveform display.

Auto: The upper and lower limits are set according to the computed result.
Manual: The upper and lower limits can be set arbitrarily. The range is from –9.9999E+30 to 9.9999E+30.

Setting the Unit

Unit can be set arbitrarily using up to four characters. The specified characters are applied to the scale values.

Linear Scaling

When performing computation on a channel that has linear scaling set, the computation is performed on the scaled value.

Notes when Performing Computation

Computation is not performed again when you change Start Point or End Point while computation is stopped. Be sure to press the Exec soft key to perform the computation again. Otherwise, the waveform will not be displayed correctly when the screen is redrawn.

Note

While computation is in execution, ▦ is displayed at the upper left corner of the screen.

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Waveform Computation

10.2 Binary Computation

Procedure

1. Press **MATH**.
2. Press the **Mode** soft key and select ON to display Math waveforms, OFF to not display them. If you select ON, proceed to step 3.

Setting the Computation Start and End Points

3. Press the **Start Point/End Point** soft key to set the jog shuttle control to Start Point.
4. Turn the **jog shuttle** to set the computation start point.
5. Likewise, set the End Point.

Setting the Computation

6. Press the **Setup** soft key. The Math1 to Math8 setup dialog boxes appear.
7. Use the **jog shuttle** and **SELECT** to select the Math waveform you wish to set. A MathX setup dialog box opens.

Setting the Computing Operation

8. Use the **jog shuttle** and **SELECT** to set Operation to Bin(S1).

Selecting the Channel on Which to Perform Computation

9. Use the **jog shuttle** and **SELECT** to select Source1.

Setting the Scaling

10. Use the **jog shuttle** and **SELECT** to set Scale to Auto or Manual.
    If you select Manual, proceed to step 8; if you select Auto, proceed to step 10.
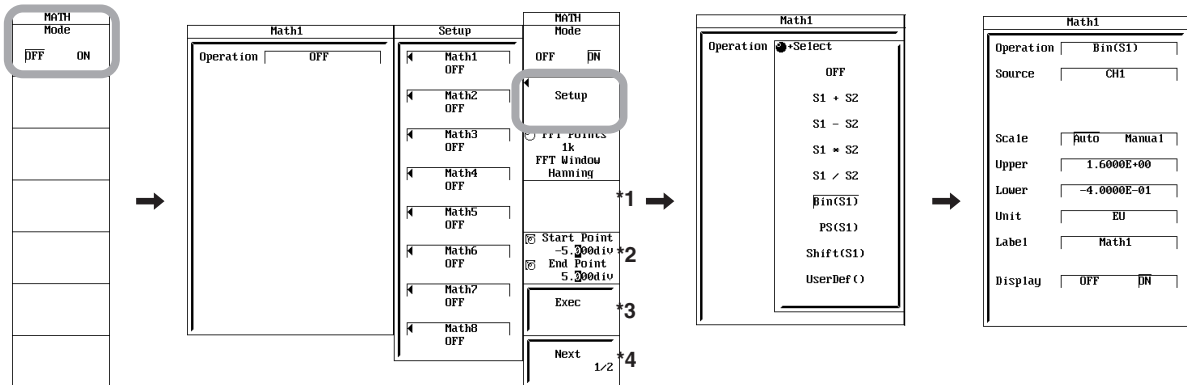
Above is the menu when the user-defined computation option is installed.
The menu on models without the option is as follows:*1: Phase Shift, *2: Threshold, *3: Start Point/End Point, *4: Exec

Setting the Upper and Lower Limits of Waveform Display

(When Scale Is Set to Manual)

11. Use the **jog shuttle** and **SELECT** to set Upper.

12. Likewise, set Lower.

Note

If you select Auto, you cannot set Upper and Lower.

Setting the Unit

13. Use the **jog shuttle** and **SELECT** to set the Unit using up to four characters according to the procedure given in section 4.2.

Setting the Label

14. Use the **jog shuttle** and **SELECT** to enter the Label according to the procedure given in section 4.2. For a description of the Label display, see section 8.10, "Setting Waveform Labels."

Turning ON/OFF the Math Waveform Display

15. Use the **jog shuttle** and **SELECT** to set Display to ON or OFF.

Setting the Threshold Level

16. On models with the user-defined computation option, press the **Next 1/2** soft key.

17. Press the **Threshold** soft key.

18. Use the **jog shuttle** and **SELECT** to set the trace (channel on which to assign the threshold level).

19. Use the **jog shuttle** and **SELECT** to set Thr Upper.

20. Likewise, set Thr Lower.

As necessary, set Math2 to Math8 in a similar fashion.

Executing the Computation

21. Press the **Exec** soft key.
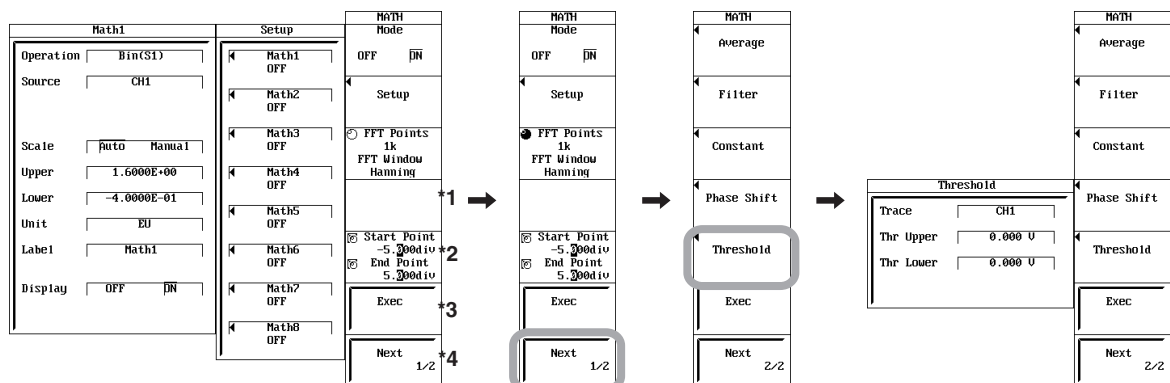
Above is the menu when the user-defined computation option is installed.
The menu on models without the option is as follows:*1: Phase Shift, *2: Threshold, *3: Start Point/End Point, *4: Exec

10

Waveform Computation

Explanation

This function converts CH1 to CH16 or Math1 to Math7 waveform to a digital signal (1s and 0s) according to the specified threshold level.

Setting the Computation Range: Start Point/End Point

By default, the measurement range is ±5 divisions of the display frame on the time axis. You can limit this range.
The concept of the computation range is analogous to the concept of the selectable range of cursor display position in cursor measurement.
For details, see section 11.5, "Selectable Range of Cursor Position."

Setting the Unit

Unit can be set arbitrarily using up to four characters. The specified characters are applied to the scale values.

Linear Scaling

When performing computation on a channel that has linear scaling set, the computation is performed on the scaled value.

Notes When Performing Computation

Computation is not performed again when you change Start Point or End Point while computation is stopped. Be sure to press the Exec soft key to perform the computation again. Otherwise, the waveform will not be displayed correctly when the screen is redrawn.

Note

While computation is in execution, ▦ is displayed at the upper left corner of the screen.

10.3 Performing Power Spectrum Computation (FFT)

Procedure

1. Press **MATH**.
2. Press the **Mode** soft key and select ON to display Math waveforms, OFF to not display them. If you select ON, proceed to step 3.

Setting the Computation Start and End Points

3. Press the **Start Point/End Point** soft key to set the jog shuttle control to Start Point.
4. Turn the **jog shuttle** to set the computation start point.
5. Likewise, set the End Point.

Setting the Computation

6. Press the **Setup** soft key. The Math1 to Math8 setup dialog boxes appear.
7. Use the **jog shuttle** and **SELECT** to select the Math waveform you wish to set. A MathX setup dialog box opens.

Setting the Computing Operation

8. Use the **jog shuttle** and **SELECT** to set Operation to PS(S1).

Selecting the Channel on Which to Perform Computation

9. Use the **jog shuttle** and **SELECT** to select Source.

Setting the Scaling

10. Use the **jog shuttle** and **SELECT** to set Scale to Auto or Manual.
    If you select Manual, proceed to step 11; if you select Auto, proceed to step 13.

Setting the Upper and Lower Limits of Waveform Display
(When Scale Is Set to Manual)

11. Use the **jog shuttle** and **SELECT** to set Upper.
12. Likewise, set Lower.

Note

If you select Auto, you cannot set Upper and Lower.

Above is the menu when the user-defined computation option is installed.
The menu on models without the option is as follows:*1: Phase Shift, *2: Threshold, *3: Start Point/End Point, *4: Exec

10

Waveform Computation

Setting the Unit

13. Use the **jog shuttle** and **SELECT** to set the Unit using up to four characters according to the procedure given in section 4.2.

Setting the Label

14. Use the **jog shuttle** and **SELECT** to enter the Label according to the procedure given in section 4.2. For a description of the Label display, see section 8.10, "Setting Waveform Labels."

Turning ON/OFF the Math Waveform Display

15. Use the **jog shuttle** and **SELECT** to set Display to ON or OFF.

Setting the Number of FFT Points

16. Press the **FFT Points/FFT Window** soft key to set the jog shuttle control to FFT Points.
17. Turn the **jog shuttle** to select 1k, 2k, 5k, 10k, 20k, 50k, or 100k.

Selecting the Time Window

18. While the jog shuttle control is set to FFT Points, press the **FFT Points/FFT Window** soft key again. The FFT Window selection menu appears.
19. Select the time window from Rect, Hanning, FlatTop, and Exponential. You can select Exponential only when the user-defined computation option is installed.
20. If you selected Exponential, press the **Exponential Window Setup** soft key.
21. Use the jog shuttle and SELECT to set Damping Rate, Force1, and Force2.

    As necessary, set Math2 to Math8 in a similar fashion.

Executing the Computation

22. Press the **Exec** soft key.
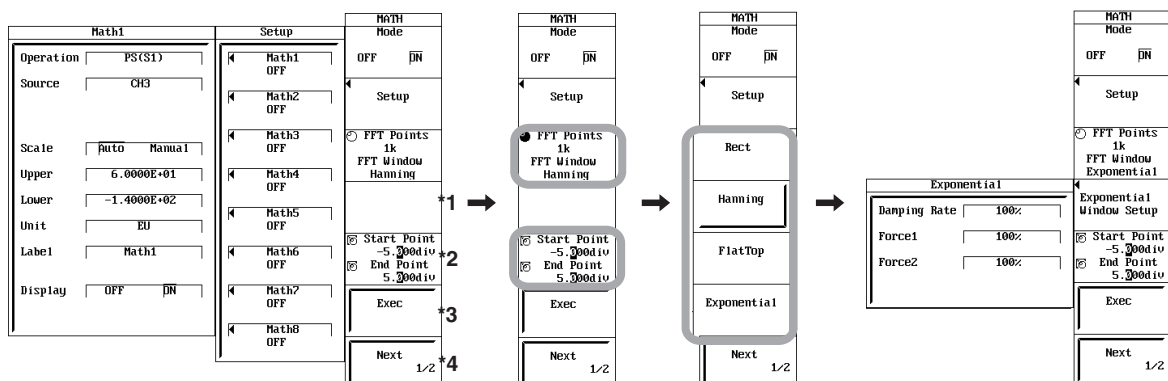
Above is the menu when the user-defined computation option is installed. The menu on models without the option is as follows:*1: Phase Shift, *2: Threshold, *3: Start Point/End Point, *4: Exec

Explanation

This function displays the power spectrum of CH1 to CH16, DSP1 to DSP6 (optional), and Math1 to Math7 waveforms.

Setting the Computation Range: Start Point/End Point

By default, the measurement range is ±5 divisions of the display frame on the time axis. You can limit this range.

The concept of the computation range is analogous to the concept of the selectable range of cursor display position in cursor measurement.

For details, see section 11.5, "Selectable Range of Cursor Position."

Number of Computed Points: FFT Point

Select 1000 (1 k), 2000 (2 k), 5000 (5 k), 10000 (10 k), 20000 (20 k), 50000 (50 k), or 100000 (100 k).

Using the number of computing points from the specified Start point, FFT is performed and the power spectrum is displayed.

Note

If you set the number of FFT points to 50k or greater, only Math1 and Math2 can be used. In this case, Math3 to Math8 cannot be used even in computations other than FFT.

Example 1) Math1: C1×C2, Math2: PS-LOGMAG(M1), Math3: C3×C4,
Math1 to Math3: The number of FFT points is 50k
→ Computes only Math1 and Math2.

Example 2) Math1: C1, Math2: C2, Math3: The number of FFT points is 50k
→ Computes only Math1 and Math2.

Selecting the Time Window

Select from the following four types.

Rect (Rectangular): Best suited for transient signals that attenuate completely within the time window.

Hanning: Best suited for continuous and non-periodic signals.

Flattop: Best suited for improve the accuracy of the level even if the frequency resolution is to be compromised.

Exponential (window): The exponential window eliminates noise components from the signal. It can be selected only when the user-defined computation option is installed.
It is effective against frequency response test signals generated through impulse excitation.

10

Waveform Computation

Damping Rate, Force1, Force 2 (When Window Is Set to Exponential)

Damping rate: Sets the weight of the last data point as a damping rate when taking the weight of the first data point of the FFT computation to be 100% (= 1). Set the value in the range of 1 to 100% (1% resolution). If the damping rate is set to 100%, the window is equivalent to a rectangular window. The setting applies to both the input signal and output (response).

Force1: Sets the area over which computation performed in terms of a percentage from the first FFT point when taking the number of FFT points to be 100%. Set the area in the range of 1 to 100% (1% resolution). If the area is set to 100%, the window is equivalent to a rectangular window. The data outside the area is computed as an average value of the area. The setting applies to the input signal (first parameter) of the one-input FFT or two-input FFT.

Force2: The setting applies to the output (response) signal (second parameter) of the two-input FFT. The setting is the same as Force1.
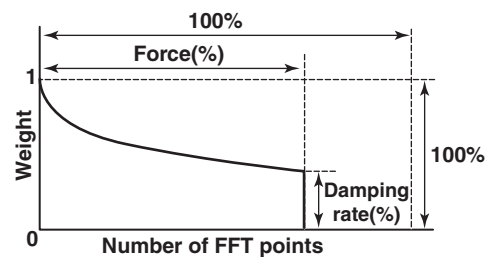
Displaying the Overall Value (Only When Measure Is Set to ON)

If the channels (Math1 to Math8) on which power spectrum computation (PS or PSD*) is selected are in the middle of the automated measurement of waveform parameters (MEASURE: ON) and Rms is ON, the screen shows "Rms = overall value."
For details on the automated measurement of waveform parameters, see section 11.6.
For details on the overall value, see page App-19.
  *   PSD is available only on models with the user-defined computation option (see section 10.5).

Note

If Window is set to Exponential, the overall value is not displayed.

Linear Scaling

When performing computation on a channel that has linear scaling set, the computation is performed on the scaled value.

Notes When Displaying Power Spectrums

• The power spectrum cannot be computed, if the displayed record length is less than number of computation points (Point).
• The number of computed points, time window, Start Point, and End Point are common to all computation channels.
• You cannot expand the FFT waveforms horizontally that would cause the number of points to be 50 or less. In such case, cursor measurement is not possible.

Notes When Performing Computation

• Computation is not performed again when you change Start Point or End Point while computation is stopped. Be sure to press the Exec soft key to perform the computation again. Otherwise, the waveform will not be displayed correctly when the screen is redrawn.
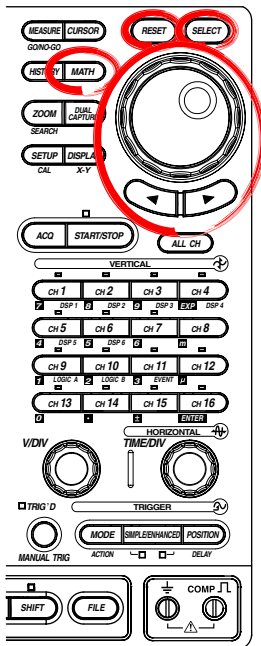• Normally, computation is performed on the sampled data stored in the acquisition memory. However, for waveforms that have been acquired in envelope mode, computation is performed on the maximum/minimum values per acquisition interval.

Note

While computation is in execution, is displayed at the upper left corner of the screen.

10.4 Phase-Shifted Display

Procedure

1. Press **MATH**.
2. Press the **Mode** soft key and select ON to display Math waveforms, OFF to not display them. If you select ON, proceed to step 3.

Setting the Computation Start and End Points

3. Press the **Start Point/End Point** soft key to set the jog shuttle control to Start Point.
4. Turn the **jog shuttle** to set the computation start point.
5. Likewise, set the End Point.

Setting the Computation

6. Press the **Setup** soft key. The Math1 to Math8 setup dialog boxes appear.
7. Use the **jog shuttle** and **SELECT** to select the Math waveform you wish to set. A MathX setup dialog box opens.

Setting the Computing Operation

8. Use the **jog shuttle** and **SELECT** to set Operation to Shift(S1).

Selecting the Channel Whose Phase Is to Be Shifted

9. Use the **jog shuttle** and **SELECT** to select Source1.
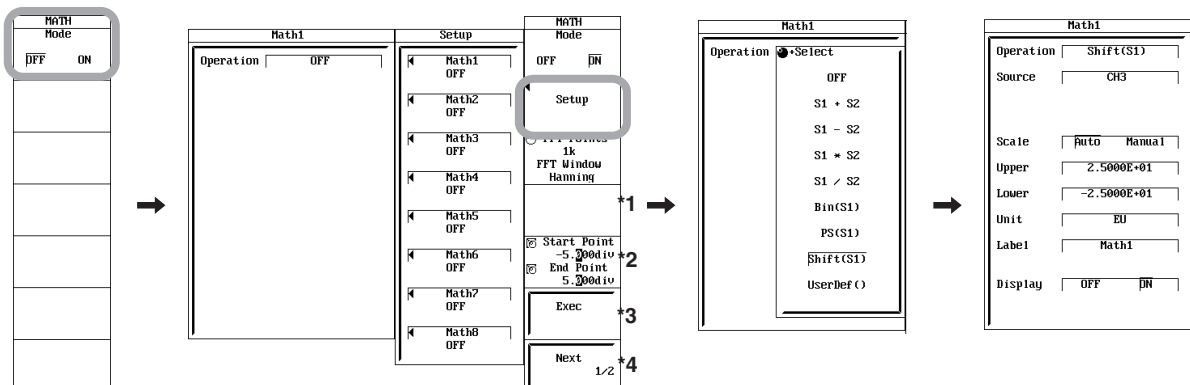
Above is the menu when the user-defined computation option is installed.
The menu on models without the option is as follows:*1: Phase Shift, *2: Threshold, *3: Start Point/End Point, *4: Exec

Selecting the Time (or Data Points) for Shifting the Phase

10. On models with the user-defined computation option, press the **Next 1/2** soft key.

11. Press the **Phase Shift** soft key. A dialog box used to set the phase appears.

12. Use the **jog shuttle** and **SELECT** to set the time or data points for shifting the phase of each waveform. If the time base is set to internal clock (Int), set the time for shifting the phase. If the time base is set to external clock (Ext), set the number of data points for shifting the phase.
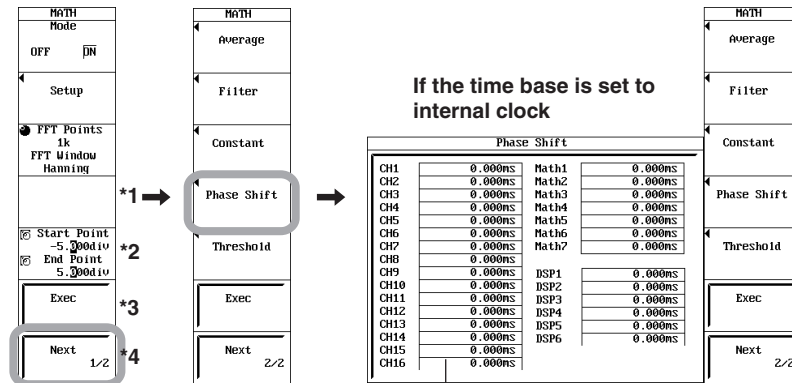
If the time base is set to external clock, the setup menu used to set the number of data points for shifting the phase appears.
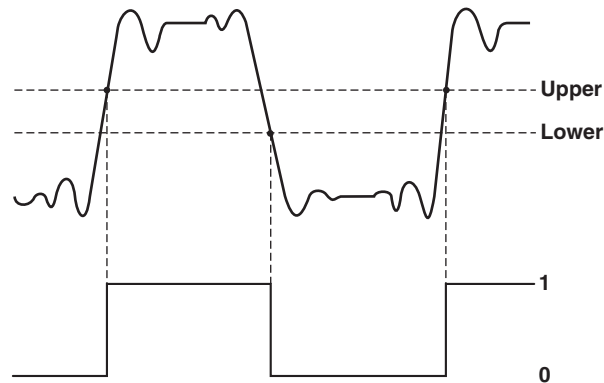
Above is the menu when the user-defined computation option is installed.
The menu on models without the option is as follows:
*1: Phase Shift, *2: Threshold, *3: Start Point/End Point, *4: Exec

Turning ON/OFF the Math Waveform Display

13. Use the **jog shuttle** and **SELECT** to set Display to ON or OFF.

As necessary, set Math2 to Math8 in a similar fashion.

Executing the Computation

14. Press the **Exec** soft key.
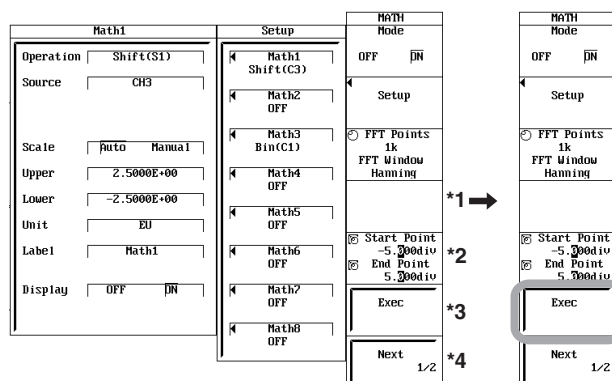
Above is the menu when the user-defined computation option is installed.
The menu on models without the option is as follows:
*1: Phase Shift, *2: Threshold, *3: Start Point/End Point, *4: Exec

Explanation

The phase of CH1 to CH16, DSP1 to DSP6 (optional), and Math1 to Math7 waveforms can be displayed with the phase shifted. Computation can also be performed on phase-shifted waveforms.

Setting the Computation Range: Start Point/End Point

By default, the measurement range is ±5 divisions of the display frame on the time axis. You can limit this range.
The concept of the computation range is analogous to the concept of the selectable range of cursor display position in cursor measurement.
For details, see section 11.5, "Selectable Range of Cursor Position."

Allowable Shift Range

The phase can be shifted in the following range.

- **When the Time Base Is Set to Internal Clock**
  Selectable range: Time value of –(record length/2) to (record length/2)
  Resolution: 1/sample rate
  The sample rate varies depending on the record length or T/div setting. For details, see appendix 1, "Relationship between the Time Axis Setting, Sample Rate and Record Length."

- **When the Time Base Is Set to External Clock**
  Selectable range: –(record length/2) to (record length/2)
  Resolution: 1

When a Waveform That Results by Offsetting the CH1 Waveform by 5 ms Is Set to Math1
- Phase Shift CH1:   5 ms
- Math1   Operation: Shift (S1)
              Source1:   CH1
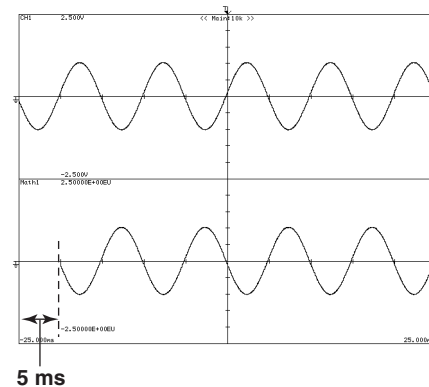
5 ms

Linear Scaling

When performing computation on a channel that has linear scaling set, the computation is performed on the scaled value.

Notes when Performing Computation

Computation is not performed again when you change Start Point or End Point while computation is stopped. Be sure to press the Exec soft key to perform the computation again. Otherwise, the waveform will not be displayed correctly when the screen is redrawn.
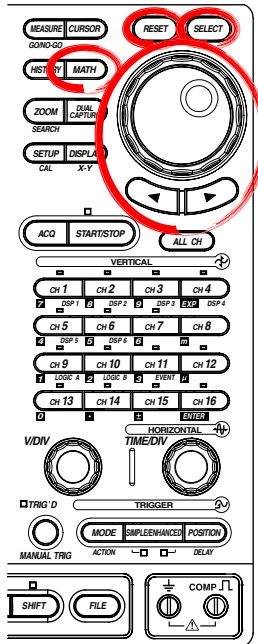
Note

While computation is in execution, ▦ is displayed at the upper left corner of the screen.

10

Waveform Computation

10.5 User-Defined Computation (Optional)

<For a description of this function, refer to page 2-48.>

Procedure

1. Press **MATH**.
2. Press the **Mode** soft key and select ON to display Math waveforms, OFF to not display them. If you select ON, proceed to step 3.

Setting the Computation Start and End Points

3. Press the **Start Point/End Point** soft key to set the jog shuttle control to Start Point.
4. Turn the **jog shuttle** to set the computation start point.
5. Likewise, set the End Point.

Setting the Computation

6. Press the **Setup** soft key. The Math1 to Math8 setup dialog boxes appear.
7. Use the **jog shuttle** and **SELECT** to select the Math waveform you wish to set. A MathX setup dialog box opens.

Setting the Computing Operation

8. Use the **jog shuttle** and **SELECT** to set Operation to UserDef( ).

User-Defined Equation

9. Use the **jog shuttle** and **SELECT** to select UserDef( ). A menu for setting the equation appears.
10. Enter the equation using up to 55 characters according to the procedure given in section 4.2. The head section (19 characters) of the entered equation is displayed in the Expression box.
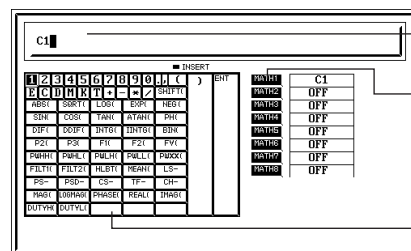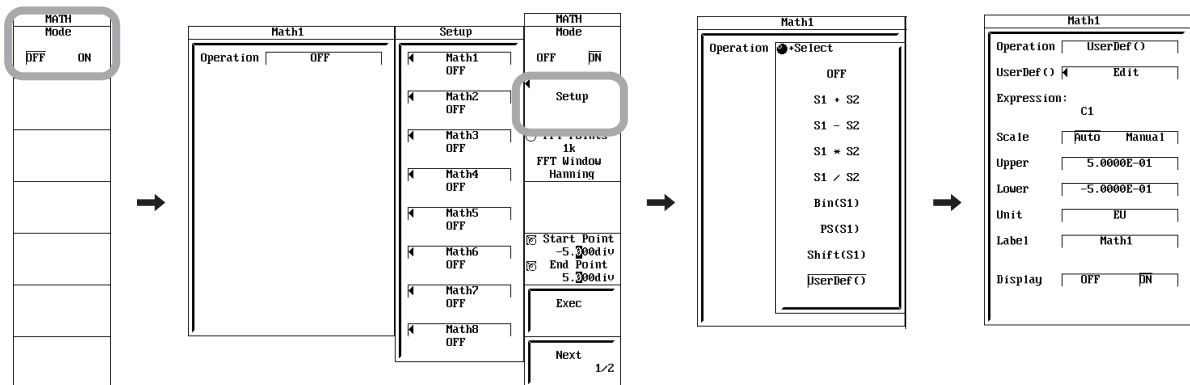
The contents entered from the soft keyboard are displayed.

Select Math1 to Math8 and press SELECT to enter the equation displayed on the right side.

Use the jog shuttle and arrow keys to select the desired operator. To confirm, select ENT.

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Setting the Scaling

11. Use the **jog shuttle** and **SELECT** to set Scale to Auto or Manual.
    If you select Manual, proceed to step 12; if you select Auto, proceed to step 14.

Setting the Upper and Lower Limits of Waveform Display

(When Scale Is Set to Manual)

12. Use the **jog shuttle** and **SELECT** to set Upper.
13. Likewise, set Lower.

Note _____

If you select Auto, you cannot set Upper and Lower.
_____

Setting the Unit

14. Use the **jog shuttle** and **SELECT** to set the Unit using up to four characters according to the procedure given in section 4.2.

Setting the Label

15. Use the **jog shuttle** and **SELECT** to enter the Label according to the procedure given in section 4.2. For a description of the Label display, see section 8.10, "Setting Waveform Labels."

Turning ON/OFF the Math Waveform Display

16. Use the **jog shuttle** and **SELECT** to set Display to ON or OFF.

    As necessary, set Math2 to Math8 in a similar fashion.

10

Waveform Computation

Setting the Threshold Level

17. Press the **Next 1/2** soft key.
18. Press the **Threshold** soft key.
19. Use the **jog shuttle** and **SELECT** to set the trace (channel on which to assign the threshold level).
20. Use the **jog shuttle** and **SELECT** to set Thr Upper.
21. Likewise, set Thr Lower.

    As necessary, set Math1 to Math8 in a similar fashion.

Setting the Digital Filter

If you specified FILT1 or FILT2 in the equation, set the digital filter.

22. Press the **Filter** soft key. The filter setup dialog box appears.
23. Use the **jog shuttle** and **SELECT** to set Filter Select to FILT1 or FILT2.
24. Use the **jog shuttle** and **SELECT** to select Filter Type from Gauss, Sharp, and IIR.
25. Press the **Filter Band** soft key to select Low-Pass, High-Pass, or Band-Pass.
26. Use the **jog shuttle** and **SELECT** to set CutOff.
    If you set Filter Band to Band-Pass, set CutOff1/CutOff2 (cutoff frequencies for both high and low).

Filter Band: When set to Band-Pass, set both CutOff1 and CutOff2.
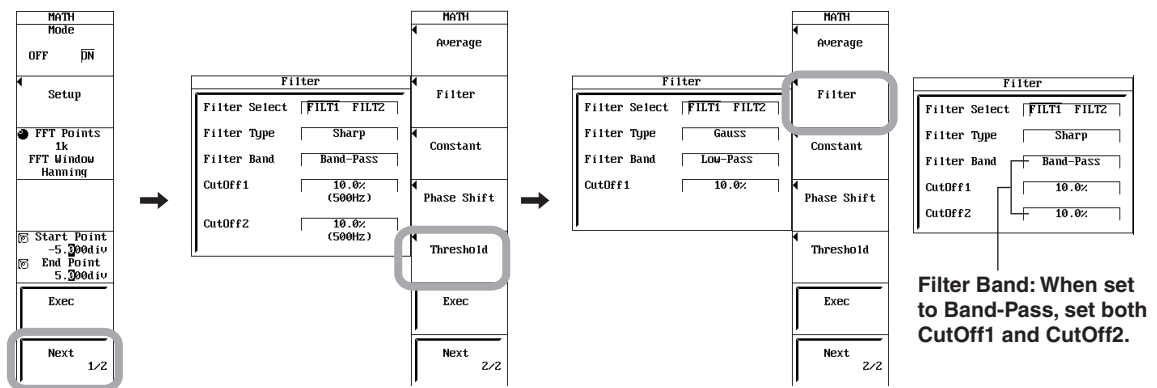
Setting the Number of Points for FFT and the Time Window

If you specified FFT in the equation, set the following items.

27. Set FFT Points and FFT Window according to steps 19 to 22 in section 10.3.

Setting the Constants (K1 to K8)

28. Press the **Next 1/2** soft key.
29. Press the **Constant** soft key. The constant setup menu appears.
30. Use the **jog shuttle** and **SELECT** to set the constants K1 to K8.

Setting Average and Peak Computation

31. Press the **Average** soft key. The average setup dialog box appears.
32. Use the **jog shuttle** and **SELECT** to select Average Mode from OFF, Linear, Exp, Cycle, and Peak. If you select Peak, the operation ends here.

• **When Linear or Exp Is Selected**

33. Use the **jog shuttle** and **SELECT** to set Average Domain to Time or Freq.
34. Use the **jog shuttle** and **SELECT** to set Linear Count (average count) or Average Weight (attenuation).

• **When Cycle Is Selected**

35. Use the **jog shuttle** and **SELECT** to set Cycle Count (the number of data points per cycle).

10

Waveform Computation
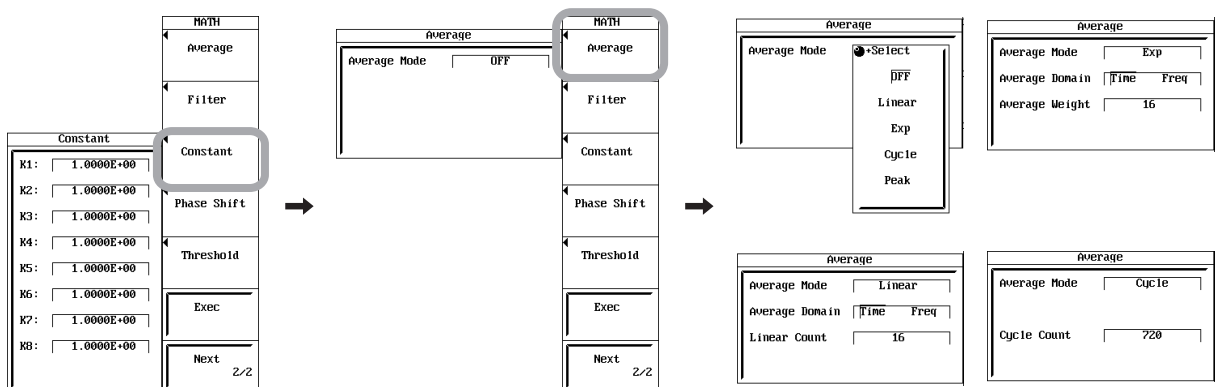
Setting the Phase Offset of Shift Computation

If you specified SHIFT in the equation, set the amount of phase shift.

36.   Press the **Phase shift** soft key.

The phase shift setup dialog box appears.

37.   Use the **jog shuttle** and **SELECT** to set the time or data points for shifting the phase of each waveform. If the time base is set to internal clock (Int), set the time for shifting the phase. If the time base is set to external clock (Ext), set the number of data points for shifting the phase.

Executing the Computation

38.   Press the **Exec** soft key.
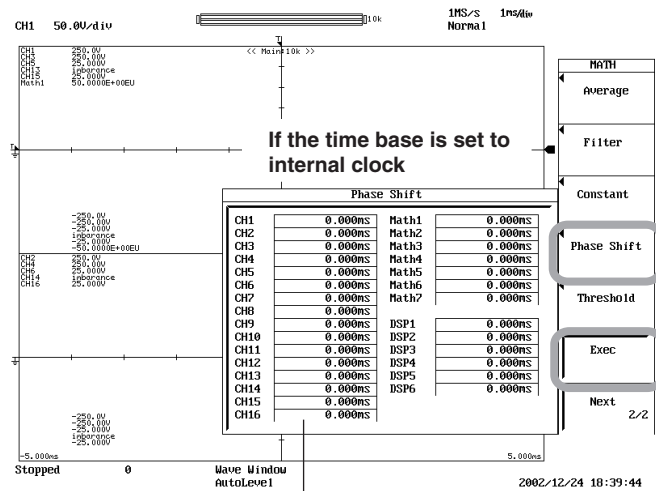
If the time base is set to internal clock

If the time base is set to external clock, the setup menu used to set the number of data points for shifting the phase appears.

DSP1 to DSP6 are optional.

Explanation

The following operators can be combined to make computations.

Available Operators

| Operator	Setting Example	Description
+,-,*,/	C1+C2	Displays the four arithmetical operations of the two specified waveform.
SHIFT	SHIFT(C1)	Displays the specified waveform with the phase shifted.
ABS	ABS(M1)	Displays the absolute value of the specified waveform.
SQRT	SQRT(C2)	Displays the square root of the specified waveform.
LOG	LOG(C1)	Displays the logarithm of the specified waveform.
EXP	EXP(C1)	Display the exponent of the specified waveform.
NEG	NEG(C1)	Displays the specified waveform inverted around 0.
SIN	SIN(T)	Displays the sine of the specified waveform.
COS	COS(C1)	Displays the cosine of the specified waveform.
TAN	TAN(C1)	Displays the tangent of the specified waveform.
ATAN	ATAN(C1,C2)	Displays the arc tangent of the two specified waveforms (a value within $\pm\pi$).
PH	PH(C1,C2)	Displays the phase difference between the two specified waveforms.
DIF	DIF(C1)	Displays the derivative of the specified waveform.
DDIF	DDIF(C1)	Displays the 2nd order derivative of the specified waveform.
INTG	INTG(C1)	Displays the integral of the specified waveform.
IINTEG	IINTEG(C1)	Displays the double integral of the specified waveform.
BIN	BIN(C1)	Displays the binary computation of the waveform.
P2	P2(C1)	Displays the square of the specified waveform.
P3	P3(C1)	Displays the cube of the specified waveform.
F1	F1(C1,C2)	Displays the $\sqrt{C1^2 + C2^2}$ of the specified waveform.
F2	F2(C1,C2)	Displays the $\sqrt{C1^2 - C2^2}$ of the specified waveform.
FV	FV(C1)	Displays the inverse of the PWHH of the pulse width.
PWHH	PWHH(M1)	Displays the pulse width computation from the rising edge to the next rising edge.
PWHL	PWHL(C2)	Displays the pulse width computation from the rising edge to the next falling edge.
PWLH	PWLH(C1)	Displays the pulse width computation from the falling edge to the next rising edge.
PWLL	PWLL(C1)	Displays the pulse width computation from the falling edge to the next falling edge.
PWXX	PWXX(C2)	Displays the pulse width computation from the rising or falling edge to the next rising or falling edge.
DUTYH	DUTYH(C1)	Positive (high) duty cycle within each cycle of the specified waveform
DUTHL	DUTYL(C1)	Negative (low) duty cycle within each cycle of the specified waveform
FILT1	FILT1(C1)	Displays the specified filter after applying a filter.
FILT2	FILT2(C1)	Displays the specified filter after applying a filter.
HLBT	HLBT(C1)	Displays the Hilbert's transform of the specified waveform.
MEAN	MEAN(C1)	Displays the moving average of the 10th order of the specified waveform.
LS-	LS-MAG(C1)	Displays the amplitude of the specified waveform's linear spectrum.
	LS-LOGMAG(C1)	Displays the logarithmic amplitude of the specified waveform's linear spectrum.
	LS-PHASE(C1)	Displays the phase of the specified waveform's linear spectrum.
	LS-REAL(C1)	Displays the real part of the specified waveform's linear spectrum.
	LS-IMAG(C1)	Displays the imaginary part of the specified waveform's linear spectrum.
PS-	PS-MAG(C1)	Displays the amplitude of the specified waveform's power spectrum.
	PS-LOGMAG(C1)	Displays the logarithmic amplitude of the specified waveform's power spectrum.

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Waveform Computation

Operator	Setting Example	Description
PSD-	PSD-MAG(C1)	Displays the amplitude of the specified waveform's power spectrum density.
	PSD-LOGMAG(C1)	Displays the logarithmic amplitude of the specified waveform's power spectrum density.
CS-	CS-MAG(C1,C2)	Displays the amplitude of the two specified waveforms' cross spectrum.
	CS-LOGMAG(C1,C2)	Displays the logarithmic amplitude of the two specified waveforms' cross spectrum.
	CS-PHASE(C1,C2)	Displays the phase of the two specified waveforms' cross spectrum.
	CS-REAL(C1,C2)	Displays the real part of the two specified waveforms' cross spectrum.
	CS-IMAG(C1,C2)	Displays the imaginary part of the two specified waveforms' cross spectrum.
TF-	TF-MAG(C1,C2)	Displays the amplitude of the two specified waveforms' transfer function.
	TF-LOGMAG(C1,C2)	Displays the logarithmic amplitude of the two specified waveforms' transfer function.
	TF-PHASE(C1,C2)	Displays the phase of the two specified waveforms' transfer function.
	TF-REAL(C1,C2)	Displays the real part of the two specified waveforms' transfer function.
	TF-IMAG(C1,C2)	Displays the imaginary part of the two specified waveforms' transfer function.
CH-	CH-MAG(C1,C2)	Displays the amplitude of the two specified waveforms' coherence function

Waveforms and Variables to Be Computed

CH waveforms (C1 to C16), DSP channel waveform (DSP1 to DSP, optional), Math waveform (M1 to M7), variable T (the total number of data points in the time direction is defined to be T. It is displayed as a rising line on the screen.)

Combinations of Computing Equations That Are Not Allowed

• An equation of a large number cannot be placed in an equation of a smaller number.
  Example: Math5 = M6+M3
• Computation containing only constants (K1 to K8) are not allowed.
  Example: Math5 = M1+K8
• Only two operators can be used in an equation for FILT1 and FILT2.
  Example: FILT1(C1)+FILT1(C2)+FILT1(C3)
• Only one operator can be used in a FFT equation.
  Example: PS–MAG(C1+C2)
• Other computations cannot be performed on the result of the FFT.
  Example: PS–MAG(C1)+C2
• Other computations cannot be performed on the pulse width computation.
  Example: PWHH(C1)+C2
• Only one operator can be used in an equation when making a Shift width computation, pulse width computation, or binary computation.
  Example: SHIFT(C1+C2), BIN(C1–C2), PWHH(C1*C1)
• The following computations cannot be performed on DSP channels.
  BIN, PWHH, PWHL, PWLH, PWLL, and PWXX

If you wish to perform an FFT, SHIFT, pulse width computation, or binary computation on the computed result such as C1+C2, enter the equations as in M1=C1+C2, M2=PS–MAG(M1).

Measurement Range: Start Point/End Point

Computation is performed on up to 800 kW of data when there is one equation, up to 400 kW when there are two equations, up to 200 kW when there is three or four equations, and up to 100 kW when there are five to eight equations.

By default, the measurement range is ±5 divisions of the display frame on the time axis. You can limit this range.

The concept of the computation range is analogous to the concept of the selectable range of cursor display position in cursor measurement.

For details, see section 11.5, "Selectable Range of Cursor Position."

Setting the Digital Filter

The following three types of filters are available.

Type	Bandwidth
Gaussian	LowPass
Sharp	LowPass/BandPass/HighPass
IIR (Butterworth)	LowPass/BandPass/HighPass

Selectable range of cutoff frequencies: 2.0% to 30.0% of the sample rate (in 0.2% steps)

Setting Average and Peak Computation

Averaging and peak computation can be performed on the computed data. Four types of operations are available: linear, exponential, cycle, and peak.

For linear averaging, set the average count (acquisition count, 2 to 128, in 2^n steps). For exponential averaging, set the attenuation constant (2 to 256, in 2^n steps).

Make sure to specify which waveform, time axis waveform or frequency waveform, to take the average. Specifying a wrong waveform will give a meaningless result.

For cycle averaging, set the number of data points of one cycle (Cycle Count) in the range, 10 to 1800. This number is applied to the data from the start to the end of the computed data, but the remaining data that cannot be divided by the Cycle Count are ignored. Cycle average cannot be performed on an FFT waveform.

For peak computation, the maximum value at each point of the computed data is determined and the waveform is displayed. For each computation, the new computed value is compared with the past value and the larger value is kept.

- **Example of Cycle Averaging**

  When the record length is 10 k, the Cycle Count is 720, the start point of computation is −5.000 divisions, and the end point is +5.000 divisions

  10k/720 = 13.88   13 cycles will be averaged.

  13×720 = 9360   Data between the start point to the 9360th point will be cycle averaged.

- **Notes When Computing Average and Peak Computation**

  - Normally auto scaling is defined for the 1st computed waveform. If you wish to obtain a computed waveform whose amplitude varies significantly after averaging (e.g. Coherent function), use manual scaling.

  - If averaging is performed, the computation is not performed again after the measurement is stopped. However, if the number of data points for the cycle average is changed, computation is performed again.

  - If the averaged waveform is measured using auto scaling and you change to manual scaling after the measurement is stopped, the new setting is not applied. The new setting is applied from the next measurement.

  - Averaging cannot be performed on pulse width computation.

  - If the computation condition is changed while averaging is in progress, the computed data is cleared at that point, and averaging starts over.

10

Waveform Computation

Setting Constants

The selectable range is from –9.9999E+30 to 9.9999E+30.

Setting the Threshold Level of Binary Computation

With binary computation, the specified waveform (CH1 to CH16, Math1 to Math7) is converted to a digital waveform of 0 and 1 with respect to the threshold level (Upper, Lower).

Upper threshold level
Lower threshold level

1

0
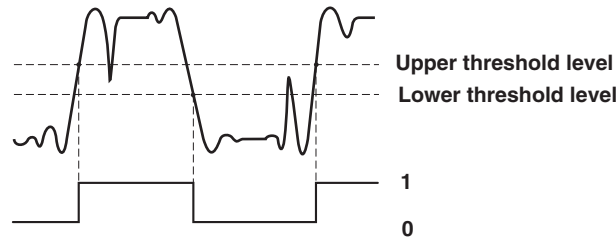
The selectable range for the threshold level varies depending on the specified waveform as shown below.

CH waveforms: 10 divisions within the display screen (resolution is (V/div setting)/100 when observing voltage and 0.1°C when observing temperature).

Math1 waveform: 10 divisions within the screen (resolution is 0.01 division).

Setting the FFT: FFT Points/FFT Window

For a description of the FFT, refer to points, FFT frequency band, and window in Section 10.3, "Performing Power Spectrum Computation (FFT)."
For details on digital filters and the FFT, refer to Appendix 5.

Phase Shift

The phase of a specified waveform is shifted. The amount of shift is specified in the phase shift setup menu.
The selectable range is Time/div*5 (the resolution is 1/(sample rate)).

Linear Scaling

When performing computation on a channel that has linear scaling set, the computation is performed on the scaled value.

Notes When Performing Computation

Computation is not performed again when you change Start Point or End Point while computation is stopped. Be sure to press the Exec soft key to perform the computation again. Otherwise, the waveform will not be displayed correctly when the screen is redrawn.

Note

While computation is in execution, ▦ is displayed at the upper left corner of the screen.

11.1 Displaying History Waveforms

<For a description of this function, refer to page 2-53.>

Procedure

Recalling Data from the History Memory

1. Press **HISTORY**.
2. Press the **Select Record** soft key.
3. Turn the **jog shuttle** to set the record No. you wish to recall. Set the record No. in the range of Start Record to End Record.
4. Press the **Display Mode** soft key to select One.

Data Accumulation Display

5. Press the **Start Record/End Record** soft key to set the jog shuttle control to Start Record.
6. Turn the **jog shuttle** to set the first record No. to be accumulated.
7. Likewise, set the last record No. (End Record) to be accumulated.
8. Press the **Display Mode** soft key to select All.
   The data of record numbers specified in steps 5 to 7 are displayed accumulated. To abort the accumulated display, press the **Display Mode** soft key to select One.

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Waveform Analysis/Search

Average Display of Data

9. Press the **Start Record/End Record** soft key to set the jog shuttle control to Start Record.
10. Turn the **jog shuttle** to set the first record No. to be averaged.
11. Likewise, set the last record No. (End Record) to be averaged.
12. Press the **Display Mode** soft key to select Ave.
    The data of record numbers specified in steps 5 to 7 are displayed averaged.
    To abort the average display, press the **Display Mode** soft key to select One.

Displaying a List of Time Stamps

13. Press the **Show Map** soft key. A list of acquired data numbers and the time at acquisition end are displayed.
14. Turn the **jog shuttle** to select the data you wish to display and press **SELECT**.

Clearing the History Memory

15. Press the **History Clear** soft key. All the waveforms in the acquisition memory are cleared.

Note

Waveform acquisition cannot be started when the HISTORY menu is displayed.
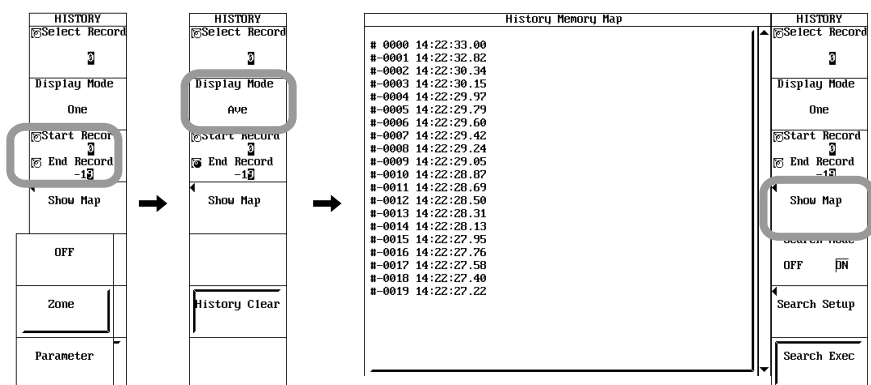
Explanation

The acquisition memory retains waveform data of the last specified number of triggers. If a trigger is activated beyond the number of triggers that can be held, the oldest waveform data is cleared.

Selected Record No.

The selectable range is 0 to –(the number of retained waveforms – 1). The default value is 0. The newest (current) waveform is 0, the waveform previous to that is –1, and so on. The number of triggers that can be held varies depending on the selected record length. For details, see appendix 2.

If the trigger count is 1, only the displayed waveform is held in the acquisition memory; waveform data in the past are not held.

Display Mode

- **Display Only the Selected Waveform: One**
  Select the waveform to be displayed using Select Record in the range specified by Start Record and End Record.

- **Display All Waveforms in the Selected Range: All**
  The waveform data specified by Start Record and End Record are displayed accumulated. The waveform data selected by Select Record is displayed brightly.

- **Average Display: Ave**
  The waveform data specified by Start Record and End Record are displayed averaged.

Show Map (A List of Time Stamps)

You can list the number of the waveform data stored in the acquisition memory and the time at acquisition end. One screen displays 75 data points of information. You can scroll through the data by using the jog shuttle.

Clearing the History Memory

- Clears all the waveforms in the acquisition memory.
- Cleared waveforms cannot be recovered.

Notes When Setting the History Memory Function

- You cannot use the history memory function when the dual capture function is used or when realtime recording is in progress.
- You cannot use the history memory function, if the acquisition mode is Average.
- If you abort the waveform acquisition, the triggered waveform is displayed as a valid waveform.
- History records are not lost when waveform acquisition is stopped and then restarted, provided that acquisition conditions remain unchanged.
- If you change the acquisition settings, history memory is cleared when you restart acquisition using the new settings.
  For details on the waveform acquisition conditions, see section 7.1, "Starting/Stopping Waveform Acquisition."
- Average display is not possible on the following waveforms.
  - Waveforms when the record length is greater than equal to 1 MW on the standard model, 2.5 MW on the M1 option model, 5 MW on the M2 option model, or 10 MW on the M3 option model.

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Waveform Analysis/Search

Notes When Recalling Data Using the History Memory Function

- You cannot use the history memory function while waveform acquisition is in progress.
- You cannot restart the waveform acquisition when the history memory menu is displayed.
- Settings are restricted by the following condition: End Record ≤ Select Record ≤ Start Record.
- If you load a waveform record from the external storage medium, the loaded waveform becomes Record 0. In the case of multiple records (sequential store), the records will be loaded sequentially, with the newest record as 0.
- Computation and automated measurement of waveform parameters are performed on the record No. specified by Select Record. Analysis of old data is possible as long as the history memory content remains unchanged after acquisition is restarted.
  However, for average display, computation is not performed again when you specify a different record.
- The time displayed in Show Map is the waveform trigger time. The information varies depending on the trigger mode as follows:

Trigger Mode	Condition	Time Displayed in Show Map
Auto/Auto Level	Roll mode	Stop time
Single	Roll mode, trigger not activated	Stop time
Log		Start time

- When displaying all waveforms, if the selected number of records is large, it may take an extended period for the display to complete. In this case, ▦ is indicated at the upper left corner of the screen. To abort the operation, set Display Mode to One.
- Turning OFF the power clears the contents of the history memory. However, if the acquisition memory backup is enabled, the contents of the history memory are backed up.
  For details on the acquisition memory backup function, see section 7.10.

11.2 Searching History Memory Data Using Zones (History Search Function)

Procedure

1. Press **HISTORY**.
2. Press the **Search Mode** soft key. The search mode menu appears.
3. Press the **Zone** soft key.

Setting the Search Zone

4. Press the **Search Setup** soft key. The search setup menu appears.
5. Press the **Select Zone** soft key. The search condition selection menu appears.
6. Press any of the **Zone1** to **Zone4** soft keys to select the search condition.

Setting the Search Condition

7. Press the **Condition** soft key to select OFF, IN, or OUT.
   If you select IN or OUT, a search window appears in the area where the Source channel is displayed.

Setting the Source Channel

8. Press the **Source** soft key. The source channel selection menu appears.
9. Press the soft key corresponding to the desired channel to select the source channel.

11

Waveform Analysis/Search

Setting the Search Window

10. Press the **Upper/Lower** soft key to set the jog shuttle control to Upper.
11. Turn the **jog shuttle** to set the top of the search range. Pressing **RESET** resets the value to default.
12. Press the **Upper/Lower** soft key to set the jog shuttle control to Lower.
13. Turn the **jog shuttle** to set the bottom ofä4he search range. Pressing **RESET** resets the value to default.
    By controlling both Upper and Lower using the **jog shuttle**, you can move the search window up and down without changing the vertical width.
14. Likewise, use the **Left/Right** soft key to set the horizontal range of the search window.
15. Repeat steps 5 to 13 to set Zone1 to Zone4.

Setting the Search Logic

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

Executing the Search

17. Pressing the **Search Exec** soft key to execute the search.
    While search is in execution, ⎙ is displayed at the upper left corner of the screen.

Displaying the Waveform That Are Found

18. Press the **ESC** to return to the HISTORY menu.
19. Press the **Show Map** soft key. A list of acquired data numbers and the time at acquisition end are displayed.
20. Turn the **jog shuttle** to select the data you wish to display and press **SELECT**.

Resetting the Search Results

21. Turn OFF the Search Mode in the HISTORY menu or turn OFF Zone1 to Zone4 and execute the search to reset the search results.
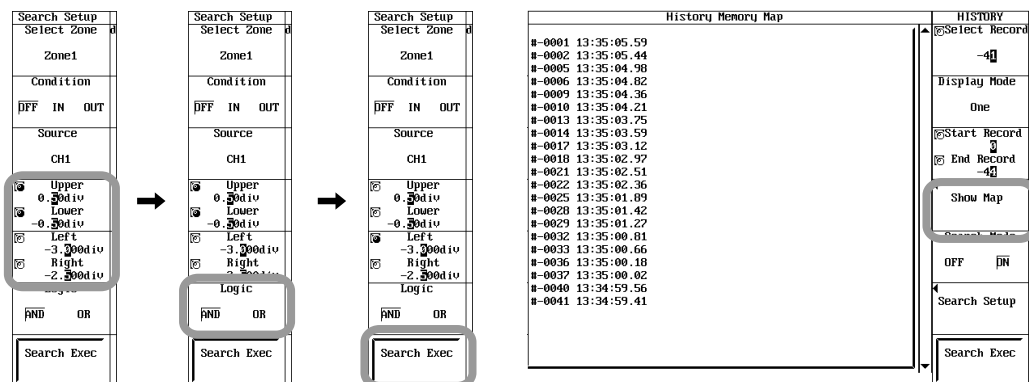
Explanation

You can search for a waveform that matches the specified conditions from the past waveforms in the acquisition memory and display it.

Select Zone

Four types of search zones can be registered in Zone1 to Zone4. You can set the channel that is to be searched, the search condition, and the search range for each search zone.

Condition

IN: Searches for waveforms that pass through the specified search window.
OUT: Searches for waveforms that do not pass through the specified window.
OFF: Does not search for waveforms.

Source

Search is carried out on the channel that is specified as the Source. The channels that can be specified are CH1 to CH16 and DSP1 to DSP6 (optional). Waveforms of other channels are also displayed.

Vertical Range of Search Window: Upper/Lower

The selectable range is ±5 divisions. The resolution is 0.01 divisions.
Upper must always be greater than or equal to Lower.

Horizontal Range of Search Window: Left/Right

The selectable range is ±5 divisions. The resolution is (10 division/display record length).
Right must always be greater than or equal to Left.

Logic

AND: Searches for waveforms that meet all search conditions from Zone1 to Zone4.
OR: Searches for waveforms that meet any one of the search conditions from Zone1 to Zone4.

Search Range of History Memory Data

The search range is between the Start Rec and the End Rec.

Search Order

The search is carried out from the newest waveform to the oldest waveform.

Show Map (A List of Time Stamps)

Only the waveforms that are found are listed in Show Map. If the Search Mode is turned OFF, all waveforms are displayed.

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Waveform Analysis/Search

11.3 Searching History Memory Data Using Parameters (History Search Function)

Procedure

1. Press **HISTORY**.
2. Press the **Search Mode** soft key. The search mode menu appears.
3. Press the **Parameter** soft key.

Setting the Search Zone

4. Press the **Search Setup** soft key. The search setup menu appears.
5. Press the **Select Param** soft key. The search condition selection menu appears.
6. Press any of the **Param1** to **Param4** soft keys to select the search condition.

Setting the Search Condition

7. Press the **Condition** soft key to select OFF, IN, or OUT.

Setting the Source Channel

8. Press the **Item Seup** soft key. The parameter selection menu appears.
9. Use the **jog shuttle** and **SELECT** to select the trace channel.
10. Use the **jog shuttle** and **SELECT** to select the parameter.

Setting the Condition Range

11. Press the **Upper/Lower** soft key to set the jog shuttle control to Upper.
12. Turn the **jog shuttle** to set the top of the search range. Pressing **RESET** resets the value to default.
13. Press the **Upper/Lower** soft key to set the jog shuttle control to Lower.
14. Turn the **jog shuttle** to set the bottom of the search range. Pressing **RESET** resets the value to default.
15. Repeat steps 4 to 14 to set Param1 to Param4.

Setting the Search Logic

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

Setting the Parameter Measuring Range

17. Press the **Time Range1/Time Range2** soft key to set the jog shuttle control to Time Range1.
18. Turn the **jog shuttle** to set the left edge of the measuring range. Pressing **RESET** resets the value to default.
19. Press the **Time Range1/Time Range2** soft key to set the jog shuttle control to Time Range2.
20. Turn the **jog shuttle** to set the right edge of the measuring range. Pressing **RESET** resets the value to default.

Executing the Search
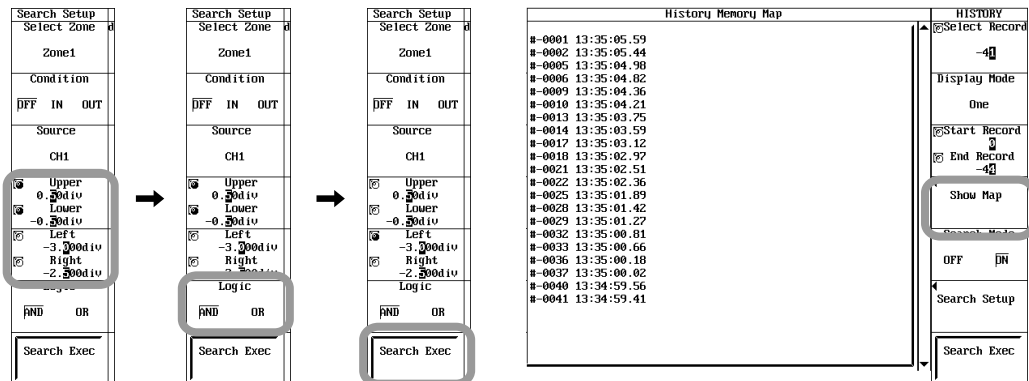
21. Pressing the **Search Exec** soft key to execute the search.
    While search is in execution, ⌫ is displayed at the upper left corner of the screen.

Displaying the Waveform That Are Found

22. Press the **ESC** to return to the HISTORY menu.
23. Press the **Show Map** soft key. A list of acquired data numbers and the time at acquisition end are displayed.
24. Turn the **jog shuttle** to select the data you wish to display and press **SELECT**.

Resetting the Search Results

25. Turn OFF the Search Mode in the HISTORY menu or turn OFF Param1 to Param4 and execute the search to reset the search results.

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Waveform Analysis/Search

Explanation

You can search for a waveform that matches the specified conditions from the past waveforms in the acquisition memory and display it.

Select Param

Four types of search condition can be registered in Parameter1 to Parameter4. You can set the channel that is to be searched, the search condition, and the search range for each search condition.

Condition

IN: Searches for waveforms entering the specified range of the specified parameter.
OUT: Searches for waveforms extending the specified range of the specified parameter.
OFF: Does not search for waveforms.

Item Setup

Assign search parameters to each trace channel. Choose one of the automated waveform measurement parameter.
The channels that can be specified are CH1 to CH16 and DSP1 to DSP6 (optional). Waveforms of other channels are also displayed.

Condition Range: Upper/Lower

Set the range that defines the specified parameter's condition.

Logic

AND: Searches for waveforms that meet all search conditions from Param1 to Param4.
OR: Searches for waveforms that meet any one of the search conditions from Param1 to Param4.

Parameter Measuring Range: Time Range1/Time Range2

Set the measuring range of the specified parameter.

Search Range of History Memory Data

The search range is between the Start Rec and the End Rec.

Search Order

The search is carried out from the newest waveform to the oldest waveform.

Show Map (A List of Time Stamps)

Only the waveforms that are found are listed in Show Map. If the Search Mode is turned OFF, all waveforms are displayed.

11.4 Search Data Using Search and Zoom Function

<For a description of this function, refer to page 2-54.>

Procedure

Edge Search
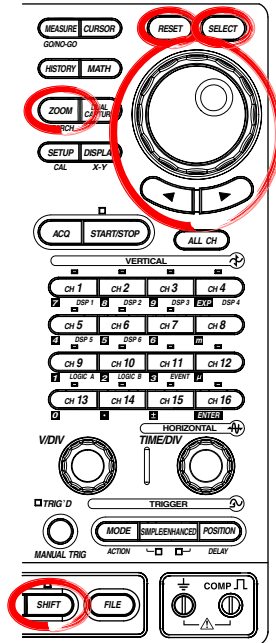
1. Press **SHIFT+ZOOM**.

Selecting the Search Type

2. Press the **Type** soft key. The search type selection menu appears.
3. Press the **Edge** soft key.

Setting the Search Condition

4. Press the **Setup** soft key. The search condition setup dialog box appears. Turn the **jog shuttle** to set the parameter.

- **Setting the Search Source Channel**
  5. Use the **jog shuttle** and **SELECT** to select Source.

- **Setting the Level**
  6. Use the **jog shuttle** and **SELECT** to set Level. Pressing **RESET** resets the level to 0 V.

- **Setting the Edge Polarity**
  7. Use the **jog shuttle** and **SELECT** to set Polarity to ⌐ or ⌐.

- **Setting the Hysteresis**
  8. Use the **jog shuttle** and **SELECT** to set Hysteresis to ⩘, ⩘, or ⩘.

- **Setting the Search Count**
  9. Use the **jog shuttle** and **SELECT** to set Count. Pressing **RESET** resets the value to 1.

- **Setting the Search Start Point**
  10. Use the **jog shuttle** and **SELECT** to set Start Point. Pressing **RESET** resets the value to –5 divisions.

11

Waveform Analysis/Search

IM 701210-06E

11-11
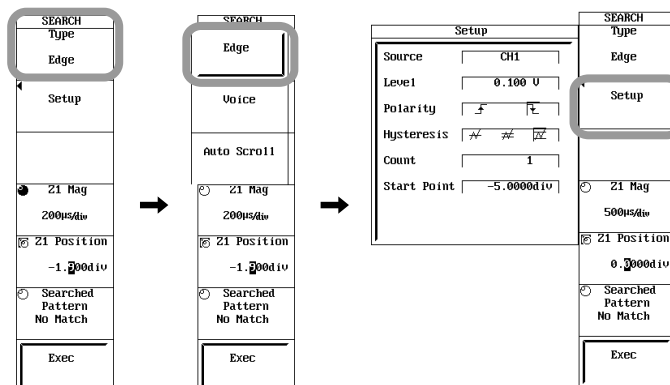
Changing the Magnification and Display Position

11. As with the zoomed waveform, you can change the zoom rate of Z1 and Z2 by pressing the **Z1 Mag/Z2 Mag** soft key and turning the **jog shuttle**.

12. As with the zoomed waveform, you can move the section that is being zoomed on Z1 or Z2 window by pressing the **Z1 Position/Z2 Position** soft key and turning the **jog shuttle**.

Setting the Display Position of the Search Results

(When Mode in the ZOOM Menu Is Set to Z1&Z2 or Main&Z1&Z2)

13. Press the **Result Window** soft key to select Z1 or Z2.

Executing the Search

14. Pressing the **Exec** soft key to execute the search. The Exec soft key changes to Abort. To abort the search, press the **Abort** soft key.
The search results are displayed in the zoomed waveform display position selected in step 11. You can search 1000 times using the same conditions. While search is in execution, is displayed at the upper left corner of the screen.
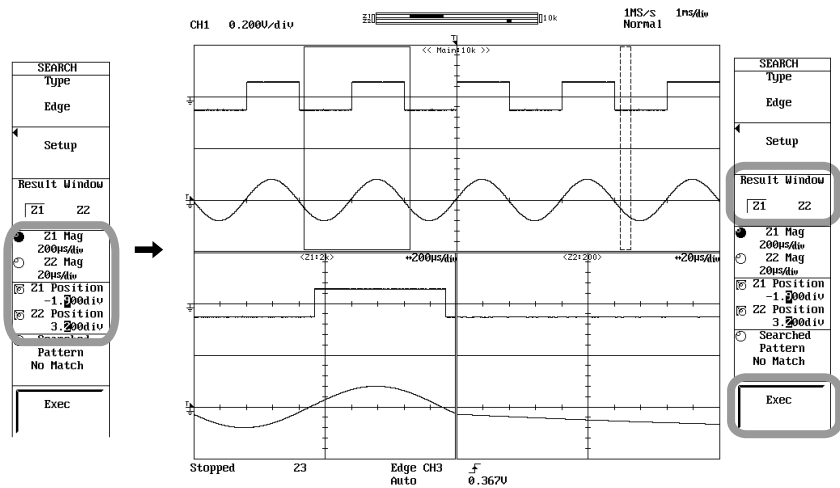
Displaying the Previous Search Results

15. Press the **Searched Pattern** soft key.

16. Turn the **jog shuttle** to specify the number of the search result you wish to display. Newer search results are displayed with higher numbers (result 2 is newer than result 1).
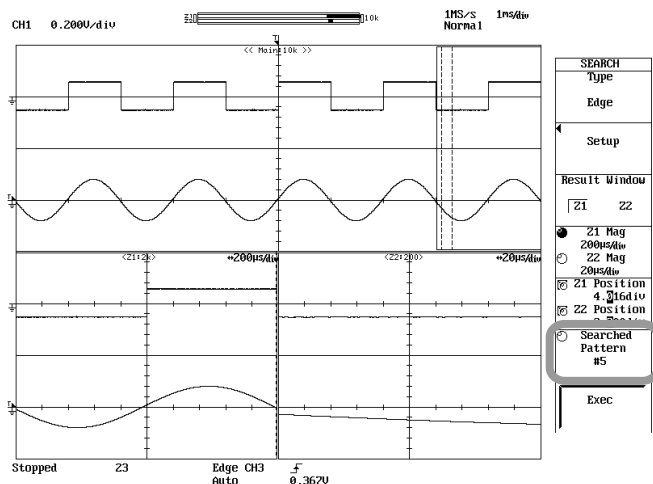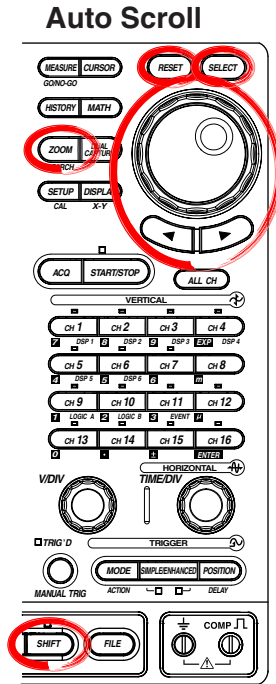
Auto Scroll

1. Press **SHIFT+ZOOM**.

Selecting the Search Type

2. Press the **Type** soft key. The search type selection menu appears.
3. Press the **Auto Scroll** soft key.

Selecting the Scroll Direction

4. Press the **Direction** soft key to set the scroll direction.

Setting the Display Position of the Search Results

(When Mode in the ZOOM Menu Is Set to Z1&Z2 or Main&Z1&Z2)

5. Press the **Result Window** soft key to select Z1 or Z2.

Changing the Magnification and Display Position

6. As with the zoomed waveform, you can change the zoom rate of Z1 and Z2 by pressing the **Z1 Mag/Z2 Mag** soft key and turning the **jog shuttle**.
7. As with the zoomed waveform, you can move the section that is being zoomed on Z1 or Z2 window by pressing the **Z1 Position/Z2 Position** soft key and turning the **jog shuttle**.

Setting the Scroll Speed

8. Press the **Speed** soft key and turn the **jog shuttle** to set the scroll speed in the range from 1 to 10.

Executing the Scroll

9. Press the **Exec** soft key. The zoom window automatically moves and the zoom position changes. When the scroll operation is in progress, the **Exec** soft key changes to the **Abort** soft key. Press the **Abort** soft key to abort the scroll operation.
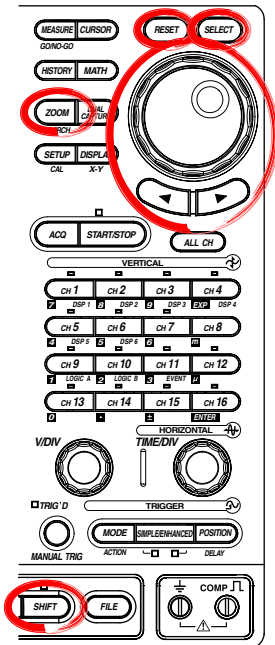
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Waveform Analysis/Search

Voice Search

1. Press **SHIFT+ZOOM**.

Selecting the Search Type

2. Press the **Type** soft key. The search type selection menu appears.
3. Press the **Voice** soft key.

Changing the Zoom Rate and Zoom Position

4. Press the **Z1 Mag/Z2 Mag** soft key to change the zoom rate of Z1 or Z2 using the jog shuttle.
5. Press the **Z1 Position/Z2 Position** soft key to change the zoom position of Z1 or Z2 using the jog shuttle.

Setting the Display Position of the Search Result Window

(When Mode in the ZOOM menu is set to Z1&Z2 or Main&Z1&Z2)

6. Press the **Result Window** soft key to select Z1 or Z2.

Executing the Search

7. Press the **Exec** soft key. The search is executed. The Exec soft key changes to Abort. To abort the search, press the **Abort** soft key. The search results are displayed in the zoomed waveform display position selected in step 4.

Playing the Voice Memo That Is Found

8. Press the **Play Start** soft key. The voice memo that was found in step 7 is played. While the voice memo is being played, the Play Start soft key changes to Play Stop. To stop the voice memo while it is playing, press the **Play Stop** soft key.

Displaying the Previous Search Results

9. Press the **Searched Pattern** soft key.
10. Turn the **jog shuttle** to specify the number of the search result you wish to display. Newer search results are displayed with higher numbers (result 2 is newer than result 1).
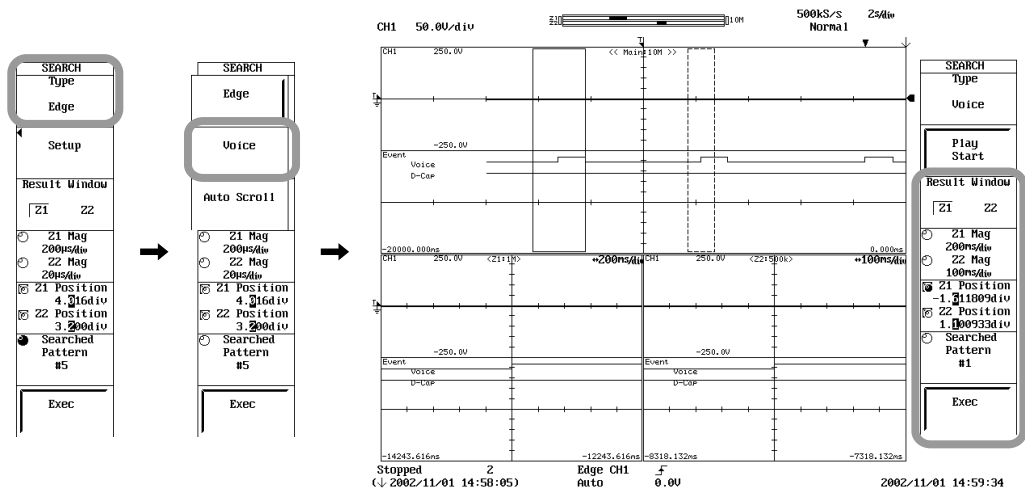
Explanation

When the data acquisition is stopped, a section of the waveform can be searched and displayed expanded.

Search Type

The following two search types are available.
* **Edge**
  Searches by counting the number of times waveform goes above (rising) or below (falling) a specified level from the starting point.

* **Auto Scroll**
  The zoom position automatically moves (auto scroll) in the specified direction. You can scroll through the zoomed waveform and stop the scrolling at the desired position.

* **Voice Search**
  Searches the start point (rising edge of the Voice bit of the event waveform) of the voice memo that has been recorded using the voice memo function (see section 7.9). Playing the voice memo that has been found is also possible.

Search Condition for Edge Search: Setup

Source: Select the channel to be searched.

Level: Set the level used to determine the rising or falling edge. The range is 10 divisions within the screen. The resolution varies depending on the module. For details, see section 6.5.

Polarity: Select the polarity from the following:
* $\mathcal{f}$:   Search by the number of times the waveform passes from below the specified level to above the specified level.
* $\mathcal{L}$:   Search by the number of times the waveform passes from above the specified level to below the specified level.

Hysteresis: Set the hysteresis.

Count: Set the number of times $\mathcal{f}$ or $\mathcal{L}$ is to be met. The selectable range is 1 to 1000000.

Start Point: Set the start position of the search. The selectable range is from –5 to 5 divisions.

Display Position of the Searched Waveform: Result Window

When the zoom mode is set to Z1 & Z2 or Main & Z1 & Z2, you can select whether to display the searched waveform in the Z1 or Z2 window.

Search Count: Searched Pattern

* **For Edge Search**
  The search can be carried out up to 1000 times. The rising or falling edge is counted from the previous search position. In addition, the past search results can also be displayed.

* **For Voice Search**
  Search can be performed on waveforms that have voice memo recorded. The start point of the voice memo is counted from the previous search position. In addition, the past search results can also be displayed.

Changing the Zoom Rate and Zoom Position

The search results are displayed in the zoomed waveform display area.   As with the zoomed waveform (see section 8.5), the zoom rate and position can be changed.

11

Waveform Analysis/Search

Notes When Searching

- Searching is not possible while the data acquisition is in progress.
- The search result is void if the following operations are carried out:
  - When data acquisition is started.
  - When Search Setup is changed.
- Patterns of waveforms that are not displayed are not searched.
- If the waveform is inverted or the offset voltage is changed, the search is performed on the waveform after the change.

Determination When Using the Edge for the Search

When the peak immediately after the rising edge of the waveform is less than or equal to the upper limit of the hysteresis or when the peak immediately after the falling edge is greater than or equal to the lower limit of the hysteresis, it is determined as false (not counted as a specified edge).

This rising edge is determined to be false.

Detection position

Upper limit of hysteresis

Lower limit of hysteresis

Specified level
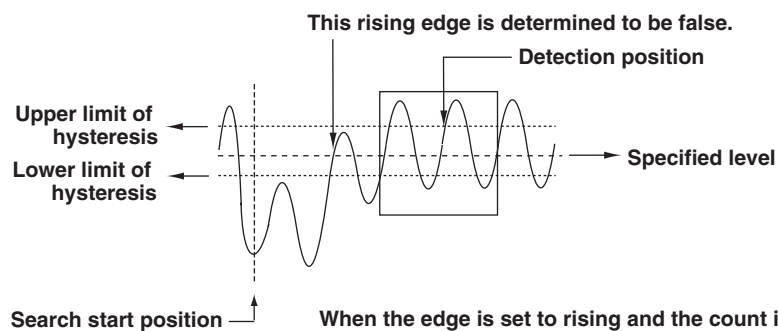
Search start position

When the edge is set to rising and the count is set to 2

In addition, in the determination of logic waveforms, the determination is performed two points after the detected position.

Search restart position (Not detected here)

Detection position   **Detection position**   **Detection position**
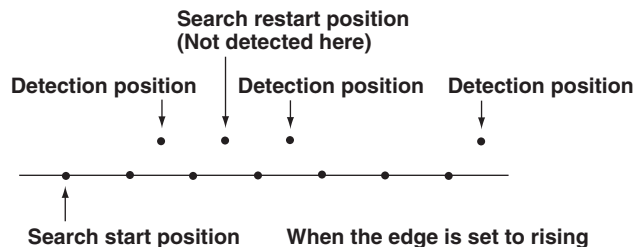
Search start position   **When the edge is set to rising**

Auto Scroll

Set the scroll speed using 10 levels from 1 to 10. The speed increases as the number gets larger. You can only change the Direction and Speed while auto scroll is in progress.

Playing of the Voice Memo (Voice Search)

When using the voice search function, the voice memo that has been found can be played by pressing the Play Start soft key. The voice memo can be played only when the searched item is the newest waveform that has been acquired to the acquisition memory. While the voice memo is being played, Play Start indication changes to Play Stop. To stop the voice memo while it is playing, press the Play Stop soft key. When the voice memo is finished playing Play Stop automatically changes to Play Start even if the Play Stop soft key is not pressed.

Note

Waveform acquisition cannot be started when the SEARCH menu is displayed.

11.5 Measuring Waveforms Using Cursors

Procedure

For H (Horizontal) Cursors (When Not Displaying the X-Y Waveform)

1. Press **CURSOR**.

Selecting the Cursor Type

2. Press the **Type** soft key. The cursor type selection menu appears.
3. Press the **Horizontal** soft key.

Selecting the Waveform to Be Measured

4. Press the **Trace** soft key. The trace selection menu appears.
5. Press the soft key corresponding to the desired waveform to select the waveform to be measured.

Moving the Cursor

6. Press the **Cursor1/Cursor2** soft key to set the jog shuttle control to Cursor1.
7. Turn the **jog shuttle** to move Cursor1.
8. Likewise, move Cursor2. If the jog shuttle control is set to both Cursor1 and Cursor2, both cursors are moved.

DSP1 to DSP6 are optional.

11

Waveform Analysis/Search

For V (Vertical) Cursors (When Not Displaying the X-Y Waveform)

1.   Press **CURSOR**.

Selecting the Cursor Type

2.   Press the **Type** soft key. The cursor type selection menu appears.
3.   Press the **Vertical** soft key.

Selecting the Waveform to Be Measured

4.   Press the **Trace** soft key. The trace selection menu appears.
5.   Press the soft key corresponding to the desired waveform to select the waveform to be measured.
     If you set the waveform to be measured to All, LogicA, LogicB, or LogicA & LogicB, proceed to step 6. If not, proceed to step 9.

Setting the Logic (When Trace Is Set to All, LogicA, LogicB, or LogicA & LogicB)

6.   Press the **Logic Setup** soft key. The logic setup menu appears.

• **Selecting the Notation of Cursor Measurement Values**

7.   Use the **jog shuttle** and **SELECT** to set Format to Binary or Hexa.

Note

The notation selected in step 7 applies to the notation of the numeric monitor display that is shown on the right side of the screen. For the procedure of displaying the numeric monitor, see section 8.13.

• **Selecting the Read Direction of Bit Data**

8.   Use the **jog shuttle** and **SELECT** to set Order to A1->A8 or B1->B8.

Moving the Cursor

6.   Press the **Cursor1/Cursor2** soft key to set the jog shuttle control to Cursor1.
7.   Turn the **jog shuttle** to move Cursor1.
8.   Likewise, move Cursor2. If the jog shuttle control is set to both Cursor1 and Cursor2, both cursors are moved.
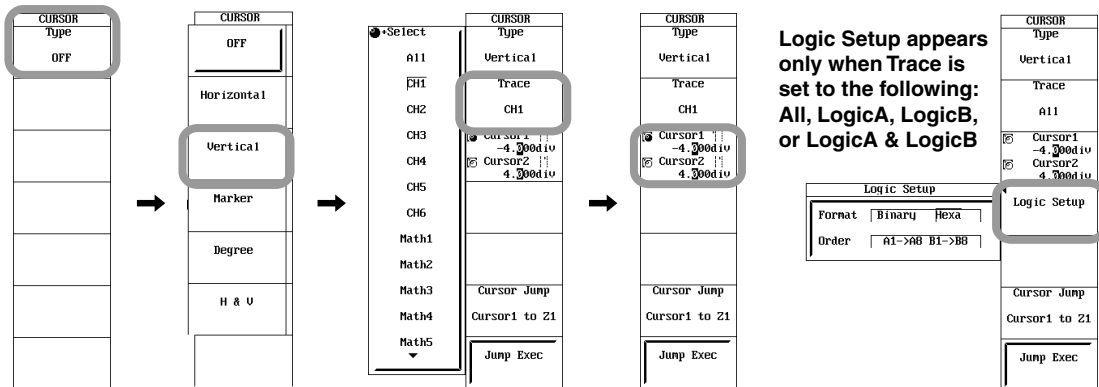
DSP1 to DSP6 are optional.

For Marker Cursors (When Not Displaying the X-Y Waveform)
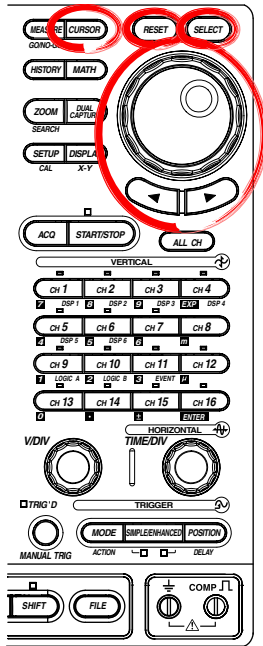
1. Press **CURSOR**.

Selecting the Cursor Type

2. Press the **Type** soft key. The cursor type selection menu appears.
3. Press the **Marker** soft key.

Selecting the Marker

4. Press the **Select** soft key to select the desired marker from M1 to M4.

Selecting the Waveform to Be Measured

5. Press the **Trace** soft key. The trace selection menu appears.
6. Press the soft key corresponding to the desired waveform to select the waveform to be measured.

Moving the Cursor

7. Press the **Position** soft key and turn the **jog shuttle** to move the cursor As the cursor is moved, the displayed value of Position changes.

DSP1 to DSP6 are optional.

11

Waveform Analysis/Search
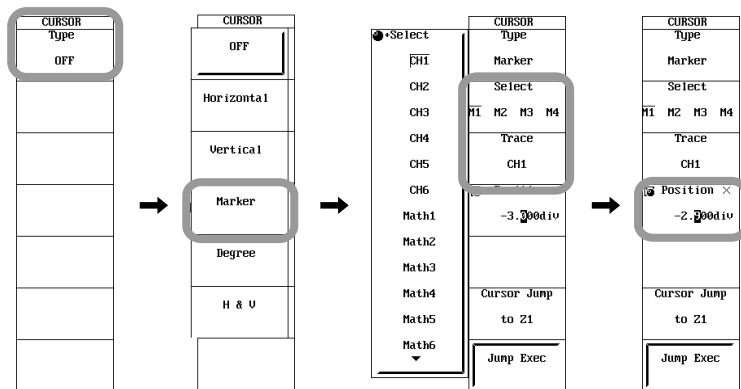
For Angle (Degree) Cursors (When Not Displaying the X-Y Waveform)
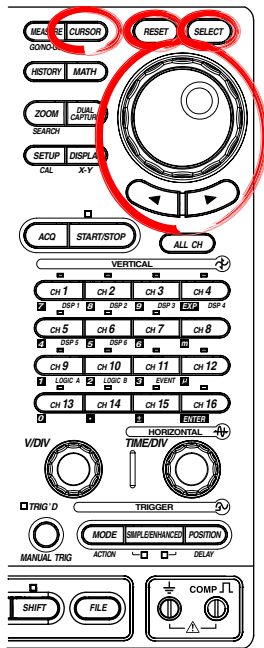
1. Press **CURSOR**.

Selecting the Cursor Type

2. Press the **Type** soft key. The cursor type selection menu appears.
3. Press the **Degree** soft key.

Selecting the Waveform to Be Measured

4. Press the **Trace** soft key. The trace selection menu appears.
5. Press the soft key corresponding to the desired waveform to select the waveform to be measured.

Moving the Cursor

6. Press the **Cursor1/Cursor2** soft key to set the jog shuttle control to Cursor1.
7. Turn the **jog shuttle** to move Cursor1.
8. Likewise, move Cursor2. If the jog shuttle control is set to both Cursor1 and Cursor2, both cursors are moved.

Moving the Reference Cursor

9. Press the **Ref1/Ref2** soft key to set the jog shuttle control to Ref1.
10. Turn the **jog shuttle** to move Ref1.
11. Likewise, move Ref2. If the jog shuttle control is set to both Ref1 and Ref2, both cursors are moved.

Setting the Reference Angle

12. Press the **Ref Value** soft key.
13. Turn the **jog shuttle** to set the reference angle in the range of 1 to 720.
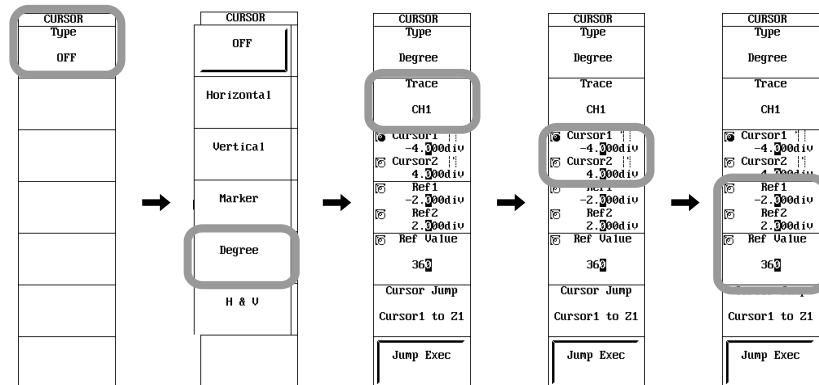
For H&V Cursors (When Not Displaying the X-Y Waveform)
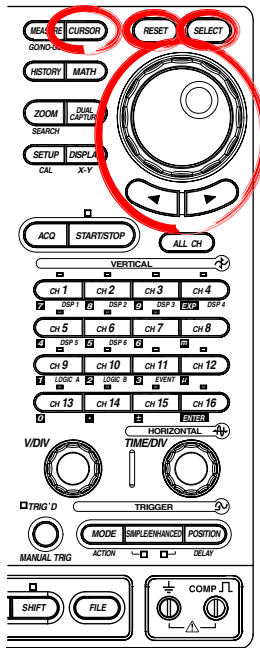
1. Press **CURSOR**.

Selecting the Cursor Type

2. Press the **Type** soft key. The cursor type selection menu appears.
3. Press the **H&V** soft key.

Selecting the Waveform to Be Measured

4. Press the **Trace** soft key.
5. Press the soft key corresponding to the desired waveform to select the waveform to be measured.

Moving the Cursor

6. Press the **Cursor1** ⌐⌐ /**Cursor2** ⌐⌐ soft key to set the jog shuttle control to Cursor1.
7. Turn the **jog shuttle** to move Cursor1.
8. Likewise, move Cursor2. If the jog shuttle control is set to both Cursor1 and Cursor2, both cursors are moved.
9. Move Cursor1 ║ and Cursor2 ║ by carrying out steps similar to steps 6 to 8.
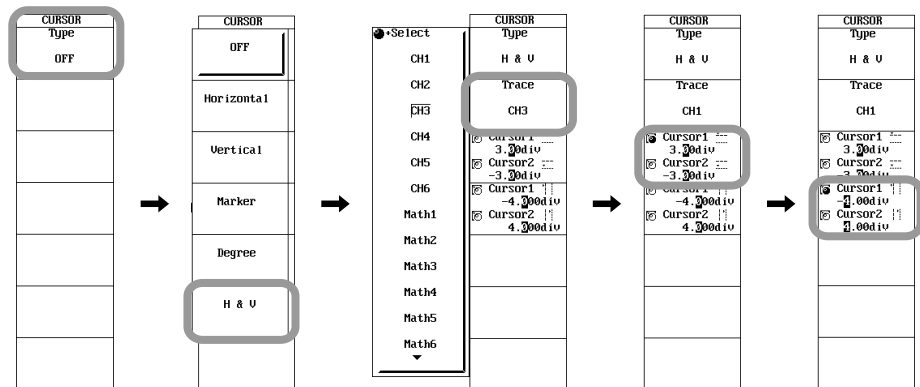
DSP1 to DSP6 are optional

Cursor Jump (for V Cursor, Marker Cursor, and Angle Cursor: Only When Not Displaying the X-Y Waveform)
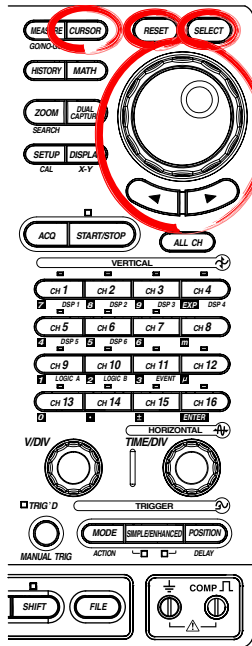
1. Follow steps 1-3 on the previous pages to set the Type to Vertical, Marker, or Degree.

Setting Jumps

2. Press the **Cursor Jump** soft key. A menu for selecting the cursor to be jumped and the jump destination appears.
3. Press the soft key corresponding to the type of jump to select the desired cursor and the destination.

Executing the Jump

4. Press the **Jump Exec** soft key. The cursor moves to the jump destination screen.
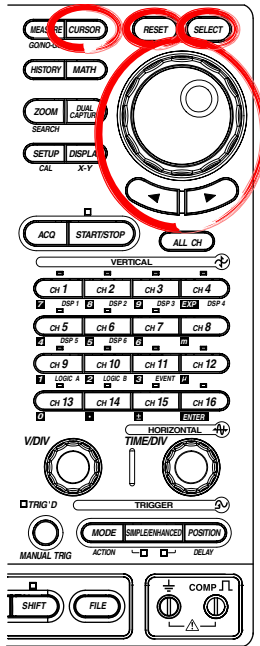
V cursor

Marker cursor

Angle cursor

CURSOR	CURSOR	CURSOR	CURSOR
Type	Type	Type	Type
Vertical	Vertical	Marker	Degree
Trace	Trace	Select	Trace
CH1	CH1	M1 M2 M3 M4	CH1
Cursor1 -4.200div	Cursor1 -4.200div	Trace	Cursor1 -4.200div
Cursor2 4.200div	Cursor2 4.200div	CH1	Cursor2 4.200div
	Cursor1 to Z1	Position -2.200div	Cursor1 to Z1
	Cursor1 to Z2		Cursor1 to Z2
Cursor Jump Cursor1 to Z1	Cursor2 to Z1	to Z1	Cursor2 to Z1
Jump Exec	Cursor2 to Z2	to Z2	Cursor2 to Z2

For H (Horizontal) Cursors (When Displaying the X-Y Waveform)

1. Press **CURSOR**.

Selecting the Cursor Type

2. Press the **Type** soft key. The cursor type selection menu appears.
3. Press the **Horizontal** soft key.

Selecting the Waveform to Be Measured

4. Press the **Trace** soft key.
5. If X Axis of the X-Y menu is set to Single, use the **jog shuttle** and **SELECT** to select the trace. If X Axis is set to Quad, press the soft key corresponding to the X-Y waveform (XY1 to XY4) to select the waveform to be measured.

Moving the Cursor

6. Press the **H Cursor1/H Cursor2** soft key to set the jog shuttle control to Cursor1.
7. Turn the **jog shuttle** to move Cursor1.
8. Likewise, move Cursor2. If the jog shuttle control is set to both H Cursor1 and H Cursor2, both cursors are moved.
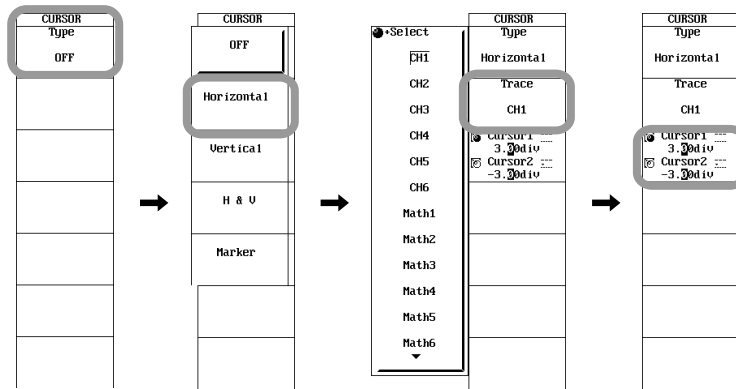
DSP1 to DSP6 are optional.

For V (Vertical) Cursors (When Displaying the X-Y Waveform)
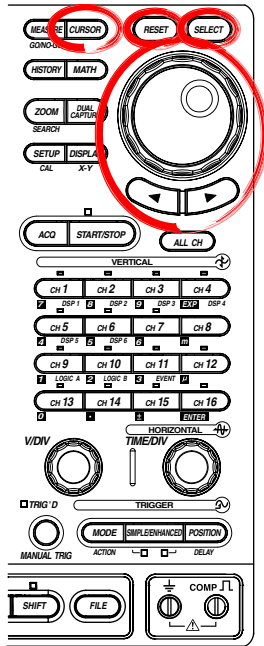
1. Press **CURSOR**.

Selecting the Cursor Type

2. Press the **Type** soft key. The cursor type selection menu appears.
3. Press the **Vertical** soft key.

Selecting the Waveform to Be Measured

4. Press the **Trace** soft key.
5. If X Axis of the X-Y menu is set to Single, the channel specified by X trace of the X-Y menu is displayed. Since this setting is for viewing purpose only, you cannot change it.
   If X Axis is set to Quad, press the soft key corresponding to the X-Y waveform (XY1 to XY4) to select the waveform to be measured.

Moving the Cursor

6. Press the **V Cursor1/V Cursor2** soft key to set the jog shuttle control to V Cursor1.
7. Turn the **jog shuttle** to move V Cursor1.
8. Likewise, move V Cursor2. If the jog shuttle control is set to both V Cursor1 and V Cursor2, both cursors are moved.
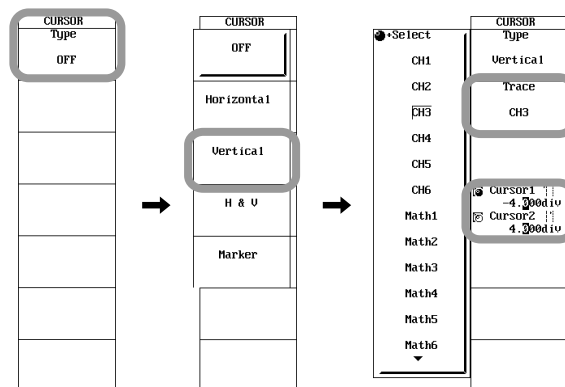
DSP1 to DSP6 are optional.

For H&V Cursors (When Displaying the X-Y Waveform)

1. Press **CURSOR**.

Selecting the Cursor Type

2. Press the **Type** soft key. The cursor type selection menu appears.
3. Press the **H&V** soft key.

Selecting the Waveform to Be Measured

4. Press the **Trace** soft key.
5. If X Axis of the X-Y menu is set to Single, use the **jog shuttle** and **SELECT** to select the trace. If X Axis is set to Quad, press the soft key corresponding to the X-Y waveform (XY1 to XY4) to select the waveform to be measured.

Moving the Cursor

6. Press the **Cursor1** ⁙⁙ /**Cursor2** ⁙⁙ soft key to set the jog shuttle control to Cursor1.
7. Turn the **jog shuttle** to move Cursor1.
8. Likewise, move Cursor2. If the jog shuttle control is set to both H Cursor1 and H Cursor2, both cursors are moved.
9. Move Cursor1 and Cursor2 by carrying out steps similar to steps 6 to 8.

DSP1 to DSP6 are optional.

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Waveform Analysis/Search

For Marker Cursors (When Displaying the X-Y Waveform)

1. Press **CURSOR**.

Selecting the Cursor Type

2. Press the **Type** soft key. The cursor type selection menu appears.
3. Press the **Marker** soft key.

Selecting the Waveform to Be Measured

4. Press the **Trace** soft key.
5. If X Axis of the X-Y menu is set to Single, use the **jog shuttle** and **SELECT** to select the trace. If X Axis is set to Quad, press the soft key corresponding to the X-Y waveform (XY1 to XY4) to select the waveform to be measured.

Moving the Cursor

6. Press the **Position** soft key.
7. Turn the **jog shuttle** to move Position.
    As the cursor is moved, the displayed value of Position changes.
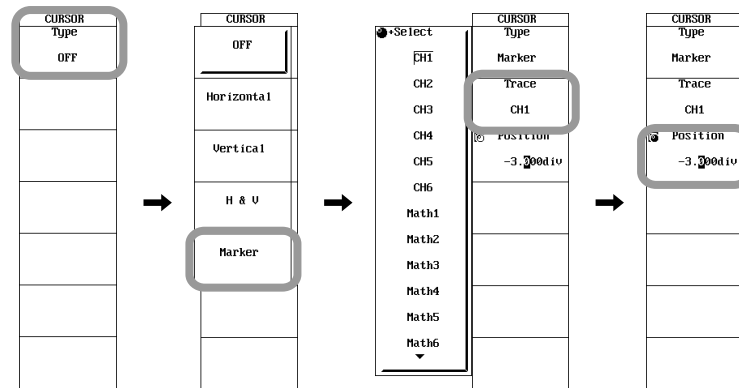
DSP1 to DSP6 are optional.

Note

The marker is displayed for the Y Trace (target Y-axis waveform) specified in the X-Y menu.

Explanation

Limitations

Cursor measurements cannot be made on the following waveforms.
- Snapshot waveforms
- Accumulated waveforms other than the newest waveform.

Cursor Types and Measurement Items: Type (When Not Displaying the X-Y Waveform)

- **H (Horizontal) Cursor**

  Measures the Y-axis value at the cursor.
  Y1: The Y-axis value at Cursor1
  Y2: The Y-axis value at Cursor2
  ΔY: The difference between the Y-axis values at Cursor1 and Cursor2

- **V (Vertical) Cursor**

  Measures the X-axis value at the cursor. Also choose the order of the data.
  X1:   The X-axis value at Cursor1
  X2:   The X-axis value at Cursor2
  ΔX: The difference between the X-axis values at Cursor1 and Cursor2
  1/ΔX: The inverse or the difference between the X-axis values at Cursor1 and Cursor2
  Y1:   The Y-axis value at Cursor1
  Y2:   The Y-axis value at Cursor2
  ΔY: The difference between the Y-axis values at Cursor1 and Cursor2

- **Marker Cursors**

  Move the cursor on the waveform data and measure the waveform data values. M1 (Marker 1) to M4 (Marker 4) can be set on different waveforms.
  Y1 to Y4: The Y-axis values of M1 to M4
  ΔY2:   The difference between the Y-axis values of M1 and M2
  ΔY3:   The difference between the Y-axis values of M1 and M3
  ΔY4:   The difference between the Y-axis values of M1 and M4
  X1 to X4: The X-axis values of M1 to M4
  ΔX2:   The difference between the X-axis values of M1 and M2
  ΔX3:   The difference between the X-axis values of M1 and M3
  ΔX4:   The difference between the X-axis values of M1 and M4

- **Angle Cursor (Degree)**

  Set the measurement zero point (position of reference cursor Ref1) and the end point (position of the reference cursor Ref2) on the X-axis within the screen and assign an angle corresponding to the width of Ref1 and Ref2. Using this angle as a reference, this function measures the angle of the two angle cursors (Cursor1 and Cursor2).
  X1:   The angle of Cursor1 from Ref1
  X2:   The angle of Cursor2 from Ref1
  ΔX: The angle difference between Cursor1 and Cursor2
  Y1:   The Y-axis value at Cursor1
  Y2:   The Y-axis value at Cursor2
  ΔY: The difference between the Y-axis values at Cursor1 and Cursor2
  Range of reference width: 1 to 720°

- **H&V Cursor**

  Measures the Y-axis and X-axis value at the cursor.
  Y1: The Y-axis value at horizontal Cursor1
  Y2: The Y-axis value at horizontal Cursor2
  ΔY: The difference between the Y-axis values at horizontal Cursor1 and horizontal Cursor2
  X1: The X-axis value at vertical Cursor1
  X2: The X-axis value at vertical Cursor2
  ΔX: The difference between the X-axis values at vertical Cursor1 and vertical Cursor2

Cursor Types and Measurement Items: Type

(When Displaying the X-Y Waveform)

- **H (Horizontal) Cursor**

  Measures the Y-axis value at the cursor.

  Y1: The Y-axis value at H Cursor1

  Y2: The Y-axis value at H Cursor2

  ΔY: The difference between the Y-axis values at H Cursor1 and H Cursor2

- **V (Vertical) Cursor**

  Measures the X-axis value at the cursor.

  X1: The X-axis value at V Cursor1

  X2: The X-axis value at V Cursor2

  ΔX: The difference between the X-axis values at V Cursor1 and V Cursor2

- **H&V Cursor**

  Measures the Y-axis and X-axis value at the cursor.

  Y1: The Y-axis value at H Cursor1

  Y2: The Y-axis value at H Cursor2

  ΔY: The difference between the Y-axis values at H Cursor1 and H Cursor2

  X1: The X-axis value at V Cursor1

  X2: The X-axis value at V Cursor2

  ΔX: The difference between the X-axis values at V Cursor1 and V Cursor2

- **Marker Cursors**

  Move the cursor on the waveform data and measure the waveform data values.

  T: Display the time difference from the trigger point at the cursor

  X: The X-axis value at Cursor

  Y: The Y-axis value at Cursor

Movement Range of the Cursors (When Not Displaying the X-Y Waveform)

- **H Cursor**

  Can be set in the range from –5 to +5 divisions from the center of the screen. The resolution is 0.01 divisions.

- **V Cursor, Marker Cursor, and Angle Cursor**

  Can be set in the range from –5 to +5 divisions from the center of the screen. The resolution is T/div $\times$ 10 ÷ display record length

Movement Range of the Cursors (When Displaying the X-Y Waveform)

- **H Cursor, V Cursor, and H&V Cursor**

  Can be set in the range from –5 to +5 divisions from the center of the screen. The resolution is 0.01 divisions.

- **Marker Cursors**

  Can be set in the range from –5 to +5 divisions from the center of the screen. The resolution is T/div $\times$ 10 ÷ display record length.

Display Format of Logic Waveforms (When Not Displaying the X-Y Waveform)

You can set the following items when measuring logic waveforms using V cursors.

- **Selecting the Notation of Cursor Measurement Values: Format**

  Select the notation system used to display cursor measurement values.

  Binary: Displays values in binary notation.

  Hexa: Displays values in hexadecimal notation.

- **Read Direction of Bit Data: Order**

  Select the direction of reading the bit data of the logic input.

  A1->A8 B1->B8: Bit 1 to bit 8 of LogicA, bit 1 to bit 8 of LogicB

  B8->B1 A8->A1: Bit 8 to bit 1 of LogicB, bit 8 to bit 1 of LogicA

- **Combining of the Bit Data**

  The data of LogicA and LogicB can be combined and handled as 16-bit data.
- **Handling of the OFF Bit**
  - In binary notation, a dash is displayed at the bit.
  - In hexadecimal notation, value is displayed as though the bit does not exist.

Measurement Example of Logic Waveforms

The values of measurement parameters Y1 and Y2 when the logic waveform is measured using vertical cursors are as follows.

- **When LogicA or LogicB is measured by itself and OFF bits do not exist**

- When the order is A1->A8 B1->B8
  Binary   Y1: 01001010
  　　　　　Y2: 10110010
  Hexa   Y1: 4A
  　　　　　Y2: B2

- When the order is B8->B1 A8->A1
  Binary   Y1: 01010010
  　　　　　Y2: 01001101
  Hexa   Y1: 52
  　　　　　Y2: 4D

- **When LogicA or LogicB is measured by itself and OFF bits exist**

- When the order is A1->A8 B1->B8
  Binary   Y1: 01-01-10
  　　　　　Y2: 10-10-10
  Hexa   Y1: 16
  　　　　　Y2: 2A

- When the order is B8->B1 A8->A1
  Binary   Y1: 01-10-10
  　　　　　Y2: 01-01-0
  Hexa   Y1: 1A
  　　　　　Y2: 15
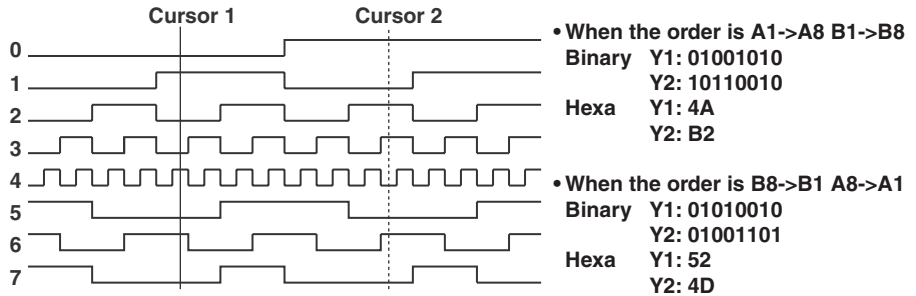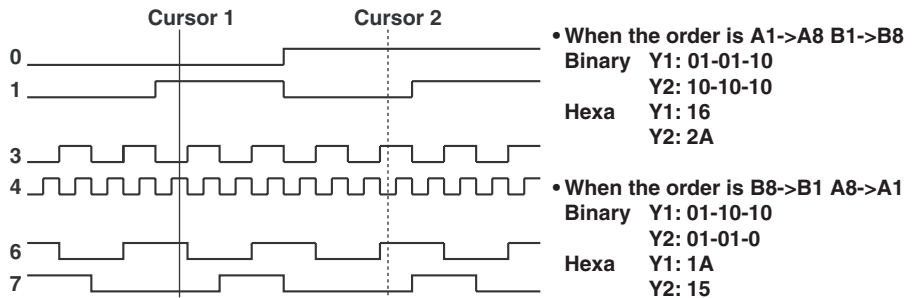
- **When LogicA & LogicB (combined data of LogicA and LogicB) is measured and OFF bits exist**

- When the order is A1->A8 B1->B8
  Binary Y1: 01-01-101-11-01
  　　　　Y2: 10-10-100-00-01-
  Hexa   Y1: 2DD
  　　　　Y2: 541

- When the order is B8->B1 A8->A1
  Binary Y1: -10-11-101-10-10
  　　　　Y2: -10-00-001-01-01
  Hexa   Y1: 5DA
  　　　　Y2: 415

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Waveform Analysis/Search
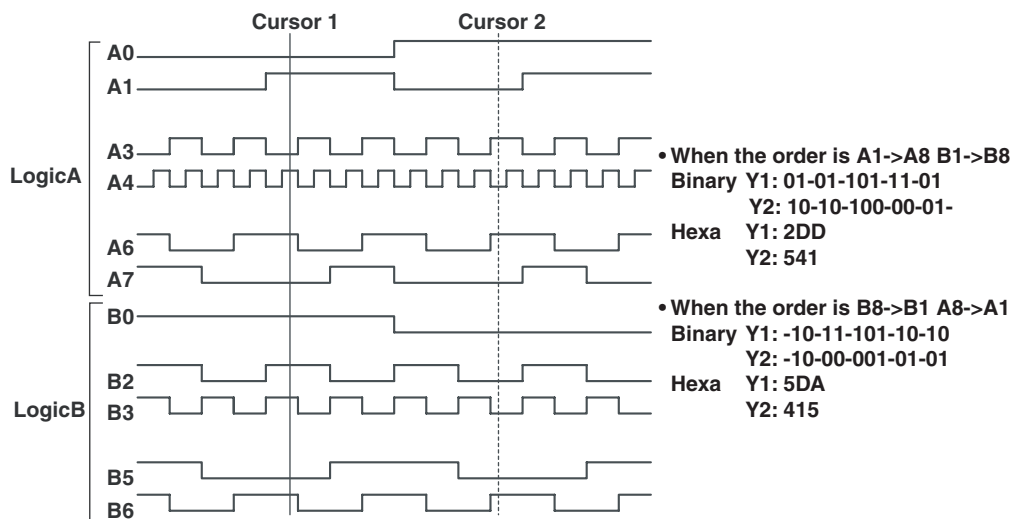
Cursor Jump (When Not Displaying the X-Y Waveform)

For V cursors, marker cursors, and angle cursors, you can move M1 to M4, Cursor1, and Cursor2 to the center of the zoom window. The cursors can be jumped in the following manner.

- **Marker Cursors**
  - to Z1:   Make the selected marker jump to the Z1 window.
  - to Z2:   Make the selected marker jump to the Z2 window.
- **V Cursor and Angle Cursor**
  - C1 to Z1:   Make Cursor1 jump to the Z1 window
  - C1 to Z2:   Make Cursor1 jump to the Z2 window
  - C2 to Z1:   Make Cursor2 jump to the Z1 window
  - C2 to Z2:   Make Cursor2 jump to the Z2 window

Notes When Making Cursor Measurements

- The time axis values are measured from the trigger position.
- The measured value will display "***," if the measurement is not possible.
- The pulse/rotate setting (see section 5.14) is applied to the X-axis (horizontal) measurement values in cursor measurements.
- If the sub waveform window is displayed when using the dual capture function, cursor measurements are made on the sub waveform. To make cursor measurements on the main waveform, turn OFF the sub waveform window in the DUAL CAPTURE menu.
- The results of cursor measurements on the sub waveforms of the dual capture function are displayed in italics.

Selectable Range of Cursor Position

In cursor measurements, measurement is performed on the data stored in the acquisition memory not on the displayed data. Since 1001 points along the time axis are used to displayed the waveform, the number of acquired data points is equal to "record length × 1.001." If the record length is set to 10 kW, the number of acquired data points is 10010. Therefore, if the record length is set to 10 kW, 10 points of measured data will exist at the same position on the screen. The cursor display position is normally within ±5 divisions around the center position of the waveform display frame. In this case, if the cursor display position is set to +5 div, only 1 point out of 10 points can be measured even if there are 10 points of measured data at the same time axis position. In such case, the cursor position can be set in the range of –5 divisions to +5.009 divisions (if the record length is set to 10 kW). In other words, the data at the right end of the waveform display frame can be measured by setting the cursor position in the range of 5.000 to 5.009 divisions. Because the number of points at the same time axis position increases as the record length gets larger, the range varies depending on the record length (5.000 to 5.0099 divisions for 100 kW).
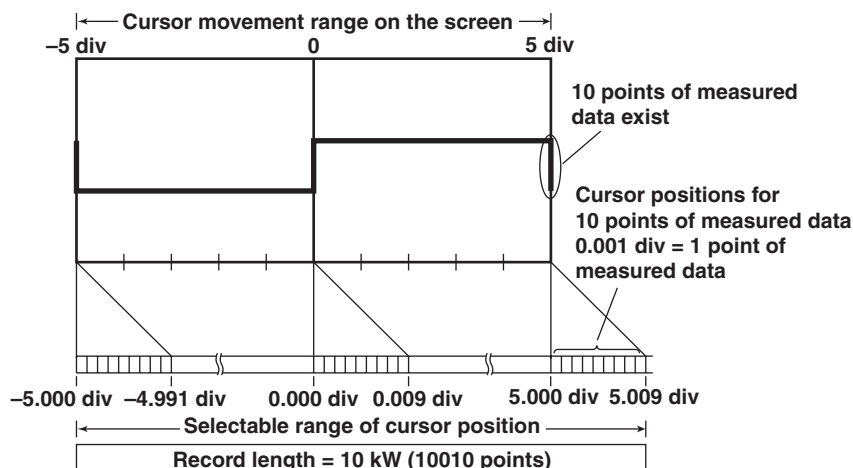
11.6 Automated Measurement of Waveform Parameters

Procedure
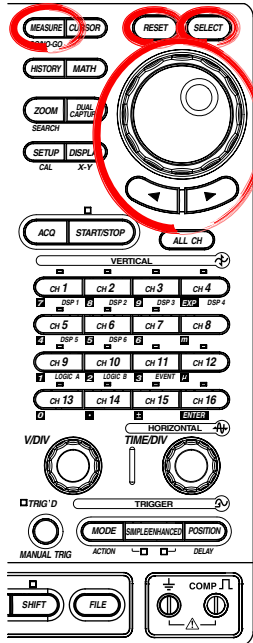
1. Press **MEASURE**.
2. Press the **Mode** soft key , and press the ON soft key.

Selecting the Measurement Parameter

3. Press the **Item Setup** soft key. The measurement parameter setup dialog box appears.

- **Selecting the Waveform to Be Measured**
  4. Press the **Trace** soft key. The trace selection menu appears.
  5. Use the **jog shuttle** and **SELECT** to select waveform to be measured.

- **Selecting the Measurement Parameter**
  6. Use the **jog shuttle** and **SELECT** to turn ON/OFF each item on the measurement parameter dialog box.
     You can turn OFF all parameters at once by pressing the **All Clear**.
     You can copy the current parameter settings to all traces by pressing the **Copy to All Trace** soft key.
  7. Repeat steps 4 to 6 as many times as necessary.

DSP1 to DSP6 are optional.

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Waveform Analysis/Search

Setting the Delay

8. Press the **Delay Setup** soft key. The Delay Setup dialog box appears.

- **Selecting the Waveform to Be Measured**

9. Press the **Trace** soft key. The trace selection menu appears.
10. Use the **jog shuttle** and **SELECT** to select waveform to be measured.

- **Setting the Delay**

11. Use the **jog shuttle** and **SELECT** to set Mode of the Delay Setup dialog box to Time, Degree, or OFF.
12. Use the **jog shuttle** and **SELECT** to set Polarity under Measure to ⌐ (rising edge) or ⌐ (falling edge).
13. Use the **jog shuttle** and **SELECT** to set Edge Count under Measure.
14. Use the **jog shuttle** and **SELECT** to select whether the trace or the trigger is to be the reference. If you select Trace, proceed to step 15.
15. Use the **jog shuttle** and **SELECT** to set Trace under Reference.
16. Use the **jog shuttle** and **SELECT** to set Polarity under Reference to ⌐ (rising edge) or ⌐ (falling edge).
17. Use the **jog shuttle** and **SELECT** to set Edge Count under Reference.
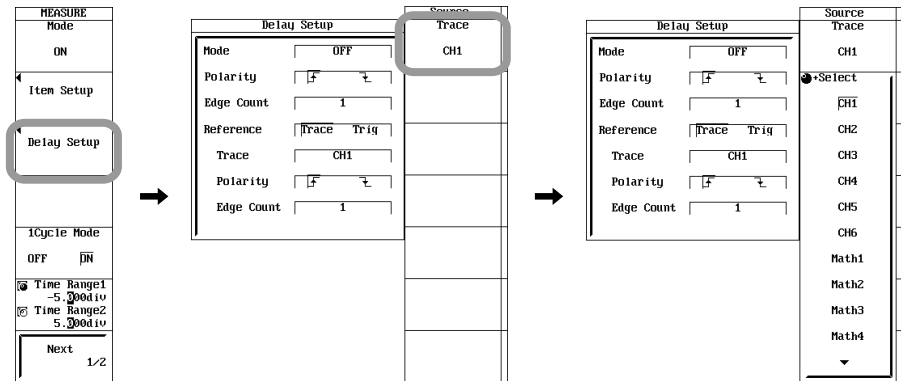
DSP1 to DSP6 are optional.

Setting the 1 Cycle Mode

18. Press the **1Cycle Mode** soft key to select ON or OFF.

Setting the Measurement Range

19. Press the **Time Range1/Time Range2** soft key to set the jog shuttle control to Time Range1.
20. Turn the **jog shuttle** to set the measurement start point.
21. Likewise, set Time Range2 (measurement end point).

Note _____

Up to 10 MW from the measurement start point (Time Range1) are measured.
_____

Selecting the Target Waveform for Distal, Mesial, and Proximal Points

22. Press the **Next 1/2** soft key
23. Press the **Trace** soft key. The trace selection menu appears.
24. Press the soft key corresponding to the desired waveform to select the target waveform.

Setting the Distal, Mesial, and Proximal Unit

25. Press the **Dist/Prox Mode** soft key to set the unit for distal, mesial, and proximal points to % or Unit. If the target waveform was set to DSP1 to DSP6 (optional) in steps 23 and 24, only % is selectable.

Setting Distal, Mesial, and Proximal

26. Press the **Distal**, **Mesial**, or **Proximal** soft key.
27. Turn the **jog shuttle** to set the distal, mesial, or proximal point.

Selecting the High and Low Setting

28. Press the **High/Low Mode** soft key to select Auto or MAX-MIN.

DSP1 to DSP6 are optional.

11

Waveform Analysis/Search
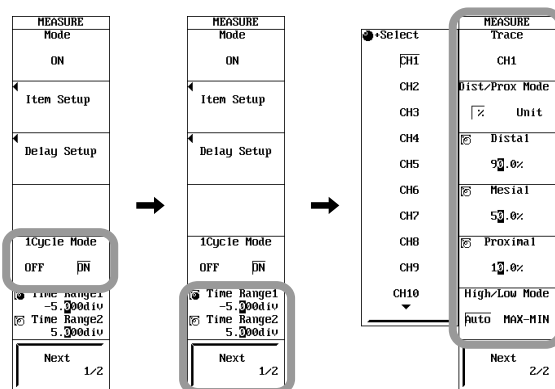
Explanation

Limitations

Automated measurement of waveform parameters cannot be performed on the following waveforms.

- Snapshot waveforms
- Accumulated waveforms other than the newest waveform.
- Sub waveforms measured using the dual capture function (version 3.10 or earlier. However, if you load the measured data of Version 3.10 or earlier into a DL750/DL750P of Version 4.01 or later, automated measurement of waveform parameters is possible.)

Measurement Parameters: Item Setup

You can select among the 28 types of measurement parameters shown below and delay between channels. Up to 48000 combinations of parameters of all traces (CH1 to CH16 and Math1 to Math8) can be saved.

- **Voltage-axis Parameters**

P-P : Peak to Peak Value (MAX - MIN) [V]
Max : Maximum Voltage [V]
Min : Minimum Voltage [V]
Rms[1]: Root Mean Square Value
$(1/\sqrt{n})(\Sigma(xi)^2)^{1/2}$ [V]
Avg : Average Voltage $(1/n)\Sigma xi$ [V]
Sdev[2]: Standard Deviation
(SDv)[2] $(1/n(\Sigma xi^2 - (\Sigma xi)^2/n))^{1/2}$ [V]

–Ovr shoot : Undershoot Value
(–Ovr)[1] (LOW - MIN)/(HIGH - LOW) x 100 [%]
+Ovr shoot : Overshoot Value
(+Ovr)[1] (MAX - HIGH)/(HIGH - LOW) x 100[%]
High : High Level Voltage [V]
Low : Low Level Voltage [V]
Amp : Amplitude (High-Low) [V]
Mid : (MAX+MIN)/2

1. If Rms is ON on the channels (Math1 to Math8) on which power spectrum computation (PS or PSD) is selected, the screen shows "Rms = overall value." For details on the power spectrum computation, see sections 10.3 and 10.5. For details on the overall value, see page App-19.
2. ( ) shows the corresponding name at the measurement item setting screen.
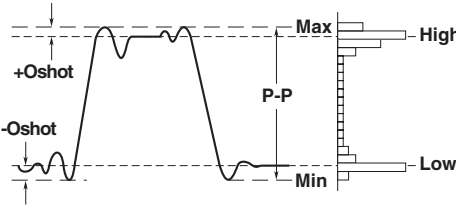
- **Time-axis Parameters**

Rise : Rise Time [s]
Fall : Fall Time [s]
Freq : Frequency [Hz],1/PERIOD
Period : Period [s]
(Prod)[1]
Avg Freq : Mean Frequency in
(FR-A)[1] Measuring Range[Hz]
Avg Period: Mean Period in
(PR-A)[1] Measuring Range[s]

+Width : Width (s) Greater than the Mesial Value
(+Wd)[1]
–Width : Width (s) Smaller than the Mesial Value
(–Wd)[1]
Duty : Duty Ratio + Width/Period x 100[%]

1. ( ) shows the corresponding name at the measurement item setting screen.
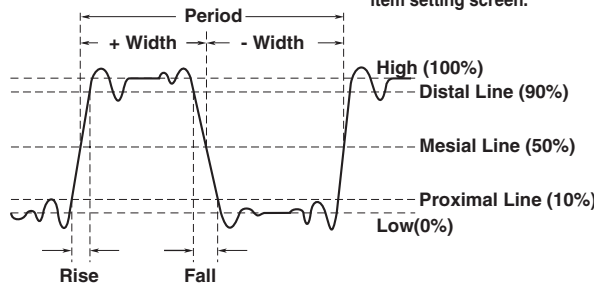
Pulse : Pulse Count
(PlsN)

When Pulse=3

Set the measurement range (T-Range) to match the pulse width of the signal being measured.
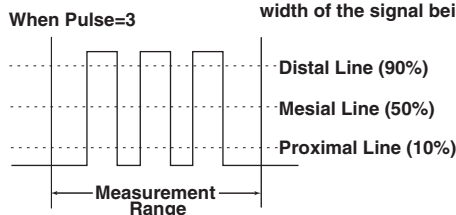
Automated measurement of various waveform parameters are performed on the data stored to the acquisition memory. Up to 48000 data points among the parameters that are automatically measured can also be saved to a file. (For details, see section 13.10.)

Burst1, Burst2: Burst Width (Bst1, Bst2)

Set the measurement range (T-Range) to match the burst width of the signal being measured.

Distal Line (90%)
Mesial Line (50%)
Proximal Line (10%)

Burst1 Width
Burst2 Width
Measurement Range
T1 cursor   T2 cursor
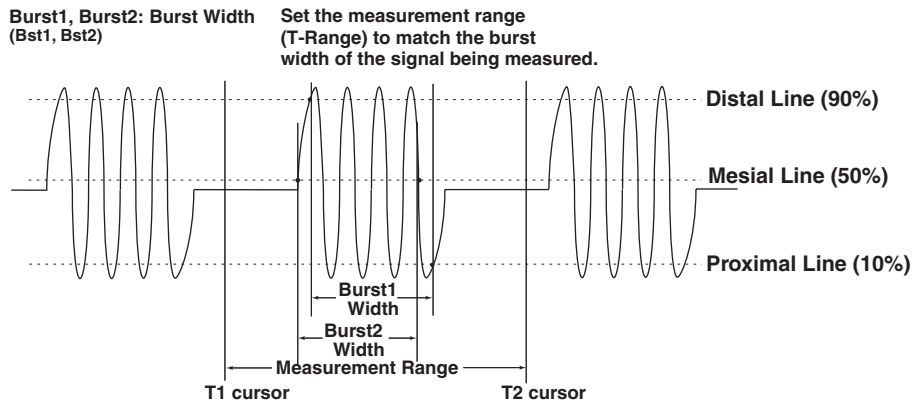
- **Other Measurement Parameters**
  Int1TY: The area under the positive amplitude
  Int2TY: The area under the positive amplitude – the area under the negative amplitude
  Int1XY: The summation of the triangular area of the X-Y waveform
  Int2XY: The summation of the trapezoidal area of the X-Y waveform
  For details regarding the area calculations, see Appendix 3, "How to Calculate the Area of a Waveform."

Setting the Delay

The time difference between the rising or falling edges of trace waveforms or trigger points is called the delay between channels.

Measurement Range

1 count   N1 count

Reference Waveform   Mesial Line

Setting Example of Reference Waveform
- Edge Polarity   : ⌐ (Rising)
- Edge Count   : N1(1 to 9)

Delay between Channels

1 count   N2 count

Setting Example of Measurement Waveform
- Edge Polarity   : ⌐ (Falling)
- Edge Count   : N2(1 to 9)

Measurement Waveform
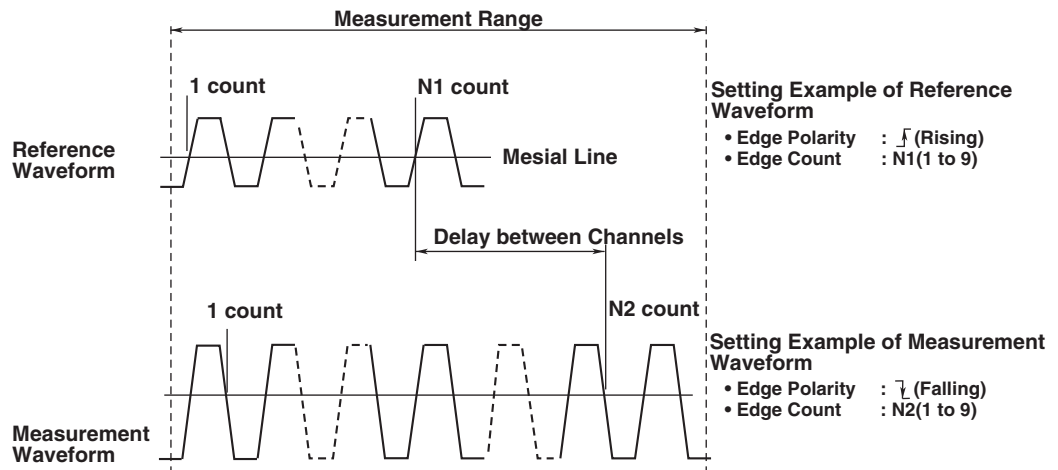
- If Mode is set to Time or Degree, measurements will be made. The default setting is OFF.
  Time: Display the delay between channels as a time
  Degree: Display the delay between channels as an angle
           Degree = Delay (s)/Period (s) × 360 (deg). The period is that of a reference waveform.
- Select ⌐ (rising edge) or ⌐ (falling) for the slope of the edge to be detected using Edge Polarity. The default setting is rising.
- Set the number of edges to detect before actually considering it a detection point in Edge Count. The range is an integer from 1 to 9. The default value is 1.

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Waveform Analysis/Search

- The voltage level at the detection point is the mesial point.
- The parameter name when the measured value is displayed is (Dly).

Note

If the Mode is set to Degree and the reference waveform is Trig, the measured value shows "***."

1 Cycle Mode

This mode is used to compute items related to the voltage axis or the area over one cycle after determining the cycle. This mode is suited to items such as Rms and Avg that produce errors depending on the measurement range.
This mode does not affect the items related to the time axis or the area of the X-Y waveforms.

Setting the Measurement Range (Time Range1/Time Range2)

By default, the ±5 divisions of the time axis display frame is the measurement range. However, this range can be shortened. The measurement range is specified using two vertical cursors. The measurement start point is the position where the fine dotted line is located, and the measurement end point is the position where the coarse dotted line is located. Up to 10 MW from the measurement start point (Time Range1) are measured. The concept of the measurement range is analogous to the concept of the selectable range of cursor display position in cursor measurement.
For details, see section 11.5, "Selectable Range of Cursor Position."

Setting the Distal, Mesial, and Proximal Unit: Dist/Prox Mode

Select the method of assigning the three levels that are used as references in measurements such as the rise and fall times.

- **%**
  The distal, mesial, and proximal values are set in terms of percentages when High of any trace (CH1 to CH16, DSP1 to DSP6 (optional), Math1 to Math8) and Low are taken to be 100.0% and 0.0%, respectively.
- **Unit**
  Set the distal, mesial, and proximal values of any trace (CH1 to CH16, Math1 to Math8) to arbitrary voltage or temperature values.

Setting Distal, Mesial, and Proximal

Unit: Dist/Prox Mode
Proximal range: 0.0 to 100.0 (resolution: 0.1%) or voltage or temperature
                  corresponding to ±10 divisions (resolution: varies depending on the
                  module). For details, see section 5.3.)
Mesial range: 0.0 to 100.0 (resolution: 0.1%) or voltage or temperature
                  corresponding to ±10 divisions (resolution: varies depending on the
                  module). For details, see section 5.3.)
Distal range: 0.0 to 100.0 (resolution: 0.1%) or voltage or temperature
                  corresponding to ±10 divisions (resolution: varies depending on the
                  module). For details, see section 5.3.)

Selecting the High and Low Setting: High/Low Mode

High indicates the 100% level in measurements such as the rise or fall time. And, Low indicates the 0% level. Select the assignment method of High and Low from the following two methods.

- **Auto**

  Sets the higher amplitude level to High and lower level to Low within the measurement range based on the voltage level frequency of the waveform by taking the effects of ringing, spikes, etc. into consideration. This method is best-suited when measuring rectangular waveforms and pulse waveforms.

- **MAX-MIN**

  Sets the maximum value to High and lowest value to Low in the measurement range. This method is best-suited when measuring sine waveforms, ramp waveforms, etc. It is not suited for measurement of waveforms with ringing and spikes.

Notes When Performing Automated Measurement of Waveform Parameters

- The measurement value displays "***" if the measurement is not possible (such as when the measurement range is greater than or equal to 10 MW).
- For waveforms of small amplitude, correct measurements may not be possible.
- If there are two or more cycles of a waveform in the measurement range, the measurement is made on the first waveform.
- Automated measurement is not possible on logic waveforms.
- If automated measurement is made on waveforms that are measured using the realtime recording function, the execution of the automated measurement takes a long period due to the hard disk access.
- Depending on the conditions such as the memory length, the number of measured items, and the input waveform, the execution of the automated measurement may take an extended period. While automated measurement is in progress, ⟨⟩ is indicated at the upper left corner of the screen.
- To abort the automated measurement, set Mode to OFF. The process is aborted at that point.
- If X Axis is set to Quad in the X-Y menu, Int1XY and Int2XY cannot be measured.
- For FFT waveforms, only Max and Min can be measured.
- If the sub waveform window of the dual capture function is showing, automated measurement of waveform parameters is performed on the sub waveform.
  To perform automated measurement of waveform parameters on the main waveform, turn OFF the sub waveform window.
- The results of automated measurements on the sub waveforms of the dual capture function are displayed in italics.

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Waveform Analysis/Search

11.7 Performing Statistical Processing

Procedure
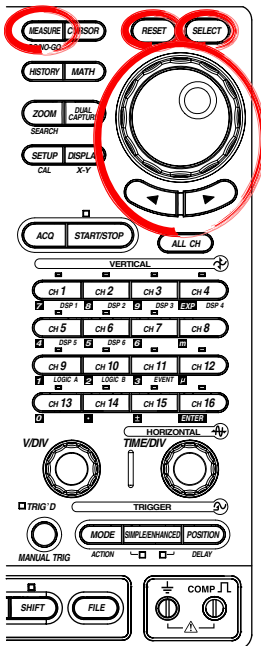
Setting Normal Statistical Processing

1. Press **MEASURE**.
2. Press the **Mode** soft key to select **Statistics**.
3. Press the **Item Setup** soft key. The measurement parameter dialog box and the measurement channel menu appear.
4. Press the **Trace** soft key and use the **jog shuttle** and **SELECT** to select the measurement channel.
5. Turn the **jog shuttle** to move the cursor to the parameter you wish to turn ON.
6. Press **SELECT** to turn on the parameter selected in step 5.
   You can turn OFF all parameters at once by pressing the **All Clear**. You can copy the current parameter settings to all traces by selecting "**Copy to All Trace**."
7. Repeat steps 4 to 6 as many times as necessary. Press **ESC**.

   The setting of other parameters is the same as the automated measurement of waveform parameters (see step 8 and following steps in section 11.6).

DSP1 to DSP6 are optional.

Setting Cycle Statistical Processing

1. Press **MEASURE**.
2. Press the **Mode** soft key to select **Cycle Statistics**.
3. Press the **Item Setup** soft key. The measurement parameter dialog box and the measurement channel menu appear.
4. Press the **Trace** soft key and use the **jog shuttle** and **SELECT** to select the measurement channel.
5. Turn the **jog shuttle** to move the cursor to the parameter you wish to turn ON.
6. Press **SELECT** to turn on the parameter selected in step 5.
   You can turn OFF all parameters at once by pressing the **All Clear**. You can copy the current parameter settings to all traces by selecting "**Copy to All Trace**."
7. Repeat steps 4 to 6 as many times as necessary. Press **ESC**.
8. Press the **Cycle Trace** soft key. The cycle trace menu appears.
9. Press the soft key corresponding to the channel to be used to determine the cycle. If Own is specified, the cycle is determined on each waveform for statistical processing.

   The setting of other parameters is the same as the automated measurement of waveform parameters (see step 19 and following steps in section 11.6).

Executing Statistical Processing

10. Press the **Measure Exec** soft key. Statistical processing is executed. Press the same key again to abort.
    Proceed to step 11.

DSP1 to DSP6 are optional.

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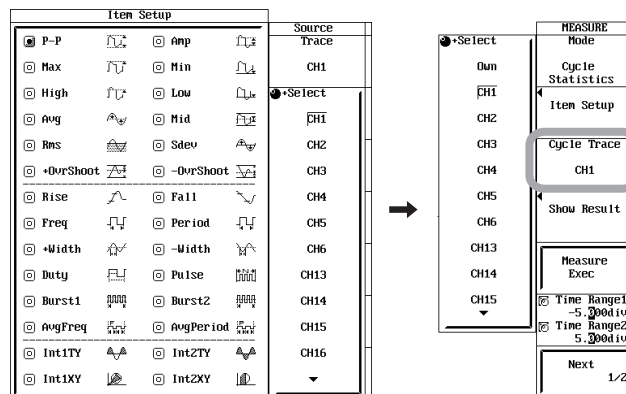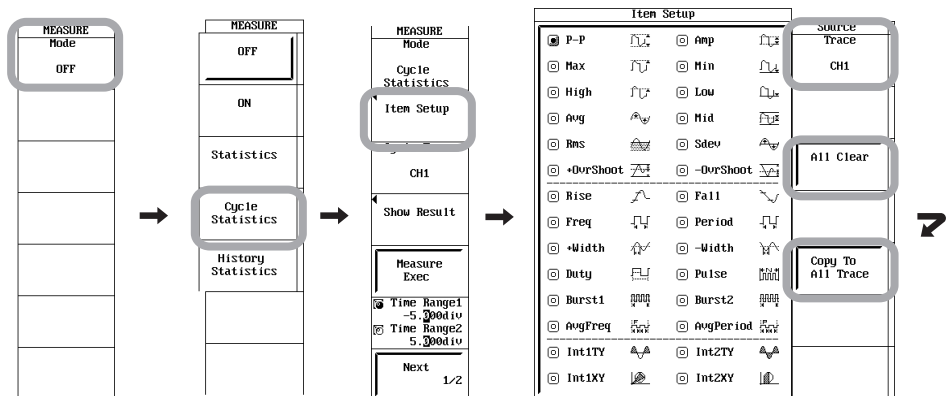
Setting Statistical Processing of History Data

1. Press **MEASURE**.
2. Press the **Mode** soft key to select History Statistics.
3. Press the **Item Setup** soft key. The measurement parameter dialog box and the measurement channel menu appear.
4. Press the **Trace** soft key and use the **jog shuttle** and **SELECT** to select the measurement channel.
5. Turn the **jog shuttle** to move the cursor to the parameter you wish to turn ON.
6. Press **SELECT** to turn on the parameter selected in step 5.
   You can turn OFF all parameters at once by pressing the **All Clear**. You can copy the current parameter settings to all traces by selecting "**Copy to All Trace**."
7. Repeat steps 4 to 6 as many times as necessary. Press **ESC**.

   The setting of other parameters is the same as the automated measurement of waveform parameters (see step 8 and following steps in section 11.6).

Executing Statistical Processing

8. Press the **Measure Exec** soft key. Statistical processing is executed. Press the same key again to abort.
   Proceed to step 11.

DSP1 to DSP6 are optional.

Displaying the Results of Statistical Processing

11. Press the **Show Result** soft key to display a list of the results of statistical processing. Press the arrow key to scroll the list horizontally. Turn the jog shuttle to scroll the list vertically.

Press the Max/Min Item1 to Max/Min Item6 soft keys to move the cursor to the maximum and minimum values of each waveform parameter. The displayed parameters from the left end correspond to Item1, Item2, Item3, Item4, Item5, and Item6.

You can press the Sort soft key to sort the list in ascending (FWD) or descending (REV) order.

DSP1 to DSP6 are optional.
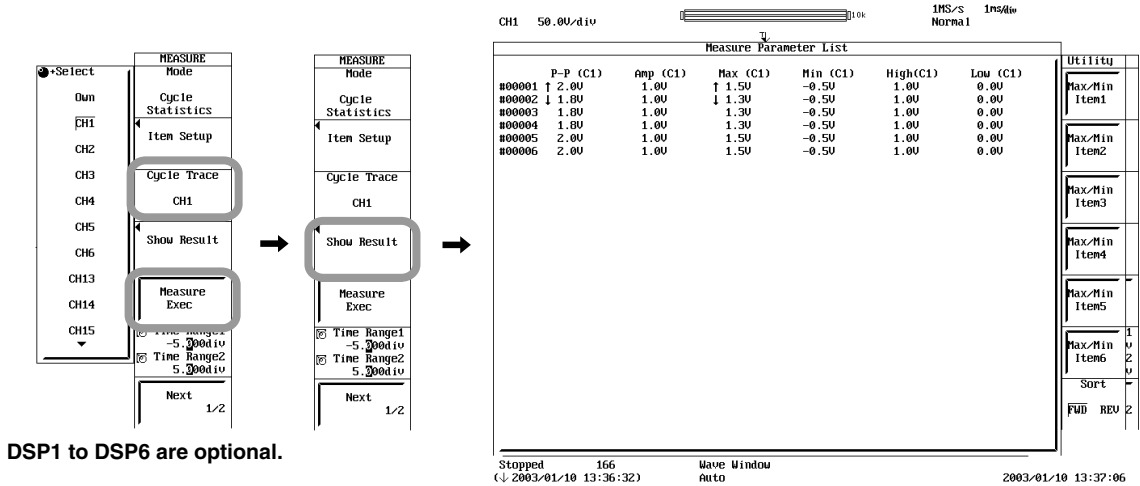
Explanation

Statistical processing is performed on the same measurement parameters as those of the automated measurement of waveform parameters. The following five statistics are determined on the three measured values of automated measurement parameters.

- Max: Maximum value
- Min: Minimum value
- Avg: Average value
- Sdv: Standard deviation
- Cnt: Number of measured values used in the statistical processing

For example, if you selected P-P of CH1 as an automated measurement parameter, the maximum, minimum, average, standard deviation, and the number of measured values used in the statistical processing are displayed at the bottom section of the screen.

The result of statistical processing that can be displayed is three parameters of automated measurement. If you selected four or more parameters for automated measurement, the first three parameters in the automated measurement parameter selection menu (P-P, Amp, Max, Min, *, Init1XY, and Init2XY) of Item Setup are displayed in order from the smallest channel.

Example 1: When CH1: P-P, Amp; CH2: Min; and CH3: Max, Min are selected
CH1: P-P, CH2: Min, and CH3: Max are displayed.

Example 2: If CH1: Max, Min and CH2: P-P and Amp are selected
CH1: Max, Mix, and CH2: P-P are displayed.

The results of statistical processing that are not displayed can be loaded in the following manner.

- Load the results into your PC using the communication function.
- Save the results of statistical processing as measured values of automated measurement parameters (see section 13.10) and load the values into your PC.
- Scroll the list of statistical processing results using the arrow keys.

Statistical processing includes three types: normal statistical processing, cycle statistical processing, and statistical processing of history data.

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Waveform Analysis/Search

Normal Statistical Processing (Statistics)

Statistical processing is performed on all acquired waveforms while acquiring waveforms. If you stop waveform acquisition and start it again, statistical processing continues from the statistical processing result obtained up to the previous stop. Statistical processing is performed on the selected parameters for automated measurement that are not displayed. Therefore, if you disable the statistical processing of a displayed automated measurement parameter while waveform acquisition is in progress, the statistical processing results of the next selected automated measurement parameter in line to be displayed are displayed. The number of measured values used in the statistical processing (Cnt) is the number of waveforms that have been acquired up to that point.

If you add statistical processing on a new automated measurement parameter while waveform acquisition is in progress or when it is stopped, the number of measured values used in the statistical processing (Cnt) is the number of waveforms that have been acquired since the parameter was added.

Cycle Statistical Processing

The cycle of the displayed waveform is determined in order from the oldest data, the selected parameters for automated measurement are measured on the data within the cycle, and statistical processing is performed. The cycle is determined in the same fashion as the Period for the waveform parameter. You can select whether to apply the cycle of the specified waveform to all waveforms or determine the cycle for each waveform.

- CH, Math, DSP: Performs automated measurement of waveform parameters on all target waveforms per cycle of the specified channel, and performs statistical processing.
- Own: Determines the cycle for each target waveform, performs automated measurement of waveform parameters for each cycle, and performs statistical processing. However, if signals of different cycles are applied to multiple channels, automated measurement of waveform parameters and statistical processing are performed for the number of cycles of the channel whose cycle is the slowest on all other channels.

When Own is selected as the waveform used to determine the cycle
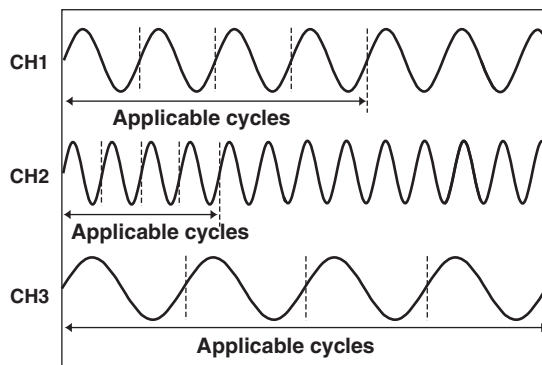
In the left figure, the number of cycles of the channel whose cycle is the slowest (CH3) is 4. Therefore, statistical processing is performed on the 4 oldest cycles of data for CH1 and CH2, also. The rest of the data is not used in statistical processing.

Statistical processing is performed from the oldest data of the displayed waveform in blocks of cycles.

It can not be used with the 1 cycle mode at the same time.

In addition, the following waveform parameters are not measured:

- For waveforms on which the cycle is measured: Avg Freq (average frequency), Avg Period (average period), PlsN (pulse count), Int1XY (area), Int2XY (area), and Delay.
- For other waveforms: Int1XY (area), Int2XY (area), and Delay.

Statistical Processing of History Data

Performs automated measurement of waveform parameters on the waveform that is acquired using the history memory function and performs statistical processing. Statistical processing is performed from the oldest waveform. The range on which the statistics are measured is the waveform that is displayed on Show Map. It can be used with Delay and 1 cycle mode.

Target Waveforms

CH1 to CH16, DSP1 to DSP6 (optional), and Math1 to Math8
However, Math1 to Math8 are not applicable for statistical processing of history data.

Automated Measurement Parameters for Statistical Processing

The parameters on which statistical processing is performed are the parameters of automated measurement of waveform parameters in section 11.6. The result of statistical processing that can be displayed is only three parameters of automated measurement.

Measurement Range for Statistical Processing

The measurement range is the same as that specified for automated measurement of waveform parameters (see section 11.6).

Show Results

If you perform cycle statistical processing or statistical processing of history data, a list of measured results can be displayed for the selected automated measurement parameters. The waveforms are numbered from the oldest cycle data or history data, and the corresponding results of automated measurement are displayed. The maximum and minimum values of each waveform parameter are displayed using ↑ (maximum) and ↓ (minimum). If there are multiple points that are of the same value, the maximum and minimum values are marked on the oldest data. The number of data points that can be listed is 48000. If this value is exceeded, the most recent 48000 points of automated measurement parameters of history waveforms or data are displayed. In this case, the maximum and minimum values may exist outside the displayed list. In such case, ↑ (maximum) and ↓ (minimum) that are outside the range are not displayed.
In statistical processing of history data, you can select a waveform using the jog shuttle and press SELECT to display the selected historical waveform.
In cycle statistical processing, you can select a number using the jog shuttle and press SELECT to zoom in on the waveform (1 cycle) of the selected number. Statistical processing is performed only on the data that can be listed.

Notes When Performing Statistical Processing

- While statistical processing is in progress, ⌨ is indicated at the upper left corner of the screen. All soft keys except the Measure Abort soft key are disabled.
- Statistical processing is not possible in the following cases.
  - Realtime recorded waveforms
  - FFT waveforms
  - The number of data points in the measurement range (see section 11.6) is greater than or equal to 10 Mpoints.
- Depending on the conditions such as the record length, the number of parameters on which statistical processing is performed, and the input waveform, the execution or termination (aborting) may take an extended time.

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Waveform Analysis/Search

11.8 Performing GO/NO-GO Determination Using Zones

Procedure
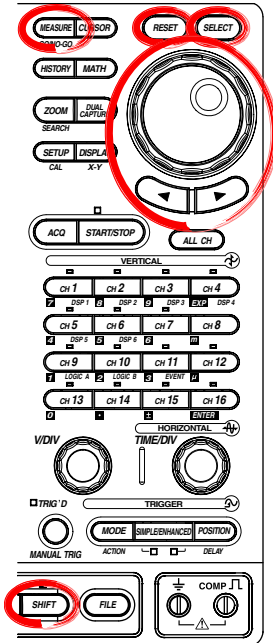
Setting GO/NO-GO Determination Mode

1. Press **SHIFT+MEASURE**.
2. Press the **Mode** soft key. A menu for setting GO/NO-GO determination mode appears.
3. Press the **Zone** soft key.

Creating a New Determination Zone

4. Press the **Edit Zone** soft key.
5. Press any of the **Zone1** to **Zone6** soft keys to select the Zone.
6. Press the **New** soft key. A menu for selecting the reference waveform for creating the zone appears.
7. Press the soft key corresponding to the reference waveform. The zone edit menu appears.

Editing the Entire Zone

8. If Edit is not set to Whole, press the **Edit** soft key to select Whole.
9. Press the **Upper/Lower** or **Left/Right** soft key to select the direction to set the zone.
10. Turn the **jog shuttle** to create the zone.
11. Repeat steps 9 and 10 to edit the zone.
12. Press the **Store as** soft key to open a menu used to set the destination for registering the new zone.
13. Press the soft key corresponding to the destination from Zone1 to Zone6.
14. Press the **Store Exec** soft key to confirm the registration.

    Proceed to step 15 to edit a section of the zone. Proceed to step 23 to finish the creation the zone.
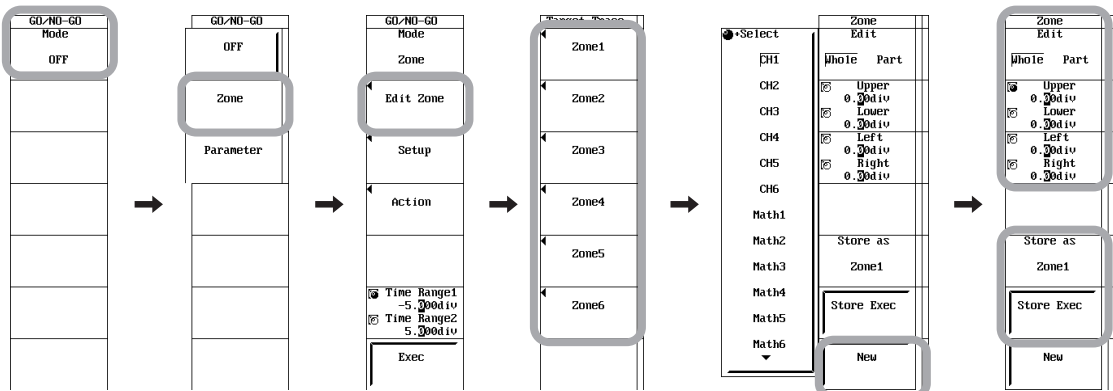
DSP1 to DSP6 are optional.

Editing a Section of the Zone

15. Press the **Edit** soft key to select Part.
16. Press the **Time Range1/Time Range2** soft key to select the right cursor or left cursor.
17. Turn the **jog shuttle** to set the right or left edge of the partial zone.
18. Press the **Upper/Lower** soft key to select the direction in which to set the zone. Then, turn the **jog shuttle** to create the zone.
19. Repeat steps 16 to 18 to create the desired zone.
20. Press the **Store as** soft key to open a menu used to set the destination for registering the new zone.
21. Press any of the **Zone1** to **Zone6** soft keys to select the destination for registering the zone.
22. Press the **Store Exec** soft key to confirm the registration.

Correcting a Preexisting Determination Zone

23. Select the determination zone you wish to correct according to steps 4 and 5.
24. Correct the zone according to steps 8 to 22.

Setting the Determination Waveform

25. Press the **ESC** or carry out an equivalent operation to return to the GO/NO-GO menu.
26. Press the **Setup** soft key. The setup menu appears.

- **Selecting the Trace**
27. Use the **jog shuttle** and **SELECT** to set Trace of number 1.

- **Selecting the Determination Criteria**
28. Use the **jog shuttle** and **SELECT** to set Mode of number 1 to OFF, OUT, or IN.

- **Selecting the Zone Number**
29. Use the **jog shuttle** and **SELECT** to select ZoneNo. of number 1 from Zone1 to Zone6.
30. As necessary, set items 2 to 16.

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Waveform Analysis/Search
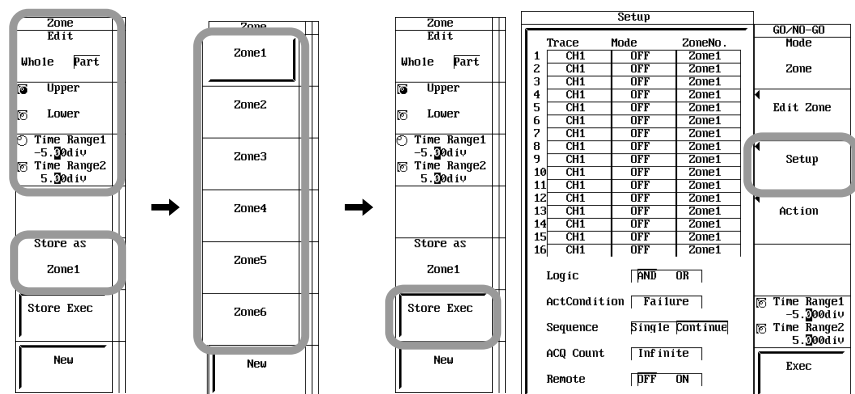
- **Setting the Logic**
  31. Use the **jog shuttle** and **SELECT** to set Logic to AND or OR.

- **Setting the Action Condition**
  32. Use the **jog shuttle** and **SELECT** to set ActCondition to Always, Failure, or Success.

- **Setting the Number of Actions**
  33. Use the **jog shuttle** and **SELECT** to set Sequence to Single or Continue.

- **Setting the Acquisition Count**
  34. Use the **jog shuttle** and **SELECT** to set ACQ Count.

- **Enabling/Disabling the External Input Signal**
  35. Use the **jog shuttle** and **SELECT** to set Remote to OFF or ON.

Selecting the Action

36. Press the **Action** soft key.
37. Use the **jog shuttle** and **SELECT** to set each action ON/OFF.
38. If you turn ON Save to File in step 37, use the **jog shuttle** and **SELECT** to set the file save format to Binary, ASCII, or Float.

Setting the Determination Range

39. Press the **Time Range1/Time Range2** soft key to set the jog shuttle control to Time Range1.
40. Turn the **jog shuttle** to set the determination start point.
41. Likewise, set Time Range2 (determination end point).

Executing the GO/NO-GO Determination

42. Press the **Exec** soft key to execute the GO/NO-GO determination. The soft key changes to **Abort**. Waveform acquisition stops automatically, when determination is finished,
    To stop the GO/NO-GO determination, press the **Abort** soft key or **START/ STOP**.
    In addition, if the following action is specified, the following icon is displayed at the upper left corner of the screen when an action is activated.
    Image/Save to File: Save destination medium (⬚ FD, ⬚ Zip disk, ⬚ PC card, ⬚ external SCSI device, ⬚ internal HD, ⬚ network drive, or ⬚ USB storage device)
    Send Mail: ⊠≈
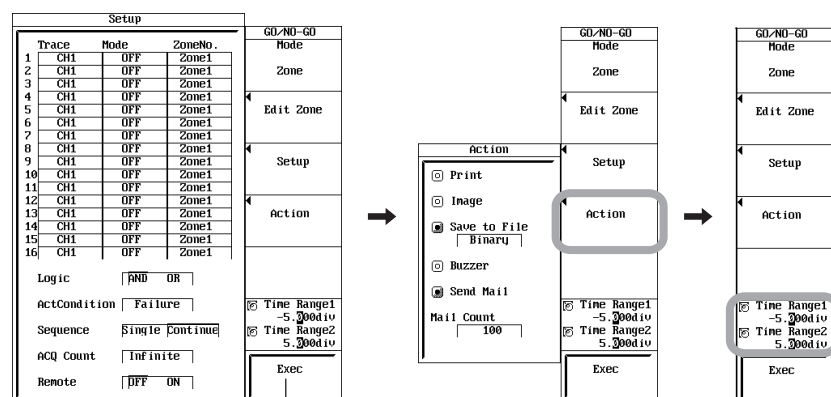
**If Remote is set to ON,
Exec (One Shot) is displayed.**

Explanation

GO/NO-GO is determined by creating a zone based on a reference waveform and checking whether or not the waveform has left or entered the zone.

Selecting the Reference Waveform: Edit Zone

Select the reference waveform used to create the determination zone. You can select any of the following waveforms, that are displayed as a trace, as the reference waveform. CH1 to CH16, DSP1 to DSP6 (optional), Math1 to Math8

Creating the Determination Zone

You can specify up to 6 determination zones. The selectable range is as follows:
•   Vertical range: ±10 divisions from the reference waveform
•   Horizontal range: ±5 divisions from the screen center

You can select input signal waveforms (CH1 to CH16), computed waveforms (Math1 to Math8), and DSP channel waveforms (DSP1 to DSP6, optional)) for the waveforms that are to be determined in the determination zones that are registered in Zone1 through Zone6. The zones that are enabled through Setup are displayed on the screen.

Note

Match the input type of the target waveform to the reference waveform that was used when the zone was created.
For example, if the reference waveform was created from a "voltage input waveform," set the target waveform to "voltage input waveform." Correct determination cannot be made if the target waveform is set to "strain" or "temperature."

Setting the Determination Conditions: Setup

•   **Selecting the Target Waveform: Trace**
    Select the waveform from CH1 to CH16 and Math waveforms.

•   **Setting the Determination Mode**
    IN: GO condition when all the applicable waveforms enter the determination zone. NO-GO if any of the waveforms exists the determination zone.
    OUT: GO condition when all the applicable waveforms are outside the determination zone. NO-GO if any of the waveforms enters the determination zone.
    OFF: Does not perform GO/NO-GO determination.

•   **Zone Number: ZoneNo.**
    Select the zone number from Zone1 to Zone6.

•   **Setting the Logic**
    AND: Executes the action when all conditions (1 to 16 types) are met.
    OR: Executes the Action when any one of the conditions (1 to 16 types) is met.

•   **Action Condition: ActCondition**
    Always: Always executes the action.
    Failure: Execute the action when the GO condition is not met.
    Success: Execute the action when the GO condition is met.
    When Always is selected, the operation specified by Action is executed each time the trigger occurs. This function is useful such as when you wish to print the screen image data to a printer each time the trigger occurs.

•   **Setting the Number of Actions: Sequence**
    Single: Performs the action once.
    Continue: Repeats the action up to acquisition count specified by ACQ Count. (If the count is set to Infinite, the action is repeated until the waveform acquisition is stopped.)

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Waveform Analysis/Search

- **Setting the Number of Waveform Acquisitions: ACQ Count**
  Set the number of waveform acquisitions.
  Infinite: Continues until the waveform acquisition is stopped using the Abort soft
                   key or START/STOP.
  1 to 65536: Stops when the specified number of waveforms is acquired.

- **GO/NO-GO Determination Using an External Input Signal: Remote**
  GO/NO-GO determination can be performed by synchronizing to an external signal
  applied to the GO/NO-GO I/O terminal. The determination result can also be output
  externally. Remote must be turned ON in order to perform GO/NO-GO determination
  using an external signal.

Note

Snapshot cannot be executed when GO/NO-GO determination using waveform zone is in
progress.

Action: Set Action

The following five types of actions can be executed when the condition is met.

- **Print the Screen Image Data: PRINT**
  Prints the screen image data on the printer (Printer (built-in printer), USB (USB
  printer), Net Print (network printer)) specified by Print to in the PRINT menu.

- **Save the Screen Image Data: Image**
  Saves the screen image data to the destination (FD, Zip disk, PC card, internal HD
  (optional), SCSI device, or USB storage device) specified in the IMAGE SAVE menu.

- **Save the Waveform Data: Save to File**
  Saves the waveform data in binary, ASCII, or floating format to the destination (FD,
  Zip disk, PC card, internal HD (optional), SCSI device, USB storage device) specified
  in the FILE menu. The save format is synchronized to data type (see section 13.7) on
  the FILE menu.

- **Buzzer**
  Sounds a buzzer.

- **Send Mail**
  Sends an e-mail message to a specified address. (when the Ethernet interface option
  is installed)
  For the procedure in setting the address, see section 16.5, "Sending Period Mail or
  Action Mail."

Setting the Determination Range (Time Range1/Time Range2)

By default, the determination range is ±5 divisions of the display frame on the time axis.
You can limit this range. The concept of the determination range is analogous to the
concept of the selectable range of cursor display position in cursor measurement. For
details, see section 11.5, "Selectable Range of Cursor Position."

Executing/Aborting GO/NO-GO Determination

The operation starts when you press the Exec soft key. Waveform acquisition is
automatically stopped when the determination is complete. To forcibly stop the
operation, press START/STOP or the Abort soft key.
If Remote is turned ON, determination is executed using the input from the external
terminal. To forcibly stop the operation, press START/STOP.
Pressing the Exec (One Shot) soft key executes the same operation as the input from
the external terminal.

Save to File/PRINT/Image Operation

Operation is carried out according to the settings of FILE, PRINT, and IMAGE SAVE.

File Name When Action Is Set to Save to File or Image

The file is saved using Numbering under the File menu or the Image Save menu.
For details, see section 13.11, "Saving the Screen Image Data" or section 13.7, "Saving/Loading Waveform Data."

Notes When Performing GO/NO-GO Determination

• The determination results (the number of determinations and failures) are displayed.
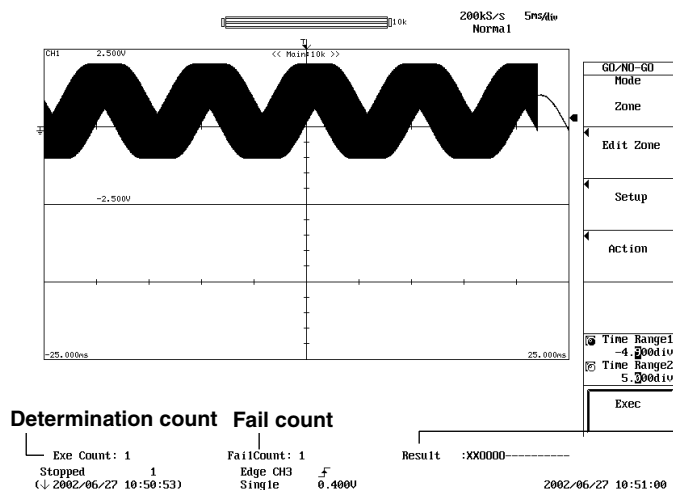
Indicates whether the condition of each determination waveform 1 to 16 is met.

XXOOOO------------

1,2,3, ... ,16: Determination waveform

O: The specified condition is met
X: The specified condition is not met
-: Determination waveform for which a condition is not specified

In this example, the condition of determination waveform 1 is not met and the condition of determination waveform 3 is met.

• All keys other than START/STOP and the Abort soft key are disabled during the determination. (When Remote is ON, the Exec (One Shot) soft key is also valid.)
• When GO/NO-GO determination is executed, the trigger mode is automatically changed to Single.
• Determination is not possible when the acquisition mode is set to Average.
• Determination is not possible when realtime recording is in progress or when waveforms are being acquired using the dual capture function.
• If any of the following actions is activated while the DL750/DL750P is being accessed through the FTP server function or the Web server function, the action is not executed until the access is finished.
Printing/saving of the screen image data and saving of the waveform data

Notes When Action Is Set to Save to File or Image Save

• Do not specify the root directory of the medium as the save destination directory. (Only up to 512 files can be saved to the root directory of a medium that has been formatted using the DL750/DL750P.)
• The maximum number of files that can be created in a single directory is 5000. Do not place files in the save destination folder before starting GO/NO-GO determination.
• If you select Save to File and Image Save simultaneously, separate the folders specified by the FILE menu and the IMAGE SAVE menu.
• If you selected Numbering for the file name assignment method (Auto Naming) in the FILE menu and the IMAGE SAVE menu, the creation of files takes an extended period when the number of saved files becomes large. When creating more than 2000 files, select Date for Auto Naming.

Note
The zone waveforms you create can be stored as setup data on a storage medium such as a floppy disk, Zip disk, PC card, or internal hard disk (optional).

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Waveform Analysis/Search

11.9 GO/NO-GO Determination Using Measured Waveform Parameters
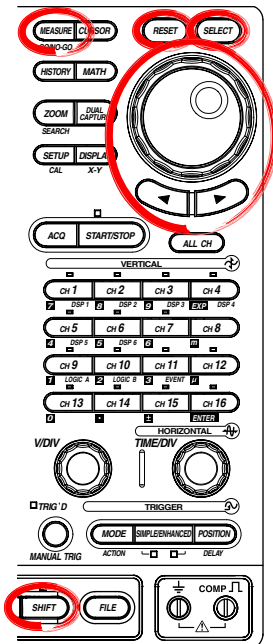
Procedure

Setting GO/NO-GO Determination Mode

1. Press **SHIFT+MEASURE**.
2. Press the **Mode** soft key. A menu for setting GO/NO-GO determination mode appears.
3. Press the **Parameter** soft key.

Setting the Determination Conditions

4. Press the **Setup** soft key. A criteria setup dialog box appears. Use the jog shuttle or arrow keys to move the cursor to the item you wish to set.

- **Selecting the Target Waveform**
5. Use the **jog shuttle** and **SELECT** to set Trace of number 1.

- **Selecting the Determination Criteria**
6. Use the **jog shuttle** and **SELECT** to set Mode of number 1 to OFF, OUT, or IN.

- **Selecting the Parameter**
7. Use the **jog shuttle** and **SELECT** to select Item of number 1 from P-P to Int2XY.
8. As necessary, set items 2 to 16.

- **Setting the Upper and Lower Limits**
9. Use the **jog shuttle** and **SELECT** to set Upper of number 1.
10. Likewise, set Lower of number 1.

- **Setting the Logic**
11. Use the **jog shuttle** and **SELECT** to set Logic to AND or OR.

- **Setting the Action Condition**
12. Use the **jog shuttle** and **SELECT** to set ActCondition to Always, Failure, or Success.
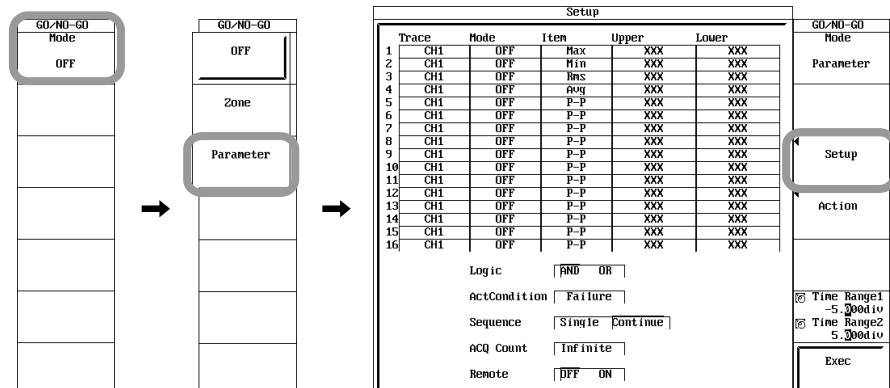
- **Setting the Number of Actions**
    13. Use the **jog shuttle** and **SELECT** to set Sequence to Single or Continue.

- **Setting the Number of Determinations**
    14. Use the **jog shuttle** and **SELECT** to set ACQ Count.

- **Enabling/Disabling the External Input Signal**
    15. Use the **jog shuttle** and **SELECT** to set Remote to OFF or ON.

Selecting the Action

16. Press the **Action** soft key.
17. Use the **jog shuttle** and **SELECT** to set each action ON/OFF.
18. If you turn ON Save to File in step 17, use the **jog shuttle** and **SELECT** to set the file save format to Binary, ASCII, or Float.

Setting the Determination Range

19. Press the **Time Range1/Time Range2** soft key to set the jog shuttle control to Time Range1.
20. Turn the **jog shuttle** to set the determination start point.
21. Likewise, set Time Range2 (determination end point).

Executing the GO/NO-GO Determination

22. Press the **Exec** soft key to execute the GO/NO-GO determination. The soft key changes to **Abort**. Waveform acquisition stops automatically, when determination is finished,
    To stop the GO/NO-GO determination, press the **Abort** soft key or **START/STOP**.
    In addition, if the following action is specified, the following icon is displayed at the upper left corner of the screen when an action is activated.
    Image/Save to File: Save destination medium (FD, Zip disk, PC card, external SCSI device, internal HD, network drive, or USB storage device)
    Send Mail:

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Waveform Analysis/Search
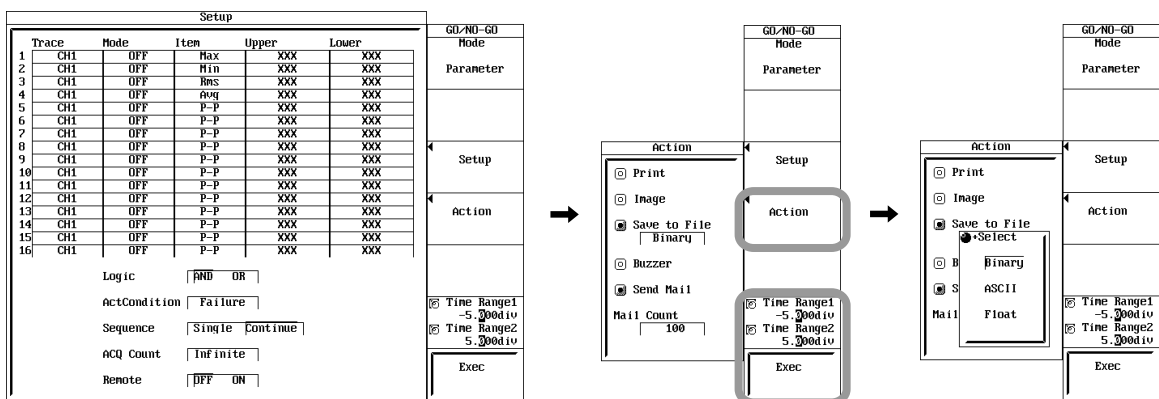
Explanation

By setting the upper/lower limits of the automated measurement of waveform parameters, GO/NO-GO determination is performed on whether the measured value enters the range or exits the range.

Setting the Determination Conditions: Setup

- **Selecting the Target Waveform: Trace**
  Select the waveform from CH1 to CH16, DSP1 to DSP6 (optional), and Math waveforms.

- **Setting the Determination Mode**
  OFF: Does not perform GO/NO-GO determination.
  IN: Go condition when the value enters the specified upper and lower limits.
  OUT: Go condition when the value exits from the specified upper and lower limits.

- **Selecting the Parameter: Item**
  The waveform parameters that can be used are all the items of automated measurement of waveform parameters (28 types) given in section 11.6. Up to 16 types of parameters can be determined simultaneously.

- **Setting the Upper and Lower Limits of Parameters**
  The upper and lower limits vary depending on the parameters. They can be set in the range –9.9999E+30 to 9.9999E+30.

- **Setting the Logic**
  AND: Executes the action when all parameter conditions (1 to 16 types) are met.
  OR: Executes the action when any one of the parameter conditions (1 to 16 types) is met.

- **Action Condition: ActCondition**
  Always: Always executes the action.
  Failure: Execute the action when the GO condition is not met.
  Success: Execute the action when the GO condition is met.
  When Always is selected, the operation specified by Action is executed each time the trigger occurs. This function is useful such as when you wish to print the screen image data to a printer each time the trigger occurs.

- **Setting the Number of Actions: Sequence**
  Single: Performs the action once.
  Continue: Repeats the action up to acquisition count specified by ACQ Count. (If the count is set to Infinite, the action is repeated until the waveform acquisition is stopped.)

- **Setting the Number of Determinations: ACQ Count**
  Set the number of waveform acquisitions.
  Infinite: Continues until the waveform acquisition is stopped using the Abort soft key or START/STOP.
  1 to 65536: Stops when the specified number of waveforms is acquired.

- **GO/NO-GO Determination Using an External Input Signal: Remote**
  GO/NO-GO determination can be performed by synchronizing to an external signal applied to the GO/NO-GO I/O terminal. The determination result can also be output externally. Remote must be turned ON in order to perform GO/NO-GO determination using an external signal.

Note

- The interval over which GO/NO-GO determination is performed is set using Time Range1 and Time Range2 in the GO/NO-GO menu. Other items follow the settings specified in the Measure menu.
- If you are not going to perform GO/NO-GO determination using an external signal, make sure to turn OFF Remote. Leaving it ON can cause instability in the start/stop operation of data acquisition using the START/STOP key

Action: Set Action

The following five types of actions can be executed when the condition is met.

- **Print the Screen Image Data: PRINT**
  Prints the screen image data on the printer (Printer (built-in printer), USB (USB printer), or Net Print (network printer)) specified by Print to in the PRINT menu.

- **Save the Screen Image Data: Image**
  Saves the screen image data to the destination (FD, Zip disk, PC card, internal HD (optional), SCSI device, or USB storage device) specified in the IMAGE SAVE menu.

- **Save the Waveform Data: Save to File**
  Saves the waveform data in binary, ASCII, or floating format to the destination (FD, Zip disk, PC card, internal HD (optional), SCSI device, or USB storage device) specified in the FILE menu. The save format is synchronized to data type (see section 13.7) on the FILE menu.

- **Buzzer**
  Sounds a buzzer.

- **Send Mail**
  Sends an e-mail message to a specified address. (when the Ethernet interface option is installed)
  For the procedure in setting the address, see section 16.5, "Sending Periodic Mail or Action Mail."

Setting the Determination Range (Time Range1/Time Range2)

By default, the determination range is ± 5 divisions of the display frame on the time axis. You can limit this range. The concept of the determination range is analogous to the concept of the selectable range of cursor display position in cursor measurement. For details, see section 11.5, "Selectable Range of Cursor Position."

Executing/Aborting GO/NO-GO Determination

The operation starts when you press the Exec soft key. Waveform acquisition is automatically stopped when the determination is complete. To forcibly stop the operation, press START/STOP or the Abort soft key.
If Remote is turned ON, determination is executed using the input from the external terminal. To forcibly stop the operation, press START/STOP.
Pressing the Exec (One Shot) soft key executes the same operation as the input from the external terminal.

Save to File/PRINT/Image Operation

Operation is carried out according to the settings of FILE, PRINT, and IMAGE SAVE.

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Waveform Analysis/Search

File Name When Action Is Set to Save to File or Image

If the Auto Naming of the File menu or the Image Save menu is OFF, numbers are automatically assigned to the file names. Otherwise, the file is saved using the specified method.
For details, see section 13.11, "Saving the Screen Image Data" or section 13.7, "Saving/Loading Waveform Data."

Notes When Performing GO/NO-GO Determination

• The determination results (the number of determinations and failures) are displayed.

Determination count   **Fail count**

Measured values for each waveform parameter
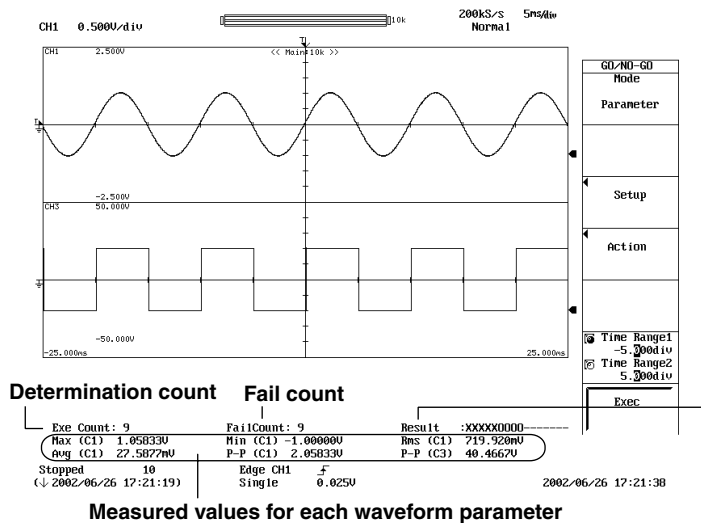
Indicates whether the condition of each waveform parameter 1 to 16 is met. Waveform parameters

XXXXXOOOO--------
1,2,3, ...,16: waveform parameter

O: The specified condition is met
X: The specified condition is not met
-: Waveform parameter for which a condition is not specified

In this example, the condition of waveform parameter 1 is not met and the condition of waveform parameter 6 is met.

• All keys other than START/STOP and the Abort soft key are disabled during the determination. (When Remote is ON, the Exec (One Shot) soft key is also valid.)
• When GO/NO-GO determination is executed, the trigger mode is automatically changed to Single.
• Determination is not possible when the acquisition mode is set to Average.
• The determination period is synchronized to the trigger. (However, triggers are not accepted while the action after determination is being carried out.)
• Determination is not possible when realtime recording is in progress or when waveforms are being acquired using the dual capture function.
• If any of the following actions is activated while the DL750/DL750P is being accessed through the FTP server function or the Web server function, the action is not executed until the access is finished.
Printing/saving of the screen image data and saving of the waveform data

Notes When Action Is Set to Save to File or Image Save

• Do not specify the root directory of the medium as the save destination directory. (Only up to 512 files can be saved to the root directory of a medium that has been formatted using the DL750/DL750P.)
• The maximum number of files that can be created in a single directory is 5000. Do not place files in the save destination folder before starting GO/NO-GO determination.
• If you select Save to File and Image Save simultaneously, separate the folders specified by the FILE menu and the IMAGE SAVE menu.
• If you selected Numbering for the file name assignment method (Auto Naming) in the FILE menu and the IMAGE SAVE menu, the creation of files takes an extended period when the number of saved files becomes large. When creating more than 2000 files, select Date for Auto Naming.

11.10 Using the GO/NO-GO Determination I/O Function

GO/NO-GO determination can be performed by applying an external signal to the GO/NO-GO I/O terminal of the DL750/DL750P. The determination result can also be output externally from the terminal.

GO/NO-GO Determination I/O Terminal Connector

Type

Modular jack (RJ-11). Use the optional accessory 366973 (sold separately) for the cable. If you are using a commercially sold cable (4 contact modular cable for telephone circuits), wire the pins according to the following figure.

I/O Level

Within 0 to 5 V, threshold level: TTL

Pin Arrangement

Pin No.	Signal Name		
1	NC (no connection)		
2	START IN	IN	Start at low
3	GO OUT	OUT	Active low
4	NOGO OUT	OUT	Active low
5	GND		
6	SPEAKER		
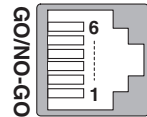
Connector on the DL

Input Signal

START IN (Negative Logic)

This signal is used when performing GO/NO-GO determination by synchronizing to an external input signal. The signal is valid only when "Remote" is ON. If "Remote" is OFF, GO/NO-GO determination is performed regardless of the external signal input (the GO/NO-GO determination result is output).
See below for the timing chart.

Signal Input Circuit
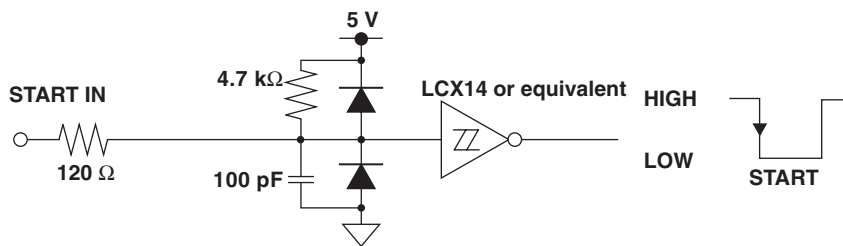
Output Signal

NOGO OUT (Negative Logic)

When the determination result is "NO-GO" (fail), the output signal level changes from high level to low level temporarily.

GO OUT (Negative Logic)

When the determination result is "GO" (pass), the output signal level changes from high level to low level temporarily.

Signal Output Circuit

GO/NO-GO I/O Timing

When Remote Start is OFF, START IN is not used. GO OUT and NO-GO OUT are output using the internal determination timing.

Remains at low output until the next determination can be accepted.
The time is extended while outputting to the built-in printer or internal storage medium.
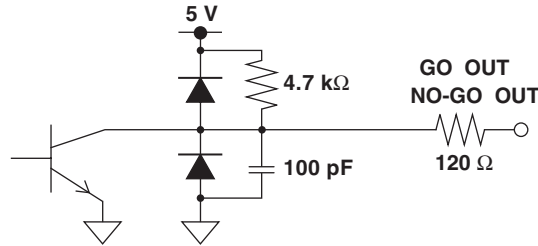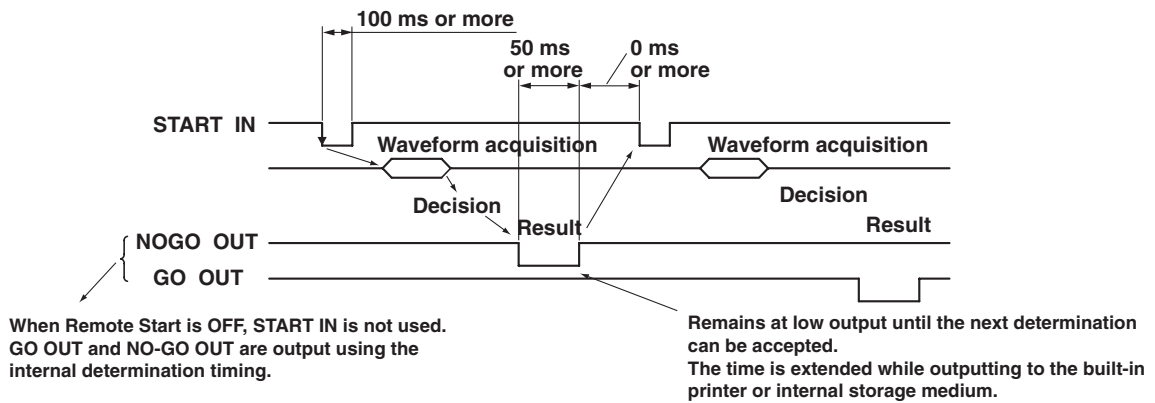
GO/NO-GO Cable (366973, Sold Separately)

• Use this cable only for the GO/NO-GO determination on the DL750/DL750P.
• See the following figure for the connection to external devices.

Approx. 1.5 m

Wires are separated.
Modify them to suit your needs.

RJ-11 connector

To the DL750/DL750P
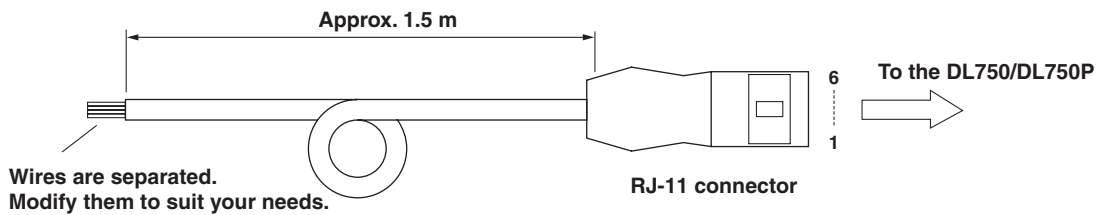
Color	Pin No.	Signal Name	Logic
Yellow	2	START IN	Negative
White	3	GO OUT	Negative
Green	4	NOGO OUT	Negative
Blue	5	GND	

12.1 Loading the Roll Paper and Paper Feeding

This section describes how to load the DL750 roll paper. For the procedure to load the DL750P roll paper, see section 9.1 in the User's Manual Part 1.

Printer Roll Paper

Use only the YOKOGAWA's dedicated roll paper (for the DL750 and OR100E/OR300E). When you are using the printer for the first time, use the roll paper that came with the package. Order extra rolls from your nearest YOKOGAWA dealer.

Part No.:   B9988AE
Specifications: Thermal paper, 10 m
Minimum Q'ty: 10 rolls

Roll Paper Handling

The paper is a thermal paper that changes color with the application of heat. Take note of the following points.

Storage Precautions

The paper starts changing color at around 70° C. It is affected by heat, humidity, light, and chemicals regardless of whether the paper has been used.
*   Store the paper rolls in a cool, dry, and dark place.
*   After opening the package, use it quickly.
*   If the paper is left in contact with plastic film (such as a vinyl chloride film or Scotch tape) containing plasticizers for an extended time, the paper will lose some of its ability to reproduce color. If you are going to store the paper in a folder, for example, use a folder made of polypropylene.
*   When using glue on the paper, do not use glue containing organic solvents such as alcohol or ether, as they will change the color of the paper.
*   For prolonged storage, we suggest you copy the roll paper. Due to the characteristics of the thermal paper, the recording section may lose color over time.

Handling Precautions

*   Be sure to use only genuine paper rolls provided by YOKOGAWA.
*   Touching the paper with sweaty hands can leave finger print marks or blur the printing.
*   Rubbing the surface with a hard object can cause the paper to change color due to the heat caused by friction.
*   If chemicals, oil, or other liquids come in contact with the paper, the paper may change color or the printing may fade.

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Printing the Screen Image Data

Loading the Roll Paper

Procedure
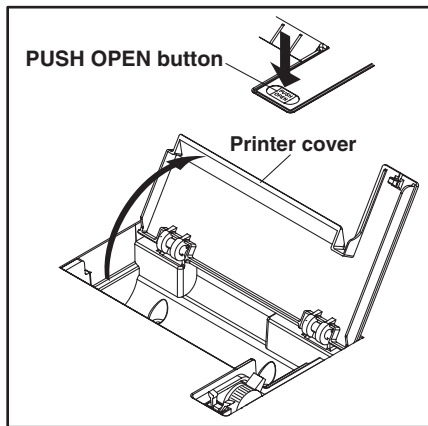
1. Press the PUSH OPEN button and remove the printer cover lock. Pull up on the handle located on the right side of the printer cover to open the cover.
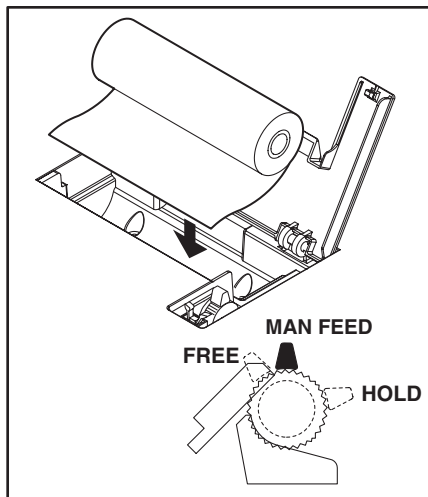
2. Move the release arm, located on the right near the front, to the MAN FEED position.
Have the inner side of the roll paper (the side that is not glossy) showing on top and set to the holder.
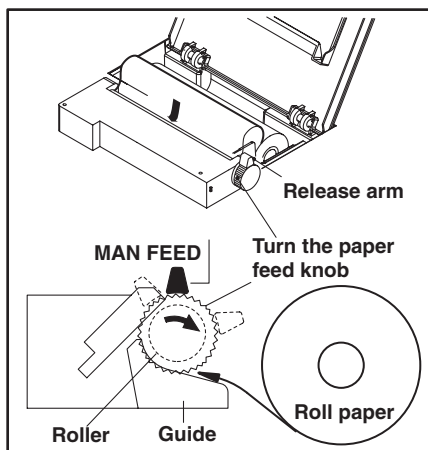
3. Insert the edge of the roll paper evenly in the space between the roller and the black guide, then rotate the paper feed knob away from you until about 10 cm of the paper is showing from the top of the roller.
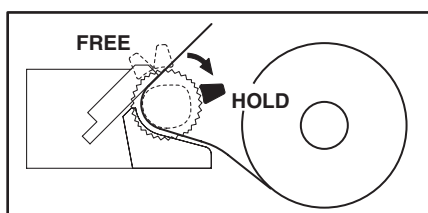
4. Move the release arm to the FREE position and straighten out the paper. Then, move the release arm to the HOLD position.
The printing will fail with an error message, if the release arm is in the FREE or MAN FEED position during operation.
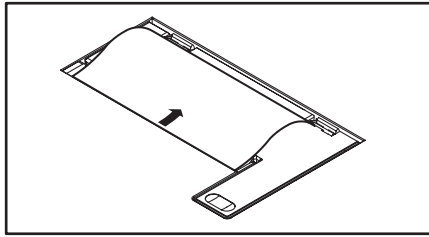
5. Pull the printer cover back to its original position and close the cover. Make sure that the edge of the roll paper is showing from the opening of the printer cover.
Push the printer cover down firmly until it clicks into place.

Note

- When closing the printer cover, be sure to set the release arm position to HOLD.
- After installing the roll paper, make sure that the paper is feeding properly according to the steps given below. If the paper is not being fed evenly, continue to feed the paper for approximately 30 cm. The paper will straighten out.

Feeding the Paper

You can feed the paper to check whether the roll paper has been loaded properly or to skip dirty sections.

Procedure
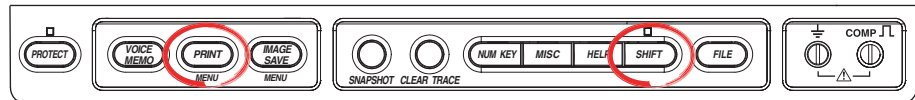
1. Press **SHIFT+PRINT**.
2. Press the **Print to** soft key. The printer selection menu appears. (Net Print appears only when the Ethernet interface option is installed.)
3. Press the **Printer** soft key.
4. Press the **Paper Feed** soft key to feed the paper.

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Printing the Screen Image Data
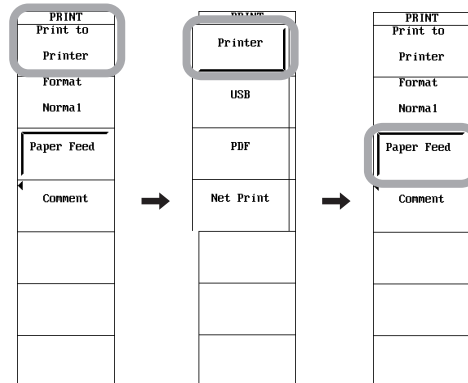
12.2 Printing on the Built-in Printer

Procedure
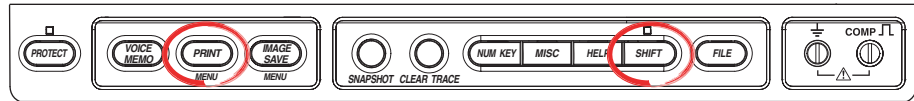
1. Press **SHIFT+PRINT**.

Selecting the Printer

2. Press the **Print to** soft key. The printer selection menu appears. (Net Print appears only when the Ethernet interface option is installed.)
3. Press the **Printer** soft key.

Setting the Output Format

4. Press the **Format** soft key. The output format selection menu appears.
5. Press the **Normal**, **Fine**, **Zoom Print**, or **A4 Print** soft key.
   A4 Print is displayed only on the DL750P.
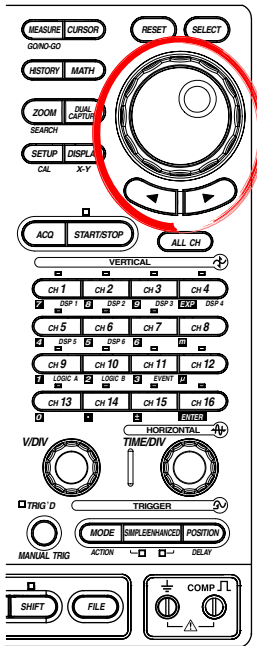
Printing in Normal Output Format (When Normal Is Selected in Step 5)

Setting a Comment

6. Press the **Comment** soft key.
7. Enter the comment string according to the procedure given in section 4.2.
   Proceed to step 29.

Note

The comment setting is linked with the PRINT menu > Comment setting.
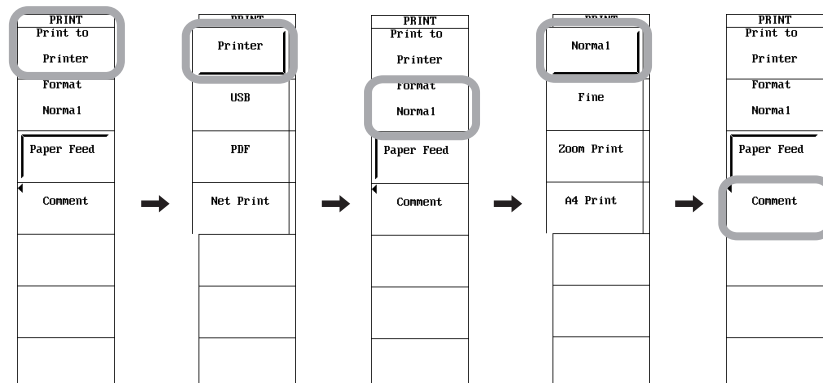
Fine Print (When Fine Is Selected in Step 5)

Setting the Print Magnification

6. Press the **Print Mag** soft key, and use the **jog shuttle** to set the print magnification. The number of pages that will be printed is displayed according to the magnification.

Setting the Print Range

7. Press the **Time Range1/Time Range2** soft key to set the jog shuttle control to Time Range1.
8. Use the **jog shuttle** and **SELECT** to set the print start point.
9. Likewise, set Time Range2 (print end point).
Proceed to step 10.
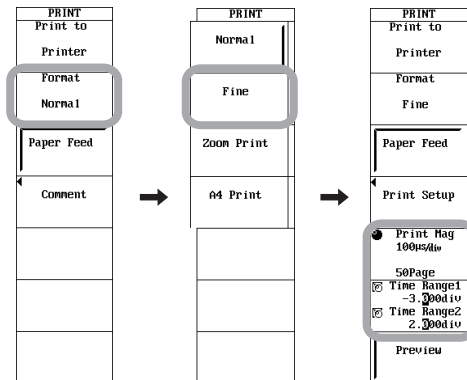
Zoom Print (When Zoom Print Is Selected in Step 5)

Setting Zoom Box Z2

6. Press the **Z2 Mag/Z2 Position** soft key to set the jog shuttle control to Time Z2 Mag.
7. Turn the **jog shuttle** to set the zoom rate of the Z2 zoom box.
8. Likewise, set the zoom position of the Z2 zoom box with Z2 Position.
Proceed to step 10.

Note
- In zoom print, the range of zoom box Z2 (10 divisions) is printed.
- The Z2 Mag/Z2 Position setting is linked with the ZOOM menu (see section 8.5) setting.

Setting the Print Magnification

9. Press the **Print Mag** soft key, and use the **jog shuttle** to set the print magnification. The number of pages that will be printed is displayed according to the magnification.
Proceed to step 10.
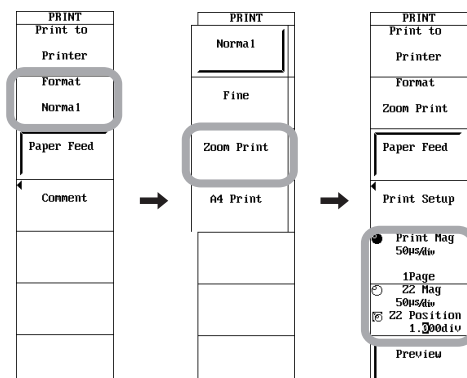
A4 Print (When Fine Is Selected in Step 5)

Proceed to step 10.
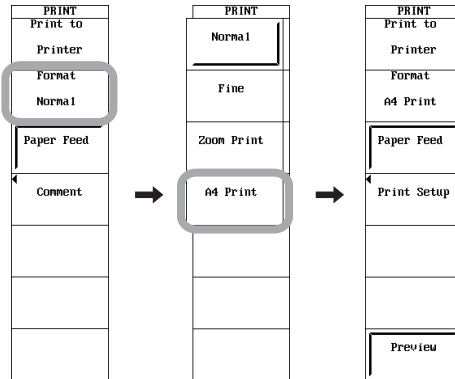
Specifying the Print Settings

- **DL750**
    10. Press the **Comment** soft key.
    11. Enter the comment text according to the procedure in section 4.2.
        Proceed to step 27.

Note

The comment setting is linked with the PRINT menu > Comment setting.

- **DL750P**
    10. Press the **Print Setup** soft key.

    Setting the Print Format
    11. Use the **jog shuttle** and **SELECT** to select Format from Single (1 division) to Hexadecimal (16 divisions).

Note

The print format setting is linked with the DISPLAY menu > Format setting.

Setting the Extra Area
12. Use the **jog shuttle** and **SELECT** to set **Extra Area** to ON or OFF.

DL750   DL750P
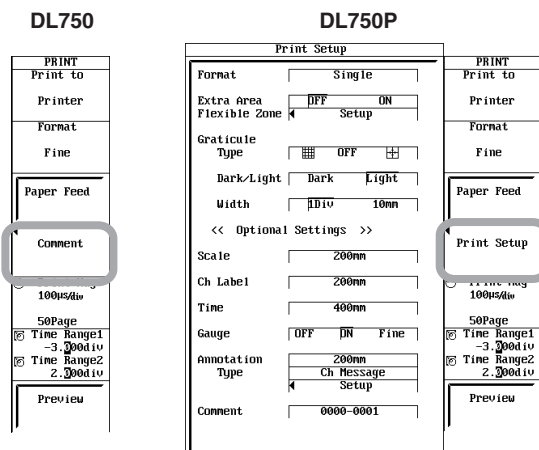
Setting the Flexible Zone

13. Use the **jog shuttle** and **SELECT** to select **Setup** in **Flexible Zone**.

14. Use the **jog shuttle** and **SELECT** to set Mode to OFF or ON.

15. Use the **jog shuttle** and **SELECT** to set Upper/Lower of the waveform to be recorded.

Setting the Graticule

• **Setting the Grid**

16. Use the **jog shuttle** and **SELECT** to set Type to ▦, OFF, or ⊞.

• **Setting Dark/Light**

17. Use the **jog shuttle** and **SELECT** to set Dark/Light to Light or Dark.

• **Setting the Width of the Vertical Scale**

18. Use the **jog shuttle** and **SELECT** to set Width to 1div or 10mm.
    Proceed to step 19.

Note
    The grid setting is linked with the DISPLAY menu > Graticule setting. However, if OFF is selected, the DISPLAY menu is set to ⌞⌝.

Setting Details

Setting the Print Interval of Scale Values

19. Use the **jog shuttle** and **SELECT** to set Scale to OFF, 200mm, 400mm, or 800mm.

Setting the Print Interval of Channel Labels

20. Use the **jog shuttle** and **SELECT** to set CH Label to OFF, 200mm, 400mm, or 800mm.

Setting Whether to Print the Time

21. Use the **jog shuttle** and **SELECT** to set Time to OFF, 200mm, 400mm, or 800mm.

Setting the Gauge Print

22. Use the **jog shuttle** and **SELECT** to set Gauge to OFF, ON, or Fine.

```
                    Print Setup
Format              [      Single      ]

Extra Area          [OFF       ON]
Flexible Zone     ◄       Setup       ►

Graticule
    Type            [ ▦    OFF    ⊞ ]

    Dark/Light      [ Dark     Light ]

    Width           [ 1Div     10mm ]

     << Optional Settings >>

Scale               [      200mm      ]

Ch Label            [      200mm      ]

Time                [      400mm      ]

Gauge               [ OFF    ON   Fine ]

Annotation          [      200mm      ]
    Type            [   Ch Message    ]
                  ◄       Setup       ►

Comment             [    0000-0001    ]
```

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Printing the Screen Image Data

Setting the Annotation

23. Use the **jog shuttle** and **SELECT** to set the print interval of annotations in the right column of Annotation to OFF, 200mm, 400mm, or 800mm.

24. Use the **jog shuttle** and **SELECT** to set the type of annotation to be printed in the right column of Type to CH Information, CH Message, or CH Data.
    If CH Message is selected, proceed to step 25.
    If CH Information or CH Data is selected, proceed to step 26.

25. Use the **jog shuttle** and **SELECT** to select Setup. Then, enter the message you wish to print for the channel using up to 80 characters according to the procedure in section 4.2.

Setting a Comment

26. Use the **jog shuttle** and **SELECT** to select Comment. Then, enter the comment text you wish to print using up to 20 characters according to the procedure in section 4.2.

Note

The comment setting is linked with the PRINT menu > Comment setting.

Previewing the Print Image

27. Press the **Preview** soft key. The print image is displayed on the screen.
    Turn the **jog shuttle** to change the displayed page.

28. Press the **Quit** soft key. The original display appears.
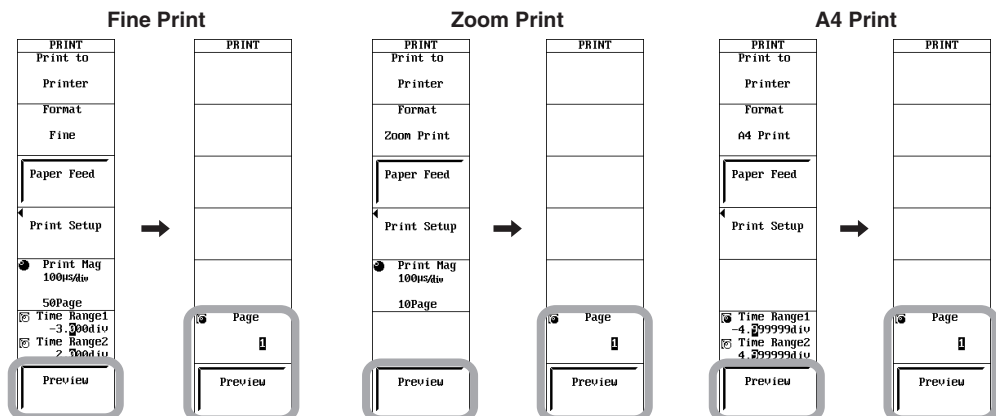
Executing the Printing

29. Press **PRINT**. The screen image data is printed on the built-in printer.
    To abort printing, press **PRINT** while printing is in progress.
    While printing is in progress, [icon] is indicated in the upper left corner of the screen.

Explanation

Output Format: Format

Select from three types: Normal, Fine, and Zoom Print.

Normal

Prints using normal size.

Fine

The print range on the waveform displayed on the screen (Time Range1 and Time Range2) is specified, and the print range is printed magnified.

Time Range1 Time Range2

Normal waveform

TIME/DIV: 10 ms/div

PRINT menu
• Mag: 2 ms/div

The five divisions specified by Time Range1/Time Range2 are magnified to 2 ms/div.
→ Printed on 3 pages as shown below.

Print example

Page 1   Page 2   Page 3
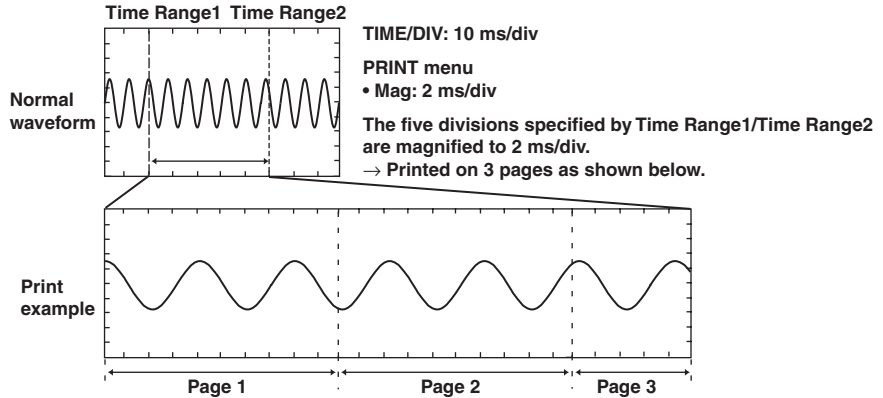
Zoom Print

The range of zoom box Z2 of the zoom function (see section 8.5) is magnified and printed.

Zoom box Z2

Main (Normal waveform)

Z2 (Zoom waveform)

TIME/DIV: 10 ms/div

ZOOM menu
• Z2 Mag: 5 ms/div
• Z2 Position: –0.5 div

PRINT menu
• Mag: 2 ms/div

Waveform in Z2 is magnified to 2 ms/div. → Printed on 3 pages as shown below.

Print example

Page 1   Page 2   Page 3
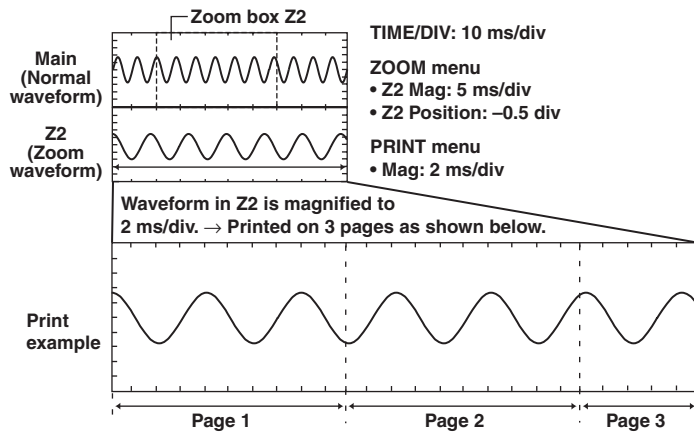
A4 Print (DL750P Only)

Prints the waveform displayed on the screen to an A4 size paper.

Print example

Normal waveform

The waveform displayed on the screen is automatically adjusted to fit on an A4 size paper and printed.

A4 size
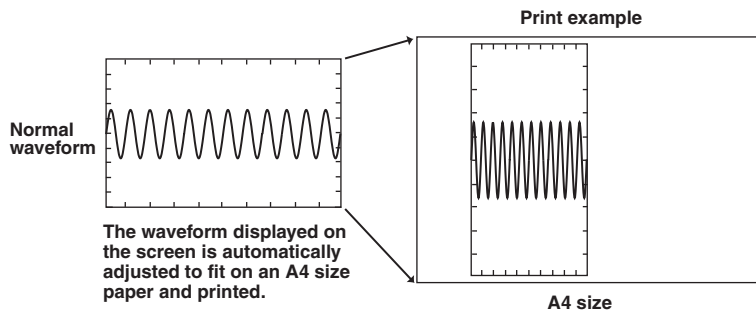
Printing Using Normal Output Format

Comment

A comment string of up to 20 characters can be printed at the top section of the print area. The comment setting is linked with the PRINT menu > Comment setting.

Fine Print, Zoom Print, and A4 Print

Print Magnification: Print Mag

Set the print magnification only during fine print and zoom print. The selectable range varies depending on the T/div setting and record length.

Print Range: Time Range1/Time Range2

Set the print range only during fine print. Set the print range in the range of –5 divisions to 5 divisions.

Zoom Box Z2: Z2 Mag/Z2 Position

Set zoom box Z2 only during zoom printing. The zoom box Z2 setting is linked to the ZOOM menu setting. For details such as the selectable range, see section 8.5.

Print Setup

Format

Select the number of divisions of the print area when printing on the built-in printer.

Single: 1 division   Quad: 4 divisions
Dual: 2 divisions   Octal: 8 divisions
Triad: 3 divisions   Hexadecimal: 16 divisions

The format setting is linked with the DISPLAY menu > Format setting.

Extra Area

The extra area can be set only when the format is set to Single, Dual, Triad, or Quad.

- **When the Format Is Single**
  If extra area is turned ON, the top 16 cm of the print area (20 cm) is used to print waveforms, and the remaining 4 cm is used to print waveform information (extra area). Annotations (see the next page) and logic waveforms are printed in the extra area. The default setting is OFF.

- **When the Format is Dual, Triad, or Quad**
  If extra area is turned ON, the area below each of the divided waveform recording area is used to print the waveform information (extra area). If extra area is turned OFF, the extra area between each waveform recording area disappears. The magnification of the vertical axis of each waveform recording area is adjusted automatically according to the paper size and printed. The default setting is ON.

Flexible Zone

The flexible zone can be set only when the format is Single and the extra area is OFF. The position in the print area (20 cm) where each waveform is to be recorded is set with Upper and Lower (%). The Upper value can be set in the range of 2% to 100%. The Lower value can be set in the range of 0% to 98%. Each value can be set in 1% steps. The minimum width is 2%.

[Example]

• When Flexible Zone on CH1 is set to Upper = 20% and Lower = 0%

  The CH1 waveform is printed in the area from the bottom to 4 cm of the print area.

• When Flexible Zone on CH2 is set to Upper = 80% and Lower = 20%

  The CH2 waveform is printed in the area from 4 cm to 16 cm from the bottom of the print area.

Graticule

• **Type**

  Select the graticule type from ▦, OFF, or ⊞.

  The grid setting is linked with the DISPLAY menu > Graticule setting. However, if OFF is selected, the DISPLAY menu is set to ▢.

• **Dark/Light**

  Set the graticule Dark/Light setting to Light or Dark.

• **Width of the Vertical Graticule: Width**

  Select how to set the vertical graticule width. For details on the format of the graticule lines that are printed, see page 9-10.

  1div: Graticule obtained by dividing the print zone into 10 areas

  10mm: mm graticule type

Details

• **Print Interval of Scale Values: Scale**

  Select the interval for the scale printed at the top and bottom edges of the print area from OFF, 200 mm, 400 mm, or 800 mm. If OFF is selected, the scale is not printed.

• **Print Interval of Channel Labels: CH Label**

  Select the interval for printing waveform channel labels from OFF, 200 mm, 400 mm, or 800 mm. The channel label is printed near each waveform. If OFF is selected, the channel labels are not printed.

• **Time Print: Time**

  Select the interval for printing the time from OFF, 200 mm, 400 mm, or 800 mm. The time is printed at the top section of the print area. If OFF is selected, the times are not printed.

• **Gauge Print**

  Select whether to not print (OFF), print (ON), or print in detail (Fine) on the left side of the print area. If ON is selected a gauge that equally divides the waveform display area into two is displayed. If Fine is selected, a gauge that equally divides the waveform display area into 10 is displayed. The gauge, scale values, an arrow indicating the ground position, and V/div (Value/div)* are printed.

  * Depending on the setting, V/div (Value/div) may not be printed.

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Printing the Screen Image Data

- **Annotation**
Channel information, channel messages, or measured values are printed. Use Annotation to select the print interval from OFF, 200 mm, 400 mm, and 800 mm. Use Type to select the type of annotation to be printed from CH Information, CH Message, and CH Data.

CH Information
Prints settings such as V/div, filter, and module.
CH Message
Prints the character string (up to 80 characters) that is assigned to each channel.
CH Data
Prints the measured values at a given interval using numeric values.

The position where annotations are printed varies depending on the display (recording) format and extra area settings as follows:

- When Format is Single, Dual, Triad, or Quad, and Extra Area is ON
  The annotations are printed in the extra area. The annotations do not overlap the waveform print area.
- When Format is Single, Dual, Triad, or Quad, and Extra Area is OFF
  The annotations are printed at the bottom section of the waveform print area.
- When Format is Octal or Hexadecimal
  The annotations are printed between the divided waveform print areas (between the grids).

Note
If all of the conditions below are met, only up to 67 characters of CH Message are printed.
Format: Single/Dual/Triad/Quad, Extra Area: OFF, Scale: Other than OFF

- **Comment**
A comment string of up to 20 characters can be printed at the top section of the print area. The comment setting is linked with the PRINT menu > Comment setting.

Preview

A preview of the print image data can be displayed in the specified output format.

Notes on Fine Print, Zoom Print, and A4 Print

- Fine print, zoom print, and A4 print cannot be carried out while waveform acquisition is in progress.
- Only Main waveforms are applicable for fine print and A4 print.
- If waveforms are being displayed using the history memory function, only the waveforms specified by Selected Record No. are applicable for fine print, zoom print, and A4 print.
- Fine print, zoom print, and A4 print cannot be carried out when X-Y waveforms are being displayed.
- Fine print, zoom print, and A4 print cannot be carried out on waveforms acquired using the snapshot, accumulated waveform, and dual capture functions.
- If the number of printed pages exceeds 100, fine print cannot be carried out. (The number of printed pages is determined by the Print Mag and Time Range settings.)

Examples of Fine Print and Zoom Print

DL750

DL750P

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Printing the Screen Image Data
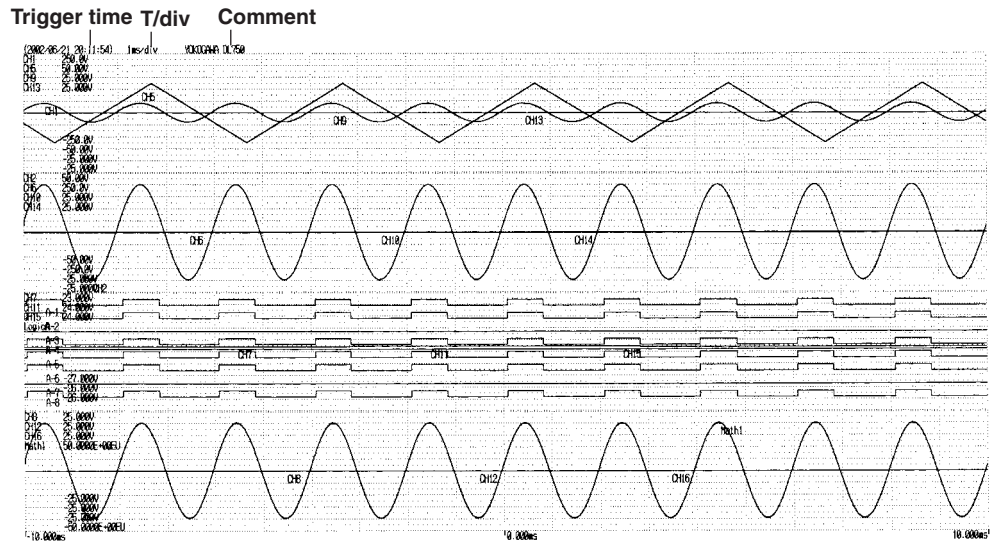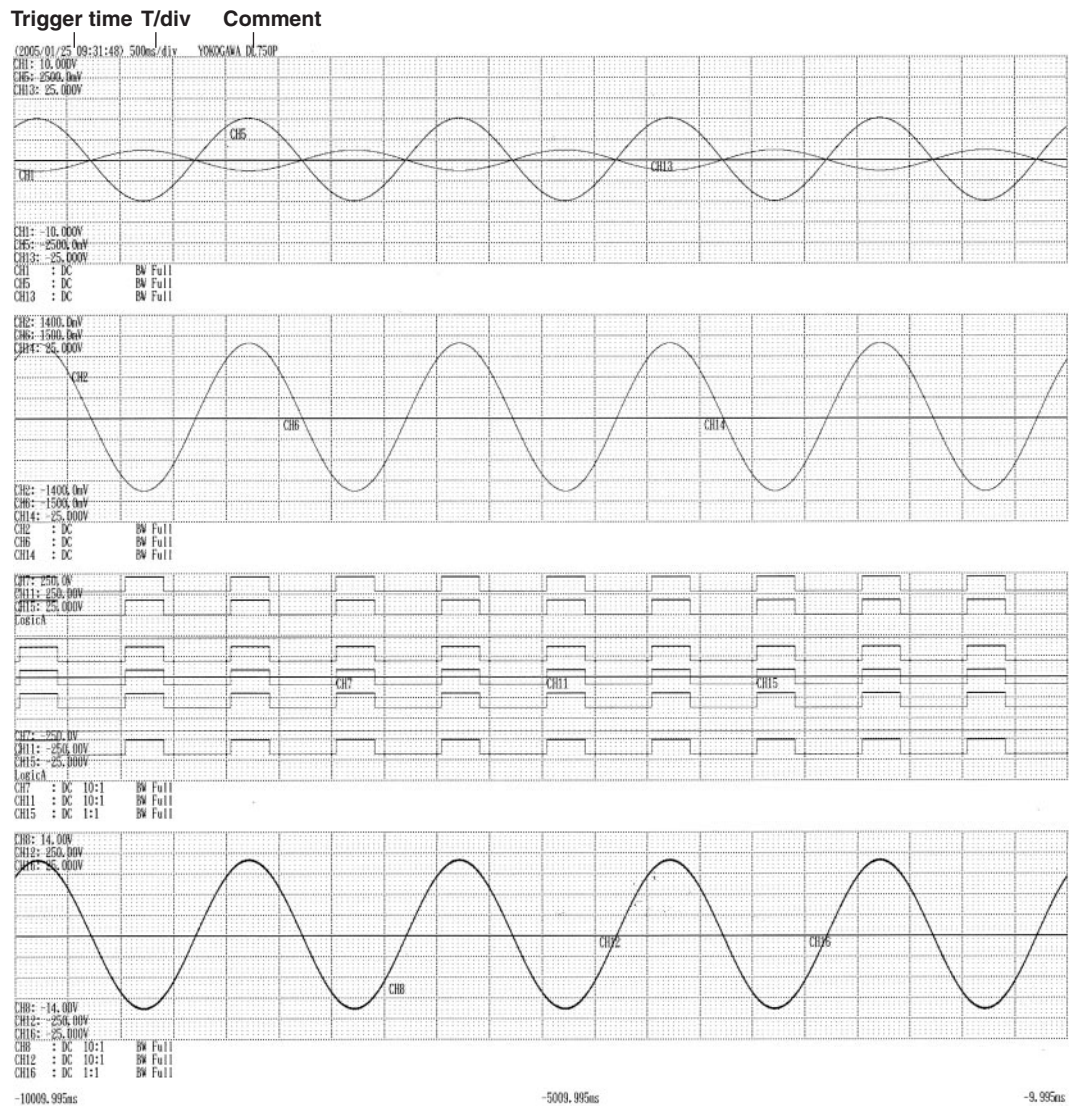
12.3 Printing Screen Image Data to a USB Printer

Procedure

1. Connect the DL750/DL750P and a USB printer using a USB cable. For details, see the explanation in the next section.

Selecting the Printer

2. Press **SHIFT+PRINT**.
3. Press the **Print to** soft key. The printer selection menu appears. (Net Print appears only when the Ethernet interface option is installed.)
4. Press the **USB** soft key.

Confirming the Printer That Is Connected

5. Press the **Select** soft key. The USB Device List appears. Check the printer that is connected.

Note

You can also check the printer that is connected from the MISC > USB > USB List soft key menu.

Setting the Output Format

6.   Press the **Format** soft key. The output format selection menu appears.

7.   Select the soft key corresponding to the output format from ESC-P to BJ.

Setting the Color

8.   Press the **Color** soft key to select ON or OFF.

Setting a Comment

9.   Press the **Comment** soft key.

10.   Enter the comment string according to the procedure given in section 4.2.

Setting the Print Resolution (When Format Is BJ)

11.   Press the **Resolution** soft key. The print resolution setup menu appears.

12.   Press any of the soft keys corresponding to 180 dpi, 300 dpi, 360 dpi, and 600 dpi.

Executing the Print Operation

13.   Press **PRINT**. The screen image data is printed on the USB printer.
      To abort printing, press **PRINT** while printing is in progress.
      While printing is in progress, ⬛ is indicated at the upper left corner of the screen.

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Printing the Screen Image Data

Explanation

You can print the screen image data to a USB printer via the USB PERIPHERAL interface.

USB PERIPHERAL Connector

To connect a USB printer to the DL750/DL750P, connect a USB cable to the USB PERIPHERAL connector. There are two USB PERIPHERAL connectors (ports).
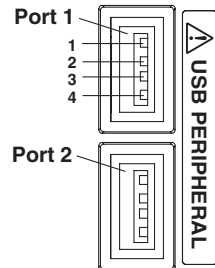
Pin No.	Signal Name	
1	VBUS:	+5 V
2	D–:	–Data
3	D+:	+Data
4	GND:	Ground

Printers That Can Be Used

USB printers conforming to USB Printer Class Ver. 1.1 that support the following print formats can be used.

Note
- Connect only the printers that are allowed.
- For details on USB printers that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

Connection Procedure

When connecting a USB printer, directly connect the keyboard to the DL750/DL750P using a USB cable as shown below. You can connect the USB cable regardless of the power ON/OFF state of the DL750/DL750P (supports hot-plug). Connect the type A connector of the USB cable to the DL750/DL750P; connect the type B connector to the printer. When the power switch is ON, the printer is detected and enabled approximately 6 s after it is connected.

Note
- Connect the printer directly without going through a hub.
- Do not connect USB devices other than USB keyboard, USB mouse, USB printer, and USB storage device that can be used to the USB PERIPHERAL connector.
- Do not connect multiple printers to the USB PERIPHERAL connector.
- Never turn OFF the printer or remove the USB cable while the printer is printing.
- Do not connect or disconnect the USB cable after the power is turned ON until key operation is ready (approximately 20 to 30 s).

Output Format

You can select the output format that is sent to the USB printer from the following five types.

- ESC-P
- ESC-P2
- LIPS3
- PCL5
- BJ (can be used on models that support the BJC-35V native commands)

Output Resolution When Printing Using the BJ Format

When printing the screen image data to a USB BJ printer, select the output resolution from 180 dpi, 300 dpi, 360 dpi, and 600 dpi.

Comment

A comment string of up to 0 characters can be printed at the bottom right section. The comment setting is linked with the PRINT menu > Comment setting.

Color

Select from the following:

ON: Print the data using colors similar to the screen. (No background color and grid printed in black)

OFF: Prints the image using the same colors as the image printed using the built-in printer.

Notes When Printing on the USB Printer

- Images may not print properly on some printers. Use USB printers that have been tested for compatibility.
- You can also print to a USB printer that is connected to your PC. Save the screen image data to a floppy disk, a Zip disk, or a PC card according to the procedure given in section 13.11, "Saving Screen Image Data." Then, load the data on the PC and print it.

Note

    The DL750/DL750P does not detect "out of paper" and printer errors on the USB printer. If an error occurs, press PRINT again to stop the printing.

12.4 Printing the Screen Image Data on a Network Printer

<For a description of this function, refer to page 2-62.>

Procedure
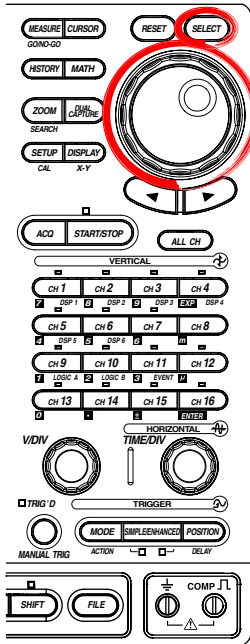
Configuring the Network

1. Configure the TCP/IP and network printer according to the procedures given in section 16.2, "Configuring the TCP/IP" and section 16.4, "Configuring the Network Printer."

Selecting the Printer

2. Press **SHIFT+PRINT**.
3. Press the **Print to** soft key. The printer selection menu appears. (Net Print appears only when the Ethernet interface option is installed.)
4. Press the **Net Print** soft key.

Selecting the Output Format

5. Press the **Format** soft key.
6. Select the soft key corresponding to the output format from ESC-P to PostScript.

Setting the Color (When Format Is ESC-P, ESC-P2, PCL5, or BJ)

7. Press the **Color** soft key to select ON or OFF.

Setting a Comment

8. Press the **Comment** soft key.
9. Enter the comment according to the procedure given in section 4.2.

Setting the Print Resolution (When Format Is BJ)

10. Press the **Resolution** soft key. The print resolution setup menu appears.
11. Press any of the soft keys corresponding to 180 dpi, 300 dpi, 360 dpi, and 600 dpi.
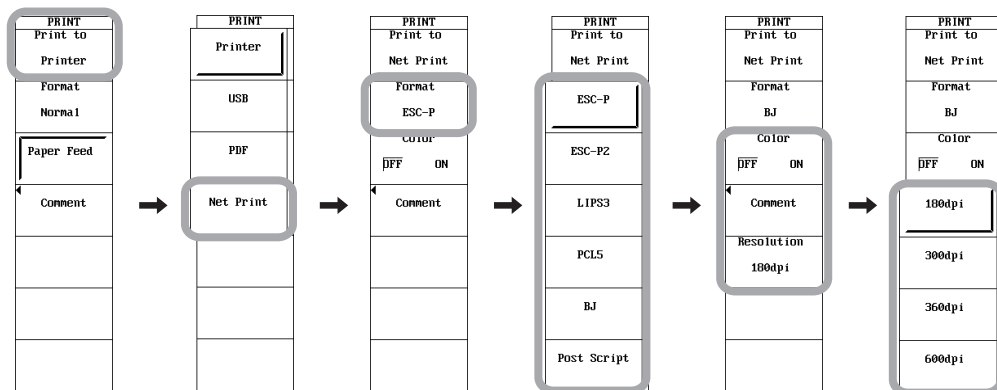
Executing the Print Operation

12.   Press **PRINT**. The screen image data is printed on the network printer. To abort printing, press **PRINT** while printing is in progress.

While printing is in progress, 🖨 is indicated at the upper left corner of the screen.

Explanation

Like the built-in printer, you can print the screen image data on a network printer[1] via the Ethernet network.

1. Printing is possible on a printer or printer server supporting the TCP/IP protocol.

Selecting the Output Format

The following six printer formats are supported.

- ESC-P
- ESC-P2
- LIPS3
- PCL5
- BJ
- PostScript

Output Resolution When Printing Using the BJ Format

When printing the screen image data to a BJ printer, select the output resolution from 180 dpi, 300 dpi, 360 dpi, and 600 dpi.

Comment

A comment string of up to 20 characters can be printed at the bottom right section. The comment setting is linked with the PRINT menu > Comment setting.

Color

Select from the following:

ON: Print the data using colors similar to the screen. (No background color and grid printed in black)

OFF: Prints the image using the same colors as the image printed using the built-in printer.

Note _____
      Printing is possible on printers that support the TCP/IP protocol.

13.1 Floppy Disks/Zip Disks/PC Cards

Three types of built-in storage are available: floppy disk drive, Zip disk drive (DL750 only), and PC card drive (one type is selected at the time of purchase).

Floppy Disks That Can Be Used

The following types of 3.5" floppy disks can be used. You can format the disk on the DL750/DL750P.

*   **2HD**

    Formatted to 1.44 MB using MS-DOS.
*   **2DD**

    Formatted to 720 KB using MS-DOS.

Inserting the Floppy Disk into the Floppy Disk Drive

With the label facing toward you, insert the disk from the side with the shutter. Insert the disk until the eject button pops out.

Removing the Disk from the Floppy Disk Drive

Check that the access indicator is turned OFF and press the eject button.

Access indicator

Label side

Eject button
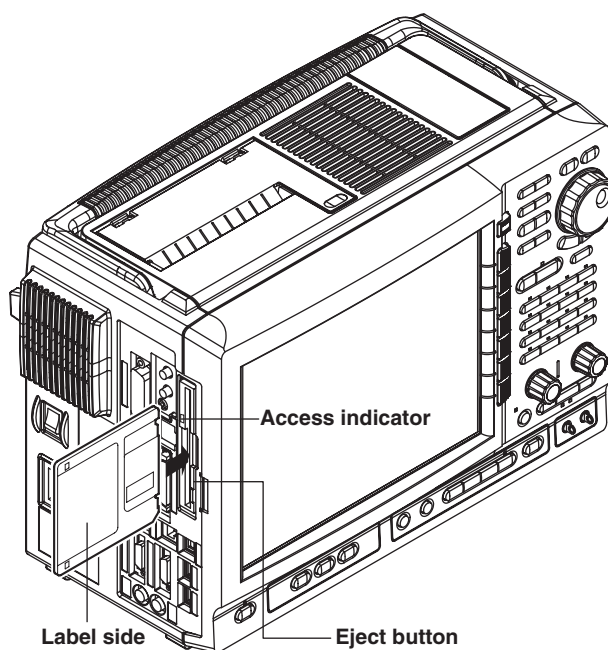
CAUTION

Removing the floppy disk while the access indicator is blinking can damage the magnetic head of the floppy disk drive or destroy the data on the floppy disk.

General Handling Precautions of Floppy Disks

The DL750/DL750P cannot read floppy disks with bad sectors. Repair the sectors using a PC before using those disks in the DL750/DL750P.

For the general handling precautions of the floppy disk, read the instruction manual that came with the floppy disk.

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Saving and Loading Data

Zip Disks

Zip Disks That Can Be Used

The following types can be used. You can format the disk on the DL750.
Size: 100 MB or 250 MB
Format: FDISK 1 partition (hard disk format)

Inserting the Zip Disk into the Zip Drive

With the label facing toward you, insert the disk from the side with the shutter.

Removing the Zip Disk from the Zip Drive

With the DL750 turned ON, check that the access indicator is OFF and press the eject
button.
If you need to use the Zip disk again, wait at least three seconds after removing it before
reinserting it into the drive.

Label side   **Eject button**
                                  Access indicator
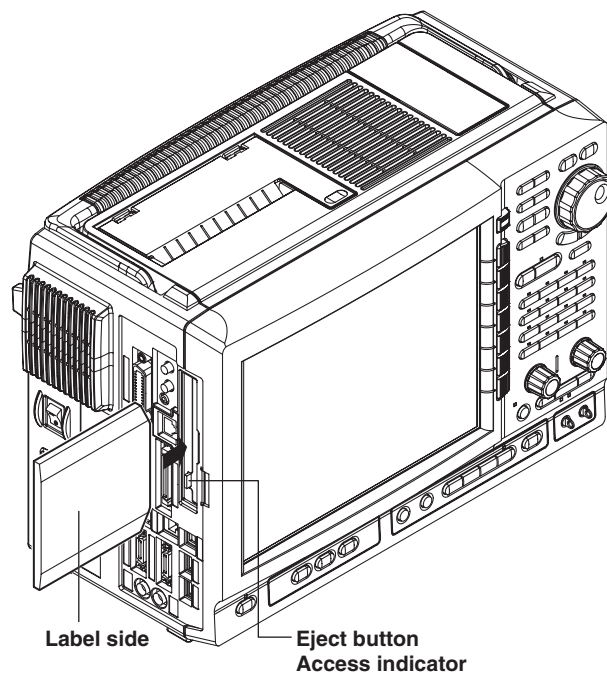
Procedure When the Zip Disk Cannot Be Ejected

If the Zip disk cannot be removed by performing the steps above, carry out the following steps to remove it.

Insert a pin of approx. 1 mm in diameter into the eject button hole and press slowly. This will cause the Zip disk to be ejected.

Eject button of the Zip disk

Zip disk eject hole

Insert a pin.
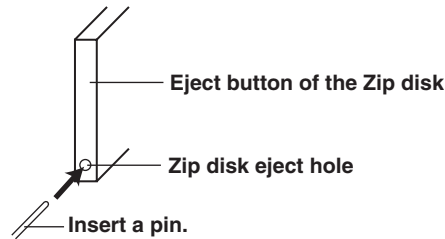
⚠ CAUTION

- Removing the Zip disk while the access indicator is ON may destroy the data on the Zip disk.
- Do not use the Zip drive if the DL750 is installed using the stand. (For the installation position, see section 3.2.)
- When turning ON/OFF the DL750, have the Zip disk removed from the drive.
- Do not insert the Zip disk into the drive, or remove the Zip disk from the drive while the DL750 is starting up after turning ON the power (see section 3.4, "Power Up Operation"). Doing so can damage the disk.
- The access indicator illuminates immediately after the Zip disk is inserted. Do not operate the DL750 while the access indicator is illuminated. Such act can lead to erroneous operation.

General Handling Precautions of Zip Disks

For the general handling precautions of the Zip disk, read the instruction manual that came with the Zip drive.

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Saving and Loading Data

PC Cards

PC Cards That Can Be Used

The DL750/DL750P supports flash ATA cards (PC card TYPE II) and compact flash (using the PC card TYPE II adapter). In addition, some of the Flash ATA HDD cards can be used.
For details, contact your nearest YOKOGAWA dealer.

Note

> To use the PC card on the PC, use a PC that supports the PC card. Depending on the PC that you are using, the PC cards indicated above may not operate properly. Check it beforehand.

Inserting the PC Card

With the label side of the PC card facing toward you, insert the PC card into the drive. The PC card drive is located on the left side panel of the DL750/DL750P.

Ejecting the PC Card

Check that the PC card is not being accessed, and press the PC card ejection button to the right of the drive.

Label side — **Eject button**
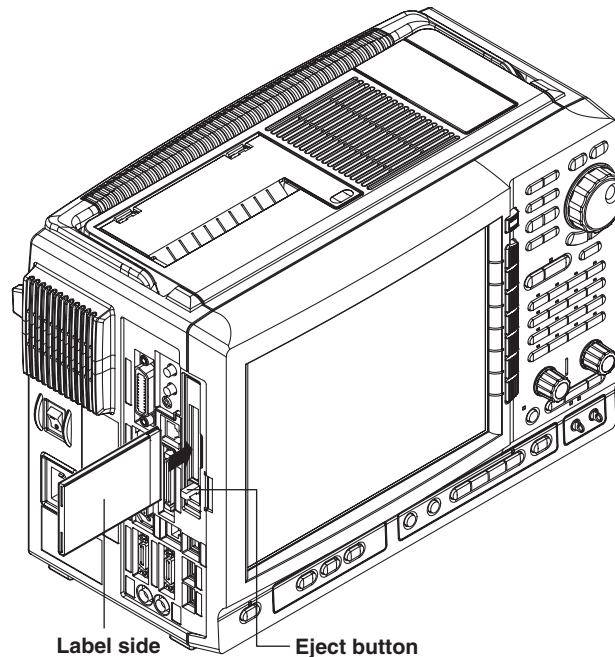
⚠ CAUTION

- The DL750/DL750P may malfunction if the PC card is frequently inserted and ejected (inserted and ejected within a 1-s time period).
- Removing the PC card while it is being accessed may destroy the data on the PC card.

General Handling Precautions of PC Cards

For the general handling precautions of the PC card, read the instruction manual that came with the PC card.

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Saving and Loading Data

13.2 Internal Hard Disk (Optional)

⚠️

CAUTION

- When using the DL750/DL750P in a vibrating environment, turn OFF the motor rotation of the internal hard disk.
- Do not place more than 512 files in the root directory of the internal hard disk. If the number of files exceeds 512, all file access operations slows down. In addition, the operation of realtime recording cannot be guaranteed.
- If an external SCSI device is connected, do not change the HDD Motor setting.

Procedure

1. Press **MISC**.
2. Press the **Next 1/2** soft key.
3. Press the **Others** soft key.
4. Press the **HDD Motor** soft key to select ON or OFF.
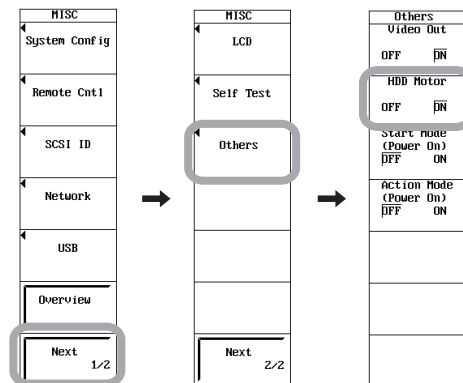
Explanation

You can turn ON/OFF the motor rotation of the internal hard disk on the DL750/DL750P.
If you turn OFF the internal hard disk motor, the internal hard disk cannot be accessed.
To save various data to the internal hard disk, turn the HDD Motor ON.
Turning OFF the HDD Motor protects the internal hard disk from vibrations.

Note
Even if the motor rotation is turned OFF, the motor rotation is turned ON for approximately 1 minute after the power is turned ON.

13.3 Connecting a USB Storage Device (MO Disk Drive, Hard Disk, or Flash Memory) to the USB PERIPHERAL Interface

Model That Can Connect a USB Storage Device

- DL750: Check the overview screen by choosing MISC > Overview.
  If USB Storage: Yes and Soft Version: 6.02 (or later) are displayed, a USB storage device can be connected.
- DL750P: All DL750Ps can connect to a USB storage device.

USB PERIPHERAL Interface Specifications

Item	Specifications
Connector type	USB type A connector (receptacle)
Electrical and mechanical specifications	Conforms to USB Rev.1.1
Data rate	12 Mbps maximum
Power Supply	5 V, 500 mA* (per port)
Number of ports	2

* Devices whose maximum current consumption exceeds 100 mA cannot be connected simultaneously to the two ports.

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

Connecting the USB Storage Device

When connecting a USB storage device, directly connect the printer to the DL750/DL750P using a USB cable as shown below. You can connect the USB cable regardless of whether the power switch on the DL750/DL750P is ON or OFF (supports hot-plugging). When the power switch is ON, the USB storage device is detected and enabled approximately six seconds after it is connected.

Compatible USB Storage Devices

The DL750/DL750P can use HD drives, MO drives, and flash memories that support USB (USB Mass Storage Class).

Note

- Do not connect USB devices other than a USB keyboard, USB mouse, USB printer, or USB storage device to the USB PERIPHERAL connector.
- The DL750/DL750P has two USB PERIPHERAL ports. However, USB devices whose maximum consumption current exceeds 100 mA cannot be connected simultaneously to the two ports.

CAUTION

- Do not remove the USB storage device or turn OFF the power when the USB storage device is being accessed. If you do, the data on the USB storage device may be destroyed.
- An access icon is displayed at the upper left corner of the screen while the USB storage device is being accessed.

General Handling Precautions of USB Storage Devices

For the general handling precautions of the USB storage device, read the instruction manual that came with the device.

13.4 Connecting a SCSI Device

SCSI Specifications

Item	Specifications
Interface standard	SCSI (Small Computer System Interface), ANSI X3.131-1986
Connector type	Half pitch 50 pins (pin type)
Connector pin assignment	Unbalanced (single-ended), see table below.

25 23 24 - - - - - - - 3 2 1 ⟵ **Pin No.**

50 49 48 - - - - - - - 28 27 26
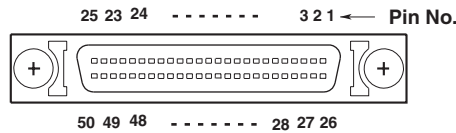
Pin No.	Signal Name	Pin No.	Signal Name
1 to 12	GND	38	TERMPWR
13	NC	39, 40	GND
14 to 25	GND	41	-ATN
26	-DB0	42	GND
27	-DB1	43	-BSY
28	-DB2	44	-ACK
29	-DB3	45	-RST
30	-DB4	46	-MSG
31	-DB5	47	-SEL
32	-DB6	48	-C/D
33	-DB7	49	-REQ
34	-DBP	50	-I/O
35 to 37	GND		

Items Necessary for Connection

Cable

Use a commercially sold cable that is 3 m or less in length that has a characteristic impedance between 90 and 132 Ω.

Connection Procedure

1. Connect the SCSI cable to the SCSI connector on the left side panel of the DL750/DL750P.
2. Turn ON the SCSI device and the DL750/DL750P (in that order).
   To format the disk, follow the procedure described in the section 13.5, "Formatting the Storage Medium."

Connectable SCSI Devices

SCSI devices that can be connected to the DL750/DL750P are MO disk drives and Zip drives.

For details on which devices can be connected, contact your nearest YOKOGAWA dealer.

For general handling precautions for the connected SCSI device, see the instruction manual that is provided with the device.

Note

- If the external SCSI device that is connected cannot be detected on the DL750/DL750P, execute the initialization of the SCSI ID using SCSI ID > Initialize SCSI on the MISC menu.
- The DL750/DL750P has a built-in SCSI terminator. When using multiple SCSI devices, connect the DL750/DL750P to the end of the chain. The terminator is always ON when the power is ON.
- Do not connect an external SCSI device with the same ID as that specified using SCSI ID > Internal ID on the MISC menu.

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Saving and Loading Data

13.5 Formatting the Storage Medium

Procedure

1. Press **FILE**.
2. Press the **Utility** soft key. The Utility setup menu and the File List window appear.

Selecting the Storage Medium to Be Formatted

3. Press the **Function** soft key. The file function selection menu is displayed.
4. Press the **Format** soft key. A media list is displayed in the File List window. (Net Drive cannot be formatted.)
5. Turn the **jog shuttle** to select the storage medium to be formatted.
   If no external SCSI devices (option) or USB storage devices are detected, the internal hard disk option is not installed, and only the floppy disk, Zip disk, or PC card is inserted in the drive, only [FD], [Zip], or [PC card] is displayed.
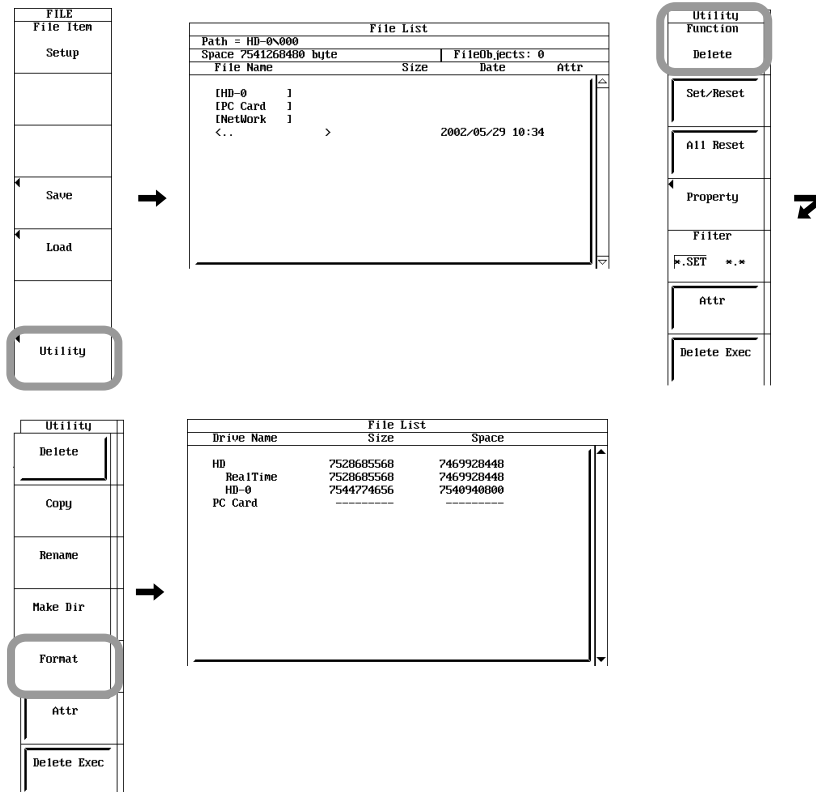
Selecting the FD Format

6.   Press the **Format** soft key. The format selection menu appears.
7.   Turn the **jog shuttle** to select 2DD 720K or 2HD 1.44M.
       Proceed to step 9.

Selecting the Zip Disk, PC Card, or USB Storage Device Format

6.   Press the **Format** soft key. The format selection menu appears.
       No setting is necessary in formatting the Zip disk, PC card, or USB storage device.
       Proceed to step 11.

Selecting the Number of Partitions of the PC Card

6.   Press the **Format** soft key. The format selection menu appears.
       Proceed to step 9.

Selecting the Number of Partitions of the SCSI Device

6.   Press the **Format** soft key. The format selection menu appears.
7.   Press the **Partition** soft key.
8.   Turn the **jog shuttle** to set the number of partitions.
       Proceed to step 9.

Note
> The number of partitions is 1 for removable disks (such as SCSI and Zip disks).

Selecting the Number of Partitions of the Internal Hard Disk (Optional)

- **Selecting the Number of Partitions**
6.   Press the **Format** soft key. The format selection menu appears.
7.   Press the **Partition** soft key.
8.   Turn the **jog shuttle** to set the number of partitions to 2 or 3.

- **Setting the Realtime Recording Area**
9.   Press the **RealTime Recording Area** soft key.
10.   Turn the **jog shuttle** to set the realtime recording area in the range of 30 to 70% of the entire capacity of the internal hard disk. Proceed to step 11.

Note
> Do not place files other than those created by realtime recording in the Real Time area of the internal hard disk. Otherwise, the realtime recording may not operate properly.

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Saving and Loading Data
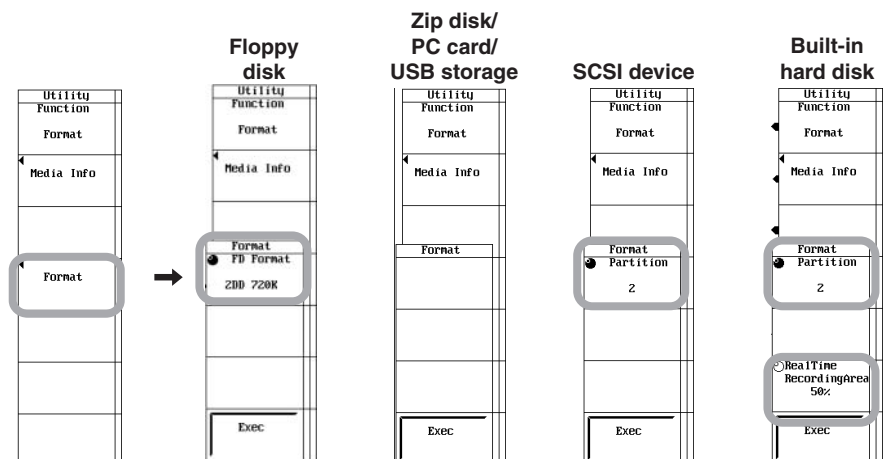
Executing/Aborting the Format Operation

9.   Press the **Exec** soft key. An Alert dialog box appears.

10. Turn the **jog shuttle** to select OK or cancel.

11. Select OK and press **SELECT** to execute the format operation.
     Select Cancel and press **SELECT** to cancel the format operation.
     While the medium is being formatted, an icon corresponding the medium (⊡ FD, 🗜 Zip disk, 🗂 PC card, ⌨ external SCSI device, 🖿 internal HD, or ⊟ USB storage device) being formatted is displayed at the upper left corner of the screen.
     Select Cancel and press **SELECT** to cancel the format operation.

Viewing the Media Information

Select the storage medium according to steps 1 to 5.

Press the **Media Info** soft key. The information about the storage medium that was selected in step 5 is displayed.
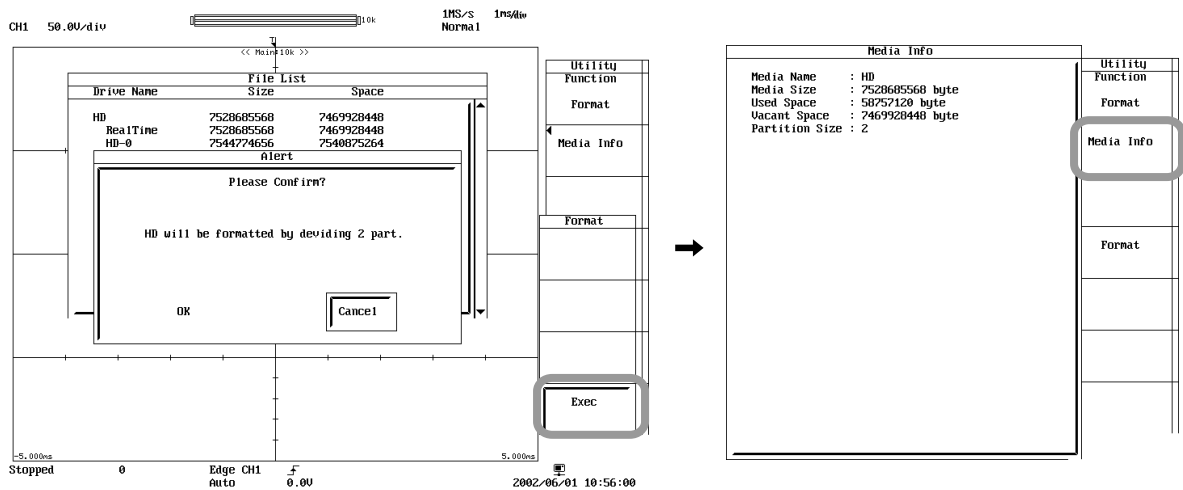
Explanation

Formatting a Floppy Disk

When using a new floppy disk, you must format it. Select the format that is appropriate for the floppy disk that you are using from below.

*   **2DD 720K**

    Formats a 2DD floppy disk to 720 KB/9 sectors.

*   **2HD 1.44M**

    Formats a 2HD floppy disk to 1.44 MB/18 sectors.

Formatting a Zip Disk, PC Card, or USB Storage Device

When using a new Zip disk, you need to format it.
The format for 250 MB and 100 MB disks is as follows:

    FDISK 1 partition

Flash ATA cards are formatted to IBM-compatible format.

    2GB or more: FAT32
    Less than 2GB: FAT16

Formatting an External SCSI Device

The formats of the disk that are connected via the SCSI (option) are as follows:

*   **MO**

    Semi-IBM format. Handled as a removable disk.

*   **Zip**

    FDISK 1 partition. Handled as a fixed disk.

Formatting the Internal Hard Disk (Optional)

*   **Selecting the Number of Partitions**

    You can set the number of partitions to 2 or 3.

*   **Setting the Realtime Recording Area**

    You can set the realtime recording area to 30%, 40%, 50%, 60%, or 70% of the entire capacity of the internal hard disk. The default value is 50%.

Selecting the Number of Partitions

You can set partitions on the internal hard disk (optional) and some of the external SCSI devices. However, partitions cannot be specified on removable disks. You can select the number of partitions from 1 to 3 (2 or 3 on the internal hard disk).

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Saving and Loading Data

<u>**Media Info**</u>

Lists the information about the selected medium. The following information is displayed.

- Media Name: Name of the medium.
- Media Size: Total size.
- Used Space: Size of the used area.
- Vacant Space: Size of the free area.
- Partition Size: Number of partitions.

Note

- If you format a medium that has data stored on it, all the data are cleared when the medium is formatted.
- It takes approximately a minute and a half to format a floppy disk.
- It takes approximately 10 s to format a 250-MB Zip disk.
- It takes a few seconds to format a PC card.
- It takes approximately 30 s to 1 minute to format the internal hard disk (optional).
- You cannot format a floppy disk if the write-protect is ON.
- Do not format a disk while the DL750/DL750P and a PC is connected via a SCSI cable.
- Floppy disks that are formatted to formats other than those listed in this section cannot be used.
- If an error message is displayed after the format operation, the target medium may be damaged.
- You can use floppy disks that are formatted using MS-DOS on a PC.
- This function cannot be used when using the FTP server function, the FTP client function, network printer function or the Web server function.

13.6 Changing the SCSI ID Number

Procedure
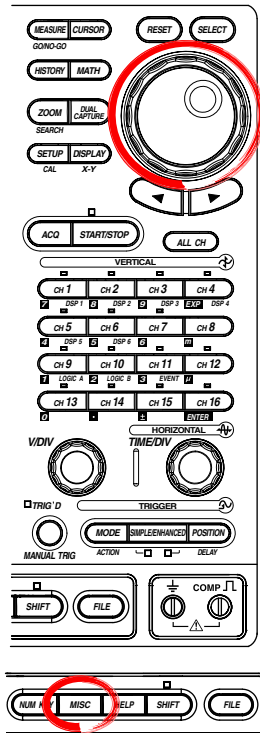
1. Press **MISC**.
2. Press the **SCSI ID** soft key. The SCSI ID number setup menu appears.

Changing the ID Number of the DL750/DL750P

3. Press the **Own ID** soft key.
4. Turn the **jog shuttle** to select a value in the range of 0 to 7.

Changing the ID Number of the Internal Hard Disk

5. Press the **Internal ID** soft key.
6. Turn the **jog shuttle** to select a value in the range of 0 to 7.

Executing the ID Number Change

7. Press the **Initialize SCSI** soft key. The SCSI ID is changed to the selected ID number.
    The SCSI icon (SCSI) at the upper left corner of the screen blinks while the change is in progress. When the change is complete, the icon disappears.

Note

- If you do not execute Initialize SCSI after changing Own ID or Internal ID, the new ID is not activated until the DL750/DL750P is powered up the next time.
- To save the data after executing Initialize SCSI, select the destination medium and directory.

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Saving and Loading Data
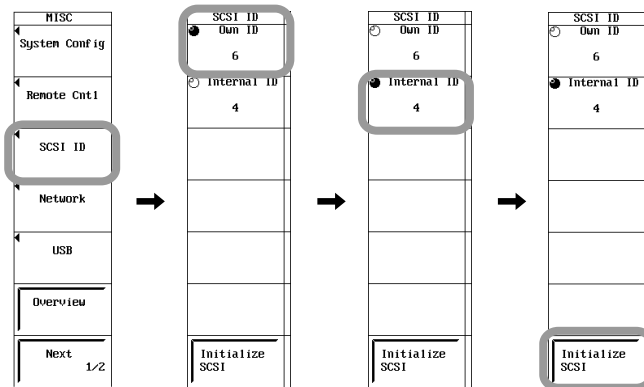
Explanation

The SCSI ID number is used to distinguish between the various devices connected to the SCSI chain. Make sure not to use duplicate ID numbers on any of the connected devices.

Selectable Range of Own ID Number

Own ID (the ID number of the DL750/DL750P) can be set in the range of 0 to 7. The default value is 6.

Selectable Range of Internal ID Number

Internal ID (ID number of the internal hard disk (optional) can be set in the range of 0 to 7. The default value is 4.

Notes When Setting the ID Number

* If you change the ID number, make sure to press the Initialize SCSI soft key.
* Do not set the same SCSI ID number for the external SCSI device and the internal hard disk of the DL750/DL750P.
* The SCSI ID numbers of external SCSI devices are automatically detected when the DL750/DL750P is turned ON.
* If you change the ID number of the external SCSI device, make sure to execute Initialize SCSI to detect the new SCSI ID.
* SCSI ID (Own) and SCSI ID (Internal) cannot be set to the same value.

13.7 Saving/Loading the Waveform Data

⚠

CAUTION

Never remove the storage medium (disk) or turn OFF the power while the access indicator or the floppy disk, Zip disk, or internal hard disk (optional) icon is blinking. Such acts can damage the storage medium or destroy the data on the medium.

Procedure

Saving the Waveform Data
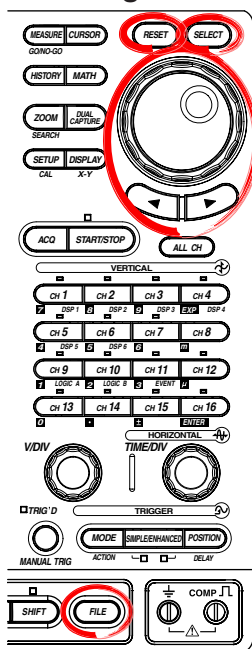
1. Press **FILE**.
2. Press the **File Item** soft key. The File Item setup menu appears.
3. Press the **Waveform** soft key.

Selecting the Data Type

4. Press the **Data Type** soft key. The data type selection menu appears.
5. Press the **Binary**, **ASCII**, or **Float** soft key to select the data type.

Note

- Binary files can be saved and loaded. ASCII and Float files can only be saved.
- Select Real Time when loading or converting the waveform that has been realtime recorded. For details, see section 13.14.
- The data type is synchronized to the data type that is selected when Save to File is selected for the action-on-trigger, action on log end (see section 6.18), or GO/NO-GO determination (see sections 11.8 and 11.9) action.

Selecting the Waveform to Be Saved

6. Press the **Save** soft key. The save setup menu appears.
7. Press the **Trace** soft key. The waveform selection menu appears.
8. Press the soft key corresponding to the desired channel to select the waveform.

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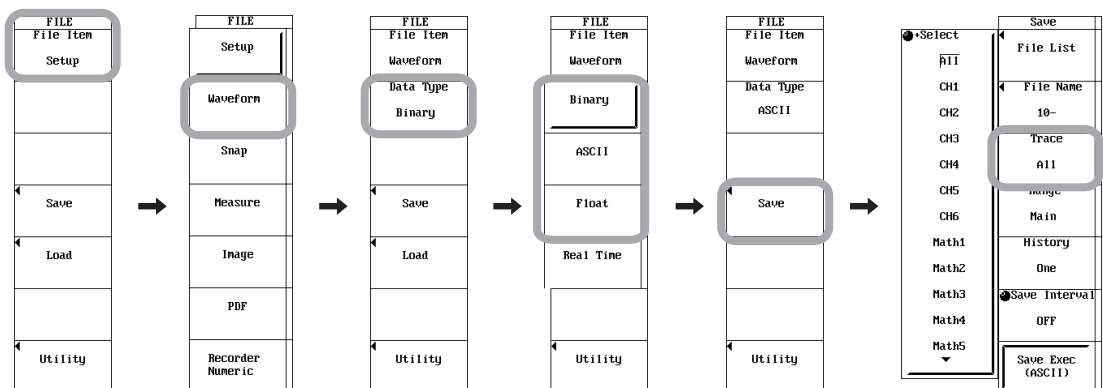
Saving and Loading Data

Selecting the Range of Waveform to Be Saved

9. Press the **Range** soft key. A menu for selecting the range of waveform to be saved appears.
10. Press the **Main**, **Z1**, or **Z2** soft key to select the waveform save range.
11. Press the **History** soft key to save all the data in the history memory (All), save only the selected waveform (One), or save the average data in the history memory (Ave).

    If you select All after performing a search on the history memory data, only the searched waveforms are saved.

Compressing the Data and Saving/Decimating the Data and Saving

• **Decimating the Data and Saving (When Data Type Is Set to ASCII)**
    12. Press the **Save Interval** soft key.
        Turn the **jog shuttle** to set the save interval from OFF, Per5 to Per5000.

• **Compressing the Data and Saving (When Data Type Is Set to Binary)**
    12. Press the **P-P Comp** soft key to select ON (compress and save) or OFF (do not compress and save).
        If P-P Comp is turned ON when saving waveform data, only the maximum and minimum values of the multiple data points existing at the same time position are saved. Consequently, the file size is reduced.

Note

If P-P Comp is set to ON, you cannot set the save range using Range.
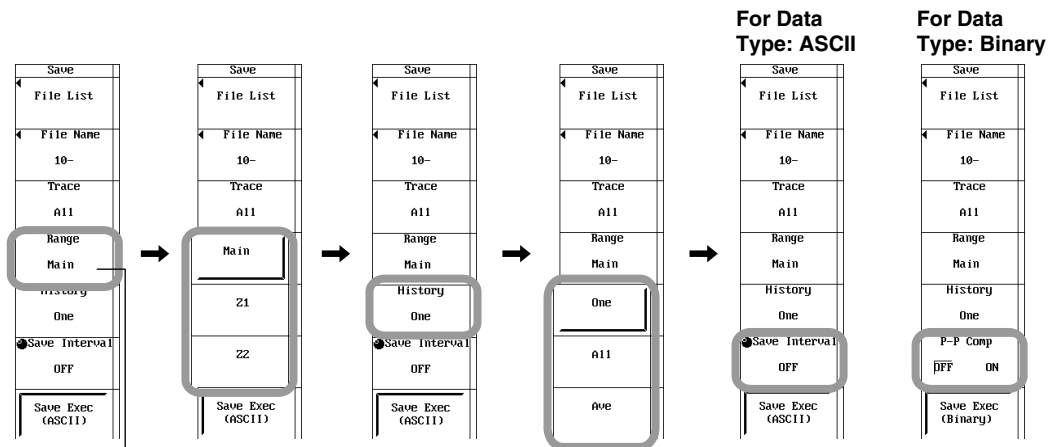
Selecting Save Destination Medium

13.   Press the **File List** soft key. The File List window appears.

14.   Turn the **jog shuttle** to select the save destination medium (indicated by brackets).

15.   Press **SELECT** to confirm the storage medium.

Selecting the Destination Directory

(Perform this operation when directories are present on the medium.)

16.   Turn the **jog shuttle** to select the save destination directory (indicated by < >).

17.   Press **SELECT** to confirm the directory. The selected medium/directory is displayed in "Path=......" located above and to the left of the File List window. Select <..> to move to the parent directory.

Note

If History is set to All, MATH channels are not saved. If you wish to save the data of MATH channels, set History to One.
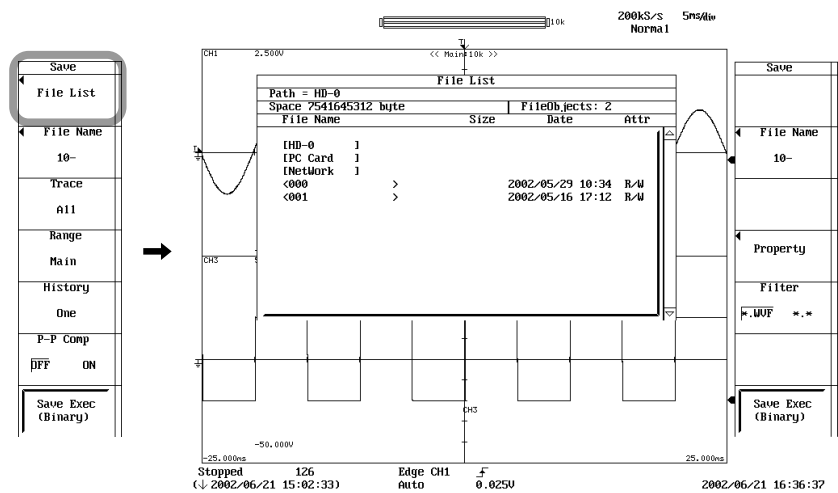
Setting the File Name and Comment

18. Press the **File Name** soft key. The file name setup menu appears.
19. Turn the **jog shuttle** to select Auto Naming.
20. Press **SELECT** to select OFF, Numbering, or Date.
21. Turn the **jog shuttle** to select File Name.
22. Enter the file name using up to 16 characters according to the procedure given in section 4.2.
23. Turn the **jog shuttle** to select Comment.
24. Enter the comment using up to 160 characters according to the procedure given in section 4.2.

Executing the Save Operation

25. Press the **Save Exec** soft key. The data is saved to the directory indicated by Path=...... At the same time, the **Save Exec** soft key changes to an **Abort** soft key.
    While the data is being saved, an icon corresponding the save destination medium (⧠ FD, 🔲 Zip disk, ⧠ PC card, ⧠ external SCSI device, ⧠ internal HD, or ⧠ USB storage device) is displayed at the upper left corner of the screen.

Note _____

The voice memo function (section 7.9) can be used to record voice memos while waveforms are being acquired (when in roll mode display). The voice memo is saved along with the waveform data. Voice memo can be attached only to waveform data in binary format (.wvf extension) and realtime recorded waveform data (.wdf extension). In addition, the voice memo is saved only when History: One is selected in step 11 of page 13-18.
_____

Aborting the Save Operation

26. Press the **Abort** soft key. The save operation is aborted. At the same time, the **Abort** soft key changes to a **Save Exec** soft key.

Specifying the File to Be Displayed on the File List Window

27. On the screen showing the File List window, press the **Filter** soft key to select *.extension or *.*.
28. Turn the **jog shuttle** to select the files in the File List window.

Displaying Properties

29. Press the **Property** soft key. Information about the selected file is displayed.
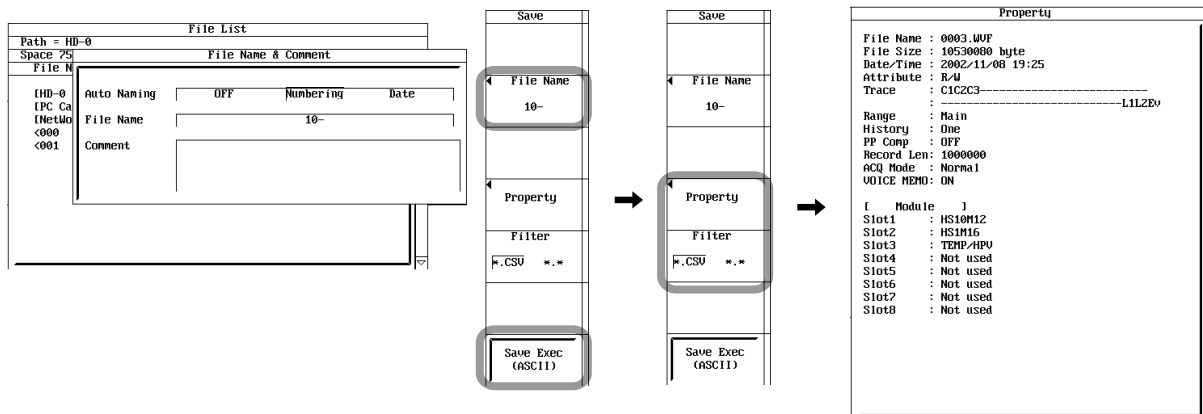
Loading the Waveform Data
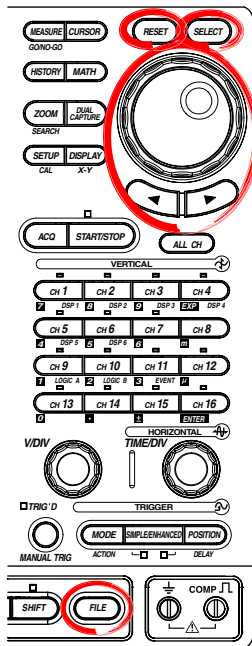
1. Press **FILE**.
2. Press the **File Item** soft key. The File Item setup menu appears.
3. Press the **Waveform** soft key.

Selecting the Data Type

4. Press the **Data Type** soft key. The data type selection menu appears.
5. Press the **Binary** soft key.

Selecting the Load Source Medium/Directory

6. Press the **Load** soft key. The load setup menu and File List window appear.
7. Select the load source directory according to steps 13 to 18 in "Saving the Waveform Data."

Selecting the File to Be Loaded

8. Turn the **jog shuttle** to select the file.

Executing the Load Operation

9. Press the **Load Exec** soft key. A dialog box appears showing the module information of the selected waveform data and the current module information of the DL750/DL750P.
10. Press the **Load Exec** soft key again. The selected file is read from the directory indicated in Path=...... At the same time, the **Load Exec** soft key changes to an **Abort** soft key.

Note
- Waveform data on modules whose information differs from the current module information of the DL750/DL750P cannot be loaded.
- Waveform data that has voice memo recorded (waveform data in binary format (.wvf extension) and realtime recorded waveform data (.wdf extension)) can also be loaded. For details on the voice memo function, see section 7.9.

Aborting the Load Operation

11. Press the **Abort** soft key. The load operation is aborted. At the same time, the **Abort** soft key changes to a **Load Exec** soft key.
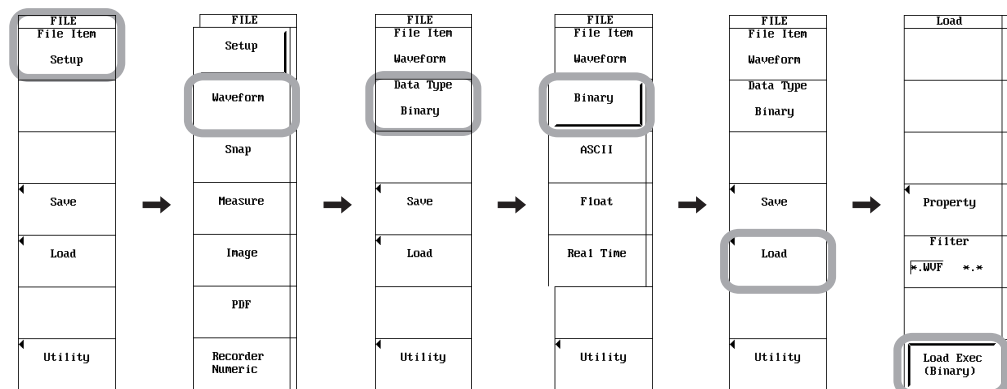
Specifying the Files to Be Displayed in the File List Window and Displaying Properties

12. Carry out steps 27 to 29 in "Saving the Waveform Data."

Note
When a file saved by specifying Z1 (or Z2) is loaded, the data of the record length of Z1 (or Z2) is displayed right justified.

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Saving and Loading Data

Explanation

Selecting the Data Type

- **Binary**
- The sampled data in the acquisition memory is saved in binary format.
- The data that is saved can be loaded to display the waveform and compute numeric data.
  If saved data is loaded, the accumulate setting is always turned OFF.
- A header file that is used when analyzing the waveform on a PC is automatically created. The header file cannot be opened on the DL750/DL750P. For details on the header file format, see appendix 4, "ASCII Header File Format."
- The extension is .WVF. The extension of the header file name is .HDR.
- When saving waveform data in binary format, a header file is automatically created with the extension .HDR. When the DL750/DL750P is used to copy, delete, change filenames, or change file attribute of waveform data files (files with .WVF extension), the header files are automatically updated to reflect the changes. Do not delete only the header file or only the waveform data file, as this may cause a system malfunction.
- Waveforms measured using the dual capture function are saved simultaneously to the main waveform data file and sub waveform data file (dual capture data file).
  - The sub waveform data file is automatically saved to a file name that results by adding two characters "DC" to the file name of the main waveform data file.
  - The sub waveform data file is loaded at the same time the main waveform data is loaded.
  - You cannot load only the sub waveform data file.
  - Do not delete only the main waveform data file or only the sub waveform data file.

- **ASCII**
- The units of the sampled data in the acquisition memory are converted per the specified range and saved in ASCII format. The data can be used to analyze the waveform on a PC.
- The file cannot be loaded to the DL750/DL750P.
- The extension is .CSV.
- Waveforms measured using the dual capture function are saved simultaneously to the main data file and dual capture data file. The dual capture data file is automatically saved to a file name that results by adding two characters "DC" to the file name of the main data file.
- If the file size exceeds 2 GB depending on the combination of the record length and the number of channels, the files cannot be created.

- **Float**
- The units of the sampled data in the acquisition memory are converted per the specified range and saved in 32-bit floating format. The data can be used to analyze the waveform on a PC.
- The order of the data is little-endian (Intel format).
- The file cannot be loaded to the DL750/DL750P.
- The extension is .FLD.
- Waveforms measured using the dual capture function are saved simultaneously to the main data file and dual capture data file. The dual capture data file is automatically saved to a file name that results by adding two characters "DC" to the file name of the main data file.
- If the file size exceeds 2 GB depending on the combination of the record length and the number of channels, the files cannot be created.

Data Size

The following table shows the data size when the record length is set to 100 kW, waveform data of CH1 to CH4 are saved, all Math channels are turned OFF, and using history waveform 1 condition.

Data Type	Extension	Data Size (Bytes)
Binary	.WVF	Approx. 800 K ((100 kW + 32) $\times$ 4 channels $\times$ the number of history waveforms $\times$ 2)
	.HDR	Approx. 2 K (approx. 3 K when Math1 and Math2 are ON)
ASCII	.CSV	4 to 5 MW
Float	.FLD	Approx. 1.6 M ((100 kW + 32) $\times$ 4 $\times$ the number of history waveforms $\times$ 4)

Waveform to Be Saved: Trace

- You can save all the waveforms or the specified waveforms from CH1 to CH16, DSP1 to DSP6 (optional), Math waveforms, logic waveforms, and event waveforms.
- The setup parameters including vertical axis, horizontal axis, and trigger of the waveform to be saved are also saved.
- For waveforms that are loaded using the history memory function, you can select whether to save all of the history data, save the average of the history data, or save just the current displayed waveform on the screen. If History is set to All, MATH channels are not saved. If you wish to save the data of MATH channels, set History to One. You can also save only the results obtained by searching the history memory data. For a description of searching the history memory data, see section 11.2.
- For a description of snapshot waveforms, see section 13.9.

Selecting the Range of the Waveform to Be Saved

Select the range (region) of the waveform from the following list of choices. Only the data that has been saved by selecting Binary in the aforementioned section "Selecting the Data Type" can be loaded in the DL750/DL750P.

- **Main**
  The range of the normal (Main) waveform. It is the range defined by the displayed record length (range displayed on the screen).
- **Z1**
  The range of zoom waveform Z1.
- **Z2**
  The range of zoom waveform Z2.

Compressing the Data and Saving: P-P Comp (When Data Type Is Set to Binary)

You can select whether to P-P compress the waveform data before saving.
Power spectrum computation data cannot use P-P compression.

Decimating the Data and Saving: Save Interval (When Date Type Is Set to ASCII)

When saving to ASCII format, data is decimated and converted to ASCII format before the data is saved.
Save Interval: OFF (no decimation), Per 5, Per 10, Per 20, Per 50, Per 100, Per 200, Per 500, Per 1000, Per 2000, and Per 5000
For example, if Per 5 is selected, the data is decimated as follows.
   "First data point" "+5" "+10" "+15" ...

13

Saving and Loading Data

Selecting the Storage Medium and Directory

Media on which saving and loading are possible are displayed on the File List window.

- **Display Examples of Storage Media**

  [FD]:   Floppy disk

  [ZIP]:   Zip disk

  [PC Card]:   PC card

  [HD]:   Hard disk

  [SCSI5]:   SCSI device with the ID number set to 5[1]

  [SCSI5-1]:   Partition 1 of a SCSI device whose ID number is 5[1]

  [NetWork]:   Network drive (when the Ethernet interface option is installed)

  [USB]:   USB storage device

  1. When a SCSI device whose ID number is 5 is connected

Setting the File Name

You can specify the file name using up to 16 characters. The characters that can be used are 0-9, A-Z, %, _, (, and).

- **Auto Naming**

  Select from the following three types.

  - OFF: The name specified by File Name is attached.

  - Numbering: Files are automatically named with four digit numbers from 0000 to 4999. You can specify a common name (up to four characters, specified by File Name) that is placed before the number.

  - Date: Files are automatically named using 8 characters (base 36 consisting of 0 to 9 and A to Z) based on the date and time. (The file name specified by File Name is void.)

Year
Month
Day
Hour

Time in unit of 100 ms
0 ms=0000, 100 ms=0001, ... , 59 min 50 s 900 ms=0RRZ
0 hour=0, ... , 9 hour=9, 10 hour=A, ... , 23 hour=N
1 day=1, ... , 10 day=A, ... , 31 day=V
1 month=1, ... , 10 month=A, 11 month=B, 12 month=C
2000 year=0, ... , 2010 year=A, ... , 2035 year=Z

Note

> Up to 16 characters can be entered for the common name. Characters exceeding 16 characters are void.

- **Setting a Comment**

  A comment of up to 160 characters can be added and saved. Comments are optional. All characters (including spaces) can be used.

Specifying the File to Be Displayed on the File List Window: Filter

Specify the type of files to be displayed.

- *.WVF/*.CSV/*.FLD: Displays only the files that have the same file format as the file being saved.
- *.*:   Displays all the files in the medium/directory.

Property

Displays the following information about the selected file: filename.extension, the file size, the date/time the file was saved, the attribute, the comment, the presence of voice memo, the module configuration when the file was saved, the conditions for saving, etc.

Note

- An error occurs, if a key other than the Abort key is pressed while saving or loading a file.
- Saving and Loading is not possible while data acquisition is in progress.
  If waveform data is loaded, the accumulate setting is always turned OFF.
- If you change the extension of the saved data such as on a PC, the file can no longer be loaded.
- Up to 36 characters can be displayed in "Path."
- File names are not case-sensitive. Comments are case-sensitive. In addition, the following five file names cannot be used due to limitations of MS-DOS.
  AUX, CON, PRN, NUL, CLOCK, COM1 to COM9, and LPT1 to LPT9
- The waveform data loaded from a file overwrites the data in the acquisition memory. Once the memory is overwritten, the old data cannot be recovered. It is recommended that the current waveform data be saved before loading data from a file.
- If the total number of files and directories exceed 5000 in a single directory, the file list is no longer displayed.
- This function cannot be used when using the FTP server function, network printer function, or the Web server function.
- Waveform (.wvf) and header (.hdr) files are saved as file pairs. If you specify "*.*" for the files to be displayed (Filter) on the File List and manipulate individual files (Delete, Rename, or Copy), the file can no longer be loaded.
- Files that do not have an archive attribute are not displayed in the File List window. Do not remove the archive attribute of the files saved by the DL750/DL750P using your PC.

Data Format When Storing Multiple Records

When multiple records are stored (history memory, for example), the following data format is used.

ASCII Format: CR+LF is inserted between records.
```
<Header>
Measured data 1-1 of CH1, Measured data 1-1 of CH2, Measured data 1-1 of CH3, ... , [ CR+LF]    ┐
Measured data 1-2 of CH1, Measured data 1-2 of CH2, Measured data 1-2 of CH3, ... , [ CR+LF]    │ Record 1
                ⋮
Measured data 1-m of CH1, Measured data 1-m of CH2, Measured data 1-m of CH3, ... , [ CR+LF]    ┘
[ CR+LF]
Measured data 2-1 of CH1, Measured data 2-1 of CH2, Measured data 2-1 of CH3, ... , [ CR+LF]    ┐
Measured data 2-2 of CH1, Measured data 2-2 of CH2, Measured data 2-2 of CH3, ... , [ CR+LF]    │ Record 2
                ⋮
Measured data 2-n of CH1, Measured data 2-n of CH2, Measured data 2-n of CH3, [ CR+LF]          ┘
[ CR+LF]
                ⋮
```

Float Format: Stored in blocks of channels.

| |
|---|
| Measured data of record 1 of CH1 |
| Measured data of record 2 of CH1 |
| ⋮ |
| Measured data of record N of CH1 |
| Measured data of record 1 of CH2 |
| Measured data of record 2 of CH2 |
| ⋮ |
| Measured data of record N of CH2 |
| ⋮ |

13.8 Saving/Loading the Setup Data

⚠️ **CAUTION**

Never remove the storage medium (disk) or turn OFF the power while the access indicator or the floppy disk, Zip disk, or internal hard disk (optional) icon is blinking. Such acts can damage the storage medium or destroy the data on the medium.

Procedure

Saving the Setup Data

1. Press **FILE**.
2. Press the **File Item** soft key. The File Item setup menu appears.
3. Press the **Setup** soft key.

Selecting Save Destination Medium

4. Press the **Save** soft key. The save setup menu appears.
5. Press the **File List** soft key. The File List window appears.
6. Turn the **jog shuttle** to select the save destination medium (indicated by brackets).
7. Press **SELECT** to confirm the storage medium.

Selecting the Destination Directory

(Perform this operation when directories are present on the medium.)

8. Turn the **jog shuttle** to select the save destination directory (indicated by < >).
9. Press **SELECT** to confirm the directory. The selected medium/directory is displayed in "Path=......" located above and to the left of the File List window. Select <..> to move to the parent directory.

Setting the File Name and Comment

10. Press the **File Name** soft key. The file name setup menu appears.
11. Turn the **jog shuttle** to select Auto Naming.
12. Press **SELECT** to select OFF, Numbering, or Date.
13. Turn the **jog shuttle** to select File Name.
14. Enter the file name using up to 16 characters according to the procedure given in section 4.2.
15. Turn the **jog shuttle** to select Comment.
16. Enter the comment using up to 160 characters according to the procedure given in section 4.2.

Note

You can set up to 16 characters for the file name, but only 15 characters are displayed on the setup menu.

Executing the Save Operation

17. Press the **Save Exec** soft key. The data is saved to the directory indicated by Path=...... At the same time, the **Save Exec** soft key changes to an **Abort** soft key.
    While the data is being saved, an icon corresponding the save destination medium (FD, Zip disk, PC card, external SCSI device, internal HD, or USB storage device) is displayed at the upper left corner of the screen.

Aborting the Save Operation

18. Press the **Abort** soft key. The save operation is aborted. At the same time, the **Abort** soft key changes to a **Save Exec** soft key.

Specifying the File to Be Displayed on the File List window

19. On the screen showing the File List window, press the **Filter** soft key to select *.SET or *.*.
20. Turn the **jog shuttle** to select the files in the File List window.

Displaying Properties

21. Press the **Property** soft key. Information about the selected file is displayed.

13
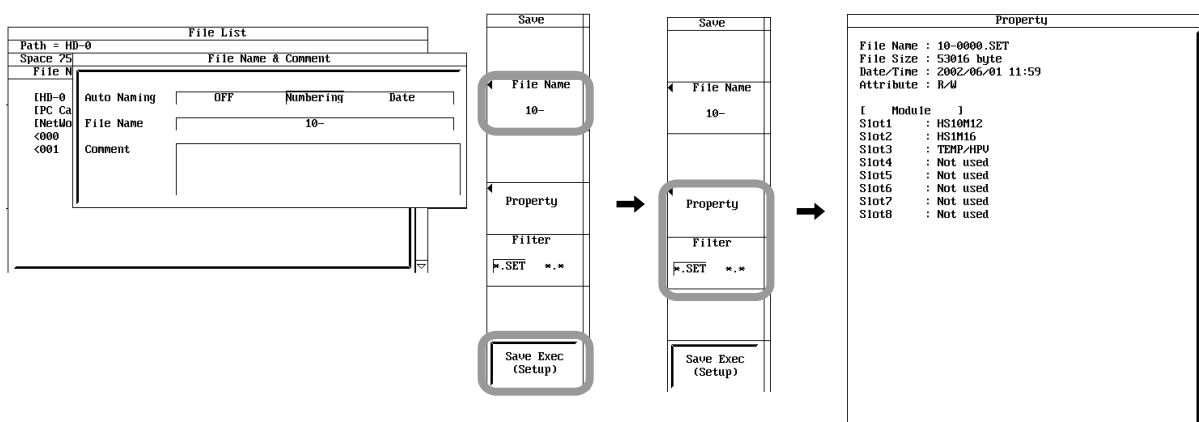
Saving and Loading Data

Loading the Setup Data
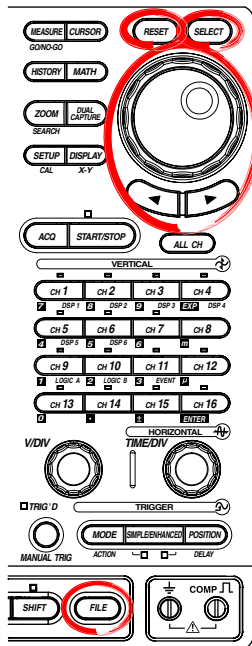
1. Press **FILE**.
2. Press the **File Item** soft key. The File Item setup menu appears.
3. Press the **Setup** soft key.

Selecting the Load Source Medium/Directory

4. Press the **Load** soft key. The load setup menu and File List window appear.
5. Select the load source directory according to steps 4 to 9 in "Saving the Setup Data."

Selecting the File to Be Loaded

6. Turn the **jog shuttle** to select the file.

Executing the Load Operation

7. Press the **Load Exec** soft key. A dialog box appears showing the module information of the selected setup data and the current module information of the DL750/DL750P.
8. Press the **Load Exec** soft key again. The selected file is read from the directory indicated in Path=...... At the same time, the **Load Exec** soft key changes to an **Abort** soft key.

Note

If the module information of the setup data and the current module information of the DL750/DL750P differ, the setup data cannot be loaded.

Aborting the Load Operation

9. Press the **Abort** soft key. The load operation is aborted. At the same time, the **Abort** soft key changes to a **Load Exec** soft key.

Specifying the Files to Be Displayed in the File List Window and Displaying Properties

10. Carry out steps 19 to 21 in "Saving the Setup Data."
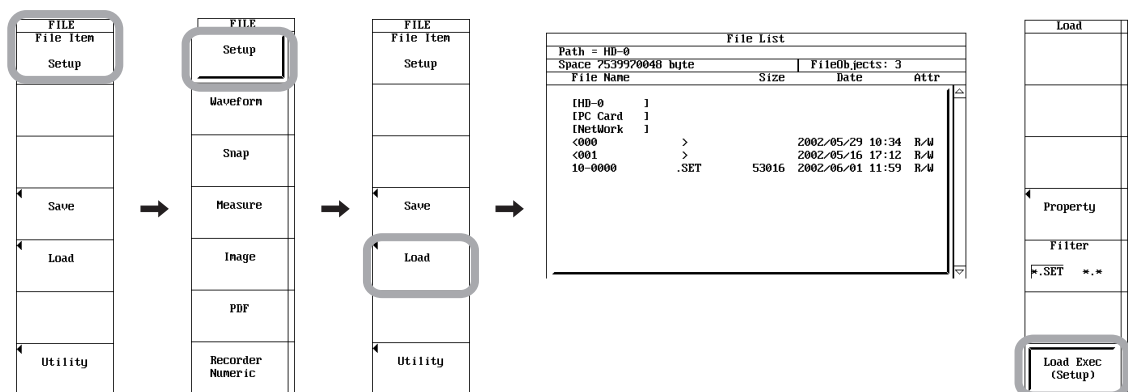
Explanation

Setup Parameters That Are Saved

The setup parameter of each key existing at the time of the save operation can be saved. However, setup parameters such as the date and time, communications, and SCSI ID numbers are not saved.

Number of Bytes Needed in Saving Setup Data

Approx. 64 KB

Selecting the Storage Medium and Directory: File List

Media on which saving and loading are possible are displayed on the File List window.
* **Display Examples of Storage Media**

[FD]:	Floppy disk
[ZIP]:	Zip disk
[PC Card]:	PC card
[HD]:	Internal hard disk
[SCSI5]:	SCSI device with the ID number set to 5[1]
[SCSI5-1]:	Partition 1 of a SCSI device whose ID number is 5[1]
[NetWork]:	Network drive (when the Ethernet interface option is installed)
[USB]:	USB storage device

  1. When a SCSI device whose ID number is 5 is connected

Setting the File Name

You can specify the file name using up to 16 characters. The characters that can be used are 0-9, A-Z, %, _, (, and).
* **Auto Naming**

  Select from the following three types.
  * OFF: The name specified by File Name is attached.
  * Numbering: Files are automatically named with four digit numbers from 0000 to 4999. You can specify a common name (up to four characters, specified by File Name) that is placed before the number.
  * Date: Files are automatically named using 8 characters (base 36 consisting of 0 to 9 and A to Z) based on the date and time. (The file name specified by File Name is void.)

```
Year
 Month
  Day
   Hour

 ┌─┬─┬─┬─┬─┬┄┬┄┐
 └─┴─┴─┴─┴─┴┄┴┄┘
                │     │
                └─────┘
            Time in unit of 100 ms
            0 ms=0000, 100 ms=0001, ... , 59 min 59 s 900 ms=0RRZ
         0 hour=0, ... , 9 hour=9, 10 hour=A, ... , 23 hour=N
       1 day=1, ... , 10 day=A, ... , 31 day=V
     1 month=1, ... , 10 month=A, 11 month=B, 12 month=C
   2000 year=0, ... , 2010 year=A, ... , 2035 year=Z
```

Note

Up to 16 characters can be entered for the common name. Characters exceeding 16 characters are void.

* **Setting a Comment**

  A comment of up to 160 characters can be added and saved. Comments are optional. All characters (including spaces) can be used.

13

Saving and Loading Data

Notes When Saving Setup Data

- You cannot save setup data while waveform acquisition is in progress. Press START/
  STOP to stop the acquisition first.
- The number of directories and files that is displayed in the file list is up to 5000. If the
  number of directories and files in a directory exceeds 5000, the file list displays 5000
  directories and files, but the ones that are displayed cannot determined.

Extension of Setup Data

A .set extension is automatically attached to the file name.

Specifying the File to Be Displayed on the File List Window: Filter

Specify the type of files to be displayed.
- *.SET: Displays only setup data files.
- *.*:   Displays all the files in the medium/directory.

Property

Displays the following information about the selected file: filename.extension, the file
size, the date the file was saved, the attribute, the comment, and the module
configuration when the file was saved, etc.

Note

- An error occurs, if a key other than the Abort key is pressed while saving or loading a file.
- Saving and Loading is not possible while data acquisition is in progress.
- If you change the extension of the file such as on a PC, the file can no longer be loaded.
- Up to 36 characters can be displayed in "Path."
- File names are not case-sensitive. Comments are case-sensitive. In addition, the
  following five file names cannot be used due to limitations of MS-DOS.
  AUX, CON, PRN, NUL, CLOCK, COM1 to COM9, and LPT1 to LPT9
- If the setup parameters that are saved to a file are loaded, the key settings are changed to
  the loaded information and cannot be undone. It is recommended that you first save the
  current setup parameters and then load the setup parameters from a file.
- Setup parameters such as the date and time, communications, SCSI ID numbers, menu
  language, message language, and USB keyboard language are not saved. Therefore,
  loading setup parameters from a file will not change the these settings.
- This function cannot be used when using the FTP server function, network printer function
  or the Web server function.
- Files that do not have an archive attribute are not displayed in the File List window. Do not
  remove the archive attribute of the files saved by the DL750/DL750P using your PC.

13.9 Saving/Loading Snapshot Waveforms

⚠ CAUTION

Never remove the storage medium (disk) or turn OFF the power while the access indicator or the floppy disk, Zip disk, or internal hard disk (optional) icon is blinking. Such acts can damage the storage medium or destroy the data on the medium.

Procedure

Saving Snapshot Waveforms

1. Press **FILE**.
2. Press the **File Item** soft key. The File Item setup menu appears.
3. Press the **Snap** soft key.

Selecting Save Destination Medium

4. Press the **Save** soft key. The save setup menu appears.
5. Press the **File List** soft key. The File List window appears.
6. Turn the **jog shuttle** to select the save destination medium (indicated by brackets).
7. Press **SELECT** to confirm the storage medium.

Selecting the Destination Directory

(Perform this operation when directories are present on the medium.)

8. Turn the **jog shuttle** to select the save destination directory (indicated by < >).
9. Press **SELECT** to confirm the directory. The selected medium/directory is displayed in "Path=......" located above and to the left of the File List window. Select <..> to move to the parent directory.

13

Saving and Loading Data

Setting the File Name and Comment

10. Press the **File Name** soft key. The file name setup menu appears.
11. Turn the **jog shuttle** to select Auto Naming.
12. Press **SELECT** to select OFF, Numbering, or Date.
13. Turn the **jog shuttle** to select File Name.
14. Enter the file name using up to 16 characters according to the procedure given in section 4.2.
15. Turn the **jog shuttle** to select Comment.
16. Enter the comment using up to 160 characters according to the procedure given in section 4.2.

Note _____

You can set up to 16 characters for the file name, but only 15 characters are displayed on the setup menu.

_____

Executing the Save Operation

17. Press the **Save Exec** soft key. The data is saved to the directory indicated by Path=...... At the same time, the **Save Exec** soft key changes to an **Abort** soft key.

Aborting the Save Operation

18. Press the **Abort** soft key. The save operation is aborted. At the same time, the **Abort** soft key changes to a **Save Exec** soft key.
    While the data is being saved, an icon corresponding the save destination medium (FD, Zip disk, PC card, external SCSI device, internal HD, or USB storage device) is displayed at the upper left corner of the screen.

Specifying the File to Be Displayed on the File List Window

19. On the screen showing the File List window, press the **Filter** soft key to select *.SNP or *.*.
20. Turn the **jog shuttle** to select the files in the File List window.

Displaying Properties

21. Press the **Property** soft key. Information about the selected file is displayed.
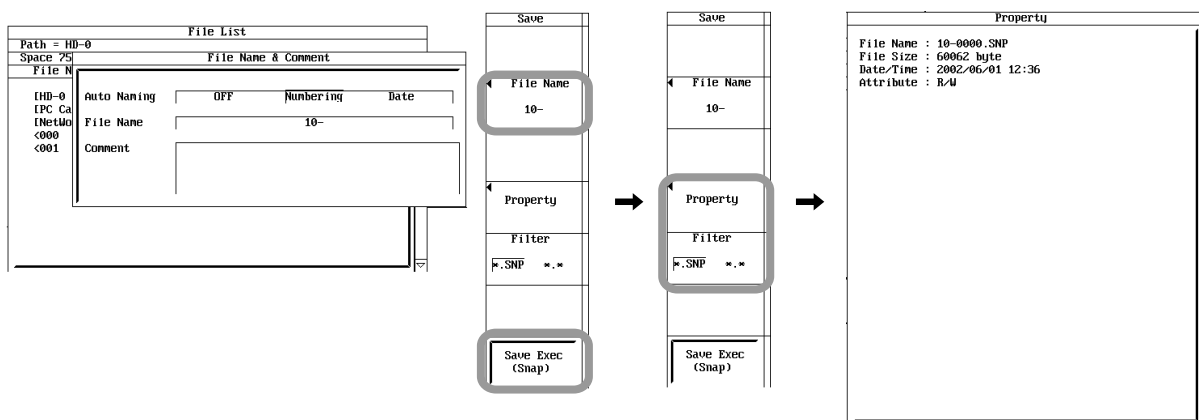
Loading Snapshot Waveforms
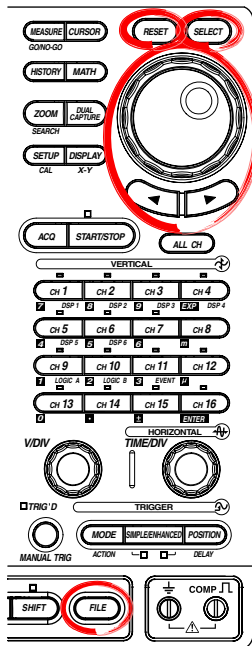
1. Press **FILE**.
2. Press the **File Item** soft key. The File Item setup menu appears.
3. Press the **Snap** soft key.

Selecting the Load Source Medium/Directory

4. Press the **Load** soft key. The load setup menu and File List window appear.
5. Select the load source directory according to steps 4 to 9 in "Saving Snapshot Waveforms."

Selecting the File to Be Loaded

6. Turn the **jog shuttle** to select the file.

Executing the Load Operation

7. Press the **Load Exec** soft key. The selected file is read from the directory indicated in Path=...... At the same time, the **Load Exec** soft key changes to an **Abort** soft key.

Aborting the Load Operation

8. Press the **Abort** soft key. The load operation is aborted. At the same time, the **Abort** soft key changes to a **Load Exec** soft key.

Specifying the Files to Be Displayed in the File List Window and Displaying Properties

9. Carry out steps 19 to 21 in "Saving Snapshot Waveforms."

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Saving and Loading Data
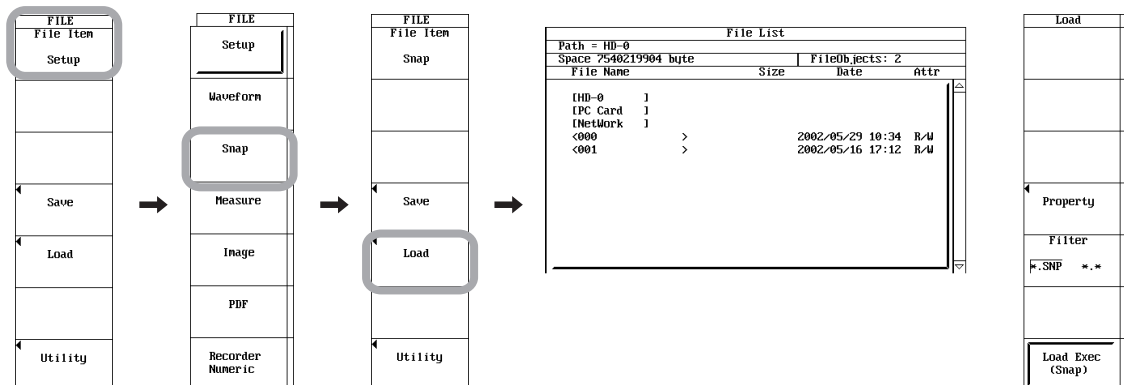
Explanation

You can take snap shots of the waveform and save the image to the file. You can also load the snapshot waveform.

Data Size

Approx. 60 KB

Data Extension

The extension is .SNP.

The selection of the medium and directory, file name, auto naming function, comments, specification of the files to be displayed in the File List window, and properties are the same as those for saving/loading normal waveform data.
For details, see section 13.7, "Saving/Loading the Waveform Data."

Clearing the Waveform

The loaded snapshot waveform is cleared when CLEAR TRACE or initialization is performed.

Note

- An error occurs, if a key other than the Abort key is pressed while saving or loading a file.
- This function cannot be used when using the FTP server function, network printer function, or the Web server function.

13.10 Saving the Results of the Automated Measurement of Waveform Parameters

<For a description of this function, refer to page 2-64.>

CAUTION

Never remove the storage medium (disk) or turn OFF the power while the access indicator or the floppy disk, Zip disk, internal hard disk (optional), or USB storage device icon is blinking. Such acts can damage the storage medium or destroy the data on the medium.

Procedure
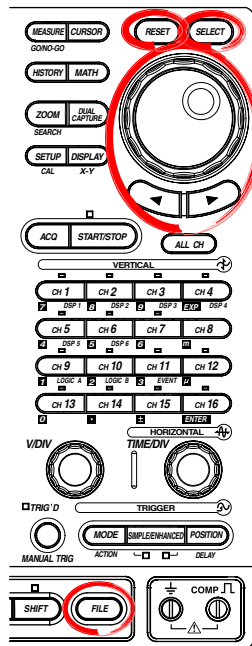
1. Press **FILE**.
2. Press the **File Item** soft key. The File Item setup menu appears.
3. Press the **Measure** soft key.

Selecting Save Destination Medium

4. Press the **Save** soft key. The save setup menu appears.
5. Press the **File List** soft key. The File List window appears.
6. Turn the **jog shuttle** to select the save destination medium (indicated by brackets).
7. Press **SELECT** to confirm the storage medium.

Selecting the Destination Directory

(Perform this operation when directories are present on the medium.)
8. Turn the **jog shuttle** to select the save destination directory (indicated by < >).
9. Press **SELECT** to confirm the directory. The selected medium/directory is displayed in "Path=......" located above and to the left of the File List window. Select <..> to move to the parent directory.

13

Saving and Loading Data

Setting the File Name and Comment

10. Press the **File Name** soft key. The file name setup menu appears.
11. Turn the **jog shuttle** to select Auto Naming.
12. Press **SELECT** to select OFF, Numbering, or Date.
13. Turn the **jog shuttle** to select File Name.
14. Enter the file name using up to 16 characters according to the procedure given in section 4.2.
15. Turn the **jog shuttle** to select Comment.
16. Enter the comment using up to 160 characters according to the procedure given in section 4.2.

Executing the Save Operation

17. Press the **Save Exec** soft key. The data is saved to the directory indicated by Path=...... At the same time, the **Save Exec** soft key changes to an **Abort** soft key.
   While the data is being saved, an icon corresponding the save destination medium ([ ] FD, [ ] Zip disk, [ ] PC card, [SCSI] external SCSI device, [ ] internal HD, or [ ] USB storage device) is displayed at the upper left corner of the screen.

Aborting the Save Operation

18. Press the **Abort** soft key. The save operation is aborted. At the same time, the **Abort** soft key changes to a **Save Exec** soft key.

Specifying the File to Be Displayed on the File List Window

19. On the screen showing the File List window, press the **Filter** soft key to select *.CSV or *.*.
20. Turn the **jog shuttle** to select the files in the File List window.

Displaying Properties

21. Press the **Property** soft key. Information about the selected file is displayed.
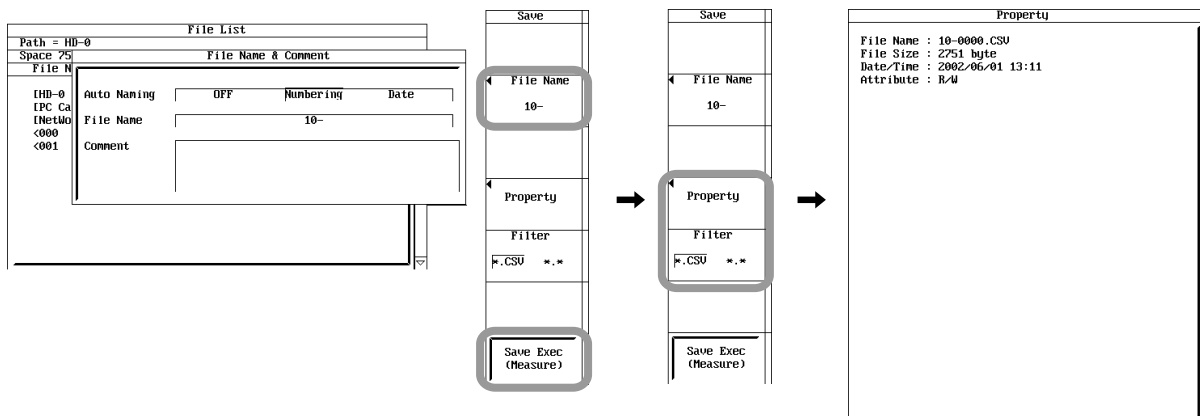
Explanation

The results of the automated measurement of waveform parameters can be saved in CSV format (.CSV extension) to a floppy disk, a Zip disk, a PC card, an external SCSI device, the internal hard disk (optional), or the USB storage device.

A CSV file is a comma-separated format file. The CSV file is one of the common file formats used to exchange data between spreadsheet and database applications.

The data that are saved are the measured results of the parameters that are specified in the automated measurement of waveform parameters.

Notes When Saving the Results of the Automated Measurement of Waveform Parameters

The restrictions are as follows.

* Up to (48000/the number of items that are turned ON) data points before the point at which the save operation is executed are saved. However, the data points that are saved are limited to those that are acquired after fixing T/div, record length, and Measure settings.

* **Output Example**

"CH1 P-P",	"CH1 Max",	"CH1 Min",	"CH2 P-P"	
"V",	"V",	"V",	"V",	
0.500E+00,	0.500E+00,	0.000E+00,	0.02E-06	Oldest data
0.375E+00,	0.375E+00,	0.000E+00,	0.02E-06	
0.313E+00,	0.188E+00,	-0.125E+00,	0.02E-06	
•	•	•	•	↓
•	•	•	•	
•	•	•	•	
•	•	•	•	Newest data

For a description of the automated measurement of waveform parameters, see section 8.2.

Data Size

The data size can be derived from the following equation.

Data size = the number of items $\times$ 15 $\times$ the number of history waveforms (bytes)

Data Extension

The extension is .CSV.

The selection of the medium and directory, file name, comments, auto naming function, specification of the files to be displayed in the File List window, and properties are the same as those for saving/loading normal waveform data.

For details, see section 13.7, "Saving/Loading the Waveform Data."

Note
* An error occurs, if a key other than the Abort key is pressed while saving a file.
* This function cannot be used when using the FTP server function, network printer function, or the Web server function.
* If you change the measurement conditions after performing automated measurement of waveform parameters, the measured results are cleared. At this point, the measured results after the change are displayed on the screen, but they cannot be saved to a file.
* If waveform parameters are measured while the sub waveform window of the dual capture function is showing, the waveform parameters shown in the sub waveform window are measured. Therefore, if you set the trigger mode to Log and change Capture Num (waveform number displayed in the sub waveform window) while making measurements using the dual capture function, the measurement results of waveform parameters become misaligned with the waveform numbers. If you wish to save the results of the automated measurement of waveform parameters after changing Capture Num, execute History statistics to align the measurement results of waveform parameters with the waveform numbers before saving the data.

13

Saving and Loading Data

13.11 Saving Screen Image Data

<For a description of this function, refer to page 2-63.>

Procedure
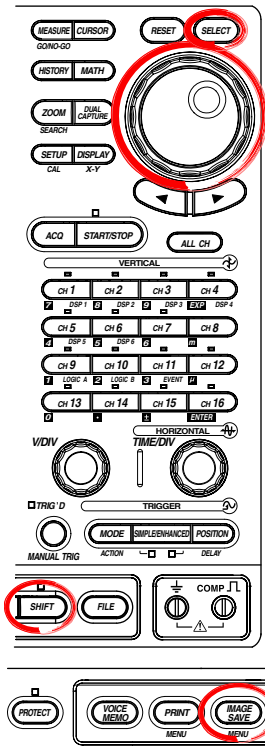
1. Press **SHIFT+IMAGE SAVE**.

Selecting the Output Format

2. Press the **Format** soft key.
3. Press the soft key corresponding to the desired output format from PNG, JPEG, BMP, and Post Script.

Setting the Color (When Format Is PNG, JPEG, or BMP)

4. Press the **Color** soft key to select ON, ON(Revers), ON(Gray), or OFF.

Setting the Compression Format (When Format Is BMP and Color Is Not OFF)

5. Press the **Compression** soft key to select ON or OFF.

Setting a Comment

5. Press the **Comment** soft key.
6. Enter the comment using up to 20 characters according to the procedure given in section 4.2.

Selecting Save Destination Medium

7. Press the **File List** soft key. The save destination File List window appears.
8. Turn the **jog shuttle** to select the save destination storage medium.

Note

Storage media such as the built-in floppy disk, Zip disk, PC card, internal HD (option), external SCSI device, and USB storage device are displayed in brackets.
- Floppy disk   [FD]   • Zip disk   [ZIP]
- PC card   [PC Card]   • Internal hard disk   [HD]
- External SCSI device [SCSI]   • USB storage device [USB]

Directories are displayed using < >.

9. Press **SELECT**. The contents of the selected storage medium or directory are displayed.
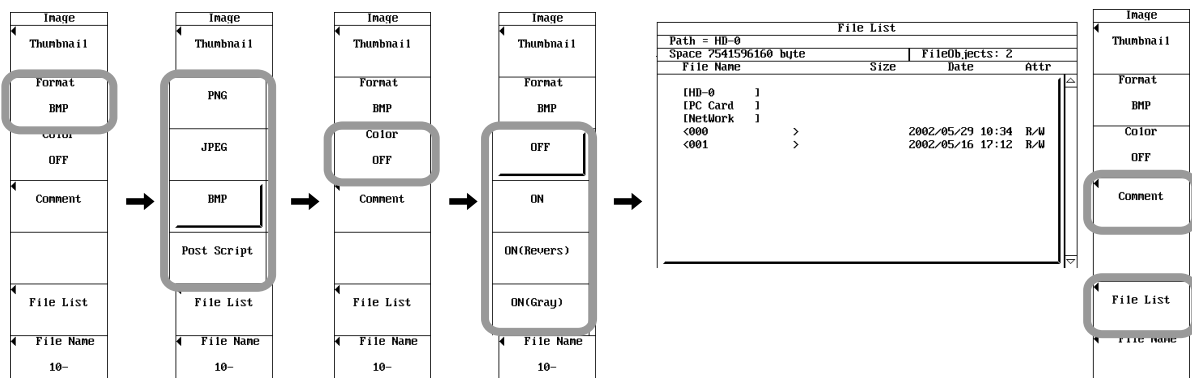
Selecting the Destination Directory

(Perform this operation when directories are present on the medium.)

10.   Turn the **jog shuttle** to select the save destination directory (indicated by < >).

11.   Press **SELECT** to confirm the new directory. The selected medium/directory is displayed in "Path=......" located above and to the left of the File List window. Select <..> to move to the parent directory.

Setting the Name of the File to Be Saved

12.   Press the **File Name** soft key. The file name setup menu appears.

13.   Turn the **jog shuttle** to select Auto Naming.

14.   Press **SELECT** to select OFF, Numbering, or Date.

15.   Turn the **jog shuttle** to select File Name.

16.   Enter the file name using up to 16 characters according to the procedure given in section 4.2.

Note
- If Auto Naming is set to Numbering, the first four characters are valid. If Auto Naming is set to Date, the file name is invalid.
- You can set up to 16 characters for the file name, but only 15 characters are displayed on the setup menu.
- When saving screen image data, voice comment data can be saved along with the screen image data. For details, see section 13.19, "Using the Voice Comment Function."

Executing the Save Operation

17.   Press **IMAGE SAVE**. The screen image data is saved to the storage medium. Pressing **IMAGE SAVE** again aborts the save operation.

While the data is being saved, an icon corresponding the save destination medium (FD, Zip disk, PC card, external SCSI device, internal HD, or USB storage device) is displayed at the upper left corner of the screen.

Note
Thumbnails of the saved screen image data can be displayed. For details, see section 13.12.

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Saving and Loading Data
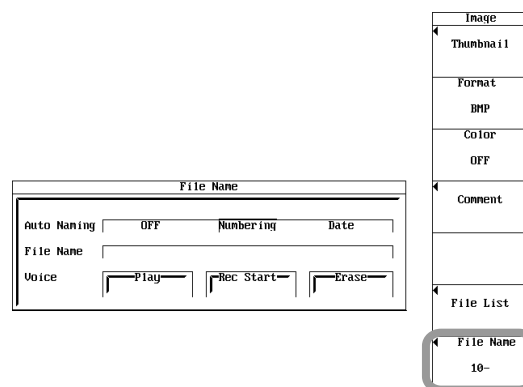
Explanation

The screen image data can be stored to a specified storage medium.
You can select the storage medium from the floppy disk, Zip disk, PC card, external SCSI device, internal hard disk (optional), and network drive (when the Ethernet interface option is installed). For details on saving data to the network drive, see section 16.3.

Setting the Output Format

Data in the following formats can be saved to a specified storage medium. The extension that is automatically attached and the file size (reference value) are indicated below.

Output Data Format	Extension	File Size[1]
PNG	*.PNG	Approx. 6 kbytes (Approx. 14 kbytes)[2]
JPEG	*.JPG	Approx. 400k bytes (Approx. 400 kbytes)[2]
BMP	*.BMP	Approx. 60 kbytes (Approx. 480 kbytes)[2]
Post Script	*.PS	Approx. 123 kbytes

1. When color is OFF
2. The file size inside the parentheses is for the case when color is ON

Setting the Color (When Format Is BMP)

Select ON, ON(Revers), ON(Gray), or OFF.

ON: Output using 256 colors.
ON(Revers): Do not output the background of the screen in color.
ON(GRAY):   Output the data using a tint of 16 gray levels.
OFF: Output in black and white.

Setting the Compression Format (When Format Is BMP and Color Is Not OFF)

When the output format is set to BMP, the data can be output by compressing using RLE. However, data compression is not possible if the color is OFF.

Setting a Comment

A comment of up to 20 characters can be added to the lower section of the screen and saved. Comments are optional. All characters (including spaces) can be used.

Setting the Save Destination: File List

The available storage medium is displayed in the File List window.

*   **Display Examples of Storage Media**
    [FD]:   Floppy disk
    [ZIP]:   Zip disk
    [PC Card]:   PC card
    [HD]:   Hard disk
    [SCSI5]:   SCSI device with the ID number set to 5[1]
    [SCSI5-1]:   Partition 1 of a SCSI device whose ID number is 5[1]
    [NetWork]:   Network drive (when the Ethernet interface option is installed)
    [USB]:   USB storage device
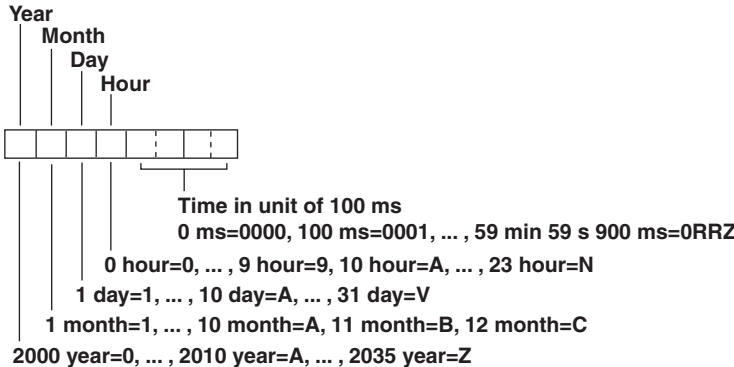   1. When a SCSI device whose ID number is 5 is connected

Floppy Disk, Zip Disk, PC Card, Internal Hard Disk, External SCSI Device, and USB Storage Device

Floppy disk, Zip disk, PC card, internal hard disk, and external SCSI device are described in sections 13.1 to 13.4. For the formatting procedure, see section 13.5.

Setting the File Name

You can specify the file name using up to 16 characters. (However, the setup menu displays only up to 15 characters.) The characters that can be used are 0-9, A-Z, %, _, (, and).

*   **Auto Naming**

    Select from the following three types.

    *   OFF: The name specified by File Name is attached.
    *   Numbering: Files are automatically named with four digit numbers from 0000 to 4999. You can specify a common name (up to four characters, specified by File Name) that is placed before the number.
    *   Date: Files are automatically named using 8 characters (base 36 consisting of 0 to 9 and A to Z) based on the date and time. (The file name specified by File Name is void.)

Year
Month
Day
Hour

Time in unit of 100 ms
0 ms=0000, 100 ms=0001, ... , 59 min 59 s 900 ms=0RRZ
0 hour=0, ... , 9 hour=9, 10 hour=A, ... , 23 hour=N
1 day=1, ... , 10 day=A, ... , 31 day=V
1 month=1, ... , 10 month=A, 11 month=B, 12 month=C
2000 year=0, ... , 2010 year=A, ... , 2035 year=Z

Note

Up to 16 characters can be entered for the common name. Characters exceeding 16 characters are void.

Notes When Saving Screen Image Data

*   The maximum number of files that can be saved when auto naming is enabled is 5000.
*   If the total number of files and directories exceed 5000 in a single directory, the file list is no longer displayed.

Extension of the Voice Comment Data File

The voice comment function (see section 13.19) can be used to attach a voice comment to screen image data to be saved. The voice comment data is saved as data separate from the screen image data. The extension of the voice comment data file varies depending on the output format of the screen image data to be saved as follows:

*   PNG file: .NCM
*   JPEG file: .JCM
*   BMP file: .BCM
*   PS file: .PCM

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Saving and Loading Data

13.12 Displaying Thumbnails of the Saved Screen Image Data

Procedure
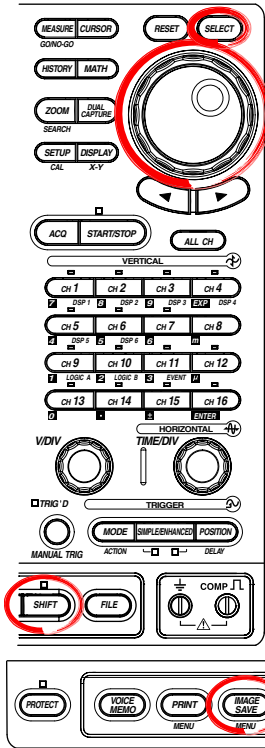
Thumbnail Display from the IMAGE SAVE Menu

1. Press **SHIFT+IMAGE SAVE**.
2. Press the **Format** soft key. The save format selection menu appears.
3. Press the soft key corresponding to the save format of the screen image data of which you wish to display the thumbnails from PNG to PostScript.

• **Displaying the Thumbnails of the Specified Screen Image Data**

4. Press the **File List** soft key. The File List window appears.
5. Turn the **jog shuttle** to select the screen image data file in the File List window.
6. Press **SELECT**. The thumbnail of the selected screen image data file is displayed at the lower right section of the File List window.
   When screen image data that has voice comment data is selected, the voice comment is played. For details on the voice comment function, see section 13.19.
   To clear the thumbnail, turn the **jog shuttle**.

Note

• If the selected screen image data file does not have data (file) for thumbnail display, an error message screen appears.
• You can press ESC to clear the thumbnail, but in this case, the File List window is also cleared. To clear only the thumbnail display, turn the jog shuttle.
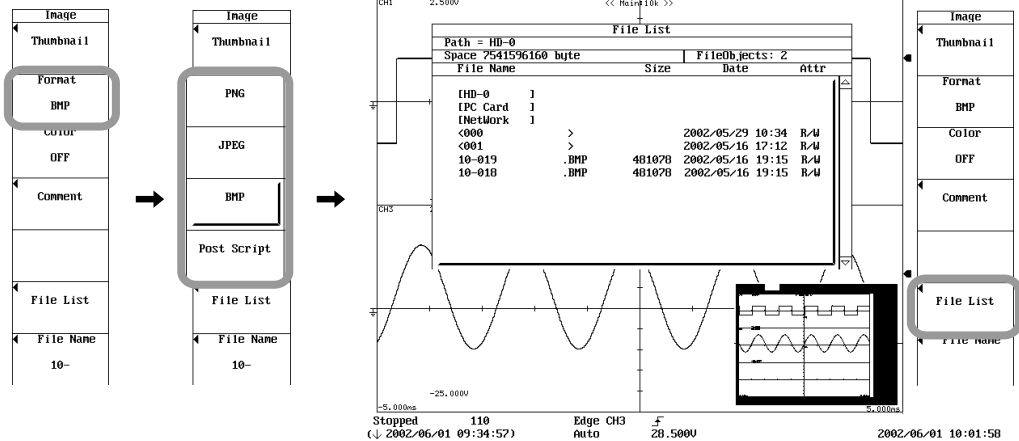
- **Listing the Thumbnails of the Specified Format**
  4.   Press the **File List** soft key. The File List window appears.
  5.   Turn the **jog shuttle** to select the directory that you wish to display the thumbnails.
  6.   Press the **Thumbnail** soft key. The thumbnails of the screen image data of the format specified in step 3 are displayed (9 thumbnails (3×3) in the waveform display area).
  7.   If there are more than 9 thumbnails, you can scroll the screen using the **jog shuttle**. To scroll the files upward, turn the **jog shuttle** counter-clockwise. To scroll the files downward, turn the **jog shuttle** clockwise. The files scroll three files at a time.
  8.   To clear the list of thumbnails, press **ESC**.

Note

If you set Path=FD (floppy disk drive) on the File List window, a list of thumbnails cannot be displayed.

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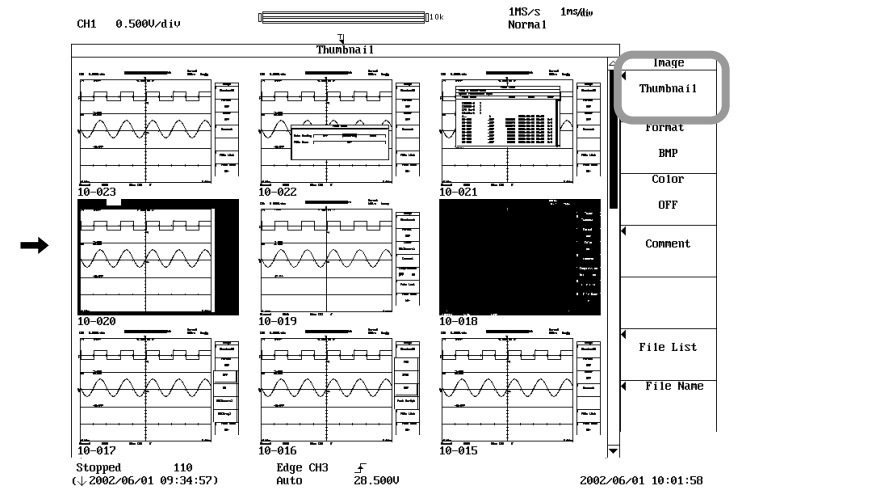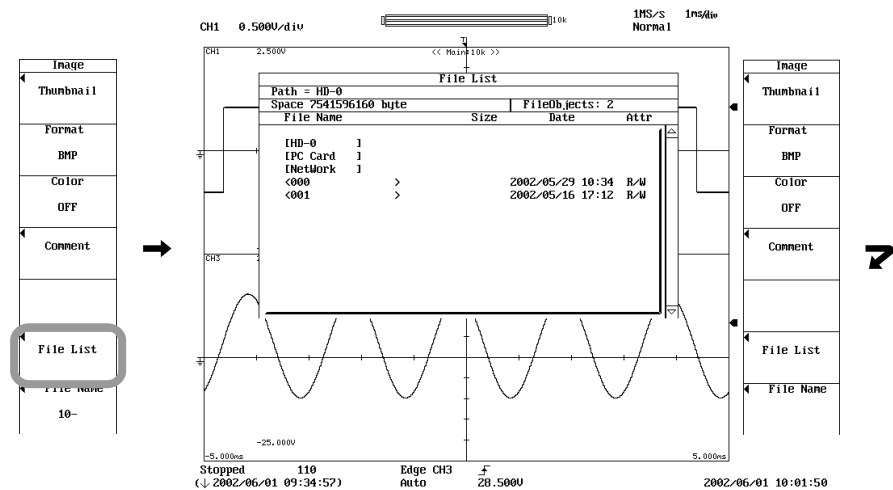
Saving and Loading Data
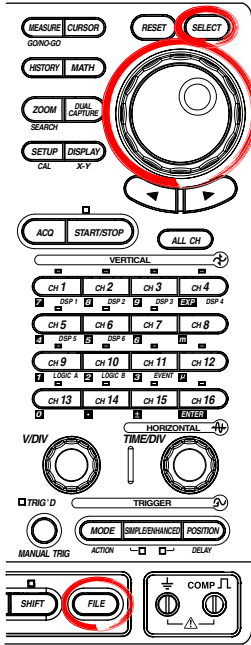
Thumbnail Display from the FILE Menu

1. Press **FILE**.
2. Press the **File Item** soft key.
3. Press the **Image** soft key.
4. Press the **Format** soft key.
5. Select the format you wish to display thumbnails from PNG to PostScript.
6. Press the **Utility** soft key. The File List window appears.
7. Turn the **jog shuttle** to select the screen image data file (file with .png, .jpg, .bmp, and .ps extensions) on the File List window.
8. Press **SELECT**. The thumbnail of the selected screen image data file is displayed at the lower right section of the File List window.
   When screen image data that has voice comment data is selected, the voice comment is played. For details on the voice comment function, see section 13.19.
   To clear the thumbnail, turn the **jog shuttle**.

Note

- If the selected screen image data file does not have data (file) for thumbnail display, an error message screen appears.
- You can press ESC to clear the thumbnail, but in this case, the File List window is also cleared. To clear only the thumbnail display, turn the jog shuttle.
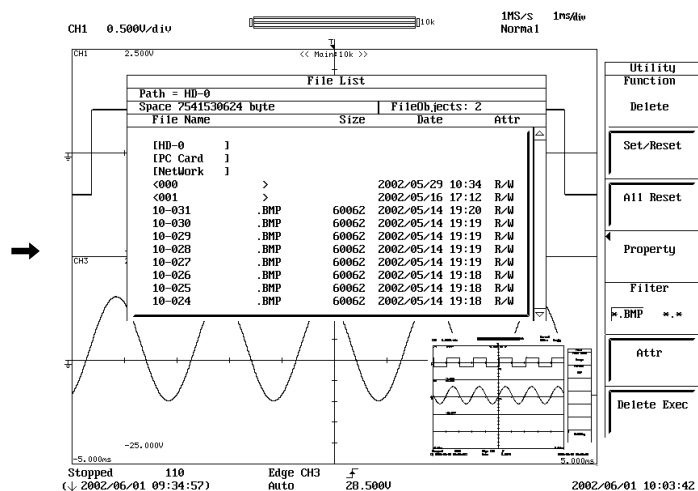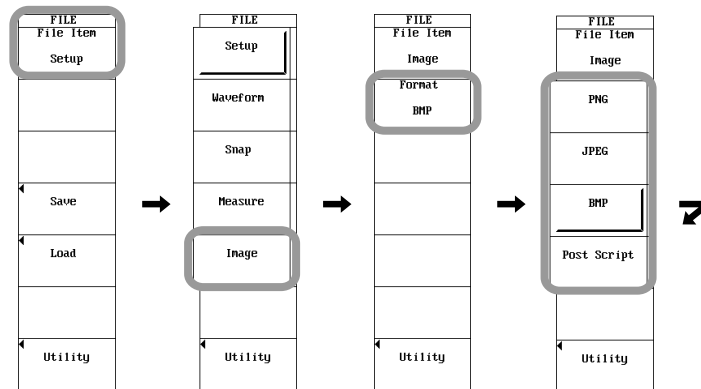
Explanation

Thumbnails of the screen image data that are saved on a storage medium can be displayed.

Thumbnail Display from the IMAGE SAVE Menu

- **Thumbnail Screen**

  Thumbnails are displayed for the screen image data files (files with .png, .jpg, .bmp, and .ps extensions) in the directory selected by File List of the IMAGE SAVE menu. The data used to display thumbnails are separate from the screen image data and are created simultaneously when the screen image data is created. The extension of thumbnail data varies depending on the output format of the original screen image data as follows:
  - PNG file: .NTD
  - JPEG file: .JTD
  - BMP file: .BTD
  - PS file: .PTD

  The data size is approximately 2 to 6 KB for all formats.

- **Thumbnail Items**

  The following two items are displayed.
  - Thumbnail of the waveform area
  - File name

- **Thumbnail Display Format**

  The number of files displayed on the thumbnail screen (the number of thumbnails displayed in the waveform area) is 9. The display order is the same as the order for displaying files in the File List window. In addition, the files are displayed from left to right and top to bottom.

- **Scrolling the Thumbnail Screen**

  If the number of thumbnails exceeds the maximum number of thumbnails that can be displayed (9), the thumbnail screen can be scrolled one row (three thumbnails) at a time. To scroll the files upward, turn the jog shuttle counter-clockwise. To scroll the files downward, turn the jog shuttle clockwise.

- **Thumbnails on the File List**

  When you select a screen image data file on the File List, the thumbnail of the screen image data is displayed at the lower right section of the File List. The file name is not displayed on the thumbnail screen on the File List.

Thumbnail Display from the FILE Menu

When you select a screen image data file on the File List, the thumbnail of the screen image data is displayed at the lower right section of the File List. The file name is not displayed on the thumbnail screen on the File List.

> *Note*
>
> The screen image data and thumbnail data are saved in file pairs. For example, if you set the output format to BMP, the following two types of files are saved.
> - 0000.BMP (screen image data)
> - 0000.BTD (thumbnail data)
>
> If you specify "*.*" for the files to be displayed (Filter) on the File List and manipulate individual files (Delete, Rename, or Copy), the thumbnail display function can no longer be used.

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Saving and Loading Data

13.13 Creating PDF Files of the Printed Image (DL750P only)

Procedure
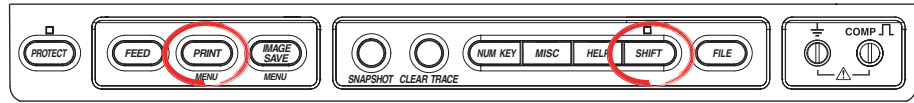
1.   Press **SHIFT+PRINT**.

Selecting the Print Destination

2.   Press the **Print to** soft key. The print destination selection menu appears. (Net Print appears only when the Ethernet interface option is installed.)
3.   Press the **PDF** soft key.
When displaying T-Y waveforms, proceed to step 4.
When displaying X-Y waveforms, proceed to step 8.

Selecting the Section to Be Output to the PDF File (Only When Displaying the T-Y Waveform)

4.   Press the **Time Range1/Time Range2** soft key.
5.   Use the **jog shuttle** and **SELECT** to set the output start point and output end point of the section to be output to the PDF file.

Setting the Print Magnification (Only When Displaying the T-Y Waveform)

6.   Press the **Print Mag** soft key.
7.   Use the **jog shuttle** to set the print magnification of the waveform when creating the PDF file. The top section of the menu shows the magnification; the bottom section shows the number of pages when the PDF file is created using the magnification indicated in the top section.
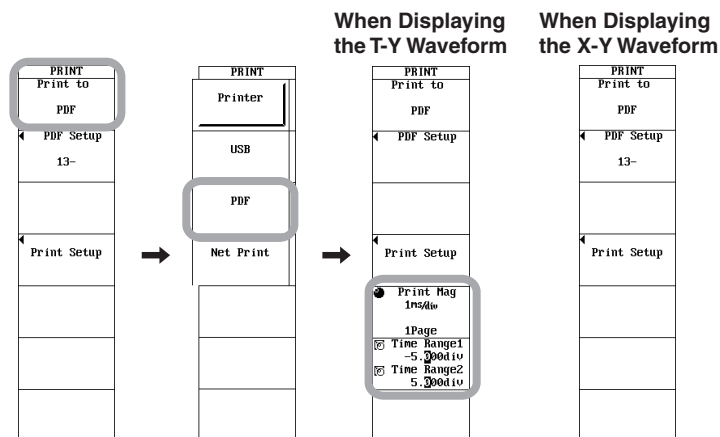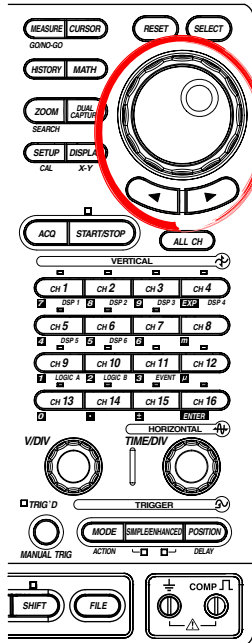
Specifying the Print Settings

8.   Press the **Print Setup** soft key. The print setup dialog box opens.
When displaying T-Y waveforms, proceed to step 9.
When displaying X-Y waveforms, proceed to steps 14 to 17 and then 23.

Setting the Print Format

9.   Use the **jog shuttle** and **SELECT** to select Format from Single (1 division) to Hexadecimal (16 divisions).

Note
The print format setting is linked with the DISPLAY menu > Format setting.

Setting the Extra Area (Only When Displaying the T-Y Waveform)

10.   Use the **jog shuttle** and **SELECT** to set **Extra Area** to ON or OFF.

Setting the Flexible Zone (Only When Displaying the T-Y Waveform)

11.   Use the **jog shuttle** and **SELECT** to select **Setup** in **Flexible Zone**.

12.   Use the **jog shuttle** and **SELECT** to set Mode to OFF or ON.

13.   Use the **jog shuttle** and **SELECT** to set Upper/Lower of the waveform to be recorded.

Setting the Graticule

• **Setting the Grid**

14.   Use the **jog shuttle** and **SELECT** to set Type to ▦, OFF, or ⊞.

• **Setting Dark/Light**

15.   Use the **jog shuttle** and **SELECT** to set Dark/Light to Light or Dark.

• **Setting the Width of the Vertical Scale**

16.   Use the **jog shuttle** and **SELECT** to set Width to 1div or 10mm.

Note
The grid setting is linked with the DISPLAY menu > Graticule setting. However, if OFF is selected, the DISPLAY menu is set to ⬚.

When Displaying the T-Y Waveform

When Displaying the X-Y Waveform

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Saving and Loading Data
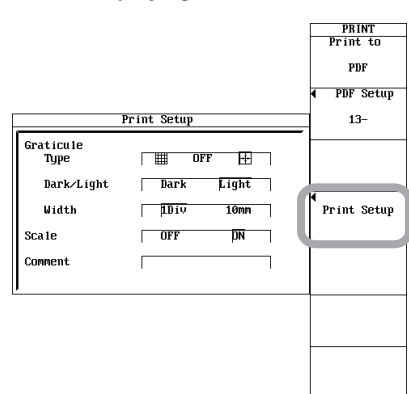
Setting Details
- **Setting the Scale Value (Only When Displaying the X-Y Waveform)**
17.   Use the **jog shuttle** and **SELECT** to set Scale to OFF or ON.

- **Setting Whether to Print the Time (Only When Displaying the T-Y Waveform)**
18.   Use the **jog shuttle** and **SELECT** to set Time to OFF, 200mm, 400mm, or 800mm.

- **Setting Whether to Print the Gauge (Only When Displaying the T-Y Waveform)**
19.   Use the **jog shuttle** and **SELECT** to set Gauge to OFF or ON.

- **Setting the Annotation (Only When Displaying the T-Y Waveform)**
20.   Use the **jog shuttle** and **SELECT** to set the print interval of annotations in the right column of Annotation to OFF, 200mm, 400mm, or 800mm.
21.   Use the **jog shuttle** and **SELECT** to set the type of annotation to be printed in the right column of Type to CH Information, CH Message, or CH Data.
      If CH Message is selected, proceed to step 22.
      If CH Information or CH Data is selected, proceed to step 23.
22.   Use the **jog shuttle** and **SELECT** to select Setup. Then, enter the message you wish to print for the channel using up to 80 characters according to the procedure in section 4.2.

- **Setting Comments**
23.   Use the **jog shuttle** and **SELECT** to select Comment. Then, enter the comment text you wish to print using up to 20 characters according to the procedure in section 4.2.

Note
- The comment setting is linked with the PRINT menu > Comment setting.
- When creating a PDF file of the print image while displaying T-Y waveforms, Scale and Ch Label settings are void.

When Displaying the T-Y Waveform   **When Displaying the X-Y Waveform**

Setting the PDF File

24.　Press the **PDF Setup** soft key to display the PDF setup dialog box.

Setting the Paper Size

25.　Use the **jog shuttle** and **SELECT** to set Paper Size to Built-in Printer, A3, A4, or A5.

Setting the Orientation (If A3, A4, or A5 was selected in step 25 (Only When Displaying the T-Y Waveform))

26.　Use the **jog shuttle** and **SELECT** to set Orientation to Landscape or Portrait.

Setting the Number of Divisions per Page (If A3, A4, or A5 was selected in step 25)

27.　Use the **jog shuttle** and **SELECT** to set Div/Page.

Setting Document Information

28.　Use the **jog shuttle** and **SELECT** to select Title, Author, Sub Title, or KeyWord. Enter the title, author, sub title of the PDF file using up to 30 characters and the keyword using up to 90 characters according to the procedure given in section 4.2.

Setting the Color

29.　Use the **jog shuttle** and **SELECT** to set Color to OFF or ON.

Enabling/Disabling Compression

30.　Use the **jog shuttle** and **SELECT** to set Compression to ON or OFF.

Setting Auto Naming

31.　Use the **jog shuttle** and **SELECT** to select Auto Naming from OFF, Numbering, and Date.

Setting the PDF File Name

32.　Use the **jog shuttle** and **SELECT** to select File Name. Then, enter the file name using up to 16 characters according to the procedure in section 4.2.

Selecting the Save Destination of the PDF File

33.　Use the **jog shuttle** and **SELECT** to select File List. Then, select the file save destination according to steps 14 to 17 in section 13.7.

When Displaying the T-Y Waveform

```
                 PDF Setup                      PRINT
                                             Print to
Paper Size  [        A3        ]                PDF
Orientation [Landscape   Portrait]
Div/Page    [       25div      ]             PDF Setup
<< Document Information >>
Title       [     TEST-0001    ]
Author      [      YOKOGAWA     ]
Sub Title   [                  ]           Print Setup
KeyWord     [                  ]
<< Optional Settings >>                    Print Mag
Color       [  OFF         ON  ]             1ms/div
Compression [  OFF         ON  ]              1Page
                                          Time Range1
                                            -5.000div
<< File Setup >>                          Time Range2
Auto Naming [ OFF  Numbering  Date ]         5.000div
File Name   [                  ]
            [      File List      ]
```

When Displaying the X-Y Waveform

```
                 PDF Setup                      PRINT
                                             Print to
Paper Size  [        A3        ]
Orientation [Landscape   Portrait]
                                             PDF Setup
<< Document Information >>                      13-
Title       [     TEST-0001    ]
Author      [      YOKOGAWA     ]
Sub Title   [                  ]           Print Setup
KeyWord     [                  ]
<< Optional Settings >>
Color       [  OFF         ON  ]
Compression [  OFF         ON  ]

<< File Setup >>
Auto Naming [ OFF  Numbering  Date ]
File Name   [                  ]
            [      File List      ]
```

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Saving and Loading Data

Executing the PDF File Generation

34. Press **PRINT**. A PDF file is created using the conditions set in steps 4 to 33. Pressing **PRINT** again aborts the save operation. While the data is being saved, an icon corresponding the save destination medium ([icon] FD, [icon] Zip disk, [icon] PC card, [icon] external SCSI device, [icon] internal HD, or [icon] USB storage device) is displayed in the upper left corner of the screen.

Explanation

Print to

When creating a PDF file of the print image (image similar to the printed output of fine print), set the print destination to PDF.

Selecting the Section to Be Output to the PDF File: Time Range1/Time Range2

Can be specified only when displaying T-Y waveforms. Set the output start point and output end point of the section to be output to the PDF file.

Print Magnification: Print Mag

Can be specified only when displaying T-Y waveforms. Set the waveform magnification for creating the PDF file. The top section of the menu shows the magnification; the bottom section shows the number of pages when the PDF file is created using the magnification indicated in the top section.

Print Setup

Format, Extra Area, Flexible Zone, and Graticule (Scale)
The items other than graticule can be specified only when displaying T-Y waveforms. The format, extra area, flexible zone, and graticule (scale) settings are the same as the settings when performing fine print or zoom print on the built-in printer. For details, see page 12-10.

Details
• **Time Print/Gauge Print**
  Can be specified only when displaying T-Y waveforms. The time print and gauge print settings are the same as the settings when performing fine print or zoom print on the built-in printer. For details, see page 12-11.
  The scale value and channel label are not printed when creating a PDF file.

• **Annotation**
  Can be specified only when displaying T-Y waveforms. The annotation setting is the same as the setting when performing fine print or zoom print on the built-in printer. For details, see page 12-11. When creating a PDF file, annotations are not printed if the print interval is set to OFF. However, if the print interval is set to value other than OFF, annotations are printed on each page of the PDF file.

• **Scale**
  Can be specified only when displaying X-Y waveforms. Select whether to print the scale.

• **Comment**
  The comment setting is the same as the setting when performing fine print or zoom print on the built-in printer. For details, see page 12-11.

Setting the PDF File

Paper Size
Select the paper size from built-in printer size, A3, A4, and A5. If the built-in printer size is selected, a PDF file is created of an image similar to the printed output on the built-in printer (A4 size).

Orientation
If the paper size is set to A3, A4, or A5, set the orientation of the PDF file to Landscape or Portrait.

Number of Divisions per Page: Div/Page
Can be specified only when displaying T-Y waveforms. If the paper size is set to A3, A4, or A5, set the number of divisions to be printed per page in the PDF file. The specified number of divisions is printed per page in the PDF file. The selectable range varies depending on the paper size, orientation, and gauge (see the previous page) as follows:

Paper Size	Orientation	Selectable Range of Div/Page	
		Gauge: OFF	Gauge: ON
Built-In Printer	-	20 (fixed)	20 (fixed)
A3	Portrait	1 to 25	1 to 20
A3	Landscape	1 to 40	1 to 35
A4	Portrait	1 to 20	1 to 15
A4	Landscape	1 to 25	1 to 20
A5	Portrait	1 to 10	1 to 10
A5	Landscape	1 to 20	1 to 15

Document Information: Title, Author, Sub Title, and KeyWord
As necessary, enter the title, author, sub title, and keyword of the PDF file to be created.

Color
The PDF file is created in color if ON is selected and monochrome if OFF is selected.

Compression
Select whether to compress the file. If ON is selected, the file is compressed. However, the generation of the PDF file takes longer than when OFF is selected.

File Setup
Set the auto naming, file name, and file output destination of the PDF file. These settings are the same as those of normal files. For details, see section 13.7.

Executing the PDF File Generation

The PDF file is created using the specified conditions. The extension to the PDF file is .pdf.

Note
- A PDF file of a print image can be created even when all waveform display (Display Mode: All) is selected in the history memory function.
- A PDF file whose size exceeds 2GB cannot be created. Adjust the number of channels, pages, and history memory pages (see section 11.1), so that only the required sections are saved to the PDF file.

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Saving and Loading Data

PDF File Example

When Displaying the T-Y Waveform (Paper Size: A4)

Gauge Date/Time T/div   File name

Scale value of the
vertical scale

V/div(Value/div)

Scale value of the
vertical scale

Annotation
(CH information)

Page

Scale value of the time axis   Scale value of the time axis
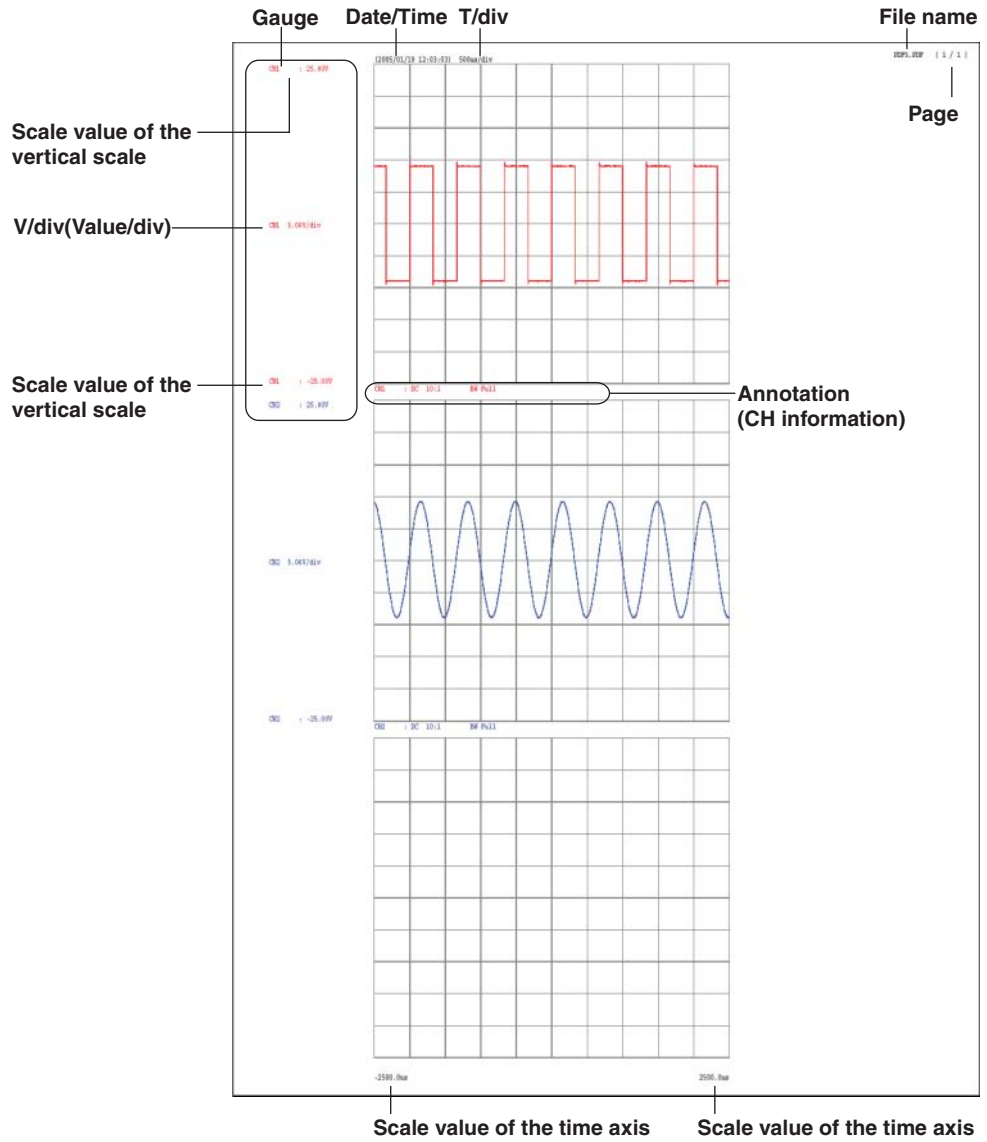
When Displaying the X-Y Waveform (Paper Size: A5)

Date/Time Sample rate   File name

Scale value
of the Y axis

Scale value of the X axis   Scale value of the X axis
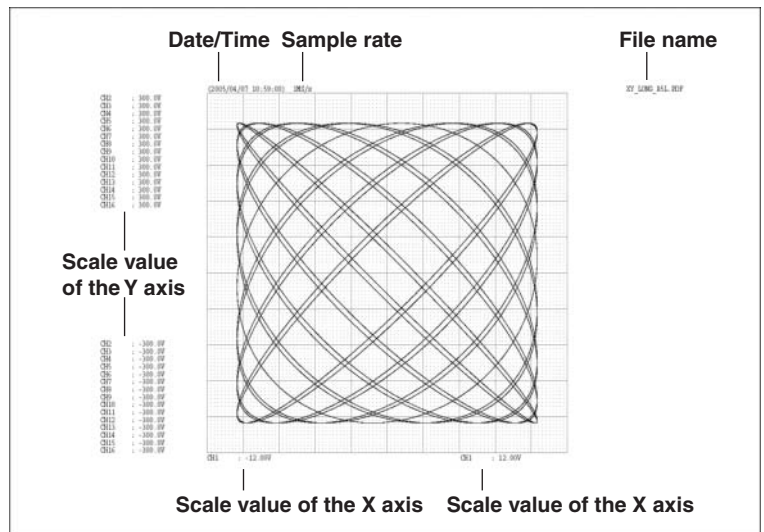
13.14 Loading/Converting Realtime Recorded Waveforms

<For a description of this function, refer to page 2-35.>

Procedure

Loading the Realtime Recorded Waveform Data
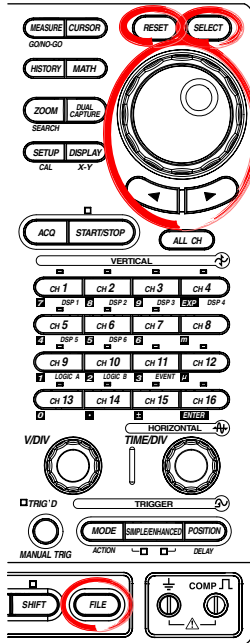
1. Press **FILE**.
2. Press the **File Item** soft key. The File Item setup menu appears.
3. Press the **Waveform** soft key.

Selecting the Data Type

4. Press the **Data Type** soft key. The data type selection menu appears.
5. Press the **Real Time** soft key.

Selecting the Load Source Medium/Directory

6. Press the **Load** soft key. The load setup menu and File List window appear.
7. Select the load source directory according to steps 13 to 18 in "Saving the Waveform Data" in section 13.7.

Note

The files that have been realtime recorded are saved in the [RealTime] drive. WDF data that is copied from the [RealTime] drive to another drive can also be loaded.

Selecting the File to Be Loaded
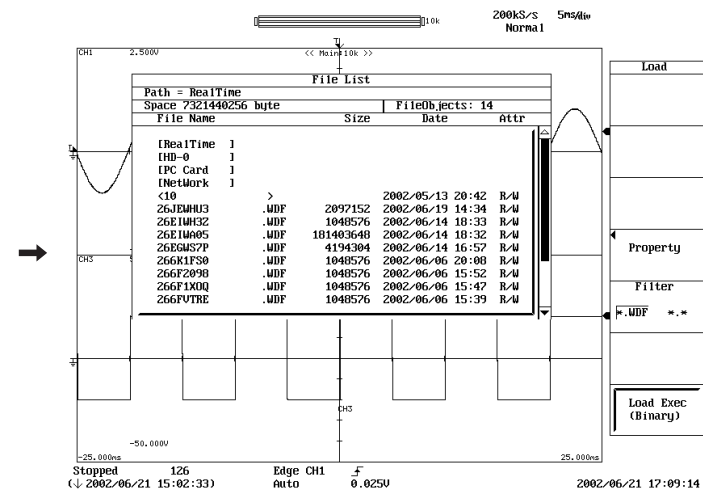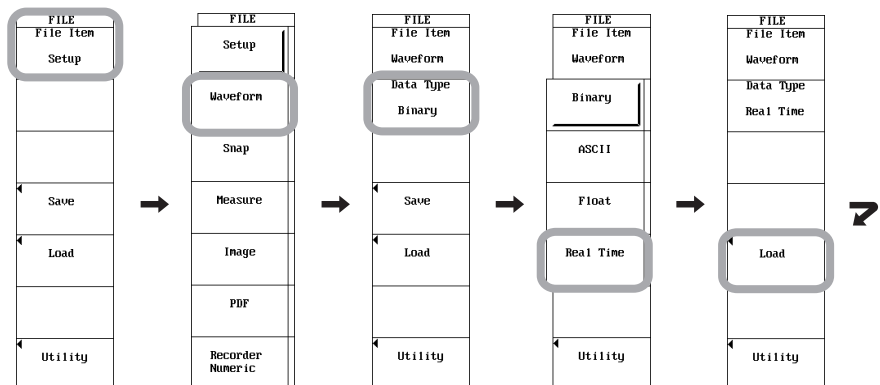
8. Turn the **jog shuttle** to select the file.

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Saving and Loading Data

Executing the Load Operation

9. Press the **Load Exec** soft key. A dialog box appears showing the module information of the selected realtime recorded waveform data and the current module information of the DL750/DL750P.

10. Press the **Load Exec** soft key again. The selected file is read from the directory indicated in Path=...... At the same time, the **Load Exec** soft key changes to an **Abort** soft key.

Note

If the module information of the realtime recorded waveform data and the current module information of the DL750/DL750P differ, the realtime recorded waveform data cannot be loaded.

Aborting the Load Operation

11. Press the **Abort** soft key. The load operation is aborted. At the same time, the **Abort** soft key changes to a **Load Exec** soft key.

Specifying the Files to Be Displayed in the File List Window and Displaying Properties

12. Carry out steps 27 to 29 in "Saving the Waveform Data" in section 13.7.

Note

Files with .WDF extension in the RealTime area and User area of the internal hard disk (optional) can be loaded.
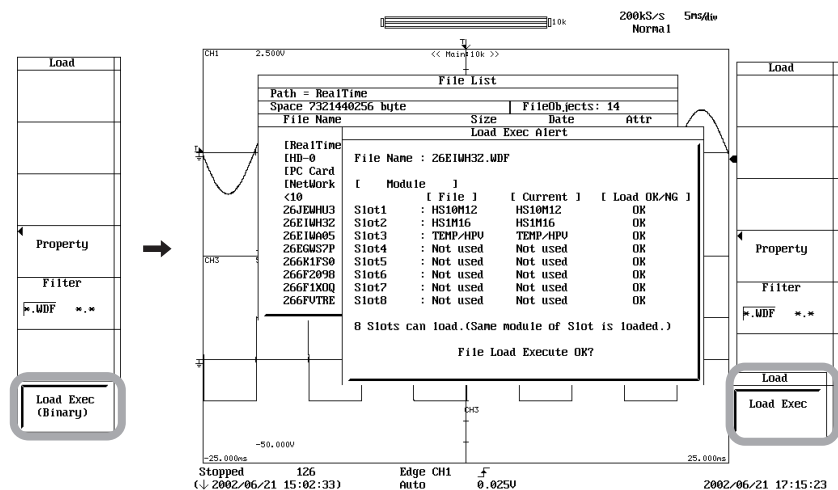
Converting the Realtime Recorded Waveform Data to Binary, ASCII, or Float Format and Saving

1. Load the realtime recorded waveform data according to the procedure described in "Loading the Realtime Recorded Waveform Data."

2. Convert the realtime recorded waveform data to Binary, ASCII, or Float format and save the data according to the procedure described in "Saving the Waveform Data" in section 13.7.

Note

Files containing realtime recorded waveform data that has been converted into Binary cannot be loaded into the DL750/DL750P.

Explanation

Selecting the Data Type

Real Time
- Data saved using realtime recording.
- The data that is realtime recorded can be loaded to display the waveform and compute numeric data.
- The extension is .WDF.

Data Size

The maximum data size is as follows: The unit of the record length is word.

(Record length $\times$ 2 $\times$ (the number of channels + 1) $\times$ (1.05 to 1.15)) bytes

[RealTime] Drive

- The WDF data that is created by the realtime recording is saved to the [RealTime] drive.
- The [RealTime] drive appears only when Data Type is set to Real Time. If you wish to manage the files on the [RealTime] drive, set Data Type to Real Time.
- You can set the size of the RealTime drive in the range of 30% to 70% of the entire capacity of the internal hard disk. This setting is entered when the internal hard disk is formatted. For details, see section 13.5.

13

Saving and Loading Data

13.15 Changing the File Attributes and Deleting Files

CAUTION

Never remove the storage medium (disk) or turn OFF the power while the access indicator or the floppy disk, Zip disk, or internal hard disk (optional) icon is blinking. Such acts can damage the storage medium or destroy the data on the medium.

Procedure
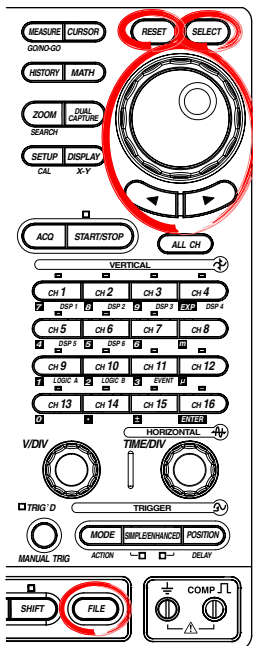
1. Press **FILE**.
2. Press the **Utility** soft key. The Utility setup menu and the File List window appear.

Selecting Media and Directories

3. Select the medium and directory according to steps 4 to 9 in section 13.8, "Saving/Loading the Setup Data."

Changing the File Attributes

4. Press the **Function** soft key. The file function selection menu is displayed.
5. Press the **Delete** soft key.
6. Turn the **jog shuttle** to select the file.
7. Press the **Attr** soft key. The attribute of the selected file changes.
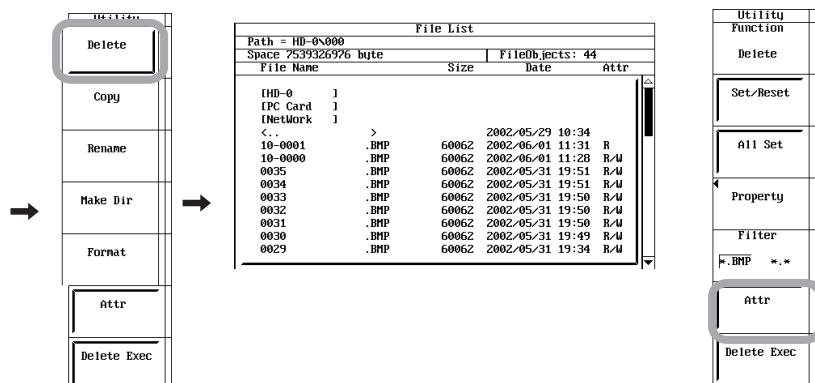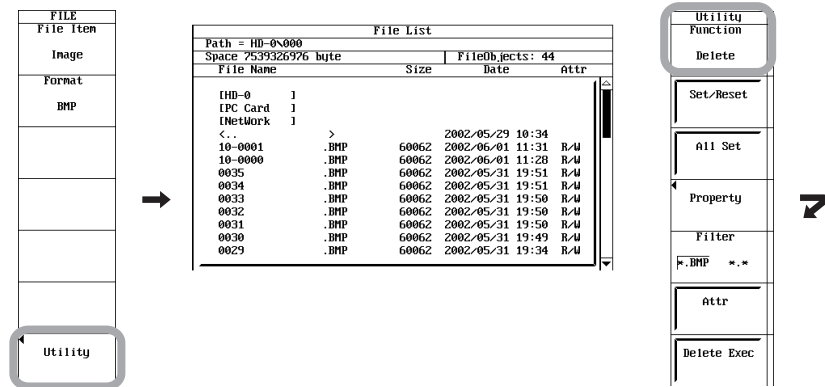
Selecting the File to Be Deleted One at a Time

8. Turn the **jog shuttle** to select the file.
9. Press the **Set/Reset** soft key. An asterisk (*) is displayed to the left of the selected file to indicate that it will be deleted. Pressing the **Set/Reset** soft key again removes the asterisk (*) to the left of the selected file. The file will not be deleted.
    Proceed to step 13.

Selecting the Files to Be Deleted at Once

10. Turn the **jog shuttle** to select the file, directory, or medium.
11. Press the **All set** soft key. Asterisks (*) are displayed to the left of every file in the directory containing the selected file or directory to indicate that they will be deleted. At the same time, the **All Set** soft key changes to an **All Reset** soft key.
12. Press the **All Reset** soft key. Asterisks (*) are removed from the left of every file in the directory containing the selected file or directory to indicate that they will not be deleted. At the same time, the **All Reset** soft key changes to an **All Set** soft key.

Executing the Delete Operation

13. Press the **Delete Exec** soft key. All files with asterisk marks are deleted.

Specifying the Files to Be Displayed in the File List Window and Displaying Properties

14. Carry out steps 19 to 21 in section 13.8, "Saving/Loading the Setup Data."
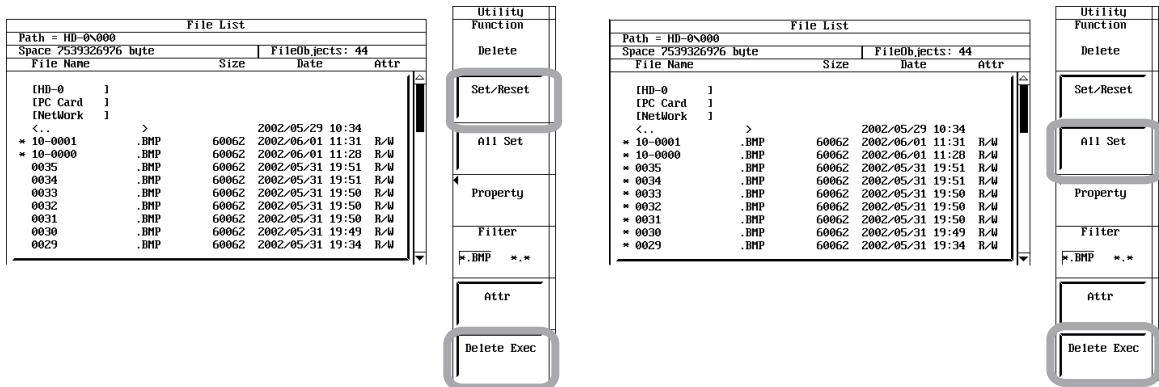
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Saving and Loading Data

Explanation

Selecting the Storage Medium and Directory: File List

Media on which saving and loading are possible are displayed on the File List window.

- **Display Example of Storage Media**

  [FD]:   Floppy disk
  [ZIP]:   Zip disk
  [PC Card]:   PC card
  [HD]:   Hard disk
  [SCSI5]:   SCSI device with the ID number set to 5[1]
  [SCSI5-1]:   Partition 1 of a SCSI device whose ID number is 5[1]
  [NetWork]: Network drive (when the Ethernet interface option is installed)
  [USB]:   USB storage device
  1. When a SCSI device whose ID number is 5 is connected

Selecting the File Attribute: Attr (excluding Net Drive)

Select the file attribute of each file from the following list of choices.

- **R/W**
  Read and write possible.
- **R**
  Read only. Cannot write to the file or delete the file.

Selecting the Files to Be Deleted

You can delete all files that have an asterisk to the left of the file name. There are two methods in selecting the files to be deleted.

- **Selecting the Files One at a Time: Set/Reset**
  Place an asterisk to the left of the file names one at a time, using the Set/Reset soft key.
- **Selecting All the Files at Once: All Set**
  Places an asterisk to the left of all the file names selected collectively using the All Set soft key.
  Selecting a file or directory and pressing the All Set soft key places an asterisk on every file in the directory containing the selected file or directory.

Specifying the File to Be Displayed on the File List Window: Filter

Specify the type of files to be displayed.

- ***.Extension**
  Displays only the data file that was selected in the File Item setup menu and the data type menu.
- ***.***
  Displays all the files in the medium.

Property

Displays the following information about the selected file: filename.extension, the file size, the date the file was saved, the attribute, etc.

Note

- Files cannot be deleted while the data acquisition is in progress.
- Data that is deleted cannot be recovered. Make sure you erase the correct files.
- You can not delete directories if there are files in them.
- If an error occurs while deleting multiple files, the files after the error occurrence are not deleted.
- You cannot change a directory attribute.
- This function cannot be used when using the FTP server function, network printer function, or the Web server function.
- The screen image data and thumbnail data are saved in pairs of files. If you specify "*.*" for the files to be displayed (Filter) on the File List and manipulate individual files (Delete, Rename, or Copy), the thumbnail display function can no longer be used.
- If the realtime recorded waveform is being displayed, the file cannot be deleted.
- If you wish to delete the files on the [RealTime] drive, set Data Type to Real Time.

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Saving and Loading Data

13.16 Copying Files

CAUTION

Never remove the storage medium (disk) or turn OFF the power while the access indicator or the floppy disk, Zip disk, internal hard disk (optional), or USB storage device icon is blinking. Such acts can damage the storage medium or destroy the data on the medium.

Procedure
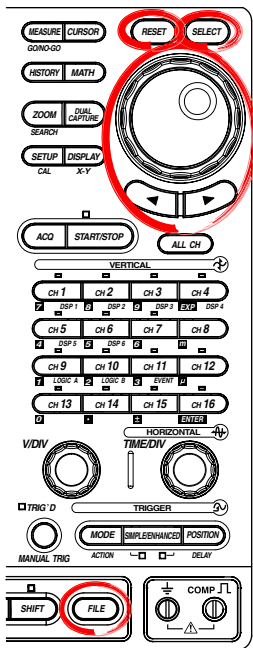
1. Press **FILE**.
2. Press the **Utility** soft key. The Utility setup menu and the File List window appear.
3. Press the **Function** soft key. The file function selection menu is displayed.
4. Press the **Copy** soft key.

Selecting Media and Directories

5. Select the medium and directory according to steps 4 to 9 in section 13.8, "Saving/Loading the Setup Data."

Selecting the Copy Source Files One at a Time

6. Turn the **jog shuttle** to select the file.
7. Press the **Set/Reset** soft key. An asterisk (*) to the left of the selected file to indicate that it will be copied. Pressing the **Set/Reset** soft key again removes the asterisk (*) to the left of the selected file. The file will not be copied. Proceed to step 11.

FILE	Utility	Utility		Utility
File Item	Function	Delete		Function
Image	Delete			Copy
Format	Set/Reset	Copy		Set/Reset
BMP	All Set	Rename		All Set
	Property	Make Dir		Property
	Filter *.BMP *.*	Format		Filter *.BMP *.*
	Attr	Attr		Attr
Utility	Delete Exec	Delete Exec		Dest Dir

```
                        File List
Path = HD-0
Space 2540899840 byte              FileObjects: 4
File Name              Size     Date          Attr
[HD-0      ]
[PC Card   ]
[NetWork   ]
<000        >                    2002/05/29 10:34  R/W
<001        >                    2002/05/16 17:12  R/W
* 10-0001   .BMP       60062     2002/06/01 13:38  R/W
  10-0000   .BMP       60062     2002/06/01 13:37  R/W
```

Selecting the Copy Source Files at Once

8. Turn the **jog shuttle** to select the file, directory, or medium.

9. Press the **All set** soft key. Asterisks (*) are displayed to the left of every file in the directory containing the selected file or directory to indicate that they will be copied. At the same time, the **All Set** soft key changes to an **All Reset** soft key.

Resetting the Selected Copy Source Files at Once

10. Press the **All Reset** soft key. Asterisks (*) are removed from the left of every file in the directory containing the selected file or directory to indicate that they will not be copied. At the same time, the **All Reset** soft key changes to an **All Set** soft key.

Selecting the Copy Destination

11. Press the **Dest Dir** soft key. The copy execution menu and the copy destination File List window appears.

Selecting Copy Destination Medium and Directory

12. Select the copy destination medium and directory according to steps 4 to 9 in section 13.8, "Saving/Loading the Setup Data."

Executing the Copy Operation

13. Press the **Copy Exec** soft key. All the copy source files with asterisk marks are copied.

Specifying the File to Be Displayed in the File List Window and Viewing File Properties

14. Carry out steps 19 to 21 in section 13.8, "Saving/Loading the Setup Data."

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Saving and Loading Data
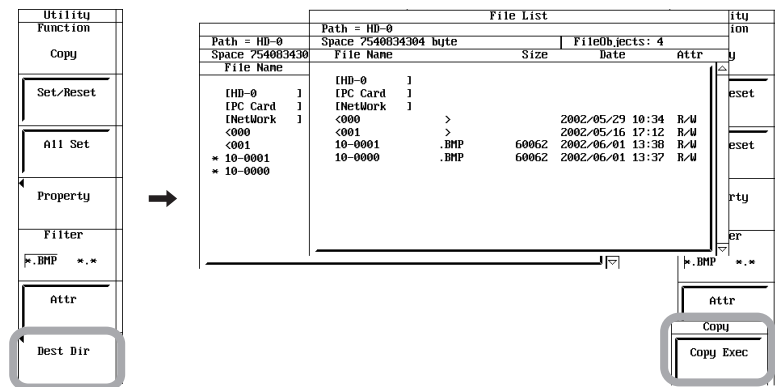
Explanation

Selecting the Copy Source Files

You can copy all files that have an asterisk to the left of the file name. There are two methods in selecting the files to be copied.

- **Selecting the Files One at a Time: Set/Reset**
  Place an asterisk to the left of the file names one at a time, using the Set/Reset soft key.
- **Selecting All the Files at Once: All Set**
  Places an asterisk to the left of all the file names selected collectively using the All Set soft key.
  If you select a file and press the All Set soft key, asterisk marks are placed on all the files in the directory containing the selected file.

Specifying the File to Be Displayed on the File List Window: Filter

Specify the type of files to be displayed.

- ***.Extension**
  Displays only the data file that was selected in the File Item setup menu and the data type menu.
- ***.***
  Displays all the files in the medium.

Property

Displays the following information about the selected file: filename.extension, the file size, the date the file was saved, the attribute, the comment, etc.

Note

- Files cannot be copied while the data acquisition is in progress.
- If an error occurs while copying multiple files, the files after the error occurrence are not copied.
- You cannot change a directory attribute.
- You cannot copy files if files with the same file name exist at the copy destination, .
- You cannot copy the same files to another directory after copying the files. Select the files to be copied again and copy them.
- The date/time information of the copied file retains the date/time information of the copy source file. However, if the copy destination is a network drive, the date/time is set to the date/time when the file is copied.
- This function cannot be used when using the FTP server function, network printer function, or the Web server function.
- The screen image data and thumbnail data are saved in pairs of files. If you specify "*.*" for the files to be displayed (Filter) on the File List and manipulate individual files (Delete, Rename, or Copy), the thumbnail display function can no longer be used.
- Copying to the [RealTime] drive is not possible. (Copying from the [RealTime] drive to other drives is possible.)

13.17 Changing the Directory/File Name of the Storage Medium and Creating Directories

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CAUTION

Never remove the storage medium (disk) or turn OFF the power while the access indicator or the floppy disk, Zip disk, internal hard disk (optional), USB storage device icon is blinking. Such acts can damage the storage medium or destroy the data on the medium.

Procedure

Changing the Directory/File Name of the Storage Medium
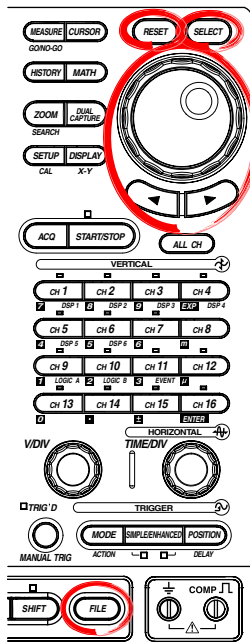
1. Press **FILE**.
2. Press the **Utility** soft key. The Utility setup menu and the File List window appear.
3. Press the **Function** soft key. The file function selection menu is displayed.
4. Press the **Rename** soft key.

Selecting Media and Directories

5. Select the medium and directory according to steps 4 to 9 in section 13.8, "Saving/Loading the Setup Data."

Changing the File Attributes

6. Change the file attribute according to steps 6 and 7 in section 13.15, "Changing the File Attributes and Deleting Files."

Changing the Directory/File Name of the Storage Medium (Excluding Net Drive)

7. Turn the **jog shuttle** to select a directory name or file name.
8. Press the **File Name** soft key. A keyboard appears. The name of directory/file is displayed in the entry box of the keyboard.
9. Enter the directory name or file name according to the procedure given in section 4.2.

Specifying the Files to Be Displayed in the File List Window and Displaying Properties

10. Carry out steps 19 to 21 in section 13.8, "Saving/Loading the Setup Data."
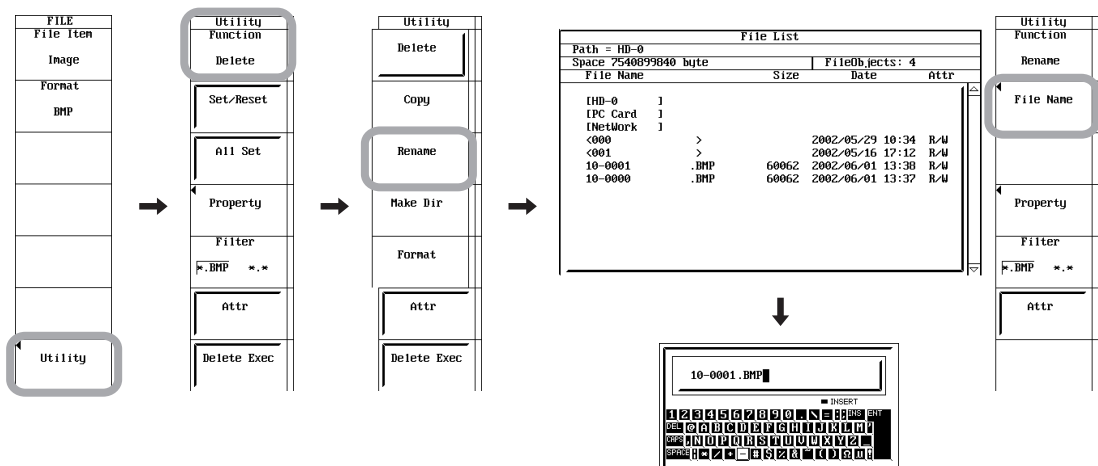
Creating a Directory
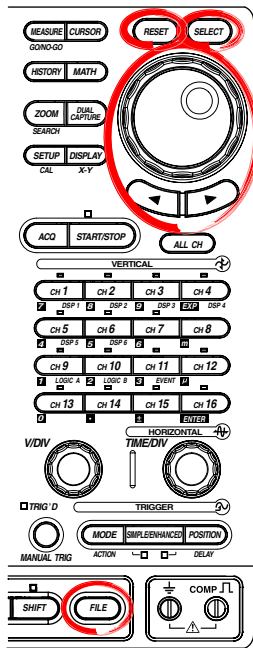
1. Press **FILE**.
2. Press the **Utility** soft key. The Utility setup menu and the File List window appear.
3. Press the **Function** soft key. The file function selection menu is displayed.
4. Press the **Make Dir** soft key.

Selecting Media and Directories

5. Select the medium and directory according to steps 4 to 9 in section 13.8, "Saving/Loading the Setup Data."

Creating Directories

6. Turn the **jog shuttle** to select a medium or directory.
7. Press the **Dir Name** soft key. A keyboard appears.
8. Enter the directory name or file name according to the procedure given in section 4.2.

Specifying the Files to Be Displayed in the File List Window and Displaying Properties

9. Carry out steps 19 to 21 in section 13.8, "Saving/Loading the Setup Data."
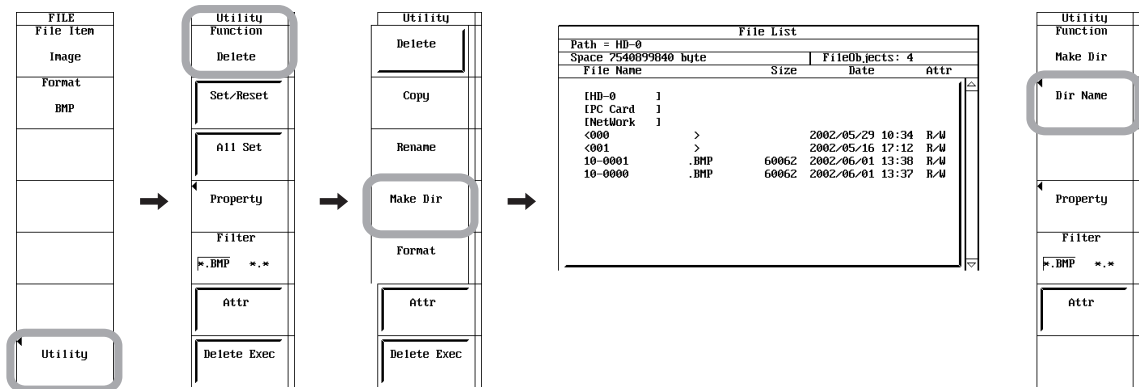
Explanation

Selecting the Storage Medium and Directory: File List

Media on which saving and loading are possible are displayed on the File List window.

- **Display Examples of Storage Media**

  [FD]:   Floppy disk
  [ZIP]:   Zip disk
  [PC Card]:   PC card
  [HD]:   Hard disk
  [SCSI5]:   SCSI device with the ID number set to 5[1]
  [SCSI5-1]:   Partition 1 of a CSI device whose ID number is 5[1]
  [NetWork]:   Network drive when the Ethernet interface option is installed)
  [USB]:   USB storage device

  1. When a SCSI device whose ID number is 5 is connected

Selecting the File Attribute: Attr (Excluding Net Drive)

Select the file attribute of each file from the following list of choices.

- **R/W**

  Read and write possible.

- **R**

  Read only. Cannot write to the file or delete the file.

Changing the Directory/File Name of the Storage Medium: Rename

Number of characters and types that can be used

Item	Number of Characters	Characters That Can Be Used
Directory name	1 to 16 characters	0 to 9, A to Z, %, _, (,), -
File name	1 to 16 characters	0 to 9, A to Z, %, _, (,), -

*   However, a directory name that starts with "ND" (ND000 for example) is not allowed.

Creating a Directory: Make Dir

You can create a new directory in the medium. See above for the assignment of the directory name when creating a new directory.

Specifying the File to Be Displayed on the File List Window: Filter

Specify the type of files to be displayed.

- ***.Extension**

  Displays only the data file that was selected in the File Item setup menu and the data type menu.

- ***.***

  Displays all the files in the medium.

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Saving and Loading Data

Property

Displays the following information about the selected file: filename.extension, the file size, the date the file was saved, the attribute, the comment, etc.

Note

- You cannot rename a directory/file or create a new directory while the data acquisition is in progress (START/STOP indicator is ON).
- You cannot change a directory attribute.
- If a file with the same name already exists in the same directory, the file cannot be renamed.
- If a directory with the same name already exists in the same directory, the directory cannot be created.
- This function cannot be used when using the FTP server function, network printer function, or the Web server function.
- The screen image data and thumbnail data are saved in pairs of files. If you specify "*.*" for the files to be displayed (Filter) on the File List and manipulate individual files (Delete, Rename, or Copy), the thumbnail display function can no longer be used.
- Directories cannot be created on the [RealTime] drive.

13.18 Connecting a PC to the DL750/DL750P via SCSI

<For a description of this function, refer to page 2-65.>

You can connect a PC to the SCSI of the DL750/DL750P and access the internal hard disk (optional) from the PC.

Supported PC OSs

Windows 98/98 SE and Windows Me
(Connection is possible on Windows 2000, Windows XP, and Windows NT, but the updating of the files on the DL750/DL750P cannot be detected due to the limitation by the OS.)

Items Necessary for Connection

Cable (SCSI cable: half pitch 50 pins, pin type)
Use a commercially sold cable that is 3 m or less in length that has a characteristic impedance between 90 and 132 Ω.

Connection Procedure

Changing the ID Number of the DL750/DL750P

Before connecting the DL750/DL750P to a PC, you may need to change the SCSI ID of the DL750/DL750P so that it does not conflict with the PC's ID. For the procedure in changing the ID, see section 13.6.

Changing the ID Number of the Internal Hard Disk Drive

Set the ID number of the internal hard disk drive so that it does not overlap with the IDs of other SCSI devices. For the procedure in changing the ID, see section 13.6.

⚠ CAUTION

- Make sure to follow the procedures exactly as written in "Connecting the instrument to the PC" described below. Otherwise, drives of other SCSI devices connected to the PC may get damaged.
- Never change the contents on the DL750/DL750P disk from the PC (read only). Writing to the disk may destroy files.
- Never perform the following operations. The internal hard disk of the DL750/DL750P will become inaccessible.
  - Delete files on the internal hard disk of the DL750/DL750P from the PC.
  - Add files to the internal hard disk of the DL750/DL750P from the PC.
- While connected to the PC, the File List window of the DL750/DL750P may not be displayed properly.
- If the connected PC enters sleep, standby, or rest mode, the DL750/DL750P will not be able to access the internal hard disk. Before connecting the PC to the DL750/DL750P, disable such modes on the PC.

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Saving and Loading Data

Connecting the DL750/DL750P and the PC

1. Turn OFF the DL750/DL750P and the PC.
2. Connect the DL750/DL750P and the PC with the SCSI cable.
3. Turn ON the DL750/DL750P first.
4. After the DL750/DL750P boots up completely, check that the connected SCSI device operates on the DL750/DL750P.
5. Turn ON the PC.

When connected to a PC running Windows Me
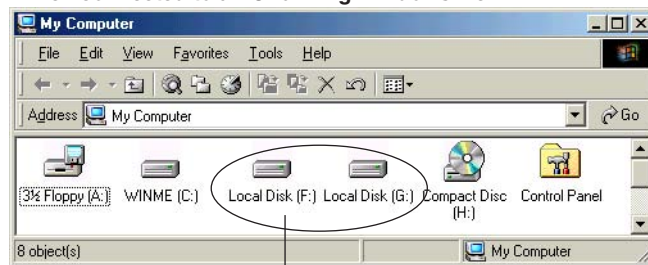
DL750/DL750P

Precautions to Be Taken When Connecting

• **Drive**
  If you format the internal hard disk using the DL750/DL750P, it is formatted into two or three partitions. For example, the PC recognizes these drives as F: and G:. The drive with the smaller drive letter (drive F: in the above example) is the area dedicated to the realtime recording. Other drives are used to store setup data, waveform data, screen image data, etc.
  The drive for realtime recording is used as a working area for the realtime recording within the DL750/DL750P. Never delete files, copy and paste files, and add new files on this drive from the PC. Otherwise, the realtime recording may not operate properly.
  Other drives are used to save other types of data such as waveforms that can be recalled later. The waveforms that can be used on the PC are saved on this drive.

• **Newly Created File During Connection**
  If a file is created with the DL750/DL750P while it is connected to the PC, the new file is not recognized by the PC.
  If the PC is running Windows 98/98 SE/Me, the following procedures allow the files to be recognized.

1. On Windows 98/98 SE/Me, open the "Settings" tab in the properties dialog box for the connected drive, and check the Removable[1] box.
2. Reboot the PC.
3. After creating a new file on the DL750/DL750P, select "Refresh" in the file list window (Explorer, for example).

1. Select "My Computer > Control Panel > System > Device Manager > Disk Drive" and select the relevant drive from the drive list. The "Removable" check box is located in the "Properties" dialog box under the "Settings" tab. You can check the drive number under "Current Drive." Windows 2000/XP does not have this function.

• **Refreshing Files (Windows 98, 98 SE, and Me)**
  If a file is updated on the DL750/DL750P, the update will be recognized by selecting "Refresh" in the file list window of the PC (Explorer, for example).

• **Drive Letter**

If the PC to which the DL750/DL750P is connected has multiple hard disks or if the hard disk is partitioned, connecting the DL750/DL750P will cause the internal hard disk of the DL750/DL750P to be assigned drive letters after the hard disks on the PC. For details, see the instruction manual for the PC or the drive.

The drive letter for the DL750/DL750P cannot be changed.

Example
• The PC uses one hard disk as a single drive
  Before connection   C: (HDD)
  After connection   C: (HDD)
                             D: (DL750/DL750P)
• The PC uses one hard disk as two drives
  Before connection   C: (HDD)
                             D: (HDD)
  After connection   C: (HDD)
                             D: (HDD)
                             E: (DL750/DL750P)

Actually, this may vary depending on how the hard disk is partitioned and the type of interface (IDE, SCSI, etc) and drive.

Note
  • The internal hard disk of the DL750/DL750P has a built-in terminator. When the DL750/DL750P is connected to a PC, it is recommended that the DL750/DL750P be connected to the end of the SCSI chain.
  • Note that the driver letter assignments are different from the DL708, DL708E, and DL716.
  • Do not access the internal hard disk of the DL750/DL750P from the PC when the internal hard disk is being accessed from the DL750/DL750P. Likewise, do not access the internal hard disk from the DL750/DL750P when the internal hard disk is being accessed from the PC.

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Saving and Loading Data

13.19 Using the Voice Comment Function

This section describes only the voice comment function. For details on the voice memo function, see section 7.9.

Before using the voice comment function, connect the earphone microphone with a PUSH switch to the DL750/DL750P by referring to section 3.14, "Connecting the Earphone Microphone with a PUSH Switch and Connecting the Speaker."

Note
- The REC LEVEL and VOLUME knobs on the left side panel click in place at the center position. When using the earphone microphone with a PUSH switch, set the REC LEVEL and VOLUME knobs to the center position to obtain adequate recording level and play volume.
- If you are outputting the voice to an external speaker for the first time by using the optional speaker cable (sold separately), set the play volume to the minimum setting using the VOLUME knob.

Procedure
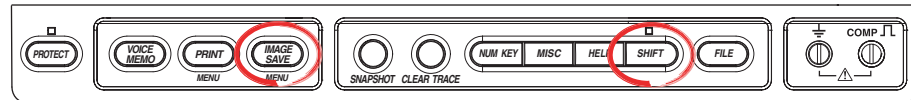
Setting the Screen Image Data Save Operation

1. Set the screen image data save operation according to steps 1 to 16 in section 13.11.

Recording a Voice Comment

There are two record methods.
- **Recording by Using the File Name Dialog Box**
    2. Use the **jog shuttle** and **SELECT** to press the **Rec Start** button on the File Name dialog box. Recording starts. The maximum record time is 10 s. The Rec Start display changes to Rec Stop.
    3. Press the **Rec Stop** button to stop the recording. (When 10 s elapses after starting the recording, the recording automatically stops even if the Rec Stop button is not pressed.) Proceed to step 4.

- **Recording by Using the PUSH Switch on the Earphone Microphone**
    2. Record the voice comment while holding down the PUSH switch on the earphone microphone.
    3. After recording, release the PUSH switch. Proceed to step 4.
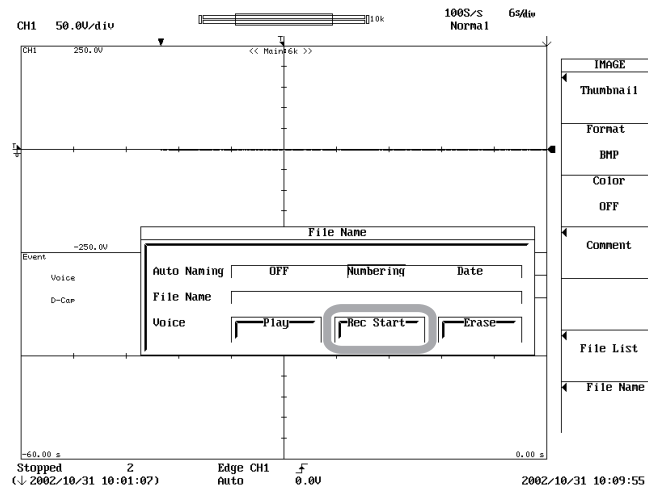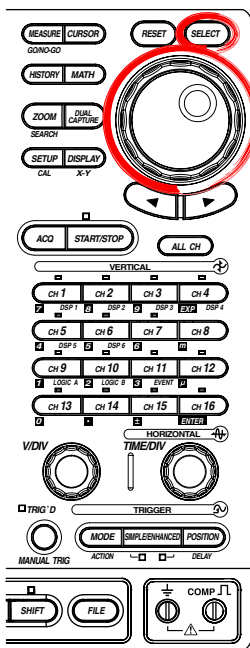
Note ───
    An icon 🖊 appears at the upper left corner of the screen while voice comment recording is in progress.
───

Playing a Voice Comment (Confirmation before Saving the Data)

4.   Press the **Play** button. The voice comment recorded in step 2 and 3 is played.

Note ───
•   If the recorded voice comment is not needed, the voice comment can be erased using the Erase button.
•   An icon 🔊 appears at the upper left corner of the screen while voice comment is being played.
───

```
                    File Name

Auto Naming    OFF      Numbering      Date
File Name
Voice        ┌──Play──┐ ┌Rec Start┐ ┌──Erase──┐     Used only when erasing
             └────────┘ └─────────┘ └─────────┘     a recorded voice comment.
```
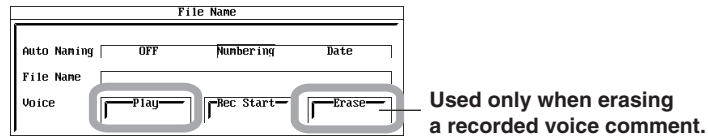
Executing the Screen Image Data Save Operation

5.   Press **IMAGE SAVE**. The voice comment data is saved along with the screen image data to the storage medium.

Note ───
    The procedure and explanation for saving the screen image data are the same as those in section 13.11. For details, see section 13.11.
───

Playing of the Voice Comment

The saved voice comment can be played from the File List window of the IMAGE and FILE menus.

6.   Open the File List window according to steps 1 to 4 on page 13-42 or steps 1 to 6 on page 13-44.

7.   Turn the **jog shuttle** to select the screen image data file in the File List window.

8.   Press **SELECT**. The voice comment is played at the same time the thumbnail of the selected screen image data file is displayed at the lower right section of the File List window.
    To clear the thumbnail, turn the **jog shuttle**.

```
CH1   50.0V/div                      ┌──────────┐10k    100S/s   6s/div
                                     └──────────┘       Normal
CH1      250.0V              << Main:6k >>                        IMAGE
                    File List                                   Thumbnail1
         Path = HD-0
         Space 3760685056 byte       FileObjects: 10           Format
         File Name          Size      Date       Attr
                                                                  BMP
         [HD-0     ]
         [HD-1     ]                                            Color
         [PC Card  ]
         [NetWork  ]                                             OFF
         0007    .BMP    60062  2002/10/31 10:10  R/W
         0006    .BMP    60062  2002/10/31 10:10  R/W           Comment
         0005    .BMP    60062  2002/10/31 10:09  R/W
         0004    .BMP    60062  2002/10/31 10:09  R/W
         0003    .BMP    60062  2002/10/31 10:09  R/W
         0002    .BMP    60062  2002/10/31 10:09  R/W
         0001    .BMP    60062  2002/10/31 10:09  R/W           File List
         0016    .BMP    60062  2002/10/31 10:09  R/W
         0000    .BMP    60062  2002/10/31 10:01  R/W           File Name

Event                                                      Thumbnail screen
    Voice
    D-Cap
-60.00 s                                          0.00 s
Stopped          Z        Edge CH1   ∫
(↓ 2002/10/31 10:01:07)   Auto      0.0V          2002/10/31 10:10:36
```

Note ───
•   While voice comment is being played, 🔊 is indicated at the upper left corner of the screen.
•   The procedure of opening the File List window from the Image Save or File menu is the same as that in section 13.12. For details, see section 13.12.
───

13

Saving and Loading Data

Explanation

A voice comment can be recorded when saving screen image data by connecting an earphone microphone with a PUSH switch to the DL750/DL750P.

Record Time

A voice comment of up to 10 s in length can be attached to a singe screen image data file.

Recording a Voice Comment: Rec Start/Rec Stop

The voice comment that is saved at the time the screen image data is saved is the voice comment that was recorded immediately before the data is saved. A voice comment is saved to a single screen image data file (never to multiple files).

> *Note*
>
> The voice comment is saved as data separate from the screen image data. For a description of the extension of voice comment data file, see the explanation in section 13.11. To erase only the voice comment of the saved screen image data, erase the relevant voice comment data on the File List window of the FILE menu. (For the procedure of displaying the File List window, see steps 1 to 7 on page 13-44. For the procedure of erasing the data, see section 13.15.)

Playing a Voice Comment (Confirmation before Saving the Data): Play

You can play the recorded voice comment to check the contents before saving the data. If you wish to change the voice comment after playing it, record the voice comment again.

The voice comment can be overwritten any number of times until the screen image data is saved. Thus, the voice comment that is saved along with the screen image data is the voice comment that is recorded immediately before the data is saved.

Erasing Voice Comments

The recorded voice comment is erased. Use caution because voice comments that are erased cannot be recovered.

14.1 External Trigger Input (TRIG IN)

⚠

CAUTION

Only input signals that meet the specifications below. Otherwise, undesirable signal such as excessive voltage may damage the DL750/DL750P.

External Trigger Input Terminal

This terminal is used when an external signal is used as a trigger source (see section 5.6).

Specifications

Connector type:	RCA jack
Input Level:	TTL (0 to 5 V)
Minimum pulse width:	500 ns
Logic:	Rising edge or falling edge
Trigger delay time:	Within (200 ns + 1 sample period)
Externally synchronized operation:	Possible (by connecting TRIG IN and TRIG OUT on two DL750/DL750Ps)

External Trigger Input Circuit Diagram and Timing Chart
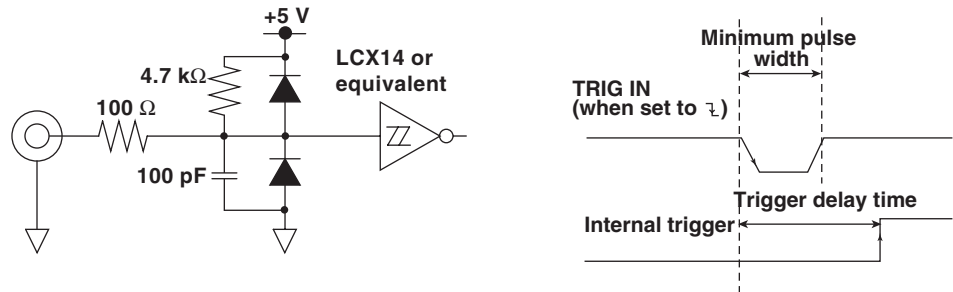
Note

By using the trigger output function, the operation of two DL750/DL750Ps can be synchronized.

14

External Trigger I/O, External Clock Input, and Video Signal Output
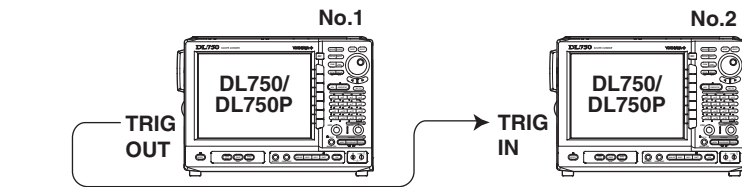
14.2 Trigger Output (TRIG OUT)

External Trigger Output Terminal

A TTL level signal is output when a trigger is activated. The signal level is normally high and goes low when a trigger is activated.

Specifications

Connector type: RCA jack
Output level: CMOS level (0 to 5 V)
Logic: Falls when the trigger is activated, rises after completing acquisition
Output delay time: Within (1 µs + 1 sample period)
Output hold time: 200 ns or more

Trigger Output Circuit Diagram and Timing Chart
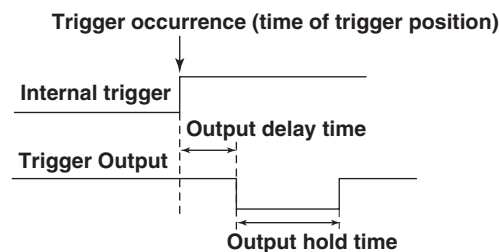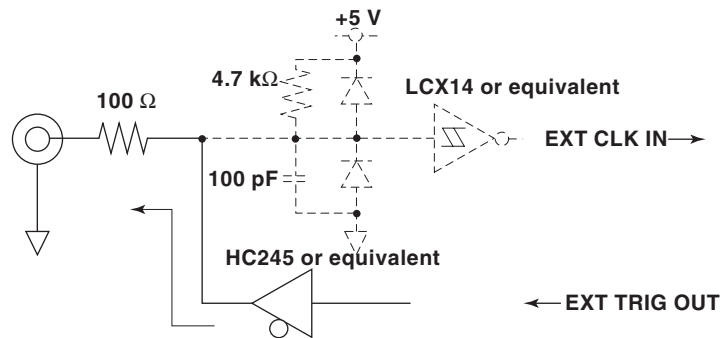
Low Level/High Level Hold Time
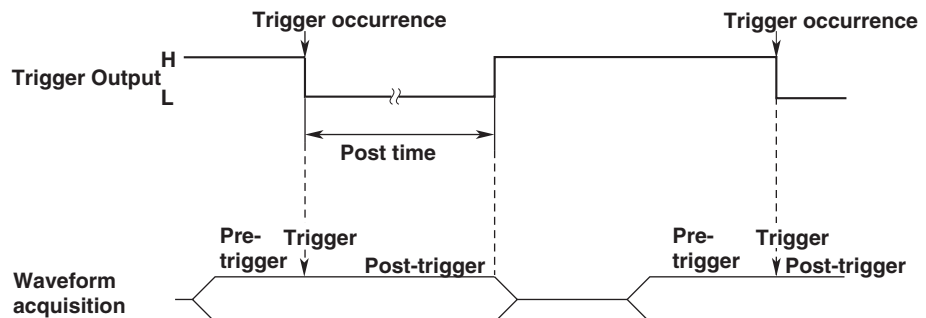
14.3 External Clock Input (EXT CLK IN)

<table>
<tr><td>

⚠

</td><td>

CAUTION

Only input signals that meet the specifications below. Otherwise, undesirable signal such as excessive voltage may damage the DL750/DL750P.

</td></tr>
</table>

External Clock Input Terminal

Use this terminal if you wish to operate the DL750/DL750P using an external clock signal.
This terminal is shared with the trigger output terminal (TRIG OUT).

Specifications

Connector type: RCA jack
Input Level: TTL (0 to 5 V)
Valid edge: Rising edge
Minimum pulse width: 400 ns or more for high and low
External clock frequency range: 1 MHz maximum.

External Clock Input Circuit Diagram
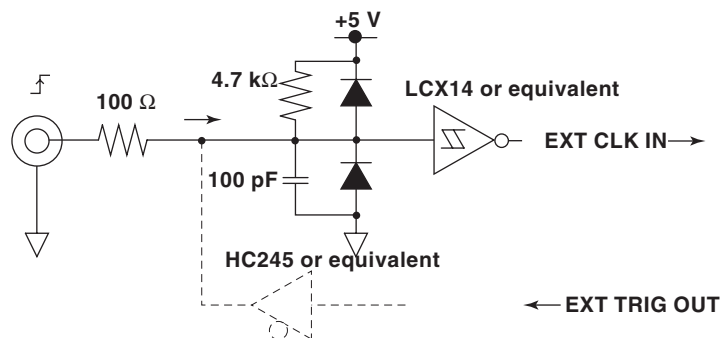
14.4 Video Signal Output (VIDEO OUT (SVGA))

⚠️

CAUTION

• Connect the cable after turning OFF the DL750/DL750P and the monitor.
• Do not short the VIDEO OUT terminal or apply external voltage to it. This may cause damage to the DL750/DL750P.

Video Signal Output Terminal
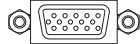
⚠ VIDEO OUT (SVGA)

The DL750/DL750P display can be output to a monitor through the video signal output. Connectable monitors are multi-sync monitors capable of displaying SVGA.

Specifications

Connector type: 15-pin D-SUB
Output type: Analog RGB output
Output resolution: SVGA output 800 × 600 dots/60 Hz Vsync
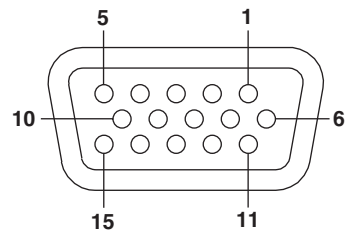
D-Sub 15-pin receptacle

Pin No.	Signal Name	Specifications
1	Red	0.7 V_{P-P}
2	Green	0.7 V_{P-P}
3	Blue	0.7 V_{P-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 the Monitor

1. Turn OFF the DL750/DL750P and the monitor.
2. Connect the DL750/DL750P and the monitor using an analog RGB cable.
3. Turn ON the DL750/DL750P and the monitor.
4. Press the **MISC** soft key.
5. Press the **Next 1/2** soft key.
6. Press the **Others** soft key.
7. Press the **Video Out** soft key to select ON. The screen of the DL750/DL750P is displayed on the monitor.
   Select OFF to stop the display on the monitor.
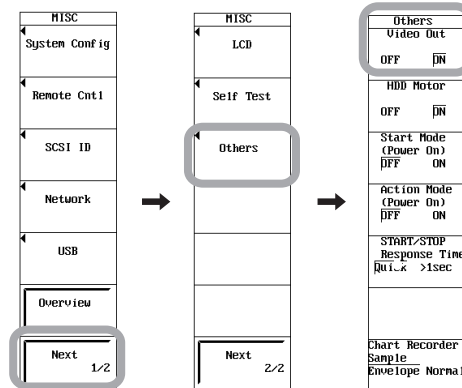
14.5 External Start/Stop Input (GO/NO-GO)

The DL750/DL750P start/stop can be controlled externally.

External Start/Stop Input Terminal

The terminal is shared with the GO/NO-GO I/O Terminal. This terminal is used as an external start/stop input when the GO/NO-GO determination I/O function is not used (when Mode is OFF on the GO/NO-GO menu).

Specifications

Modular jack (RJ-11). Use the optional accessory 366973 (sold separately) for the cable.
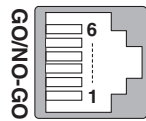
Pin No.	Signal Name	
1	NC (no connection)	
2	START IN	Start on the low edge
3	NC (no connection)	Stop on the high edge
4	NC (no connection)	
5	GND	
6	SPEAKER	

Connector on the DL

Input level: TTL (0 to 5 V)

External Start/Stop Input Circuit Diagram
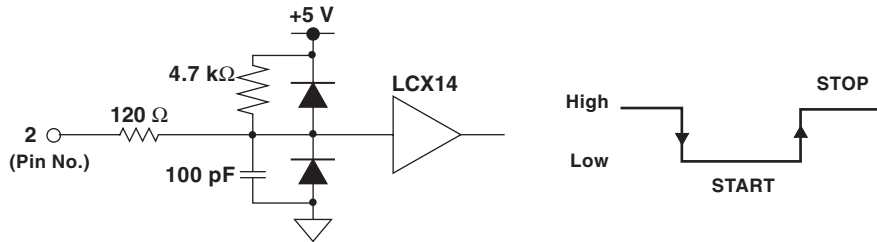
• **Switch input is possible**
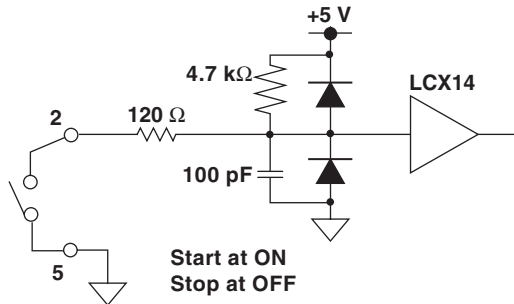
Note

Low and High edges are used to detect start/stop.

15.1 DSP Channels (Optional)

What DSP Channels Are

When the /G3 option is installed, 6 dedicated computation channels (DSP1 to DSP6) are added to the DL750/DL750P. These channels perform realtime computation such as addition, subtraction, multiplication, and division between channels as well as differentiation and integration using the 16 analog input channels (CH1 to CH16) as computation sources. DSP channels can also be specified as computation sources of other channels.

The functions of DSP channels are approximately the same as those of analog input channels. Computed waveforms can be displayed in realtime even during roll mode display.

Executable Computations

- **Addition, Subtraction, Multiplication, and Division (+, –, ×, and ÷) between Channels**
  See section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)."
- **Digital Filters (Gauss, Sharp, IIR (Butterworth), and Moving Average)**
  See section 15.3, "Using Filters (DSP Channels)."
- **Differentiation and Integration**
  See section 15.4, "Performing Differentiation and Integration (DSP Channels)."
- **Addition, Subtraction, Multiplication, and Division (+, –, ×, and ÷) with Coefficients between Channels**
  See section 15.5, "Performing Addition, Subtraction, Multiplication, and Division with Coefficients (DSP Channels)."

Comparison with Analog Input Channels (CH1 to CH16)

- The allocation of the acquisition memory of DSP channels is the same as analog input channels.
- Like analog input channels, DSP channels can be used in all acquisition modes.
- Can be used as a trigger source of simple triggers (edge trigger, see section 6.5) and the OR trigger/window trigger of enhanced triggers. It cannot be set as a trigger source of other enhanced triggers.
- Computed waveform can be displayed in realtime even during roll mode display (see page 2-4).
- Can be used as a target waveform for cursor measurement (see section 11.5).
- Can be used as a target waveform of automated measurement of waveform parameters (see section 11.6).
- Can be used as a target channel for the dual capture function (see section 7.6).

15

Notes Concerning DSP Channels

Notes When Using the DSP Channels as Computation Sources

- The maximum computation rate is 100 kS/s. If this rate is exceeded, the data is automatically re-sampled at 100 kS/s.
- The computed result is displayed in 16 bits (fixed decimal point). (Computation is performed using 32-bit floating-point decimal values, but the value is normalized to 16 bits after computation and saved to the acquisition memory.)
- All modules are computation sources.
- Analog channels (CH1 to CH16) are specified as computation sources. The computed result of a DSP channel can also be specified as a computation source of another DSP channel. However, only DSP channels with a channel number smaller than itself can be specified.

Notes Concerning Display

- **Value/Div Setting**

  The unit of the computed result of DSP channels is expressed as "Value/Div," because the result may not necessary be a voltage depending on the selected computing equation.

  Value/Div: 123 Value/Div different settings can be specified using the V/DIV knob (1-2-5 steps).

  10.00E–21 [Value/Div] to 500.0E+18 [Value/Div]

- **Variable Setting**
  - **When variable is set to OFF (zooming in or out by setting the zoom rate)**

    Zoom rate: The following zoom rates are available.

    ×0.1, ×0.111, ×0.125, ×0.143, ×0.167, ×0.2, ×0.25, ×0.33, ×0.4, ×0.5, ×0.556, ×0.625, ×0.667, ×0.714, ×0.8, ×0.833, ×1, ×1.11, ×1.25, ×1.33, ×1.43, ×1.67, ×2, ×2.22, ×2.5, ×3.33, ×4, ×5, ×6.67, ×8, ×10, 12.5, ×16.7, ×20, ×25, ×40, ×50, and ×100

    Zoom position: The waveform is zoomed around the vertical position.

  - **When variable is set to ON (vertical zoom/expand according to the upper and lower limits of the display range)**

    Upper and lower limits: ±5.0000E+22 [Value/Div]/±1.0000E–23 [Value/Div]

    Display range: Up to ±5.0000E+21.(500.0E+18 [Value/Div]×10 [Div])

                            The display will be clipped at higher values.

- **Computation Delay**

  [4 samples + the delay of the digital filter[1]]

  Varies depending on the computation rate (100 kS/s maximum) of the DSP channel.

  If the output result of a DSP channel is specified as a source of another DSP channel, the computation delay increases.

  1. For details on the computation delay of the digital filter, see appendix 6.

Notes on Other Items

- When the DSP channel is ON, the sample rate of the analog channel is limited to 5 MS/s maximum.
- You must set the sample rate to 2 MS/s or lower before turning the DSP channel display ON or OFF.

15.2 Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)

<For a description of this function, refer to page 2-50.>

Procedure
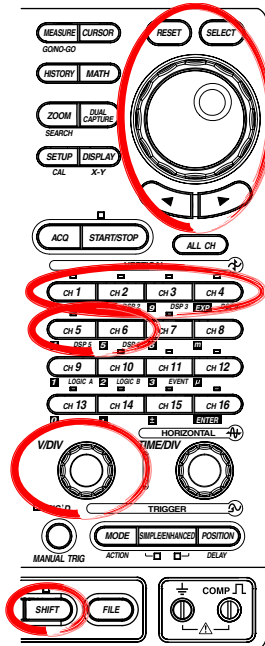
1. Press **SHIFT+CH1 to CH6** (DSP1 to DSP6).

Note

For a description of turning ON/OFF the DSP, see section 5.1. For a description of setting the vertical position, see section 5.4. For a description of zooming vertically by setting the zoom rate, see section 5.8. For a description of setting waveform labels, see section 8.10.

Setting the Computation Definition

2. Press the **Setup** soft key. A setup dialog box opens.

3. Use the **jog shuttle** and **SELECT** to set Operation to S1+S2, S1–S2, S1*S2, or S1/S2.

Selecting the Channel on Which to Perform Computation

4. Use the **jog shuttle** and **SELECT** to select Source1.

5. Likewise, select Source2

Setting Value/Div

6. Turn the V/DIV knob to set the Value/Div value.

You can also set Value/Div by pressing the **Value/Div** soft key and turning the **jog shuttle**.

Note

There are 123 (selectable range: 10.00E–21 [Value/Div] to 500.0E+18 [Value/Div]) different Value/Div settings. You set the Value/Div using 1-2-5 steps similar to the V/div setting.

Automatically Selecting the Optimum Value/Div Setting

7. Press the Optimize Value/Div soft key. The optimum Value/Div setting is automatically selected by referring to the range of the computed channel and displayed.

Note

- The Optimize Value/Div soft key appears only when Variable is OFF.
- The operation using the Optimize Value/Div soft key selects the optimum Value/Div setting by referring to the range of the computed channel. It does not select the optimum Value/Div setting for the output waveform after computation. For easy viewing of the waveform after computation, select the approximate range using Optimize Value/Div, and then use the V/DIV knob or Value/Div soft key to adjust to the optimum range.
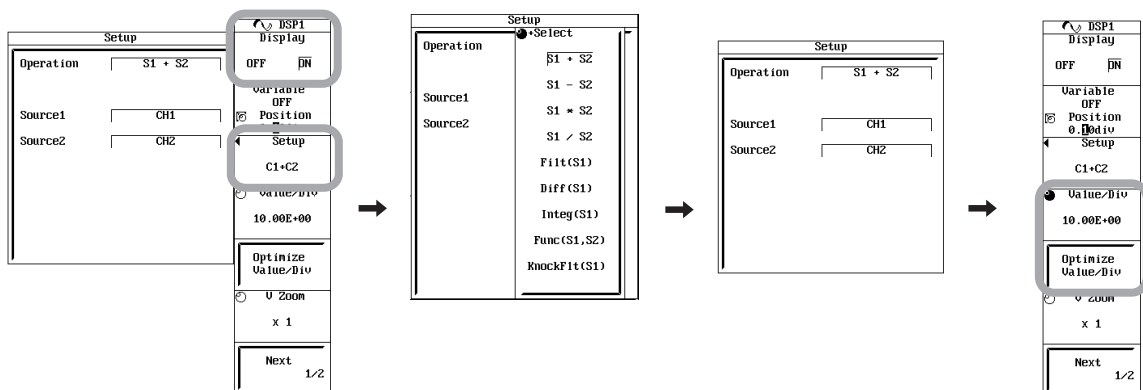
Zooming in on the Waveform

- **Zooming in or out Vertically by Setting the Zoom Rate**
  8.   Press the **Variable** soft key to select OFF.
  9.   Press the **V Zoom** soft key.
  10. Turn the **jog shuttle** to set the zoom rate.
  11. Press the **Variable** soft key to select Position.
  12. Turn the **jog shuttle** to set the vertical position. The center position of zoom changes. Proceed to step 13.

- **Zooming/Expanding Vertically According to the Upper and Lower Limits of the Display Range**
  8.   Press the **Variable** soft key to select ON.
  9.   Press the **Upper/Lower** soft key to set the jog shuttle control to Upper.
  10. Turn the **jog shuttle** to set the upper limit.
  11. Press the **Upper/Lower** soft key to set the jog shuttle control to Lower.
  12. Turn the **jog shuttle** to set the lower limit. Proceed to step 13.

Setting the Waveform Label

  13. Press the **Next 1/2** soft key.
  14. Press the **Label** soft key.
  15. Enter the waveform label according to the procedure given in section 8.10.

Setting the Unit

  16. Press the **Unit** soft key.
  17. Enter the unit according to the procedure given in section 4.2.
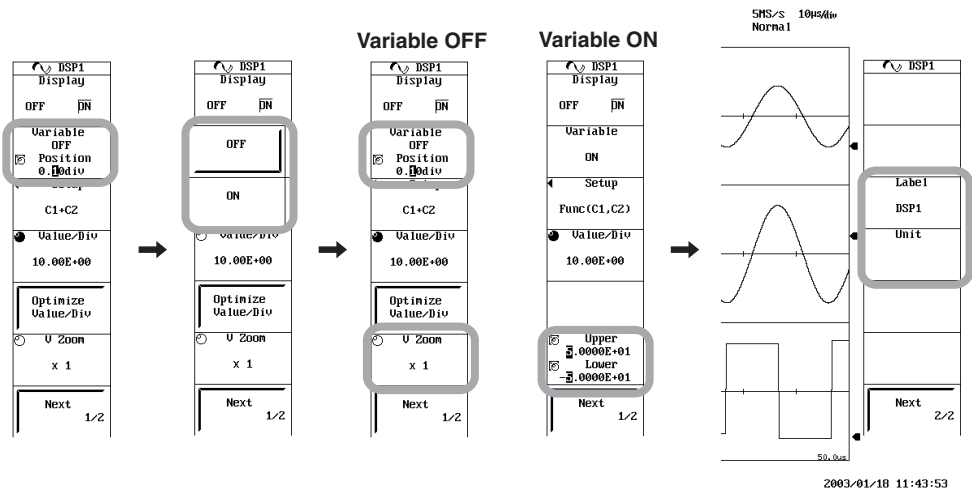
Explanation

Addition, subtraction, multiplication, and division can be performed between channels.

Computed Channels

CH1 to CH16 and DSP1 to DSP6 (optional)
The computed result of a DSP channel can be specified as a computation source of another DSP channel, but only DSP channels with a channel number smaller than itself can be specified.

Setting Value/Div

Like V/div, Value/Div is set using 1-2-5 steps. The selectable range is 10.00E–21 [Value/Div] to 500.0E+18 [Value/Div] with 123 settings.
Turn the V/DIV knob to set the Value/Div value. You can also set Value/Div by pressing the Value/Div soft key and turning the jog shuttle.

Automatically Selecting the Optimum Value/Div Setting

When you press the Optimize Value/Div soft key, the optimum range is automatically selected from the 123 Value/Div settings, and the waveform is displayed using the selected setting.

Zooming in on the Waveform

- **Zooming in or out Vertically by Setting the Zoom Rate**
  For details, see section 5.8, "Zooming Vertically by Setting the Zoom Rate" and "Notes Concerning Display" in section 15.1.

- **Zooming/Expanding Vertically According to the Upper and Lower Limits of the Display Range**
  For details, see section 5.9, "Zooming Vertically According to the Upper and Lower Limits of the Display Range" and "Notes Concerning Display" in section 15.1.

Setting the Unit

Unit can be set arbitrarily using up to four characters. The specified characters are applied to the scale values.

Note

For other notes concerning DSP channels, see section 15.1.

15

Using the DSP Channel (Optional)

15.3 Using Filters (DSP Channels)

<For a description of this function, refer to page 2-50.>

Procedure

1. Press **SHIFT+CH1 to CH6** (DSP1 to DSP6).

Note

For a description of turning ON/OFF the DSP, see section 5.1. For a description of setting the vertical position, see section 5.4. For a description of zooming vertically by setting the zoom rate, see section 5.8. For a description of setting waveform labels, see section 8.10.

Setting the Computation Definition

2. Press the **Setup** soft key. A setup dialog box opens.
3. Use the **jog shuttle** and **SELECT** to set Operation to Filt(S1).

Selecting the Channel on Which to Perform Computation

4. Use the **jog shuttle** and **SELECT** to select Source1.

Setting the Filter

5. Use the **jog shuttle** and **SELECT** to set the Filter Type to Sharp, Gauss, IIR, or Mean.

• **When Sharp or IIR Is Selected**

6. Press the **Filter Band** soft key to select Low-Pass, High-Pass, or Band-Pass.
7. Use the **jog shuttle** and **SELECT** to set CutOff.
    If Filter Band is set to Band-Pass, set PassBand and Center Frequency.
    Proceed to step 8.

• **When Gauss Is Selected**

6. Press the **Filter Band** soft key to select Low-Pass. Only Low-Pass is available for Gauss.
7. Use the **jog shuttle** and **SELECT** to set CutOff. Proceed to step 8.

Note

Set the cutoff frequency based on the current sampling frequency (fs) (100 kS/s maximum). If set above 100 kS/s, it is limited to 100 kS/s. The sampling frequency is also limited to 100 kS/s for envelope mode.

• **When Mean Is Selected**

6. Press the **TAP** soft key to set the stages to 2 to 128. Proceed to step 8.
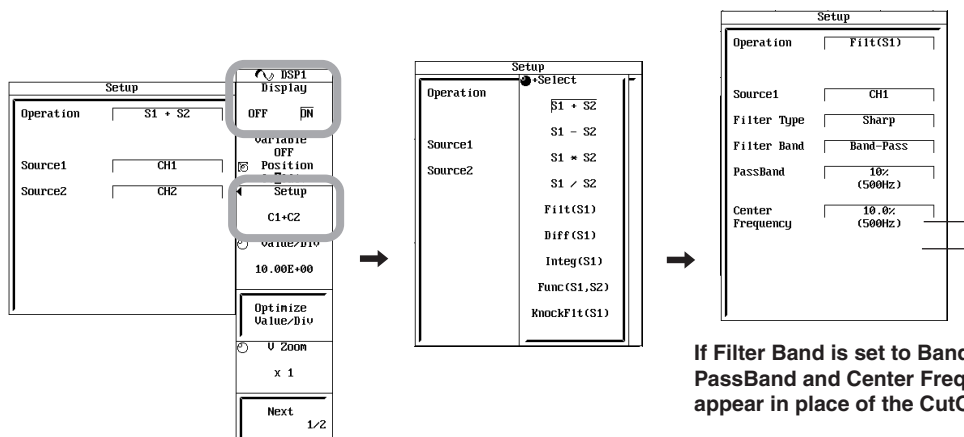
If Filter Band is set to Band-Pass, PassBand and Center Frequency appear in place of the CutOff item.

Setting Value/Div

8. Turn the V/DIV knob to set the Value/Div value.
    You can also set Value/Div by pressing the **Value/Div** soft key and turning the **jog shuttle**.

Note

There are 123 (selectable range: 10.00E–21 [Value/Div] to 500.0E+18 [Value/Div]) different Value/Div settings. You set the Value/Div using 1-2-5 steps similar to the V/div setting.

Automatically Selecting the Optimum Value/Div Setting

9. Press the **Optimize Value/Div** soft key. The optimum Value/Div setting is automatically selected by referring to the range of the computation channel and displayed.

Note

•   The Optimize Value/Div soft key appears only when Variable is OFF.
•   When using a filter, the range is set to the same range as the computed channel.

Zooming in on the Waveform

The procedure of "Zooming in or out Vertically by Setting the Zoom Rate" and "Zooming/ Expanding Vertically According to the Upper and Lower Limits of the Display Range" is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

Setting the Waveform Label

The procedure is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

Setting the Unit

The procedure is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

15

Using the DSP Channel (Optional)

Explanation

A digital filter is used to perform the computation.

Computed Channels

CH1 to CH16 and DSP1 to DSP6 (optional)
The computed result of a DSP channel can be specified as a computation source of another DSP channel, but only DSP channels with a channel number smaller than itself can be specified.

Setting the Digital Filter

The following four types of filters are available. For details, see Appendix 6.
Sharp, Gauss, Mean (moving average), and IIR (Butterworth)

Filter Format	Characteristics	Filter Type	Computation Type
Sharp	Steep attenuation slope (–40 dB per octave) Linear phase and constant group delay Ripple exists in the passband Stop band is comb-shaped	LPF[1] HPF[1] BPF[1]	FIR
Gauss	Gentle attenuation slope Linear phase and constant group delay No ripple in the passband There is no overshoot in the step response. Low order and small delay	LPF	FIR
MEAN (Moving Average)	Comb-shaped characteristics There is no overshoot in the step response. Linear phase and constant group delay	LPF	FIR
IIR (Butterworth)	Attenuation slope is between SHARP and GAUSS Not linear phase and group delay not constant No ripple in either passband or stopband Close to the characteristics of an analog filter Cutoff frequency can be set lower than SHARP/GAUSS	LPF HPF BPF	IIR

1. LPF, HPF, and BPF denote low-pass filter, high-pass filter, and bandpass filter, respectively.

The cutoff frequency, center frequency, and pass band can be specified in terms of percentages of fs (sampling frequency).

Type	Filter Band[1]	Cutoff Frequency[2]	Center Frequency[3]	Pass Band[4]
Sharp	LPF	2.0% to 30.0%	-	-
	HPF	2.0% to 30.0%	-	-
	BPF	-	3.0% to 30.0%	2% of fs
		-	4.6% to 30.0%	5% of fs
		-	7.0% to 30.0%	10% of fs
		-	9.6% to 30.0%	15% of fs
		-	12.0% to 30.0%	20% of fs
Gauss	LPF	2.0% to 30.0%	-	-
IIR	LPF	0.2% to 30.0%	-	-
	HPF	0.2% to 30.0%	-	-
	BPF	-	0.6% to 30.0%	1% of fs
		-	1.2% to 30.0%	2% of fs
		-	2.6% to 30.0%	5% of fs
		-	5.2% to 30.0%	10% of fs
		-	7.6% to 30.0%	15% of fs
		-	10.2% to 30.0%	20% of fs

1.   LPF, HPF, and BPF denote low-pass filter, high-pass filter, and bandpass filter, respectively.
2.   The cutoff frequency (CutOff) can be specified only when LPF or HPF is selected. The resolution is 0.2%.
3.   The center frequency can be specified only when BPF is selected. The resolution is 0.2%.
4.   The pass band can be specified only when BPF is selected. You can select the pass band from 1%, 2%, 5%, 10%, 15%, and 20%.

- **Setting the Number of Stages of Moving Average: TAP**
  Select the number of stages from 2, 4, 8, 16, 32, 64, and 128.

For details on other filters, see appendix 6.

Setting Value/Div

Like V/div, Value/Div is set using 1-2-5 steps. The selectable range is 10.00E–21 [Value/Div] to 500.0E+18 [Value/Div] with 123 settings.
Turn the V/DIV knob to set the Value/Div value. You can also set Value/Div by pressing the Value/Div soft key and turning the jog shuttle.

Automatically Selecting the Optimum Value/Div Setting

When you press the Optimize Value/Div soft key, the optimum range is automatically selected from the 123 Value/Div settings, and the waveform is displayed using the selected setting.

Zooming in on the Waveform

- **Zooming in or out Vertically by Setting the Magnification**
  For details, see section 5.8, "Zooming Vertically by Setting the Zoom Rate" and "Notes Concerning Display" in section 15.1.

- **Zooming/Expanding Vertically According to the Upper and Lower Limits of the Display Range**
  For details, see section 5.9, "Zooming Vertically According to the Upper and Lower Limits of the Display Range" and "Notes Concerning Display" in section 15.1.

Setting the Unit

Unit can be set arbitrarily using up to four characters. The specified characters are applied to the scale values.

Notes When Using Filters

The following limitations exist depending on the acquisition mode setting.

- **When the Acquisition Mode Is Set to a Mode Other Than Envelope**
  The digital filter frequency is set in terms of a percentage of the sampling frequency. For example, if the sampling frequency is 100 kHz and you set the cutoff frequency to 10%, the cutoff frequency is set to 10 kHz. If the sampling frequency exceeds 100 kHz, the sampling frequency of DSP channels is decimated to 100 kHz. Therefore, if the sampling frequency exceeds 100 kHz, the specified frequency is a percentage of 100 kHz regardless of the actual sampling frequency.

- **When the Acquisition Mode Is Set to Envelope**
  The sampling frequency of DSP channels is fixed to 100 kHz. The digital filter frequency is set in terms of a percentage of 100 kHz.

Note
> For other notes concerning DSP channels, see section 15.1.

15

Using the DSP Channel (Optional)

15.4 Performing Differentiation and Integration (DSP Channels)

<For a description of this function, refer to page 2-50.>

Procedure

1. Press **SHIFT+CH1 to CH6** (DSP1 to DSP6).

Note

> For a description of turning ON/OFF the DSP, see section 5.1. For a description of setting the vertical position, see section 5.4. For a description of zooming vertically by setting the zoom rate, see section 5.8. For a description of setting waveform labels, see section 8.10.

Setting the Computation Definition

2. Press the **Setup** soft key. A setup dialog box opens.
3. Use the **jog shuttle** and **SELECT** to set Operation to Diff(S1) (differentiation) or Integ(S1) (integration).

Selecting the Channel on Which to Perform Computation

4. Use the **jog shuttle** and **SELECT** to select Source1.

Setting Differentiation and Integration

- **When Diff(S1) Is Selected**
  5. Use the **jog shuttle** and **SELECT** to set Filter to ON or OFF.
  6. Use the **jog shuttle** and **SELECT** to set the CutOff in the range of 2.0% to 30.0%. Proceed to step 7.

- **When Integ(S1) Is Selected (Selecting the Reset Condition)**
  5. Use the **jog shuttle** and **SELECT** to set the each item of Auto Reset Condition to ON/OFF. Proceed to step 7.

Note

> If Over Limit is turned ON, the computation is reset when the computed result exceeds +10 divisions or –10 divisions of the Value/Div setting. If Zero Cross to Positive is turned ON, the computation is reset when the signal of the target channel produces a positive edge at the zero-crossing point. If Zero Cross to Negative is turned ON, the computation is reset when the signal of the target channel produces a negative edge at the zero-crossing point. Multiple items can be selected simultaneously.

Diff (S1): differentiation

Integ (S1): integration

Setting Value/Div

7. Turn the V/DIV knob to set the Value/Div value.

   You can also set Value/Div by pressing the **Value/Div** soft key and turning the **jog shuttle**.

Note _____

There are 123 (selectable range: 10.00E–21 [Value/Div] to 500.0E+18 [Value/Div]) different Value/Div settings. You set the Value/Div using 1-2-5 steps similar to the V/div setting.

Automatically Selecting the Optimum Value/Div Setting

8. Press the **Optimize Value/Div** soft key. The optimum Value/Div setting is automatically selected by referring to the range of the computation channel and displayed.

Note _____

*   The Optimize Value/Div soft key appears only when Variable is OFF.
*   The operation using the Optimize Value/Div soft key selects the optimum Value/Div setting by referring to the range of the computed channel. It does not select the optimum Value/Div setting for the output waveform after computation. For easy viewing of the waveform after computation, select the approximate range using Optimize Value/Div, and then use the V/DIV knob or Value/Div soft key to adjust to the optimum range.

Zooming in on the Waveform

The procedure of "Zooming in or out Vertically by Setting the Zoom Rate" and "Zooming/ Expanding Vertically According to the Upper and Lower Limits of the Display Range" is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

Setting the Waveform Label

The procedure is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

Setting the Unit

The procedure is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

15

Using the DSP Channel (Optional)

Explanation

Differentiation or integration is performed on the specified waveform.

Computed Channels

CH1 to CH16 and DSP1 to DSP6 (optional)
The computed result of a DSP channel can be specified as a computation source of another DSP channel, but only DSP channels with a channel number smaller than itself can be specified.

Setting the Cutoff Frequency of Differentiation

In the differentiation of DSP channels, differentiation can be performed after passing the input signal through a low-pass filter. The low-pass filter is a SHARP low-pass filter. For details on differentiation, see page app-44.
Selectable range of cutoff frequency: 2.0% to 30.0% of the sample rate (0.2% steps)

Setting the Reset Condition of Integration: Auto Reset Condition

Usually, the integration result is reset when waveform acquisition is started or when the target channel is turned ON/OFF. You can also set the following types of reset conditions. Multiple items can be selected simultaneously.

Over Limit: Reset when the computed result exceeds +10 division or −10 divisions of the Value/Div setting.

Zero Cross to Positive: Reset when the target channel produces a positive edge at the zero-crossing point.

Zero Cross to Negative: Reset when the target channel produces a negative edge at the zero-crossing point.

Setting Value/Div

Like V/div, Value/Div is set using 1-2-5 steps. The selectable range is 10.00E–21 [Value/Div] to 500.0E+18 [Value/Div] with 123 settings.
Turn the V/DIV knob to set the Value/Div value. You can also set Value/Div by pressing the Value/Div soft key and turning the jog shuttle.

Automatically Selecting the Optimum Value/Div Setting

When you press the Optimize Value/Div soft key, the optimum range is automatically selected from the 123 Value/Div settings, and the waveform is displayed using the selected setting.

Zooming in on the Waveform

- **Zooming in or out Vertically by Setting the Magnification**
  For details, see section 5.8, "Zooming Vertically by Setting the Zoom Rate" and "Notes Concerning Display" in section 15.1.

- **Zooming/Expanding Vertically According to the Upper and Lower Limits of the Display Range**
  For details, see section 5.9, "Zooming Vertically According to the Upper and Lower Limits of the Display Range" and "Notes Concerning Display" in section 15.1.

Setting the Unit

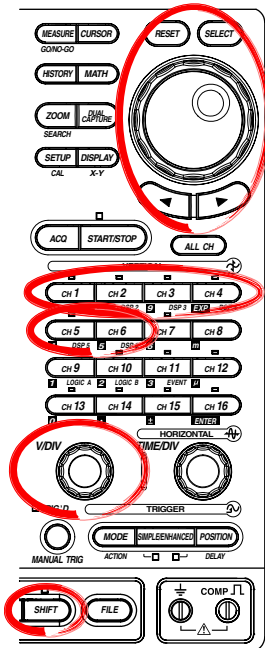Unit can be set arbitrarily using up to four characters. The specified characters are applied to the scale values.

Note

For other notes concerning DSP channels, see section 15.1.

15.5 Performing Addition, Subtraction, Multiplication, and Division with Coefficients (DSP Channels)

Procedure
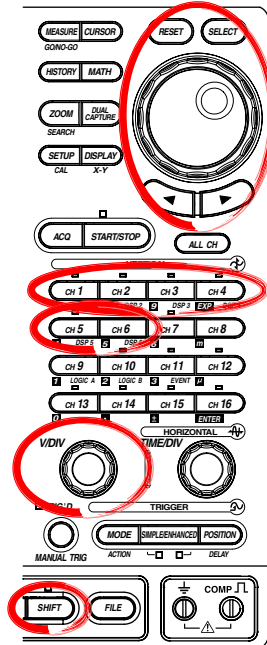
1. Press **SHIFT+CH1 to CH6** (DSP1 to DSP6).

Note

For a description of turning ON/OFF the DSP, see section 5.1. For a description of setting the vertical position, see section 5.4. For a description of zooming vertically by setting the zoom rate, see section 5.8. For a description of setting waveform labels, see section 8.10.

Setting the Computation Definition

2. Press the Setup soft key. A setup dialog box opens.

3. Use the **jog shuttle** and **SELECT** to set Operation to Func(S1, S2).

4. Use the **jog shuttle** and **SELECT** to select the Expression from the following.

   (A*S1)+(B*S2)+C
   (A*S1)–(B*S2)+C
   (A*S1)*(B*S2)+C
   (A*S1)/(B*S2)+C

Selecting the Channel on Which to Perform Computation

5. Use the **jog shuttle** and **SELECT** to select Source1.

6. Likewise, select Source2

Setting the coefficient

7. Use the **jog shuttle** and **SELECT** to set coefficient A.

8. Likewise, set coefficients B and C.

Note

The selectable range of coefficients A, B, and C is ±9.9999E–30 to ±9.9999E+30.

15

Using the DSP Channel (Optional)

Setting Value/Div

9. Turn the V/DIV knob to set the Value/Div value.

    You can also set Value/Div by pressing the **Value/Div** soft key and turning the **jog shuttle**.

Note

There are 123 (selectable range: 10.00E–21 [Value/Div] to 500.0E+18 [Value/Div]) different Value/Div settings. You set the Value/Div using 1-2-5 steps similar to the V/div setting.

Automatically Selecting the Optimum Value/Div Setting

10. Press the **Optimize Value/Div** soft key. The optimum Value/Div setting is automatically selected by referring to the range of the computation channel and displayed.

Note

*   The Optimize Value/Div soft key appears only when Variable is OFF.
*   The operation using the Optimize Value/Div soft key selects the optimum Value/Div setting by referring to the range of the computed channel. It does not select the optimum Value/Div setting for the output waveform after computation. For easy viewing of the waveform after computation, select the approximate range using Optimize Value/Div, and then use the V/DIV knob or Value/Div soft key to adjust to the optimum range.
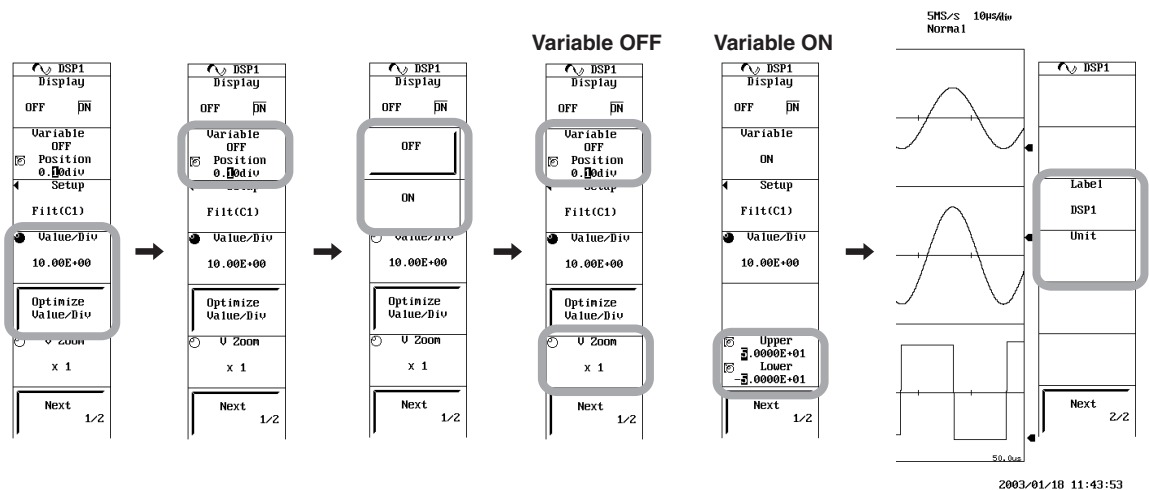
Zooming in on the Waveform

The procedure of "Zooming in or out Vertically by Setting the Zoom Rate" and "Zooming/Expanding Vertically According to the Upper and Lower Limits of the Display Range" is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

Setting the Waveform Label

The procedure is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

Setting the Unit

The procedure is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

Explanation

Addition, subtraction, multiplication, and division with coefficients can be performed between channels.

Computed Channels

CH1 to CH16 and DSP1 to DSP6 (optional)
The computed result of a DSP channel can be specified as a computation source of another DSP channel, but only DSP channels with a channel number smaller than itself can be specified.

Types of Addition, Subtraction, Multiplication, and Division with Coefficients

(A*S1)+(B*S2)+C
(A*S1)–(B*S2)+C
(A*S1)*(B*S2)+C
(A*S1)/(B*S2)+C

Selectable Range of Coefficients

The selectable range of coefficients A, B, and C is –9.9999E+30 to –0.0001E–30, 0, and +0.0001E–30 to +9.9999E+30.

Setting Value/Div

Like V/div, Value/Div is set using 1-2-5 steps. The selectable range is 10.00E–21 [Value/Div] to 500.0E+18 [Value/Div] with 123 settings.
Turn the V/DIV knob to set the Value/Div value. You can also set Value/Div by pressing the Value/Div soft key and turning the jog shuttle.

Automatically Selecting the Optimum Value/Div Setting

When you press the Optimize Value/Div soft key, the optimum range is automatically selected from the 123 Value/Div settings, and the waveform is displayed using the selected setting.

Zooming in on the Waveform

- **Zooming in or out Vertically by Setting the Magnification**
  For details, see section 5.8, "Zooming Vertically by Setting the Zoom Rate" and "Notes Concerning Display" in section 15.1.

- **Zooming/Expanding Vertically According to the Upper and Lower Limits of the Display Range**
  For details, see section 5.9, "Zooming Vertically According to the Upper and Lower Limits of the Display Range" and "Notes Concerning Display" in section 15.1.

Setting the Unit

Unit can be set arbitrarily using up to four characters. The specified characters are applied to the scale values.

Note

For other notes concerning DSP channels, see section 15.1.

15

Using the DSP Channel (Optional)

15.6 Using the Knocking Filter (DSP Channels)

Procedure
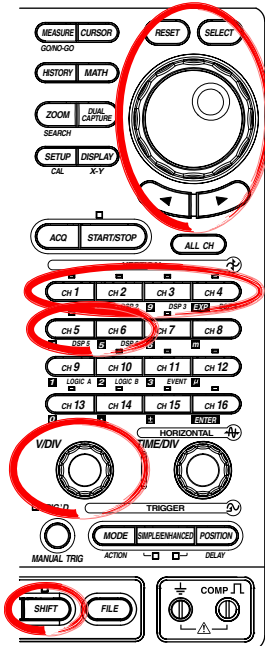
1. Press **SHIFT+CH1 to CH6** (DSP1 to DSP6).

Note

For a description of turning ON/OFF the DSP, see section 5.1. For a description of setting the vertical position, see section 5.4. For a description of zooming vertically by setting the zoom rate, see section 5.8. For a description of setting waveform labels, see section 8.10.

Setting the Computation Definition

2. Press the **Setup** soft key. A setup dialog box opens.
3. Use the **jog shuttle** and **SELECT** to set Operation to KnockFlt(S1).

Selecting the Channel on Which to Perform Computation

4. Use the **jog shuttle** and **SELECT** to select Source1.

Setting the Filter

5. Use the **jog shuttle** and **SELECT** to set the Filter Type to Sharp, IIR, or Diff.

• **When Sharp or IIR Is Selected**

6. Use the **jog shuttle** and **SELECT** to set the Filter Band to High-Pass or Band-Pass.
7. If you selected High-Pass in step 6, use the **jog shuttle** and **SELECT** to set CutOff. If you selected Band-Pass, use the **jog shuttle** and **SELECT** to set PassBand and Center Frequency. Proceed to step 8.

• **When Diff Is Selected**

6. Use the **jog shuttle** and **SELECT** to set Filter to ON or OFF.
7. Use the **jog shuttle** and **SELECT** to set CutOff. Proceed to step 8.
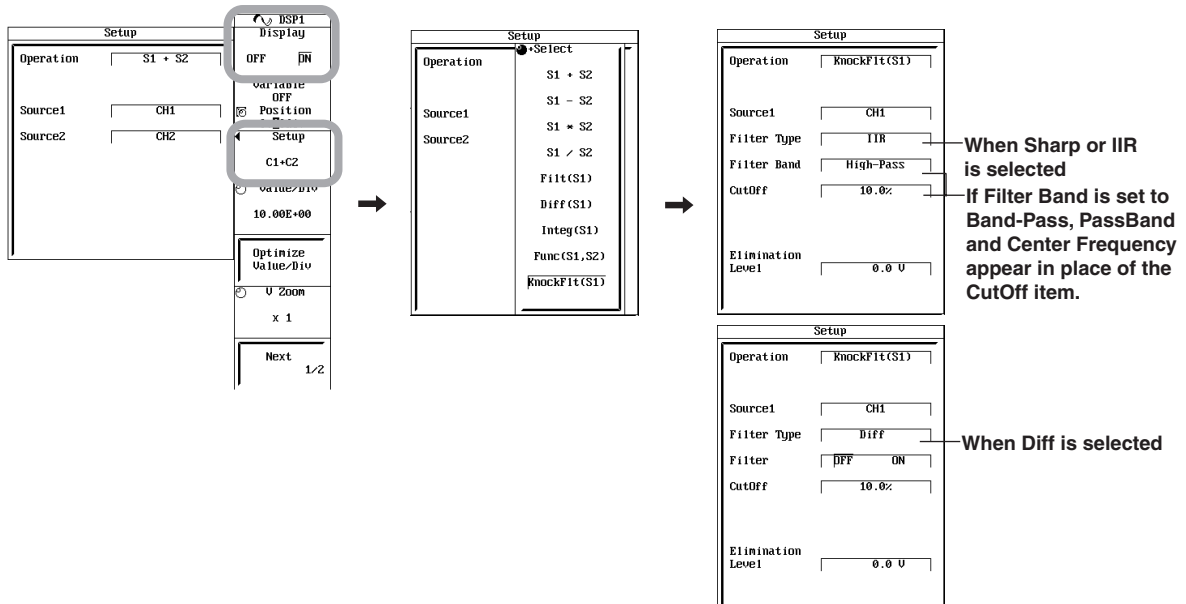
When Sharp or IIR is selected
If Filter Band is set to Band-Pass, PassBand and Center Frequency appear in place of the CutOff item.

When Diff is selected

Note

Set the cutoff frequency based on the current sampling frequency (fs) (100 kS/s maximum). If set above 100 kS/s, it is limited to 100 kS/s. The sampling frequency is also limited to 100 kS/s for envelope mode.

Setting the Elimination Level

8. Use the **jog shuttle** and **SELECT** to set Elimination Level. Press ESC.

Setting Value/Div

9. Turn the V/DIV knob to set the Value/Div value.

You can also set Value/Div by pressing the **Value/Div** soft key and turning the **jog shuttle**.

Note

There are 123 (selectable range: 10.00E–21 [Value/Div] to 500.0E+18 [Value/Div]) different Value/Div settings. You set the Value/Div using 1-2-5 steps similar to the V/div setting.

Automatically Selecting the Optimum Value/Div Setting

10. Press the **Optimize Value/Div** soft key. The optimum Value/Div setting is automatically selected by referring to the range of the computation channel and displayed.

Note

• The Optimize Value/Div soft key appears only when Variable is OFF.
• When using the knocking filter, the range is set to the same range as the computed channel.

Zooming in on the Waveform

The procedure of "Zooming in or out Vertically by Setting the Zoom Rate" and "Zooming/ Expanding Vertically According to the Upper and Lower Limits of the Display Range" is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

Setting the Waveform Label

The procedure is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

Setting the Unit

The procedure is the same as the procedure described in section 15.2, "Performing Addition, Subtraction, Multiplication, and Division (DSP Channels)." See page 15-4.

Variable OFF **Variable ON**

15

Using the DSP Channel (Optional)

Explanation

When the value of the computed channel is greater than the elimination level, filter computation is performed. If the value is less than the elimination level, the computed result is set to 0. This filter is effective such as when extracting only the knocking components from the pressure inside the engine cylinder.
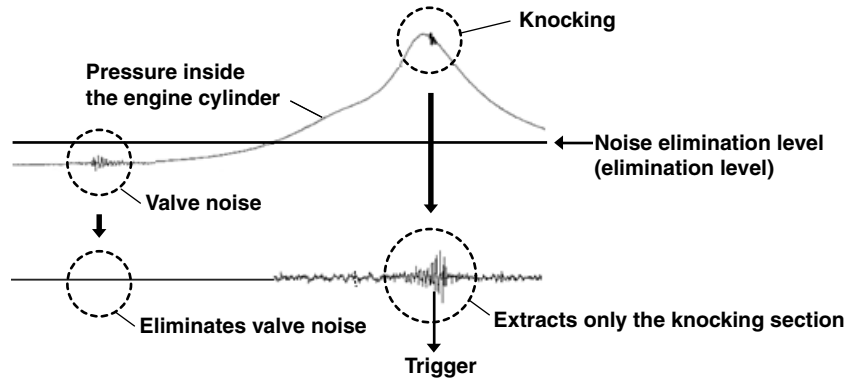
Knocking

Pressure inside
the engine cylinder

Noise elimination level
(elimination level)

Valve noise

Eliminates valve noise

Extracts only the knocking section

Trigger

Computed Channels

CH1 to CH16 and DSP1 to DSP6 (optional)
The computed result of a DSP channel can be specified as a computation source of another DSP channel, but only DSP channels with a channel number smaller than itself can be specified.

Digital Filter That Can Be Used in the Knocking Filter

The following three digital filters can be specified. (For details, see appendix 6.)
Sharp, IIR (Butterworth), and Diff (differentiation)

Filter Format	Characteristics	Filter Type	Computation Type
SHARP	Attenuation slope of the frequency response is steep (–40 dB per octave)	HPF*	FIR
	Linear phase and constant group delay	BPF*	
	Ripple exists in the passband		
	Stop band is comb-shaped		
IIR (Butterworth)	Attenuation slope is between SHARP and GAUSS	HPF	IIR
	Not linear phase and group delay not constant	BPF	
	No ripple in either passband or stopband		
	Close to the characteristics of an analog filter		
	Cutoff frequency can be set lower than SHARP/GAUSS		
Diff (differentiation)	Performs the same computation as the differentiation described in section 15.4.		

*   HPF: High-pass filter, BPF: Band-pass filter

The cutoff frequency, center frequency, and pass band can be specified in terms of percentages of fs (sampling frequency).

Type	Filter Band[1]	Cutoff Frequency[2]	Center Frequency[3]	Pass Band[4]
Sharp	HPF	2.0% to 30.0%	-	-
	BPF	-	3.0% to 30.0%	2% of fs
		-	4.6% to 30.0%	5% of fs
		-	7.0% to 30.0%	10% of fs
		-	9.6% to 30.0%	15% of fs
		-	12.0% to 30.0%	20% of fs
IIR	HPF	0.2% to 30.0%	-	-
	BPF	-	0.6% to 30.0%	1% of fs
		-	1.2% to 30.0%	2% of fs
		-	2.6% to 30.0%	5% of fs
		-	5.2% to 30.0%	10% of fs
		-	7.6% to 30.0%	15% of fs
		-	10.2% to 30.0%	20% of fs
Diff (differentiation)		Performs the same computation as the differentiation described in section 15.4.		

1　HPF: High-pass filter, BPF: Band-pass filter
2　The cutoff frequency (CutOff) can be specified only when HPF is selected.
　　The resolution is 0.2%.
3　The center frequency can be specified only when BPF is selected.
　　The resolution is 0.2%.
4　The pass band can be specified only when BPF is selected.
　　You can select the pass band from 1%, 2%, 5%, 10%, 15%, and 20%.

Setting the Elimination Level

Set the reference level for noise elimination. The selectable range and resolution of the elimination level are the same as those of the trigger level. See section 6.5.

Setting Value/Div

Like V/div, Value/Div is set using 1-2-5 steps. The selectable range is 10.00E–21 [Value/Div] to 500.0E+18 [Value/Div] with 123 settings.
Turn the V/DIV knob to set the Value/Div value. You can also set Value/Div by pressing the Value/Div soft key and turning the jog shuttle.

Automatically Selecting the Optimum Value/Div Setting

When you press the Optimize Value/Div soft key, the optimum range is automatically selected from the 123 Value/Div settings, and the waveform is displayed using the selected setting.

Zooming in on the Waveform

* **Zooming in or out Vertically by Setting the Magnification**
  For details, see section 5.8, "Zooming Vertically by Setting the Zoom Rate" and "Notes Concerning Display" in section 15.1.

* **Zooming/Expanding Vertically According to the Upper and Lower Limits of the Display Range**
  For details, see section 5.9, "Zooming Vertically According to the Upper and Lower Limits of the Display Range" and "Notes Concerning Display" in section 15.1.

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Using the DSP Channel (Optional)

Setting the Unit

Unit can be set arbitrarily using up to four characters. The specified characters are applied to the scale values.

**Notes When Using the Knocking Filter**

The following limitations exist depending on the acquisition mode setting.

*   **When the Acquisition Mode Is Set to a Mode Other Than Envelope**
    The digital filter frequency is set in terms of a percentage of the sampling frequency. For example, if the sampling frequency is 100 kHz and you set the cutoff frequency to 10%, the cutoff frequency is set to 10 kHz. If the sampling frequency exceeds 100 kHz, the sampling frequency of DSP channels is decimated to 100 kHz. Therefore, if the sampling frequency exceeds 100 kHz, the specified frequency is a percentage of 100 kHz regardless of the actual sampling frequency.

*   **When the Acquisition Mode Is Set to Envelope**
    The sampling frequency of DSP channels is fixed to 100 kHz. The digital filter frequency is set in terms of a percentage of 100 kHz.

Note
    For other notes concerning DSP channels, see section 15.1.

16.1 Connecting the DL750/DL750P to the Network

Ethernet Interface Specifications

A 100BASE-TX port is provided on the left side panel of the DL750/DL750P.

Item	Specifications
Number of communication ports	1
Electrical and mechanical specifications	Conforms to IEEE802.3
Transmission system	Ethernet (100BASE-TX/10BASE-T)
Transmission rate	100 Mbps max.
Communication protocol	TCP/IP
Supported services	FTP server, FTP client (network drive), LPR client (network printer), SMTP client (mail transmission), DHCP, DNS, and Web server
Connector type	RJ-45 connector

ETHERNET 100BASE-TX port

LINK LED
Illuminates when the link between the port on the DL750/DL750P and the connected device is established and communication is mutually possible.

ACT LED
Blinks when packet transmission is being carried out normally.

RJ-45 modular jack
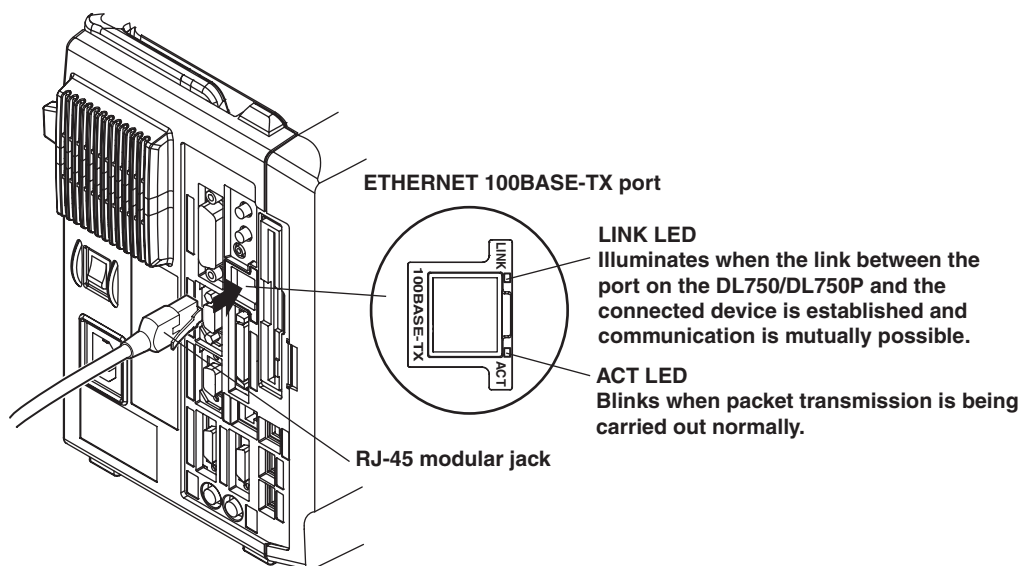
Items Necessary for Connection

Cable

Be sure to use one the following cables for connection.
* UTP (Unshielded Twisted-Pair) cable (category 5 or better)
* STP (Shielded Twisted-Pair) cable (category 5 or better)

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Ethernet Interface (Optional)

Connection Procedure

When Connecting to a Network PC or Workstation

1. Turn OFF the DL750/DL750P.
2. Connect one end of the UTP (or STP) cable to the ETHERNET 100BASE-TX terminal on the left side panel.
3. Connect the other end of the UTP (or STP) cable to a hub or router.
4. Turn ON the DL750/DL750P.

Hub or router that supports 100BASE-TX

PC or Workstation

DL750/ DL750P

UTP cable or STP cable (Straight cable)
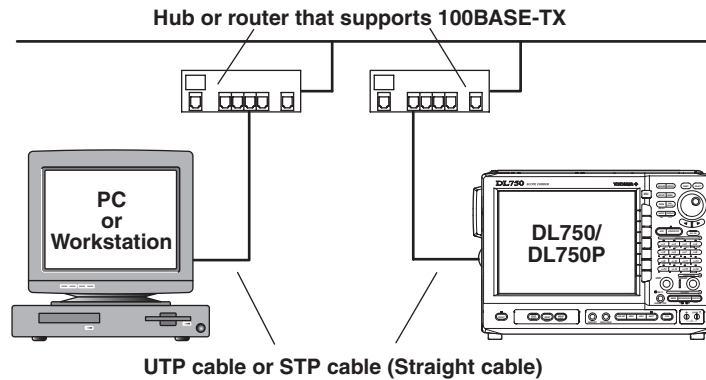
When Making a One-to-One Connection to the PC or Workstation

1. Turn OFF the DL750/DL750P and the PC or workstation.
2. Connect one end of the UTP (or STP) cable to the ETHERNET 100BASE-TX terminal on the left side panel.
3. Connect the other end of the UTP (or STP) cable to a hub or router.
4. Likewise, connect the PC or workstation to a hub or router.
5. Turn ON the DL750/DL750P.

Hub or router that supports 100BASE-TX

PC or Workstation

DL750/ DL750P

UTP cable or STP cable (Straight cable)
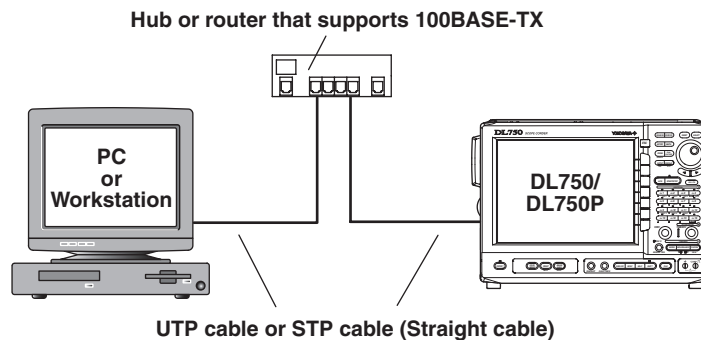
Note

- When connecting the PC or workstation one-to-one, a NIC (a 10BASE-T/100BASE-TX autoswitching card) is required for the PC or workstation.
- When using a UTP cable or STP cable (straight cable), be sure to use only a category 5 cable.
- Avoid connecting the PC or workstation directly to the DL750/DL750P without going through the hub or router. Operations are not guaranteed for communications using direct connection.

16.2 Setting up the TCP/IP

Procedure
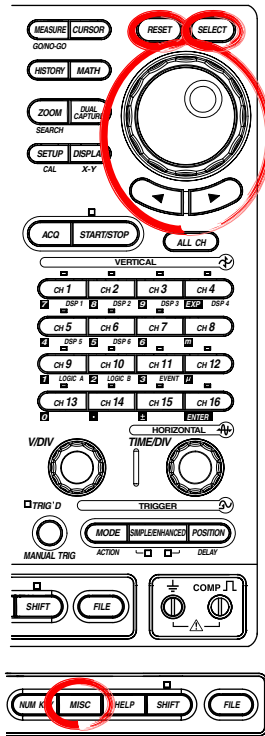
1. Press **MISC**.
2. Press the **Network** soft key.
3. Press the **TCP/IP Setup** soft key. The TCP/IP setup menu appears.

Turning DHCP ON/OFF

4. Use the **jog shuttle** and **SELECT** to set DHCP to ON or OFF.

   If you DHCP to OFF, proceed to step 5.
   If the DHCP is set to ON, you do not have to set the IP address, subnet mask, and default gateway.
   • To set up the DNS, proceed to step 11.
   • If you do not wish to set up the DNS, check the network cable connection and restart the DL750/DL750P. The IP address, subnet mask, and default gateway are automatically configured.

Setting the IP Address

Set the IP address if you turned DHCP OFF.

5. Use the **jog shuttle** and **SELECT** to set the IP Address. Enter using values in the range of 0 to 255.

Setting the Subnet Mask

Set the subnet mask if you turned DHCP OFF.

6. Use the **jog shuttle** and **SELECT** to set the Net Mask. Enter using values in the range of 0 to 255.

Setting the Default Gateway

Set the default gateway if you turned DHCP OFF.

7. Use the **jog shuttle** and **SELECT** to set the Gate Way. Enter using values in the range of 0 to 255.
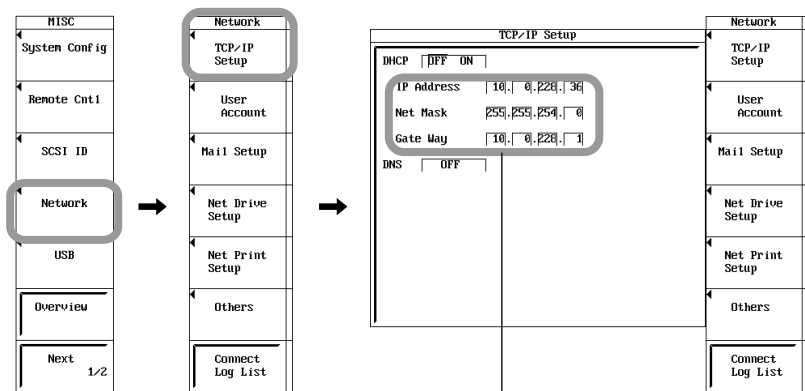
Automatically configured when DHCP is turned ON.

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Ethernet Interface (Optional)

Setting the DNS

8. Use the **jog shuttle** and **SELECT** to set DNS to ON, OFF, or AUTO. (AUTO can be specified when DHCP is ON.)
    When DNS is set to AUTO, the domain name and DNS server name are automatically configured by power-cycling the DL750/DL750P.
    If DNS is set to ON, the domain name, DNS server name, and domain suffix are displayed.
    If DNS is set to OFF, check the network cable connection and power cycle the DL750/DL750P.

Setting the Domain Name

9. Use the **jog shuttle** and **SELECT** to select Domain Name.
10. Enter the domain name according to the procedure given in section 4.2.

Setting the DNS Server

11. Use the **jog shuttle** and **SELECT** to set DNS Server1 (primary DNS server). Enter using values in the range of 0 to 255.
12. Likewise, set the secondary DNS server in DNS Server2.

Setting the Domain Suffix

13. Use the **jog shuttle** and **SELECT** to set Domain Suffix1 (primary domain suffix).
14. Likewise, set the secondary domain suffix in Domain Suffix2.

Note

For keyboard (soft keyboard) operation, see section 4.2, "Entering Values and Strings."

Turning ON/OFF the Power

15. To apply the new settings, the DL750/DL750P must be power cycled.
    After all the settings are complete, turn the power to the DL750/DL750P OFF, then back ON again.

Explanation

The following TCP/IP settings must be entered to use the Ethernet communications functions on the DL750/DL750P.
*   IP address
*   Subnet mask
*   Default gateway

IP Address (Internet Protocol Address)

Set the IP address to assign to the DL750/DL750P. The default setting is "0.0.0.0."
The IP address is an ID that is assigned to each PC on an IP network such as the internet or an intranet. The address is a 32-bit value expressed using four octets (each 0 to 255), each separated by a period as in [192.168.111.24].
Obtain an IP address from your network administrator. The setting is automatically configured in environments using DHCP.

Subnet Mask (Net Mask)

Set the mask value used when determining the subnet network address from the IP address. The default setting is "255.255.255.0."
Huge TCP/IP networks such as the Internet are often divided up into smaller networks called sub networks. The subnet mask is a 32 bit value that specifies the number of bits of the IP address used to identify the network address. The portion other than the network address is the host address that identifies individual computers on the network.
Consult your network administrator for the subnet mask value. You may not need to set the value. The setting is automatically configured in environments using DHCP.

Default Gateway

Set the IP address of the gateway (default gateway) used to communicate with other networks. The default setting is "0.0.0.0."
The default gateway has control functions that handle protocol exchanges when communicating with multiple networks, so that data transmission is carried out smoothly..
Consult your network administrator for the default gateway value. You may not need to set the value. The setting is automatically configured in environments using DHCP.

DHCP (Dynamic Host Configuration Protocol)

DHCP is a protocol that allocates setup information that are needed temporarily to the PCs connecting to the network. When DHCP is turned ON, the following settings are automatically assigned.
*   IP address
*   Subnet mask
*   Default gateway
*   DNS

To use DHCP, the network must have a DHCP server. Consult your network administrator to see if DHCP can be used.
When DHCP is turned ON, different settings may be assigned each time the power is turned ON. When using the FTP server function (see section 16.6), be sure to check the IP address and other settings of the DL750/DL750P using a PC or workstation each time you turn ON the DL750/DL750P.

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Ethernet Interface (Optional)

DNS (Domain Name System)

DNS is a system used to associate names used on the Internet called host names and domain names to IP addresses. (Given AAA.BBBBB.com, AAA is the host name and BBBBB.com is the domain name.) Instead of using the IP address, which is a sequence of numbers, host name and domain name can be used to access the network.

On the DL750/DL750P, you can specify the host by name instead of by IP address when using the FTP client function (see section 16.3) or network printer function (see sections 16.4 and 12.4).

Set the domain name, the DNS server address ("0.0.0.0" by default), and the domain suffix. In networks that support DHCP, these settings can be configured automatically. For details, consult your network administrator.

- **DNS Server: DNS Server1/DNS Server2**
  Up to two DNS server addresses can be specified (primary and secondary). If the primary DNS server is down, the secondary DNS server is automatically looked up for the mapping of the host name/domain name and IP address.

- **Domain Suffix: Domain Suffix1/Domain Suffix2**
  When the IP address corresponding to the server name with the aforementioned domain name is not found, the system may be set up to search using a different domain name. Enter this alternate domain name as the domain suffix. Up to two domain suffixes can be specified, Domain Suffix1 (primary), and Domain Suffix2 (secondary).

Note

- If you changed settings related to the Ethernet network, the DL750/DL750P must be power cycled.
- If the DL750/DL750P is turned ON with the DHCP function enabled without an Ethernet cable connected, communications and file functions may not operate properly. In this case, turn DHCP OFF and power cycle the DL750/DL750P.

- **Configuring the TCP/IP Settings of the PC**
  Communication parameters such as the IP address must also be specified on the PC side. Communication parameters are specified for each Ethernet NIC that is installed in the PC. Here, the settings of the NIC for connecting your PC and the DL750/DL750P are explained.
  If the IP address and other parameters are to be obtained dynamically using the DHCP server, the following settings are not necessary. In this case, select **Obtain an IP address automatically** under the **IP Address** tab of the **TCP/IP Properties** dialog box. For example, if you are connecting a PC and the DL750/DL750P to an independent Ethernet network, you can specify parameters as indicated in the next table. For details on the parameters, consult your system or network administrator.

Parameter	Value	Remarks
IP address	Example: 192.168.21.128	IP address for the PC
Subnet mask	Example: 255.255.255.0	Set the same value as the subnet mask that was specified for the DL750/DL750P.
Gateway	None	
DNS	Disable	
WINS	Disable	

The following procedure describes the steps for Windows 95/98/ME. For Windows NT/ 2000 Pro/XP, carry out equivalent steps accordingly.
1. Choose **Settings** > **Control Panel** from the **Start** menu to open the Control Panel folder.
2. Double-click the **Network** icon to display the following network setup dialog box.
3. Select the **TCP/IP** corresponding to the Ethernet NIC that is connected to the PC and click **Properties** to display the TCP/IP properties setup dialog box.
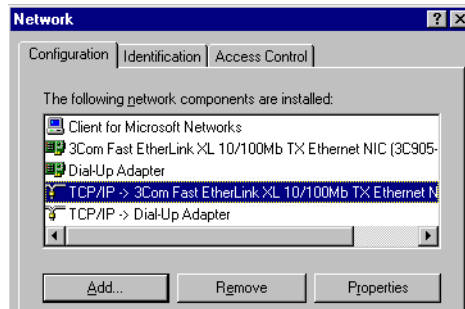
4. Set the parameters such as the IP address according to the table on the previous page and click **OK**.
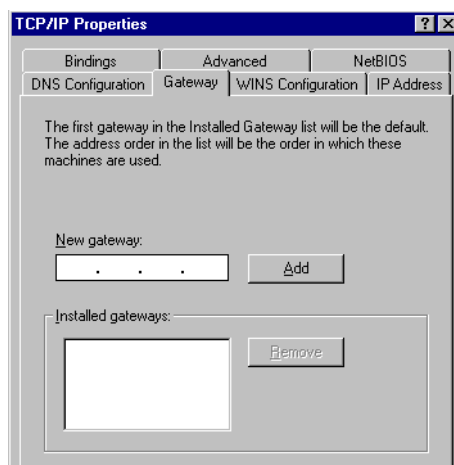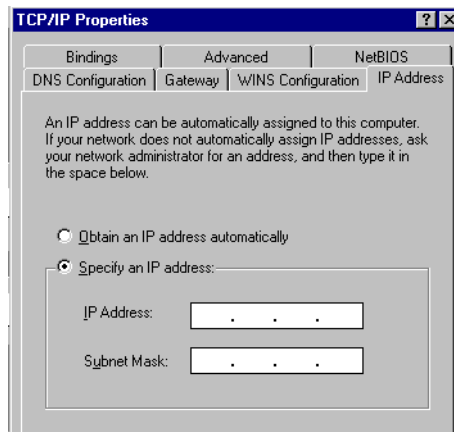
16.3 Saving/Loading Data to a Network Drive (FTP Client Function)

Procedure
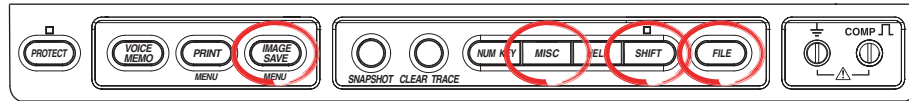
1. Press **MISC**.
2. Press the **Network** soft key.
3. Press the **Net Drive Setup** soft key. The Net Drive setup menu appears.
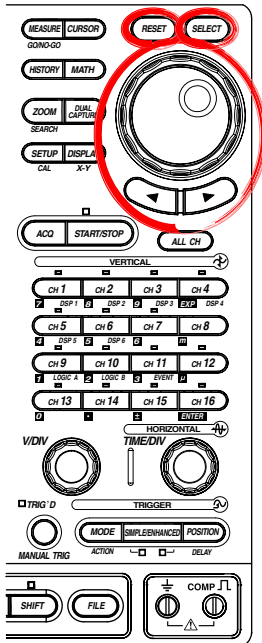
Setting the FTP Server

4. Use the **jog shuttle** and **SELECT** to select FTP Server.
5. Enter the IP address of the FTP server according to the procedure given in section 4.2. When using DNS (section 16.2), you can specify the address by name.

Setting the Login Name and Password

6. Use the **jog shuttle** and **SELECT** to select Login Name.
7. Enter the login name using up to 15 characters according to the procedure given in section 4.2.
8. Use the **jog shuttle** and **SELECT** to select Password.
9. Enter the password corresponding to the login name using up to 15 characters according to the procedure given in section 4.2.

Setting the Timeout Time

10. Use the **jog shuttle** and **SELECT** to set Time Out. The selectable range is 0 to 3600 (s).

Note

- For keyboard (soft keyboard) operation, see section 4.2, "Entering Values and Strings."
- If Login Name is set to anonymous, you do not have to enter the password.
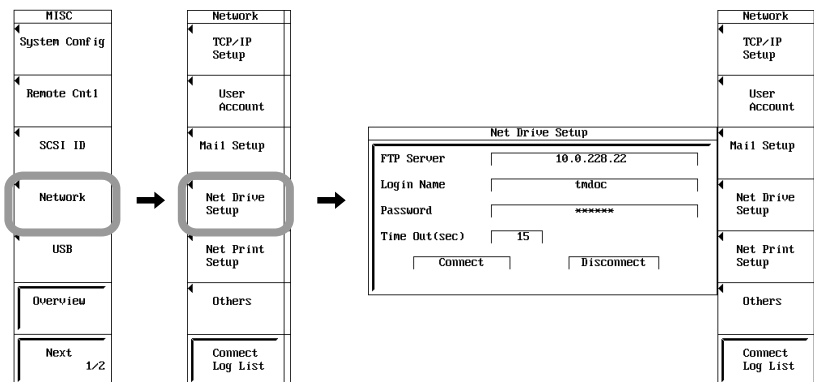
Connecting/Disconnecting to a Network Drive

11. Use the **jog shuttle** and **SELECT** to select Connect. Connection is made to the network drive. When the connection is established, 🖥 is displayed at the upper right corner of the screen.
Use the **jog shuttle** to move the cursor to Disconnect, then press **SELECT** to close the connection. The 🖥 displayed at the upper right corner of the screen disappears.

```
                    Net Drive Setup
FTP Server        |       10.0.228.22        |
Login Name        |          tmdoc           |
Password          |          ******          |
Time Out(sec)     |    15    |
        [   Connect   ]         [  Disconnect  ]
```
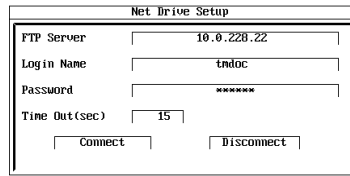
Saving/Loading the Screen Image, Waveform, and Setup Data

• **Saving/Loading the screen image data**
12. Press **SHIFT+IMAGE SAVE**.
13. Press the **File List** soft key. The File List window appears.
14. Use the **jog shuttle** to select [Network] in the File List window.
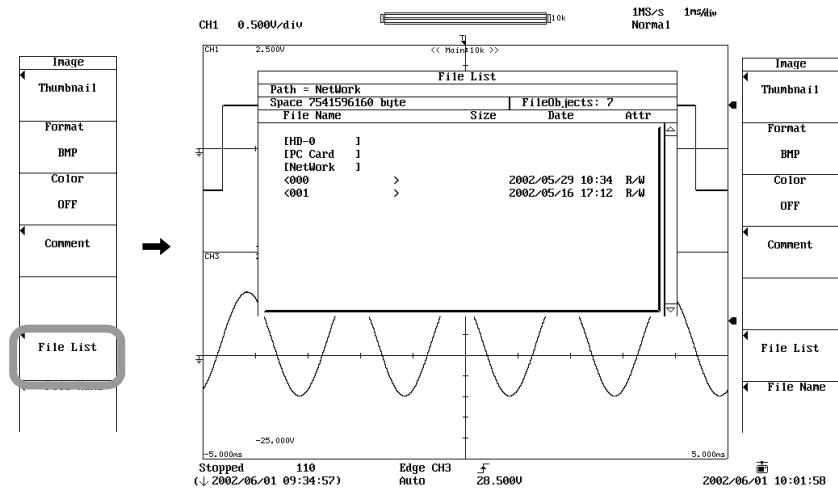
15. The succeeding procedure is the same as the procedure described in section 13.11, "Saving Screen Image Data" and section 13.12, "Displaying Thumbnails of the Saved Screen Image Data." To save screen image data by attaching a comment, see section 13.19, "Using the Voice Comment Function."

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Ethernet Interface (Optional)

• **Saving/Loading Waveform Data and Setup Data**
12. Press **FILE**.
13. Press the **Utility** soft key. The File List window appears.
14. Use the **jog shuttle** to select [Network] in the File List window.
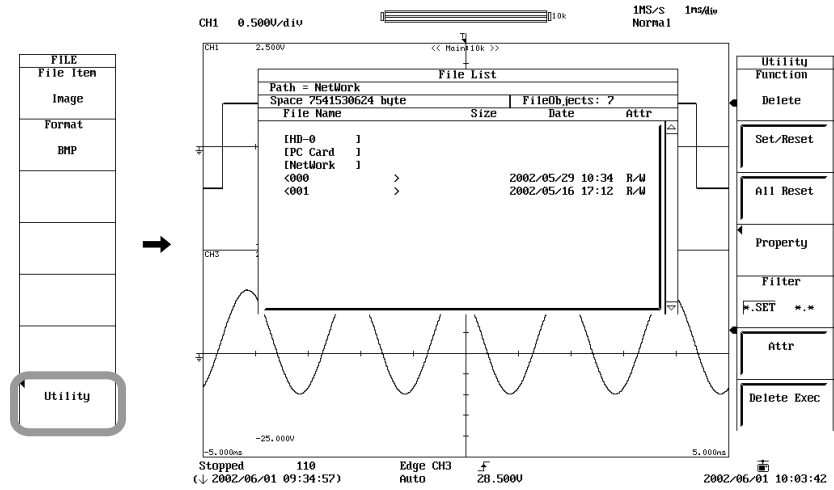
15. The succeeding procedure is the same as the procedure described in section 13.8, "Saving/Loading the Setup Data" and section 13.7, "Saving/Loading the Waveform Data." In addition, waveform data with a voice memo attached can be saved/loaded. For details, see section 7.9, "Using the Voice Memo Function."

Note

- An FTP server software must be running on the PC or workstation to which the DL750/DL750P is to be connected. In addition, the following points need attention regarding the server program settings.
- Set the list output (string returned by the dir command) to UNIX format.
- Set the home directory and its subdirectories to allow writing.
- The client cannot move above the home directory.
- The newest file is not necessarily displayed at the top of the file list.
- Files and directories that are longer than 17 characters cannot be accessed.
- Depending on the server, "<..>" that indicates a higher directory may not be displayed.
- The time information in the file list will not be displayed correctly for the following cases.
  - On Windows NT when the time stamp is displayed using am and pm.
  - Servers that return characters other than ASCII characters in the list
- The following operations are not possible.
  - Turning file protect ON and OFF on saved files.
  - Formatting a network drive.
  - Copying between network drives.
  - Renaming a file on the network.
- This function cannot be used when using the FTP server function or the Web server function.
- To use this function, you must configure TCP/IP according to the procedure given in section 16.2.
- To apply new settings that are made while connected to a network drive, drop the connection using Disconnect and reconnect.
- If you are disconnected by the server when using the FTP client, you will be automatically reconnected if you perform a file operation. This also hold true, if the network drive is selected for Save to File when using an action trigger or GO/NO-GO.

Explanation

You can save the screen image data, waveform data, and setup data to network drives via the Ethernet network in the same fashion as with the floppy disk drive, Zip disk drive, and PC card drive.

If you wish to make the DL750/DL750P the FTP server and access the DL750/DL750P from an FTP client on the network, see section 16.6.

FTP Server

Enter the IP address of the FTP server (the PC or workstation running the FTP server) on the network to which waveform and setup data will be saved. On networks supporting DNS, you can specify the host and domain by name instead of the IP address.

Login Name

Enter the login name using up to 15 characters. The default setting is "anonymous." The characters that can be used are all the ASCII characters on the keyboard.

Password

Enter the password corresponding to the login name using up to 15 characters. The characters that can be used are all the ASCII characters on the keyboard.

Time Out

When an FTP server is accessed from the DL750/DL750P and data is not transmitted for a certain period of time (timeout time), the DL750/DL750P decides that the transmission to the FTP server is not possible and closes the connection. You can set the timeout value in the range of 0 to 3600 s. The default setting is 15 s.

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Ethernet Interface (Optional)

16.4 Setting up the Network Printer

Procedure
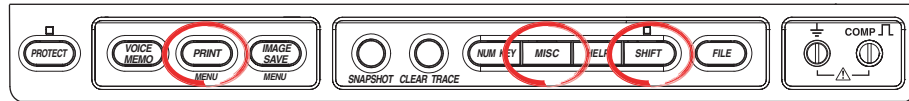
1. Press **MISC**.
2. Press the **Network** soft key.
3. Press the **Net Print Setup** soft key. The Net Print setup menu appears.
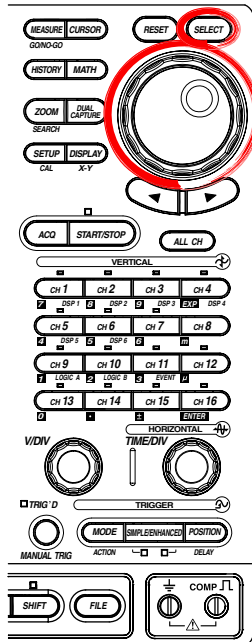
Setting the LPR Server

4. Use the **jog shuttle** and **SELECT** to select LPR Server.
5. Enter the IP address of the printer server according to the procedure given in section 4.2. If you are using DNS, you can specify the printer server by name.

Setting the Printer Name

6. Use the **jog shuttle** and **SELECT** to select LPR Name.
7. Enter the printer name according to the procedure given in section 4.2.

Note

For keyboard (soft keyboard) operation, see section 4.2, "Entering Values and Strings."

Printing the Screen Image Data

8. Print the screen image data according to the procedure given in section 12.4, "Printing the Screen Image Data on a Network Printer."

Note

• To use this function, configure the TCP/IP settings beforehand according to section 16.2, "Setting up the TCP/IP."
• Output is possible to printers or printer servers that support the TCP/IP protocol.
• This function cannot be used when using the FTP server function or the Web server function, or when performing file operations.
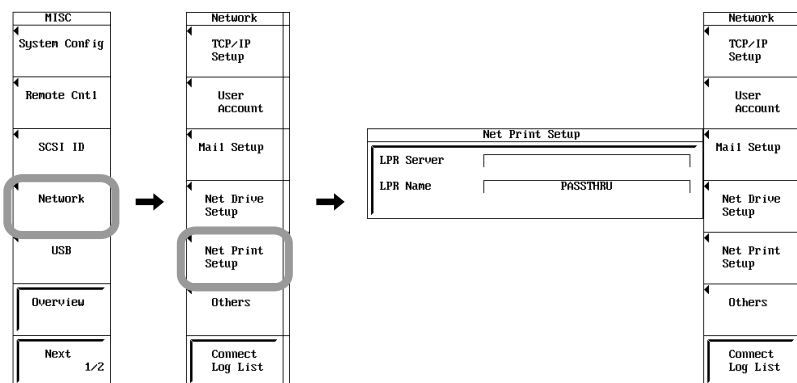
Explanation

As with the built-in printer, you can print the screen image data on a network printer via the Ethernet network.

Setting the Network Printer: Net Print Setup

* **LPR Server**
  Specify the IP address of the network printer server. On networks supporting DNS, you can specify the host and domain by name instead of the IP address.

* **Printer Name: LPR Name**
  Specify the name of the printer on which screen image data will be printed.

Selecting the Output Format

The following six printer formats are supported.
* ESC-P
* ESC-P2
* LIPS3
* PCL5
* BJ
* PostScript

16

Ethernet Interface (Optional)

16.5 Sending Periodic Mail or Action Mail (SMTP Client Function

<**For a description of this function, refer to page 2-60.**>

Procedure

Sending Periodic E-mail Messages
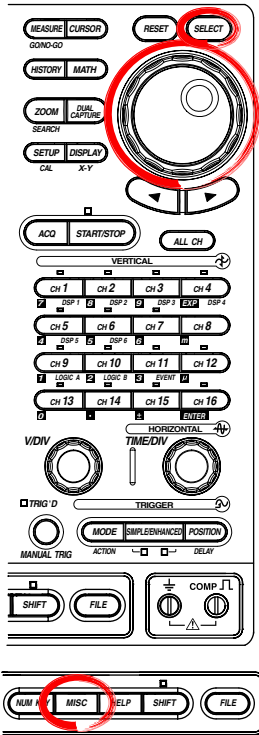
1.   Press **MISC**.
2.   Press the **Network** soft key.
3.   Press the **Mail Setup** soft key. The Mail setup menu appears.

Setting the Mail Server

4.   Use the **jog shuttle** and **SELECT** to select Mail Server.
5.   Enter the IP address of the mail server according to the procedure given in section 4.2. If you are using DNS, you can specify the mail server by name.

Setting the Recipient Mail Address

6.   Use the **jog shuttle** and **SELECT** to select Mail Address.
7.   Enter the recipient mail address using up to 40 characters according to the procedure given in section 4.2.

Setting a Comment

8.   Use the **jog shuttle** and **SELECT** to select Comment.
9.   As necessary, enter the comment using up to 30 characters according to the procedure given in section 4.2.

Setting the Time When the Mail Is to Be Sent

10.   Use the **jog shuttle** and **SELECT** to select the hour, minute, or second of MailBaseTime
11.   Enter the time when mail is to be sent according to the procedure given in section 4.2.

Setting the Attached Image File

12.   Use the **jog shuttle** and **SELECT** to select ON (attach image file) or OFF (do not attach image file).

Setting the Interval for Sending Mail

13.   Use the **jog shuttle** and **SELECT** to select Interval.
14.   Select the interval for sending mail in the range of 1 h to 24 h according to the procedure given in section 4.2.

Sending a Test Mail

15.   Turn the **jog shuttle** to move the cursor to Mail Test.
      To send a test mail to the specified recipient, press **SELECT**.
      While mail transmission is in progress, ⊠≈ is indicated at the upper left corner of the screen.
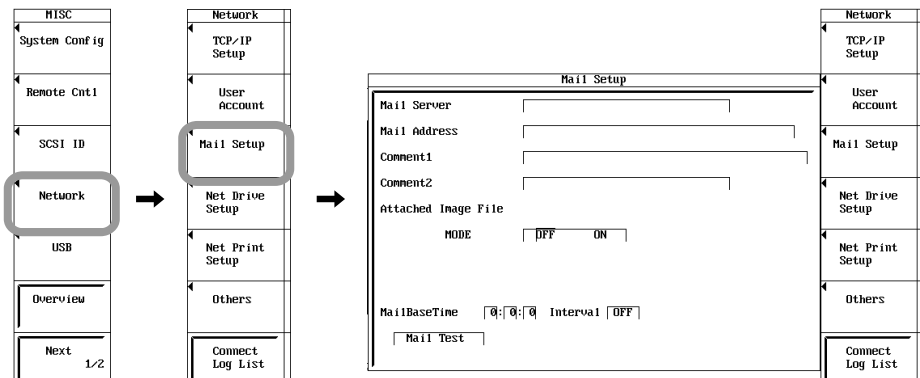
Note

- For keyboard (soft keyboard) operation, see section 4.2, "Entering Values and Strings."
- The sender (From) address of the e-mail messages sent by the DL750/DL750P is the same as the specified recipient address.
- If the transmitted contents indicate error logs, the most recent error is at the top of the error log.
- To use this function, configure the TCP/IP settings beforehand according to section 16.2, "Setting up the TCP/IP."
- If you set Interval to OFF, periodic mail is not sent.

Sending Action E-mail Messages
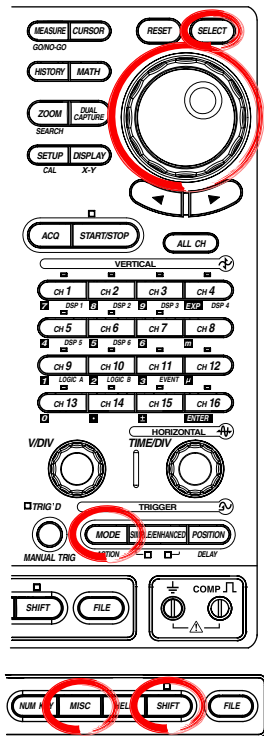
1. Set items according to steps 1 to 9 in "Sending Periodic E-mail Messages."
    You do not have to set MailBaseTime and Interval for action mail. If you wish to use only action mail, set Interval to OFF.

Setting the Action

- **From the ACTION Menu**
    2. Press **SHIFT+MODE**.
    3. Press the **Mode** soft key to select ON.
    4. Press the **Action** soft key. The action setup menu appears.
    5. Use the **jog shuttle** and **SELECT** to set Send Mail to ON.
    6. Use the **jog shuttle** and **SELECT** to set Mail Count (the number of mail messages).
    7. Press **START/STOP** to start the waveform acquisition. A mail is sent to the specified address each time a trigger occurs.
        While mail transmission is in progress, ⊠≈ is indicated at the upper left corner of the screen.

16
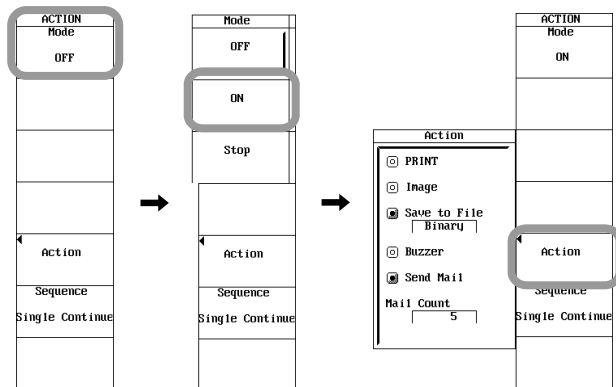
Ethernet Interface (Optional)

- **From the GO/NO-GO Menu**
  2. Press **SHIFT+MEASURE**.
  3. Press the **Mode** soft key. The Mode selection menu appears.
  4. Press the **Zone** or **Parameter** soft key.
  5. Set GO/NO-GO items according to the procedure in section 11.8 and 11.9.
  6. Press the **Action** soft key. The action setup menu appears.
  7. Use the **jog shuttle** and **SELECT** to set Send Mail to ON.
  8. Use the **jog shuttle** and **SELECT** to set Mail Count (the number of mail messages).
  9. Press the **Exec** soft key to start the GO/NO-GO operation. When a specified condition occurs, a mail is sent to the specified address.
     While mail transmission is in progress, ⊠≈ is indicated at the upper left corner of the screen.
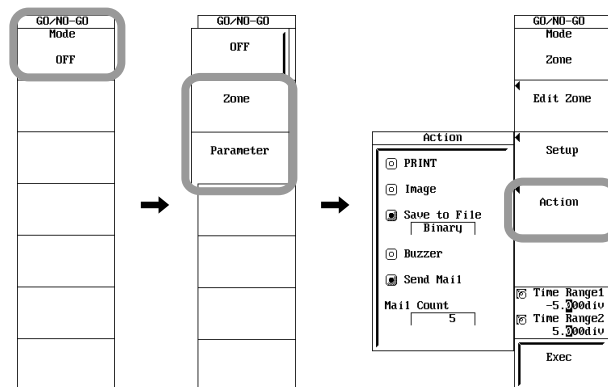
Note

- The mail recipient is the address specified in "Mail Address" of "Network"/"Mail Setup" in the MISC menu.
- The sender (From) address of the e-mail messages sent by the DL750/DL750P is the same as the specified recipient address.
- Periodic mail and action mail can be used together. To use only action mail, set Interval to OFF.
- To use this function, configure the TCP/IP settings beforehand according to section 16.2, "Setting up the TCP/IP."

Explanation

Mail Server

Specify the IP address of the network mail server. On networks supporting DNS, you can specify the host and domain by name instead of the IP address.

Mail Address

Enter the recipient address using up to 40 characters.

Comment

The comment is written on the first line of the transmitted mail. Enter it as necessary. Enter comment using up to 30 characters.

Transmission Time: MailBaseTime

The time when mail transmission is to start can be set in units of hour, minute, and second, in the following range.
0:0:0 to 23:59:59

Attaching Image Data (Attached Image File, Version 4.01 or Later)

The screen image shown at the time of mail transmission can be attached to the mail. The data format of the screen image data is the format specified in section 13.11, "Saving Screen Image Data."
The file name differs between periodic mail and action mail.

> File name of periodic mail: DL_image.png
> File name of action mail: DL_nnnn.png (where nnnn is an automatically assigned number in the range of 0001 to 1000)

Transmission Interval

The following mail transmission intervals are available.
OFF, 1 H, 2 H, 3 H, 4 H, 6 H, 8 H, 12 H, and 24 H
However, if you select OFF, periodic mails cannot be transmitted.

Sending a Test Mail: Mail Test

A test mail is sent to the address specified by Mail Address.

16

Ethernet Interface (Optional)

Periodic Mail

The DL750/DL750P status can be sent periodically to a specified mail address on the network.

*   **DL750/DL750P Information That Is Transmitted**
    *   **Acquisition Condition**
        Start/Stop, trigger condition, and acquisition counter
    *   **Error Log Information**
        Error number and corrective action in English (up to 16 errors)
    *   **Success/Fail Information of GO/NO-GO**
        Only when GO/NO-GO determination is executed (see sections 11.8 and 11.9)
    *   **Results of Waveform Parameter Measurement**
        Only when automated measurement of waveform parameters (see section 11.6) or GO/NO-GO determination using waveform parameters (see section 11.8) is executed.
        The maximum number of measurement results of waveform parameters that are sent is the same as the maximum number (24) of measurement results displayed on the DL750/DL750P.

*   **Sample Periodic Mail**
    [Comment]   aaaaaa

    [ACQ Status]   Stopped   162

    [GO/NOGO Status]   Success: 140   Fail: 21

    Max (C1)   4.16667V
    SDv (C2)   697.941mV
    Freq(C3)   500.0000kHz
    +Wd (C4)   1.00us>

    ErrNo 004 Exit from GO/NO-GO mode.

    ErrNo 806 Cannot change settings during GO/NO-GO.
    Stop the GO/NO-GO.

    ErrNo 004 Exit from GO/NO-GO mode.

    ErrNo 806 Cannot change settings during GO/NO-GO.
    Stop the GO/NO-GO.

    ErrNo 602 No SCSI device or no media inserted.
    Check the SCSI device connection and
    the SCSI ID, and make sure that the storage
    medium is inserted (if applicable).

Action Mail

Information such as the trigger time can be sent to a specified mail address on the network as an action of action-on-trigger or GO/NO-GO determination.

- **DL750/DL750P Information That Is Transmitted**
  - **Acquisition Condition**
    Start/Stop, acquisition counter
  - **Trigger Time**
  - **Success/Fail Information of GO/NO-GO**
    Only when GO/NO-GO determination is executed (see sections 11.8 and 11.9).
  - **Results of Waveform Parameter Measurement**
    Only when automated measurement of waveform parameters (see section 11.6) or GO/NO-GO determination using waveform parameters (see section 11.8) is executed.
  - **Fail Cause**
    Only when GO/NO-GO determination is executed (see sections 11.8 and 11.9).

- **Sample Action Mail**

  [Comment]   aaaaaa

  [ACQ Status]   Stopped   1

  [Trigger Date and Time]   2002/06/17   17:28:59.38

  [GO/NOGO Status]   Success: 9   Fail: 1

  [NOGO Factor]   Param4(Ch4,tWd)

  Max (C1)   4.16667V
  SDv (C2)   697.941mV
  Freq(C3)   500.0000kHz
  +Wd (C4)   1.00us>

16.6 Accessing the DL750/DL750P from a PC or Workstation (FTP Server Function)

<For a description of this function, refer to page 2-60.>

Procedure

This section describes the FTP server function when a general FTP client software (such as WS_FTP or FFFTP) is used. To use FTP through the Web browser, see section 16.7.
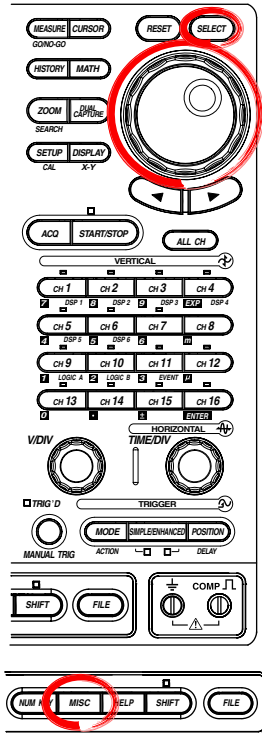
1. Press **MISC**.
2. Press the **Network** soft key.
3. Press the **User Account** soft key. The User Account setup menu appears.

Setting the User Name

4. Use the **jog shuttle** and **SELECT** to select User Name.
5. Enter the user name according to the procedure given in section 4.2. Specify anonymous if you wish to allow access to all users. To restrict access, enter the user name using up to 15 characters.

Setting the Password

6. Use the **jog shuttle** and **SELECT** to select Password.
7. Enter the password using up to 15 characters according to the procedure given in section 4.2.
   If you select the ENT key on the soft keyboard or press the ENT soft key, the entered password (appears as *****) is cleared from the soft keyboard screen. Enter the password again for confirmation. The password (appears as *****) is confirmed and displayed in the Password column of the User Account setup menu. If the password entered the second time is different from the first, the entered password is cleared from the soft keyboard screen.
   If the user name is set to anonymous, you do not have to enter the password.

Setting the Timeout Time

8. Use the **jog shuttle** and **SELECT** to set Time Out.
   The connection to the network is automatically closed if there is no access to the DL750/DL750P for the specified time.

Note

For keyboard (soft keyboard) operation, see section 4.2, "Entering Values and Strings."
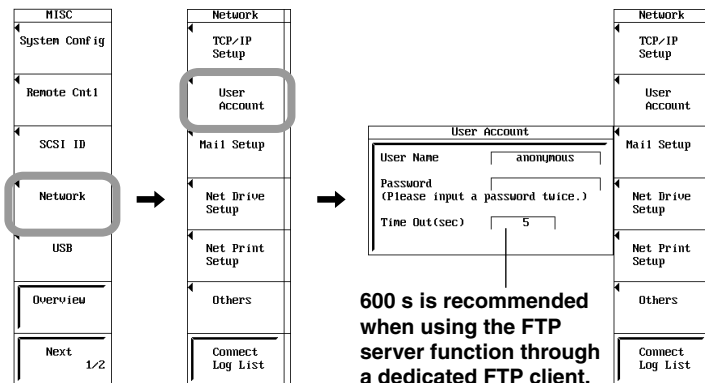
600 s is recommended when using the FTP server function through a dedicated FTP client.

Executing the FTP Client Software

9. Execute an FTP client software on the PC or workstation. Perform file operations using the user name specified in steps 4 and 5.

Displaying the Connection Log List

10. Press the **Connect Log List** soft key. The data and time, user name, and IP address of the 25 recent accesses are displayed.

Note

- The log list is cleared when the power is turned OFF.
- The DL750/DL750P supports two clients, but file operations cannot be performed simultaneously.
- When the DL750/DL750P is being accessed from a PC or workstation (logged in), 🖥 is displayed in the lower right part of the screen.
- This function cannot be used when using the FTP client function, network printer function, or the Web server function, or when performing file operations.
- To use this function, configure the TCP/IP settings beforehand according to section 16.2, "Setting the TCP/IP."
- To apply new settings, the DL750/DL750P must be power cycled.
- The files that can be uploaded to the DL750/DL750P are those with the following extensions.
  .WVF, .HDR, and .SET
  However, do not upload files to the realtime recording area.

16

Ethernet Interface (Optional)

Explanation

You can access the DL750/DL750P's floppy disk drive, Zip drive, PC card drive, internal hard disk (optional), SCSI device, or USB storage device from a PC or workstation via the Ethernet network.

To access the DL750/DL750P, an FTP client software is needed on the PC or workstation.

For a description of the FTP using the Web browser (Web server function), see section 16.7.

User Name

Enter the user name using up to 15 characters. The default setting is "anonymous." The characters that can be used are all the ASCII characters on the keyboard.

Password

Enter the password using up to 15 characters. The characters that can be used are all the ASCII characters on the keyboard.

Time Out

The connection to the network is automatically closed if there is no access to the DL750/DL750P for the specified time.

Note

- It is recommended that the timeout be set to 600 s when using the FTP server function through a dedicated FTP client.
- When using the FTP server function on a Web browser (see section 16.7), it is recommended that the timeout be set to 5 s (default value).

Connect Log List

The data and time, user name, IP address, access result of the 25 recent accesses from the PC or workstation to the DL750/DL750P are displayed.

16.7 Using the Web Server Function

You can use the Web server function on the DL750/DL750P to display the screen image of the DL750/DL750P on the Web browser window on your PC and perform file operations on the DL750/DL750P using the keys displayed on the Web browser window.

This section contains the following information.

Overview of the Web Server Function

- **FTP Server Function (On the Web Browser)**
  View the list of files stored on the storage media of the DL750/DL750P (internal hard disk or built-in storage medium) and transfer files to the PC.
- **Data Capture**
  The following operations can be carried out.
  - Change the display format of the DL750/DL750P and display data that is acquired in the history memory.
  - Display the screen image of the DL750/DL750P.
  - Save the waveform data and setup data to the PC.
  - Load the setup data stored on the PC into the DL750/DL750P.
- **Measurement Trend of the Waveform Parameter Values**
  Using the Excel function, display the trend of the selected waveform parameter values. The statistics of the measured values can also be computed.
- **Control Script**
  Control the DL750/DL750P using communication commands (see the *Communication Interface User's Manual* IM701210-18E.
- **Log**
  Displays the past log of errors that occurred on the DL750/DL750P, GO/NO-GO determination, and action-on-trigger. Up to the 30 newest incidents are logged.
- **Instrument Information**
  Display the model of the DL750/DL750P, the module configuration, the presence/absence of options, the ROM version (firmware version), etc.
- **Link**
  View the Web page for the DL750/DL750P.

System Requirements

PC Environment

- **PC**

  PC running Microsoft Windows 98 Second Edition, Microsoft Windows NT 4.0, Microsoft Windows Millennium Edition, Microsoft Windows 2000 Professional, or Microsoft Windows XP Professional.

- **OS**

  Microsoft Windows 98 Second Edition, Microsoft Windows NT 4.0, Microsoft Windows Millennium Edition, Microsoft Windows 2000 Professional, or Microsoft Windows XP Professional.

- **Internal Memory**

  64 MB or more recommended.

- **Communication Port**

  Ethernet communication port that supports 10BASE-T or 100BASE-TX. Use this communication port to connect the PC to the network.

- **Display**

  Display supported by the OS indicated above with a resolution of 1024 × 768 dots or higher.

- **Mouse or Pointing Device**

  Mouse or pointing device supported by the OS indicated above.

- **Files Required for the Web Browser**

  Of the Web server functions, the following files are required when using the data capture, measurement trend, or command script function. For the installation procedure on the PC, see "Installing Files Required for the Web Browser" (page 16-28).

  ```
  Msvbvm60.dll
  cmdlgjp.dll
  comdlg32.ocx
  ```

- **Combinations of OS and Application Software That Have Been Tested**

OS	Web Browser	Spreadsheet Software[1]
Windows NT	Internet Explorer 5.0	Microsoft Excel 97
Windows 98	Internet Explorer 5.0	Microsoft Excel 97
Windows 98 Second Edition	Internet Explorer 5.0	Microsoft Excel 97
Windows 2000 Professional	Internet Explorer 5.0/5.5/6.0	Microsoft Excel 97
Windows Millennium Edition	Internet Explorer 5.5/6.0	Microsoft Excel 97/2000/2002
Windows XP Professional	Internet Explorer 6.0	Microsoft Excel 2002

  1. The spreadsheet software is required when displaying the trend of waveform parameters of the Web server function.

DL750/DL750P Environment

- **Connection to the Network**

  Connect the DL750/DL750P to the network using the Ethernet. For the connection procedure, see section 16.1.

- **TCP/IP**

  Configure the network environment and IP address for communication using the Ethernet interface. For the procedure, see section 16.2.

- **Communication Interface**

  Set the communication interface to Network. For the procedure, see "Setting the Communication Interface to the Network" (page 16-26).

- **User Account**

  Set the user account used to access the DL750/DL750P from the PC. For the procedure, see section 16.6.

- **Time Difference from the Greenwich Mean Time**

  When using the Web server function, set the time difference from the GMT. Normally, the time difference is also set on the PC. Setting the time difference correctly allows the DL750/DL750P and the PC to detect the local time correctly. Consequently, the PC will be able to detect whether a file is new when transferring or saving the file. For the procedure, see section 16.8.

Note

- Use Internet Explorer version 5.0 or later for the Web browser.
- The Web server function contains software programs that have not been authenticated. Therefore, the following dialog box may appear. In such case, click Yes and install the software.
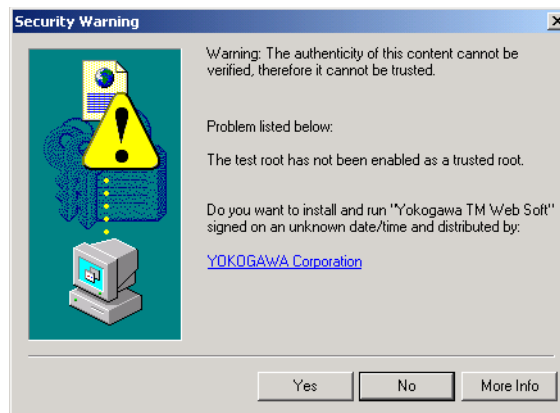
- You cannot open multiple Internet Explorer windows on the same PC and use the same function of the Web server function simultaneously.
- When using the storage function of the FTP server function (on the Web browser), data capture function, or the log display on the same PC, other Web server functions cannot be used.
- When using the storage function of the FTP server function (on the Web browser), data capture function, or the log display on a PC, other PCs cannot use the Web server function.
- The Web server functions use the Ethernet interface for communication. If the Ethernet interface is configured for controlling the DL750/DL750P using a communication command (see the *Communication Interface User's Manual* IM701210-18E), the Ethernet interface cannot be used simultaneously.
- The Web server function cannot be used while the DL750/DL750P is printing, operating files (file operation from the front panel key or file transfer using the FTP server function), realtime recording, or while the Windows network drive is being used.
- When the DL750/DL750P is registered as a network drive (see section 16.3), the Web server function cannot be used.

16

Ethernet Interface (Optional)

Preparations for Using the Web Server Function

Connecting the PC and the DL750/DL750P to the Network

Connect the PC and the DL750/DL750P to the network. For the connection procedure, see section 16.1.

Preparations on the DL750/DL750P

• Setting the Communication Interface to Network
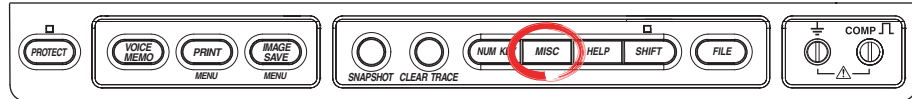
Turn ON the power to the DL750/DL750P. After the DL750/DL750P boots up normally, carry out the following procedure.

1. Press **MISC**. The MISC menu appears.
2. Press the **Remote Cntl** soft key. The Remote Cntl menu appears.
3. Press the **Device** soft key. The Device menu appears.
4. Press the **Network** soft key. The Ethernet interface is selected for the communication means.
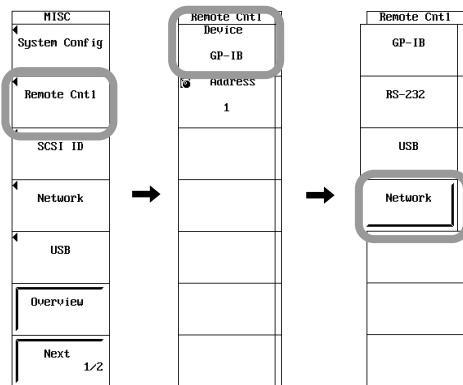
• Setting up the TCP/IP

5. Set the TCP/IP on the PC and the DL750/DL750P. For the procedure on the DL750/DL750P, see section 16.2.

• Setting the User Account Used to Access the DL750/DL750P

6. Set the user account used to access the DL750/DL750P from the PC. For the procedure, see section 16.6.

Note

The User Account in the menu that appears after step 4 is the user account that is used to control the DL750/DL750P through communication commands via the Ethernet network. It is not the user account for using the Web server function.

• Setting the Time Difference from GMT (Greenwich Mean Time)

7. Set the time difference between the location where the DL750/DL750P is located and the GMT. For the procedure, see section 16.8.

• Rebooting

8. To activate the TCP/IP, user account, and time difference settings, turn OFF the power switch. After a few seconds, turn ON the power switch and boot the DL750/DL750P.

Preparations on the PC

1. Power up the PC and log on.

    If the PC is running Windows NT, Windows 2000, or Windows XP, log on as an administrator. If you do not log on as an administrator, you may not be able to install files that are required for using the Web server function (described later).

*   **Logging into the Web Server (DL750/DL750P)**

2. Start Internet Explorer.
3. Enter the IP address of the DL750/DL750P (for example, 192.168.0.101) or the host name of the DL750/DL750P (for example, dl750-1) if a DNS server is available on the network.

    | Enter the IP address | http://192.168.0.101/ |
    | Enter the host name | http://dl750-1/ |

4. Press the ENTER key on the PC keyboard. A network password entry dialog box opens.
5. Enter the user name and password.
    *   Enter the user account (see section 16.6) used to access the DL750/DL750P. In the example below, "DLUSER" and "******" are entered for the user name and password, respectively.
    *   If the user name of the user account is set to "anonymous" (default setting), the password is not required.
6. Click **OK**. If the login to the DL750/DL750P Web server is successful, the Web server window appears.

Web Server Window

16

Ethernet Interface (Optional)
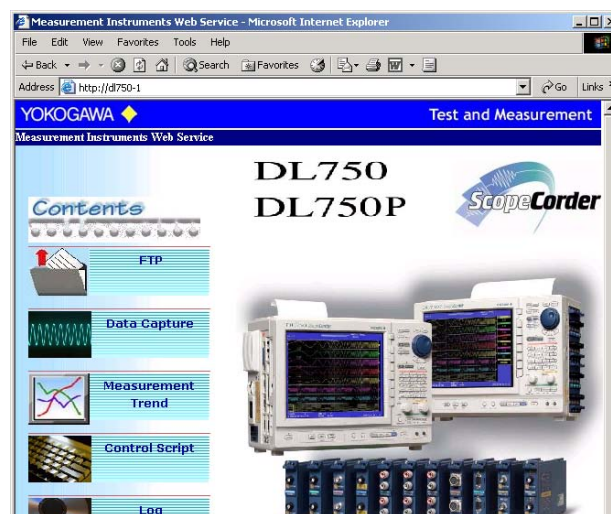
- **Installing Files Required for the Web Server**
  Using the DL750/DL750P and the PC While Connected to the Internet
  When you use the Web server function for the first time, the files required for the Web
  browser are installed automatically from the Microsoft Web site.
  > If the three files (Msvbvm60.dll, cmdlgjp.dll, and comdlg32.ocx) are already installed
  > in the PC when using the Web server function for the first time, step 7 is no required.

7.   When the data capture, measurement trend, or command script function of the
     Web server function is used for the first time, three files, Msvbvm60.dll,
     cmdlgjp.dll, and comdlg32.ocx, are automatically downloaded from the
     Microsoft Web site and installed in the PC. At this point, a dialog box for
     confirming the installation appears. Click **Yes**.
     (You may need to restart the PC during the installation.)

     After the installation completes successfully, proceed to step 9 on the next page.

or

- **Using the DL750/DL750P without Connecting to the Internet**
  If the three files, `Msvbvm60.dll`, `cmdlgjp.dll`, and `comdlg32.ocx`, are not installed in the PC when using the Web server function for the first time, install the files beforehand according to the following procedure.

  7. Download the following file from the YOKOGAWA Web site
      (http://www.yokogawa.com/tm/Bu/DLsoft/web.htm).
      YOKOGAWA T&M Web Runtime: ytmwrun.exe
      Data size: Approx. 1.5 MB
  8. Double-click ytmwrun.exe that you have downloaded. The installation of the aforementioned three files starts. Follow the instructions to install the files.

- **Checking the Web Browser (Internet Explorer) Security Settings**
  Check the security settings on the Internet Explorer. The settings indicated in the table on the next page are defaults. If the settings on your browser do not match, set them back to the settings in the table on the next page. Otherwise, the Web server function cannot be used.
  The following explanation is for Internet Explorer 5.5. For other versions, carry out equivalent steps accordingly.

  9. Choose **Internet Options** from the **Tools** menu. The Internet Options dialog box opens.
  10. Click the **Security** tab.
  11. Select a Web content zone.
      The Web service zone varies depending on the network environment and browser settings. Check with your network administrator to select the zone.

16

Ethernet Interface (Optional)
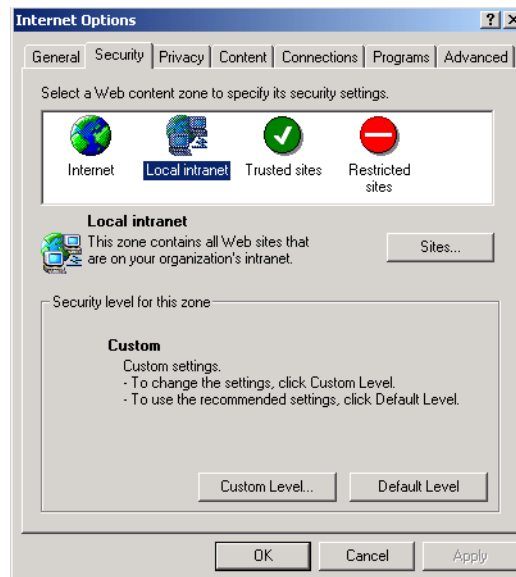
12. Click **Custom Level**. The Security Settings dialog box opens.
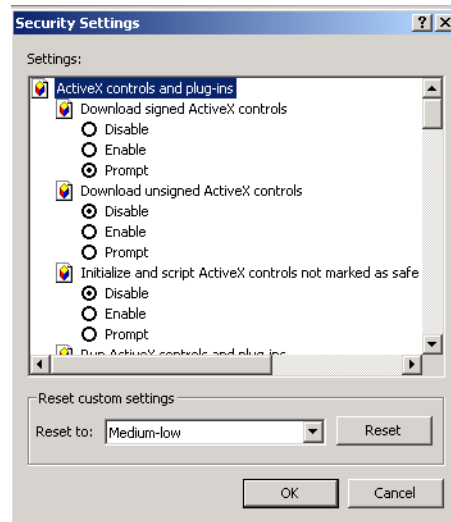
13. Set the security settings as shown in the following table.

Item	Security Level
Run ActiveX controls and plug-ins	Enable
Script ActiveX controls marked safe for scripting	Enable
Download signed ActiveX controls	Prompt

14. Click **OK**.

Using the Web Server Function

Using the FTP Server Function (On the Web Browser)

Before using this function, check that the communication interface of the DL750/DL750P is set to Network (see page 16-26).

Click the **FTP** icon on the Web server window. A window for viewing the storage media of the DL750/DL750P (storage media view window) appears.

The storage media view window may not appear. In this case, click the Refresh button on the Web browser. A login dialog box opens. Log in. The storage media view window appears.

Web Server Window
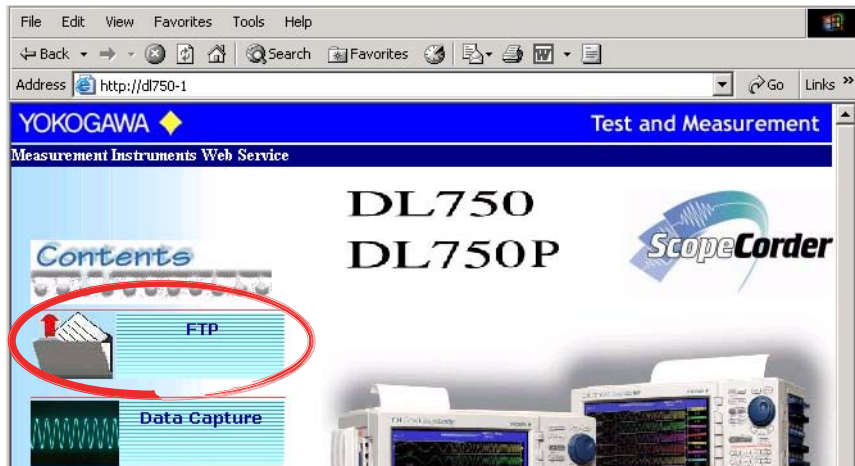
Storage Media View Window
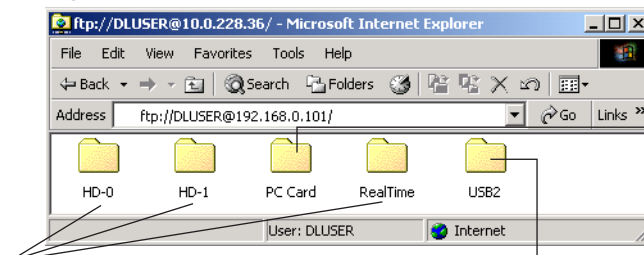
Built-in storage media
Depending on the product specifications, one of the following is displayed.
• Fd: Floppy disk
• Zip: Zip disk
• PC Card: PC card

USB storage device

Internal hard disk
• Real Time: Area used by realtime recording
• HD0, HD1:
Storage area for waveform and setup data (the number of displayed items varies depending on the number of partitions)

- You can open folders on each storage medium and view the file list.
- You can select files displayed on the window and transfer files to the PC.

16

Ethernet Interface (Optional)
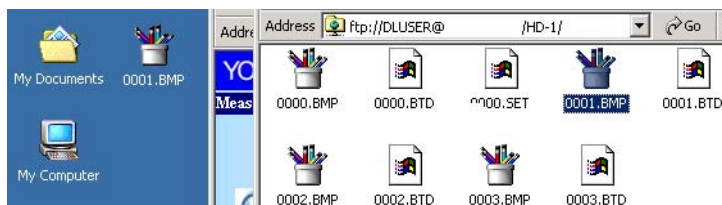
CAUTION

- Never change the contents on the DL750/DL750P disk from the PC (read only). Writing to the disk may destroy files.
- Never perform the following operations. The internal hard disk of the DL750/DL750P will become inaccessible.
  - Delete files on the internal hard disk of the DL750/DL750P from the PC.
  - Add files to the internal hard disk of the DL750/DL750P from the PC.

Note

- Up to two PCs can log into the file transfer function simultaneously.
- You cannot operate the files simultaneously from two PCs.
- When the DL750/DL750P is printing, operating files (file operation from the front panel key or file transfer using the FTP server function), or realtime recording, the Web server function cannot be used.
- To use the FTP server on a Web browser, a network user account on the DL750/DL750P must be configured. For the procedure of setting user accounts, see steps 1 to 8 in section 16.6.
- An authentication login dialog box may appear on the Web browser, when the FTP icon on the Web server window is clicked. In such case, enter the user name and password that were entered in section 16.6.

Capturing Data

Before using this function, check that the communication interface of the DL750/DL750P is set to Network (see page 16-26).

Click the **Data Capture** icon on the Web server window. The Data Capture window showing the screen image of the DL750/DL750P and the control panel that allows data saving and loading appears

Web Server Window
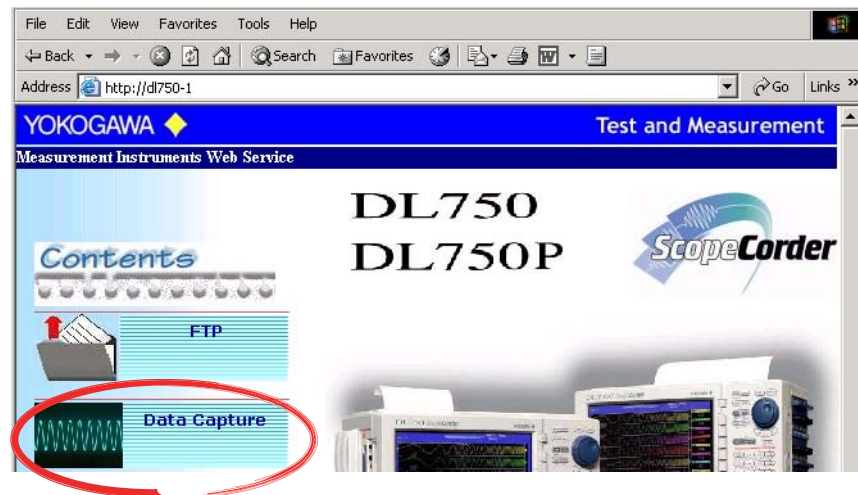
Data Capture Window
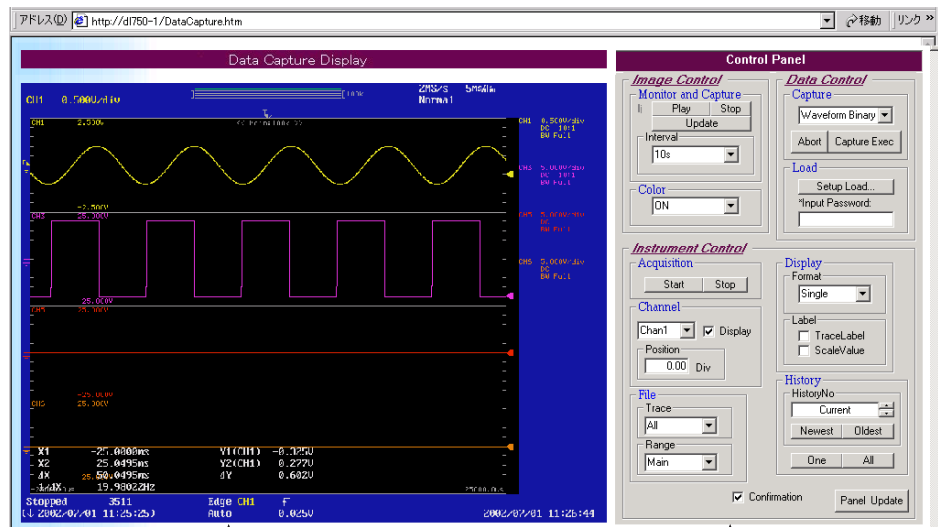
DL750/DL750P screen image   Control panel

- **Displaying and Saving the Screen Image (Image Control)**

  The screen image of the DL750/DL750P can be displayed on the PC screen and saved.

  Updating the Screen Image (Monitor & Capture)

  Play

  Click **Play** to illuminate the update indicator in green and start the updating of the screen image at the specified display update interval (see below).

  Stop

  Click **Stop** to turn off the update indicator and stop the updating of the screen image.

  Update

  The screen image is updated when you click Update.

  Interval

  Set the display update interval to 10 s, 30 s, or 60 s.

  Update indicator
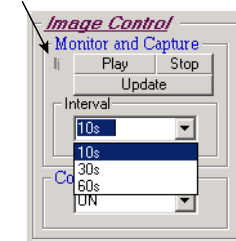
  Selecting the Display Color of the Screen Image (Color)

  Select the display color from ON, OFF, Reverse, and Gray. For a description of the displayed information for each setting, see the explanation in section 13.11.
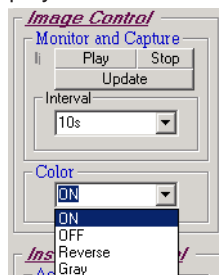
Note

The time it takes to display the screen image on the PC varies depending on the color setting. In decreasing order, the color settings are ON, Reverse, Gray, and OFF.

16

Ethernet Interface (Optional)

Saving the Screen Image in the PC

Right-click on the screen image that is displayed. A shortcut menu appears as shown in the following figure. Choose **Save Picture As** to save the current screen image.
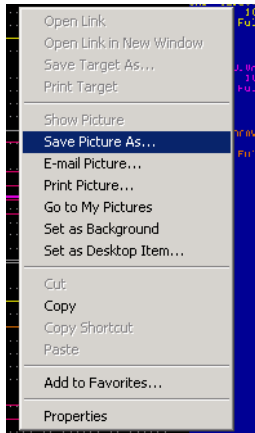
• **Saving Data in the PC and Loading Setup Data from the PC into the DL750/ DL750P (Data Control)**

Saving Data in the PC (Capture)

Data Type

Select the type of data to be saved from Waveform Binary, Waveform ASCII, Waveform Float, Setup, and Measure. For details on the settings, see the explanations in section 13.7, 13.8, and 13.10.
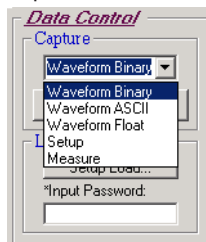
Capture Exec

Using the dialog box that appears when you click Capture Exec, set the save destination and file name and save the data.

Abort

To abort the save operation while data is being saved, click Cancel on the dialog box. Then, click Abort on the Control Panel.
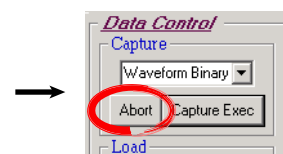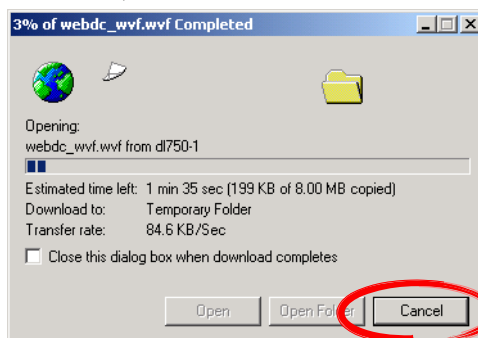
You must enter a password to abort. For details, see "Input Password" in the next section.

Loading the Setup Data from the PC into the DL750/DL750P (Load)

Input Password

Enter the password (see page 16-27) that you used to log into the Web server (DL750/DL750P). If the user name of the user account is set to "anonymous" (default setting), the password is not required.

Setup Load

Click Setup Load to display the Open dialog box. Select the setup data file you wish to load and click OK to execute the load operation.
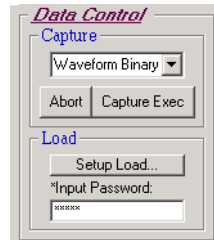
Note

- Depending on the operation condition of the DL750/DL750P (such as when measurement is in progress), data save and setup data load operations may not be possible.
- When data is being saved or the setup data is being loaded, other Web server functions cannot be used.
- When loading the setup data or when aborting the save operation, a temporary file (zzzftpzzztmpzzz.bat) is created in the start directory of the Internet Explorer. After the operation is complete, the temporary file will be deleted.
- If you execute the data save operation when there is no waveform data or waveform parameter, an error is displayed on the DL750/DL750P screen, and a 0-byte file is saved.

- **Controlling the DL750/DL750P (Instrument Control)**

You can use the PC to set the display format and the data save conditions of the DL750/DL750P. The settings entered here apply to the display format and save conditions used to save the data on the previous page

Starting/Stopping the Waveform Acquisition (Acquisition)

Start

Click **Start** to start the waveform acquisition.

Stop

Click **Stop** to stop the waveform acquisition.

Turning ON/OFF the Waveform Display and Setting the Vertical Position (Channel)

Selecting the Target Waveform

From the channel box, select the channel for turning ON/OFF the display and setting the vertical position from the following:

Chan1 to Chan16 (channels 1 to 16), DSP1 to DSP6 (optional)

Display ON/OFF

To display the waveform of the selected channel (turn it ON), select the Display check box. Clear the check box to not display the waveform of the selected channel (OFF).

Vertical Position

You can set the vertical position of the waveform of the selected channel. For a description of the selectable range of the vertical position, see section 5.4.

16

Ethernet Interface (Optional)

Setting the Display Format (Display)

Display Format

Select the number of divided windows when displaying waveforms from the following:

Single, Dual, Triad, Quad, Octal, and Hexadecimal

For the meanings of the selections, see the explanation in section 8.1.

Turning ON/OFF the Display of the Waveform Labels and Scale Values (Label)

• Display Waveform Label (TraceLabel)

To display the labels of the displayed waveforms, select the TraceLabel check box. Clear the check box to not display the labels.

• Turning ON/OFF the Display of the Upper and Lower Limits of the Displayed Waveforms (ScaleValue)

To display the upper and lower limits of the displayed waveforms, select the ScaleValue check box. Clear the check box to not display the upper and lower limits.
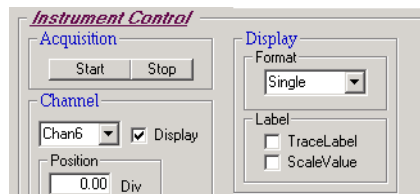
Selecting the Waveforms to Be Saved (File)

Selecting the Target Waveforms (Trace)

From the Trace box, select the waveforms to be saved from the following:

All (all waveforms), 1 to 16 (channels 1 to 16), DSP1 to DSP6 (optional), Math 1 to Math 8 (computed waveforms), PodA to PodB (logic waveforms), and Event (event waveform).

Selecting the Save Area (Range)

Select the area in which the target waveform to be saved is displayed from the following:

Main, Z1, and Z2

For the meanings of the selections, see the explanation in section 13.7.

Setting the History Data Display

Selecting by History Data Number (History No.)

You can specify the history number of the data to be displayed.

Selecting the Newest or Oldest Data

You can specify the newest or the oldest data in the history data to be displayed.

Selecting One or All

• One

Click **One** to display a single history data point that is selected by the data number or selected by newest or oldest.

• All

Click **All** to display all the history data.

Updating the Setup Condition (Panel Update)

Click **Panel Update** to update the control panel settings on the Data Capture window (PC) to match the newest setup condition on the DL750/DL750P.

Automatically Updating the Screen Image (Confirmation)

Select the Confirmation check box to automatically update the screen image using the same conditions as Color-OFF when you change the settings of the above items that would cause the screen image to change. Clear the check box to not update automatically.
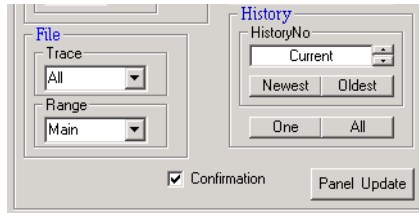
Note

- You cannot set the history data display when the DL750/DL750P is making measurements.
- Setting the history data display when there is no history data results in error.
- The timeout time on the PC when controlling the DL750/DL750P is 30 s. Depending on the DL750/DL750P condition, a timeout may occur preventing you from controlling the DL750/DL750P.

16

Ethernet Interface (Optional)

Displaying the Measurement Trend of the Waveform Parameter Values

Before using this function, check that the communication interface of the DL750/DL750P is set to Network (see page 16-26).

Click the **Measurement Trend** icon on the Web server window. The Measurement Trend window in which the trend display of the waveform parameter values can be set appears.

Web Server Window

Measurement Trend Window

← **Control panel**
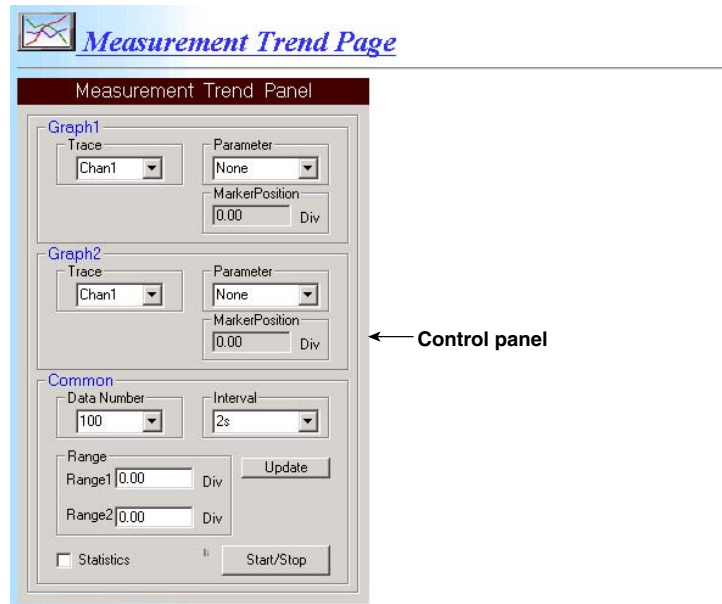
Note
- This function retrieves the selected waveform parameter values at the selected retrieve interval from the DL750/DL750P into the PC and displays the trend. To display the retrieved measurement values and trend, Microsoft Excel 97 or later must be installed on the PC.
- Set the time axis setting of the DL750/DL750P to 100 ms/div or less (faster). This function cannot be used on time axis settings that exceed 100 ms/div.
- If the measured value of a waveform parameter is not a normal number (Not A Number), the cell displaying the measured value on Microsoft Excel is set to blank.
- The retrieve interval specified using this function and the measurement interval of the waveform parameters on the DL750/DL750P are not synchronized.
- If the waveform parameter measurement is not complete within the specified retrieve interval, Not A Number is transmitted to the PC because there is no measured value. In this case, the cell displaying the measured value on Microsoft Excel is set to blank.

- **Setting the Trend Display Conditions**

  Selecting the Waveform Parameter to Be Displayed (Graph 1 and Graph 2)
  You can display two trend graphs. For each graph, you can specify the trend target waveform and the waveform parameter. When the waveform parameter is "Marker," you can set the Marker Position.

  Selecting the Target Waveform (Trace)
  From the Trace box, select the target waveform for the trend display from the following:
  Chan1 to Chan16 (channels 1 to 16), DSP1 to DSP6 (optional), Math1 to Math8 (computed waveforms)

  Selecting the Waveform Parameter
  From the Parameter box, select the target waveform parameter of the trend display (same expression as the communication command) from the following: For the meanings of the waveform parameters and the marker cursor, see the explanation in section 11.6 or 11.5.

Parameter	DL750/DL750P Menu	Parameter	DL750/DL750P Menu
None	Not selected	MINIMUM	Min
AMPLITUDE	Amp	NOVERSHOOT	-OShot
AVERAGE	Avg	NWIDTH	-Width
AVGFREQ	AvgFreq	PERIOD	Period
AVGPERIOD	AvgPriod	PNUMBER	Pulse
BWIDTH1	Burst1	POVERSHOOT	+OShot
BWIDTH2	Burst2	PTOPEAK	P-P
DELAY (For a detail setting, use Delay Setup on the DL750/DL750P)	Delay	–	–
DUTYCYCLE	Duty	PWIDTH	+Width
FALL	Fall	RISE	Rise
FREQUENCY	Freq	RMS	Rms
HIGH	High	SDEVIATION	Sdev
LOW	Low	TY1INTEG	Int1TY
MAXIMUM	Max	TY2INTEG	Int2TY
Marker(M1<2>) (marker cursor for cursor measurements)	M1<2>	XY1INTEG	Int1XY
MIDDLE	Mid	XY2INTEG	Int2XY

  Setting the Marker Position
  You can set the marker position if "Marker(M1)" or "Marker(M2)" is selected as the waveform parameter.

  Setting the Conditions for Retrieving the Measured Values of Waveform Parameters (Common)
  Number of Displayed Measured Values (Data Number)
  Select the number of measured values (measured values retrieved from the DL750/DL750P into the PC) to be displayed in the cells of Excel from the following: If the number of measured values exceeds the selected number, the values are cleared from the oldest values to display the newest measured values.
  10, 20, 50, 100, 200, and 500
  Retrieve Interval
  Select the retrieve interval from the following. However, of the selected waveform parameters, select the interval to match the longest parameter cycle measured on the DL750/DL750P.
  2 s, 5 s, 10 s, 30 s, and 60 s

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Ethernet Interface (Optional)

Measurement Range

You can set the range on the time axis for measuring the waveform parameter. Range1 and Range2 are the start and end points, respectively.

Selectable range: ±5 div

Resolution: Varies depending on the record length.

However, the measurement start point cannot be set to the same point as the measurement end point or to a value to the right of the measurement end point.

Turning ON/OFF the Statistics Display

• The statistics (Max, Min, and Average) of the waveform parameters retrieved into the PC can be displayed.

• To display the statistics, select the Statistics check box. Clear the check box to not display the statistics.

• The number of measurement values displayed in the cell of Excel is up to the number specified in "Number of Displayed Measured Values (Data Number)" on the previous page. The statistics are determined on all the measured data since the trend display was started, not on only the displayed measured values.

Updating the Setup Condition

Click **Update** to update the Marker Position and Range that are set on the control Panel of the measurement trend window to match the newest setup conditions of the DL750/DL750P.

• **Starting/Stopping the Trend Display of the Measured Values of the Waveform Parameters**

Start

Click **Start/Stop**. The indicator illuminates in yellow, and retrieval of the measured values of waveform parameters starts at the specified retrieve interval. At the same time, Microsoft Excel starts, and the measured values and trend graphs are displayed/drawn. If the statistical display is turned ON, the statistics are also displayed. The retrieval of the measured value of waveform parameter continues until the operation is stopped.

Stop

• Click **Start/Stop** while the trend display is in progress. The indicator turns OFF, and the display and drawing of the measured values and trend graph stop.

• If you attempt to save the data to a file or close Excel while the trend display is in progress, a runtime error occurs. In this case, select **No** on the runtime error dialog box and close the dialog box. Then, click **Start/Stop** on the measurement trend window to stop the trend display. After stopping the trend display, save the file or close Excel.

Display Example of Measured Values, Trend Graphs, and Statistics
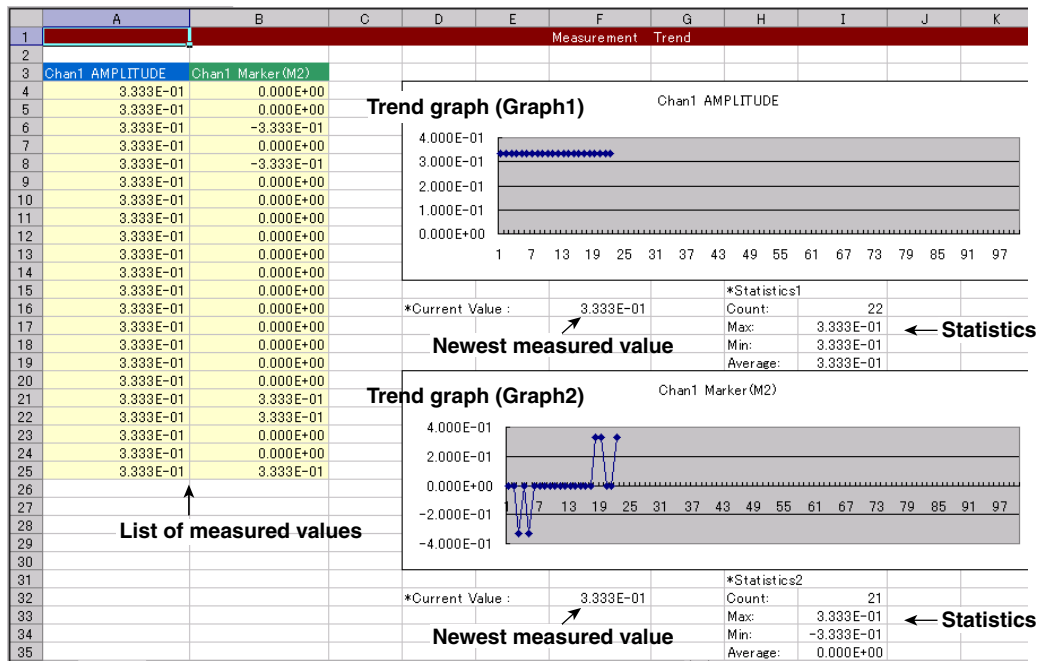
### Using the Control Script

Before using this function, check that the communication interface of the DL750/DL750P is set to Network (see page 16-26).

Click the **Control Script** icon on the Web server window. The Control Script window used to send communication commands (see the *Communication Interface User's Manual* IM701210-18E) to the DL750/DL750P and display the responses from the DL750/DL750P appears.

Web Server Window

Control Script Window

Indicator
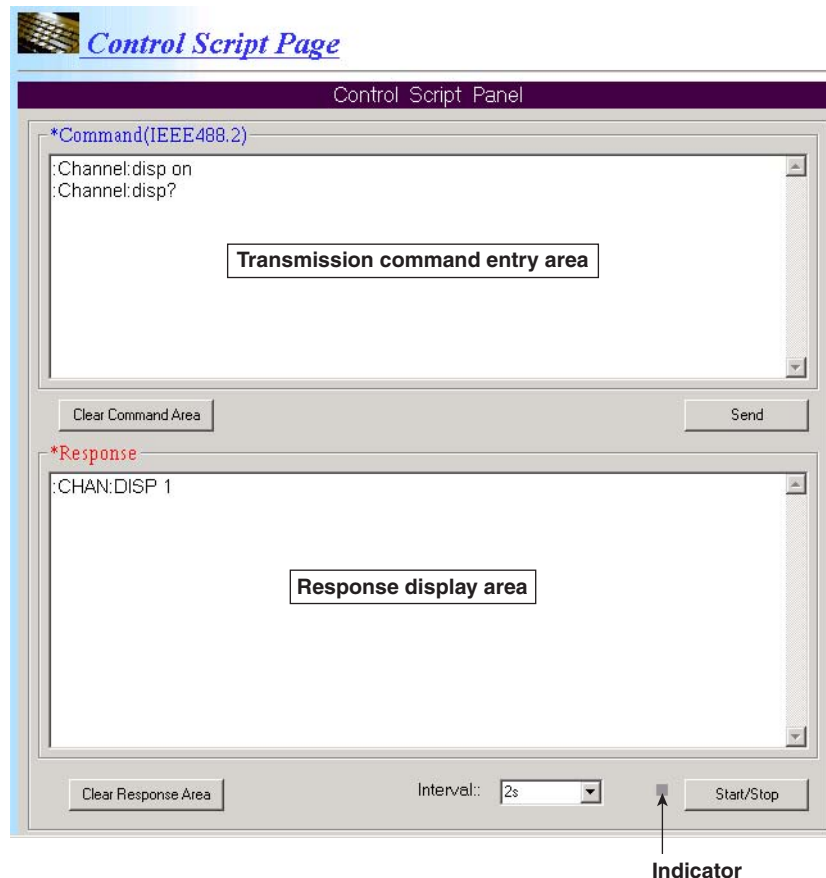
- **Sending Commands (*Command IEEE 488.2)**
  Entering the Transmission Commands
  Enter the commands in the transmission command entry area.
  Maximum number of input characters: Up to 50,000 (50 KB).
  Sending Commands
  Click **Send** to send the commands in the transmission command entry area collectively in the order displayed in the area.
  Clearing the Entered Commands (Clear Command Area)
  Click **Clear Command Area** to clear all the commands in the transmission command entry area.

- **Displaying the Responses from the DL750/DL750P (*Response)**
  The responses from the DL750/DL750P against the commands (queries) sent to the DL750/DL750P using the control script function can be received and displayed.
  Clearing the Responses (Clear Response Area)
  Click **Clear Response Area** to clear all the responses received from the DL750/DL750P that are displayed in the response display area.

- **Sending Commands Periodically and Displaying Responses**
  The commands in the transmission command entry area can be sent periodically. If commands (queries) that request responses from the DL750/DL750P are sent, the responses from the DL750/DL750P are displayed in the response display area.
  Setting the Transmission Interval
  Select the command transmission interval from the following:
  2 s, 5 s, 10 s, 30 s, and 60 s
  Starting Periodic Transmission (Start)
  Click **Start/Stop**. The indicator illuminates in yellow, and the command transmission and response display start at the specified transmission interval.
  Stopping Periodic Transmission (Stop)
  Click **Start/Stop** while the periodic transmission is in progress. The indicator turns OFF, and the command transmission and response reception/display stop. However, if the last command before stopping the periodic transmission was a query command, the response to that command is displayed in the response display area.

Note

- If a wrong command is sent, the error message is not automatically displayed in the Control Script window. The error code and message are displayed by entering the ":status:error?" command in the transmission command entry area and sending the command. You can also confirm the error on the screen image displayed using the data capture function and also on the DL750/DL750P screen.
- Binary data cannot be received or displayed.
- The transmission timeout is 30 s. Transmission and reception exceeding 30 s results in a timeout error. If all the commands specified in the transmission command entry area is sent, and the responses to the commands are not received within 30 s, a timeout error occurs.

16

Ethernet Interface (Optional)

Displaying the Log

Before using this function, check that the communication interface of the DL750/DL750P is set to Network (see page 16-26).

Click the **Log** icon on the Web server window. The Log window that can display the past log of errors that occurred on the DL750/DL750P, GO/NO-GO determination, and action-on-trigger appears. Up to the 30 newest incidents are logged. Logs older than the past 30 are not displayed.

Web Server Window
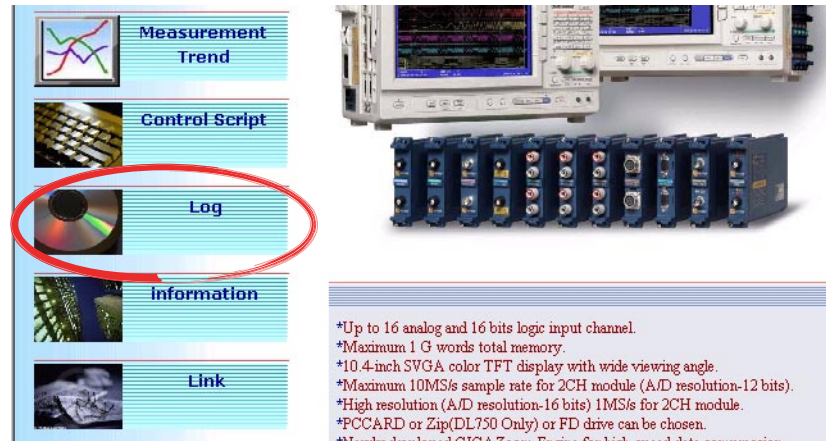
Log Window
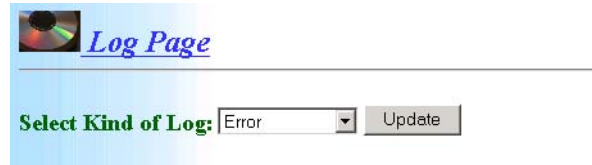
- **Displaying the Log**
  Selecting the Log Type (Select Kind of Log)
  From the list box, select the item for displaying the log from the following:
  - Error (log of errors that occurred on the DL750/DL750P)
  - Go/Nogo (log of GO/NO-GO determination)
    For the setup procedure for the GO/NO-GO determination, see sections 11.8 and 11.9.
  - Action Trigger (log of action-on-triggers)
    For the setup procedure for the action-on-trigger, see section 6.18.
  Updating the Log (Update)
  Click **Update** to display the selected log. If the selected type of log is the same as that of the log being displayed, the log is updated.

• **Log Display Example**

The following figure shows an example displaying the log of GO/NO-GO determination.

Displays "Executing..." while GO/NO-GO determination is in progress or when action-on-trigger is in execution.

No.	Date	Time	Factor	Action					
3	2002/07/18	18:16:41.36	Param1(CH1,Max)	Buzzer,File:	/SC4-1/0008.WVF	,Image:	/SC4-2/0021.BMP	,Mailto:
2	2002/07/18	18:16:29.02	Param1(CH1,Max)	Buzzer,File:	/SC4-1/0007.WVF	,Image:	/SC4-2/0020.BMP	,Mailto:
1	2002/07/18	18:16:16.88	Param1(CH1,Max)	Buzzer,File:	/SC4-1/0006.WVF	,Image:	/SC4-2/0019.BMP	,Mailto:

If screen image data or waveform data files are being saved in the GO/NO-GO determination or action-on-trigger, the files can be saved on the PC from the Log display window.

The log of GO/NO-GO determination displays the save destination drive as follows.

FD0:	**Floppy disk**
ZP0:	**Zip disk**
CA0:	**PC card**
SC5:	**SCSI device with the ID number set to 5***
SC5-1:	**Partition 1 of a SCSI device whose ID number is 5***
ND0:	**Network drive (when the Ethernet interface option is installed)**
US□-□:	**USB storage device**

        Partition number (or LUN (logical unit number))

        Address number

* When a SCSI device whose ID number is 5 is connected

Note

• When the DL750/DL750P is printing, operating files (file operation from the front panel key or file transfer using the FTP server function), or realtime recording, files cannot be saved on the PC. In addition, other Web server functions cannot be used while saving files.
• Files on the network drive (NetWork) cannot be saved to the PC.

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Ethernet Interface (Optional)
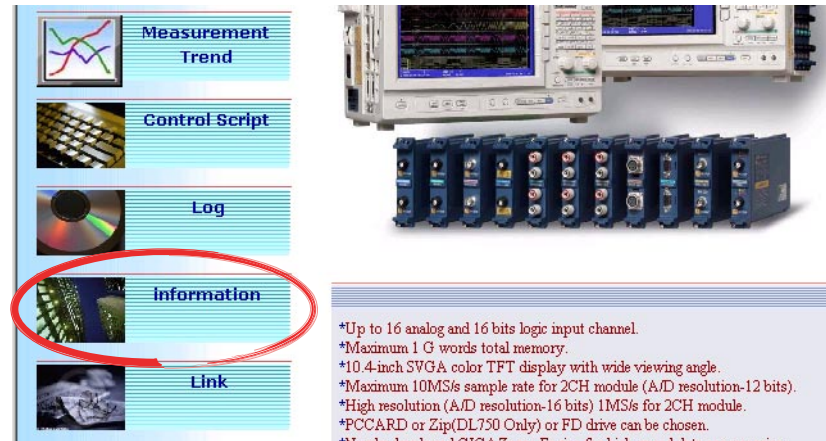
Displaying the Instrument Information

Before using this function, check that the communication interface of the DL750/DL750P is set to Network (see page 16-26).

Click the **Information** icon on the Web server window. The Information window that displays the DL750/DL750P model (Model), the maximum record length available (Record Length), the module configuration (Module), the storage media type (Media), the presence of options (Option), ROM version (firmware version, Soft Version), and other information appears.

Web Server Window

Information Window

Item	Contents
Model	701210
RecordLength	Max500MW(25MW/CH)
Module1	HS10M12 (701250)
Module2	HS1M16 (701251)
Module3	TEMP/HPV (701265)
Module4	Not used
Module5	Not used
Module6	Not used
Module7	Not used
Module8	Not used
Media	PC CARD(0)
Option	HDD:Yes
	Math:Yes
	Dsp:No
	Ether:Yes(MAC>000064_839_065)
Soft Version	1.01

Viewing the Link

Before using this function, check that the communication interface of the DL750/DL750P is set to Network (see page 16-26).
Click the **Link** icon on the Web server window. You can view the Web page for the DL750/DL750P.

Web Server Window
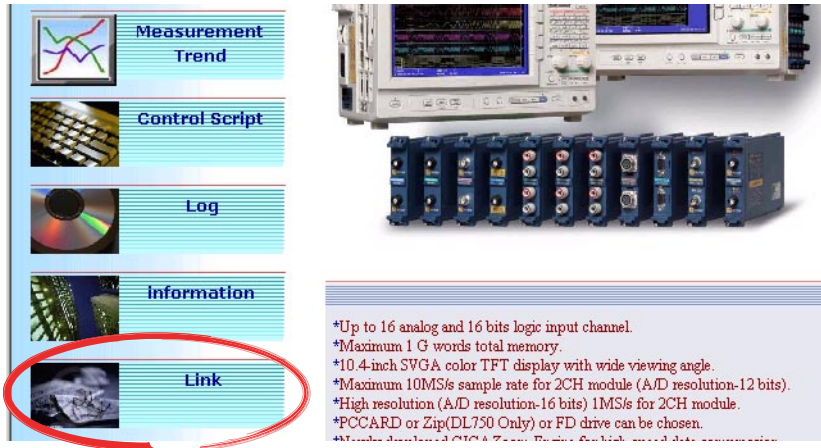
Web Page Example (English Web Page)
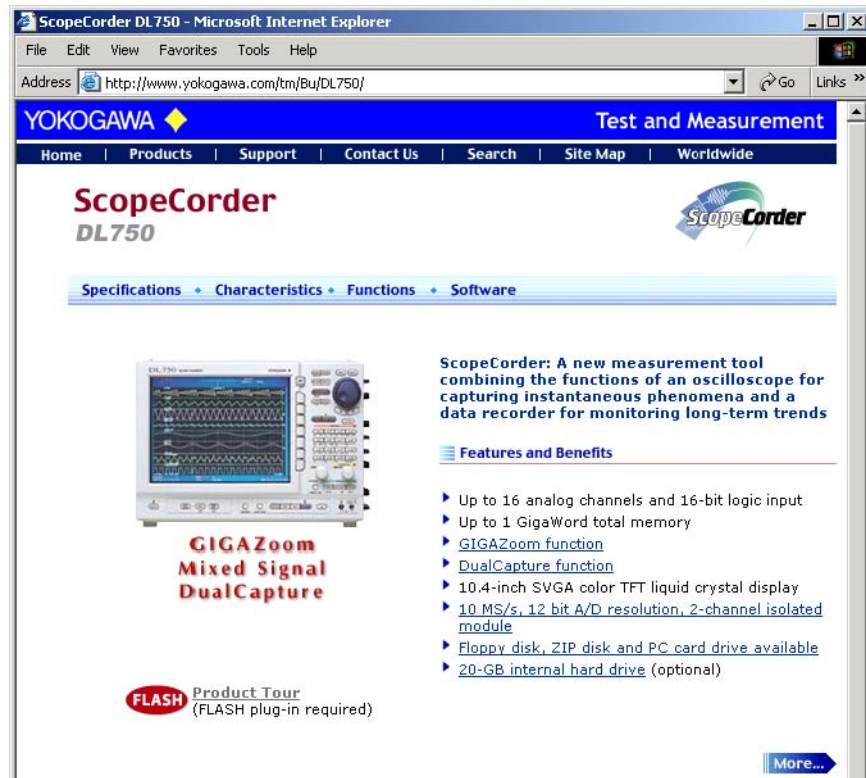
Note

- To use the link function, the PC must be connected to the Internet.
- If the message language of the DL750/DL750P is set to English, the English Web page is displayed; if the message language is set to Japanese, the Japanese Web page is displayed; if the message language is set to Chinese, the Chinese Web page is displayed. For the setup procedure for the message language, see section 17.1.

16.8 Setting the Time Difference from GMT (Greenwich Mean Time)/SNTP

Procedure
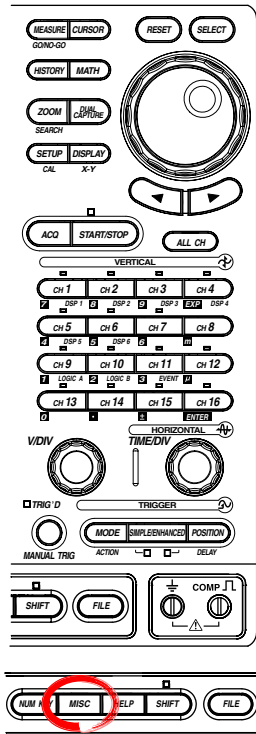
1. Press **MISC**.
2. Press the **Network** soft key.
3. Press the **Others** soft key. The Others setup menu appears.

Setting the Time Difference from GMT

4. Use the **jog shuttle** and **SELECT** to set the Time Hour of Time Difference From GMT in the range of –12 to 13.
5. Likewise, set the Minute of Time Difference From GMT in the range of 0 to 59.

Note

Minute can be specified only if Time Hour is set in the range of –11 to 12. (Minute cannot be specified if Time Hour is set to –12 or 13.)

Setting the SNTP(Simple Network Time Protocol)

6. Use the **jog shuttle** and **SELECT** to set the Exec at Power On to ON or OFF.
7. Use the **jog shuttle** and **SELECT** to select SNTP Server.
8. Enter the IP address of the SNTP server according to the procedure given in section 4.2.
9. Use the **jog shuttle** and **SELECT** to select Time Out.
10. Enter the time out time in the range from 1-60 according to the procedure given in section 4.2.
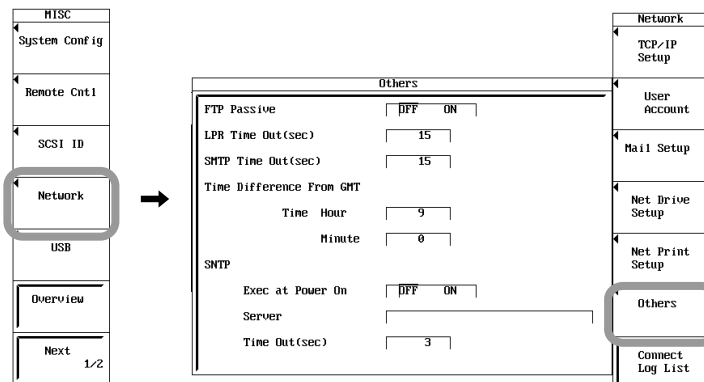
Explanation

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

Setting the Time Difference from GMT (Greenwich Mean Time)

Set the time difference in the range of –12 hour 00 minute to 13 hour 00 minute.
For example, Japan standard time is ahead of GMT by 9 hours. In this case, set Time Hour to 9 and Minute to 00.

Checking the Standard Time

Check the standard time for the region where the DL750/DL750P is to be used using one of the following methods.
*   Check the date and time settings on your PC.
*   Check the site at the following
    URL:http://www.worldtimeserver.com/

Note
> The DL750/DL750P does not support daylight savings time. To set the daylight savings time, adjust the time difference from GMT.

Setting the SNTP

When turning ON the power to the instrument, the instrument's time is synchronized with that of the SNTP server connected to the network.

Note
> *   If a time difference from world standard time (Greenwich Mean Time) is specified, the time obtained from the SNTP server is adjusted accordingly, and that time is used.
> *   When setting the date and time on the instrument, you can synchronize the time with the SNTP server. For details, see section 3.5, "Setting the Date and Time."
> *   When not synchronizing the time with the SNTP server, do not enter the SNTP server's IP address.

16

Ethernet Interface (Optional)

16.9 Checking the Presence of the Ethernet Interface and the MAC Address

Procedure
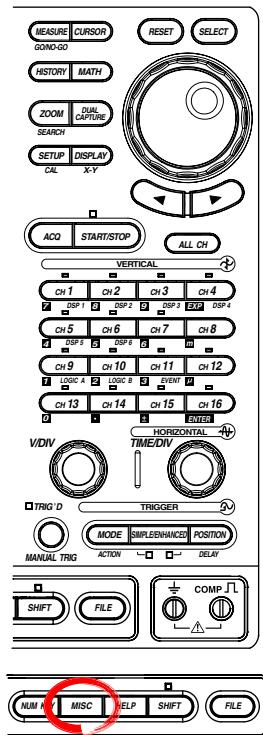
1. Press MISC.
2. Press the **Overview** soft key. The overview screen appears.
3. When Ether:Yes appears for the Option item in the overview screen, this indicates that the Ethernet interface is installed.
   The number indicated to the right is the MAC address (MAC:000064_839_065 in the following screen).

Note

- Ether: Yes is displayed only if the Ethernet interface option is installed.
- If XXXXXX_XXX_XXX is displayed for the MAC address, contact your nearest YOKOGAWA dealer.
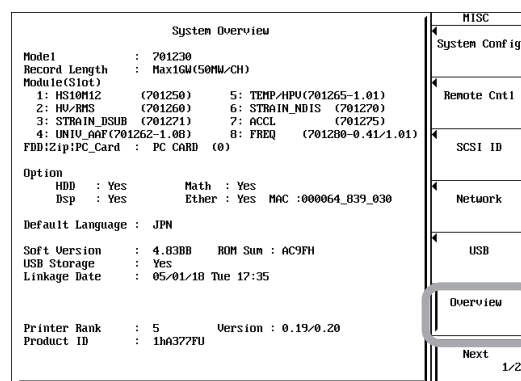
Explanation

You can check the presence of the Ethernet interface and the MAC address.
MAC address is a unique address that is pre-assigned to the DL750/DL750P.

The Presence of the Ethernet Interface

The presence of the Ethernet interface is displayed under "Ether" on the overview screen.

- Ether:Yes: The Ethernet interface is installed.
- Ether:No: The Ethernet interface is not installed.

MAC Address

MAC address is a unique address that is pre-assigned to the DL750/DL750P. It is necessary for transmitting data between nodes.

16.10 Setting the FTP Passive Mode and LPR/SMTP Timeout

Procedure
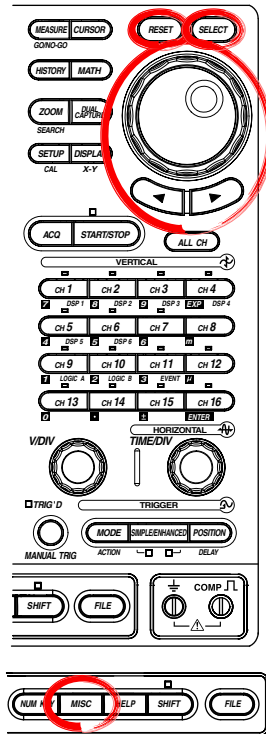
1. Press **MISC**.
2. Press the **Network** soft key.
3. Press the **Others** soft key. The Others setup menu appears.

Selecting the FTP Passive Mode

4. Use the **jog shuttle** and **SELECT** to set FTP Passive to ON or OFF.

Setting the LPR Timeout Time

4. Use the **jog shuttle** and **SELECT** to set LPR Time Out.

Setting the SMTP Timeout Time

4. Use the **jog shuttle** and **SELECT** to set SMTP Time Out.
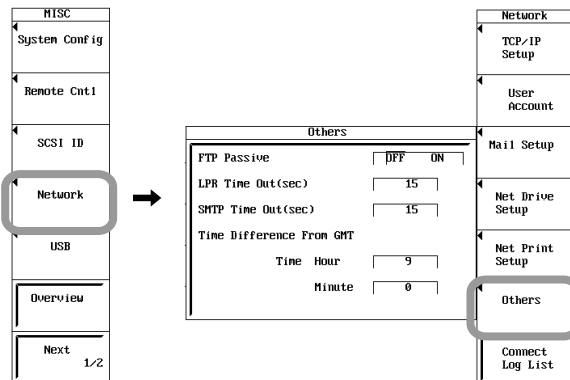
Explanation

Special settings related to the FTP client, LPR, and SMTP are entered. Normally, these parameters do not need to be specified.

Turning ON/OFF FTP Passive Mode

Turn this function ON when using the DL750/DL750P behind a firewall that requires the passive mode. The default setting is OFF. (A firewall is furnished on a system that has security features. It prevents intrusion from the outside into the network system.)

Setting the LPR Time Out

The DL750/DL750P closes the connection to the printer if there is no response from the printer for a certain period of time (timeout time) when it accesses the printer. You can set the timeout value in the range of 0 to 3600 s. The default setting is 15 s.

Setting the SMTP Time Out

When a mail server is accessed from the DL750/DL750P and connection cannot be established after a certain period of time (timeout time), the DL750/DL750P decides that the connection to the mail server is not possible and closes the connection. You can set the timeout value in the range of 0 to 3600 s. The default setting is 15 s.

16.11 Using the Instrument as a Windows Network Drive

Procedure
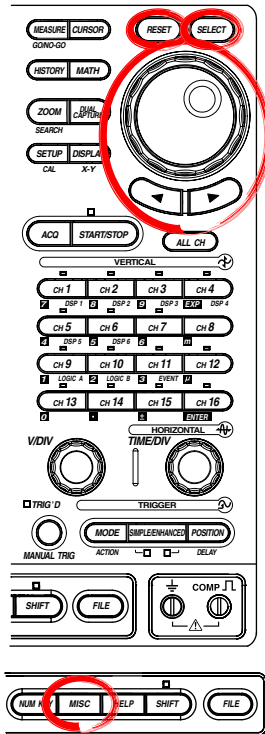
Setting the DL750/DL750P

Follow the procedures in section 16.2, "Setting up the TCP/IP," and section 16.6 "Accessing DL750/DL750P from a PC or Workstation (FTP Server Function)" to enter TCP/IP and user account settings, then connect to the network.

Setting the PC

1. Open Entire Network Places.
2. Choose Map Network Drive under Tools on the menu bar. The Map Network Drive dialog box appears.

3. Select the drive to assign in the drive selection area.
4. Enter the instrument's IP address in the folder input area using the format, http://instrument's IP address/dav/.
5. Click Finish. The enter user name and password input dialog box appears.
6. Enter the user name and password specified under user account (see section 16.6, "Accessing the DL750/DL750P from a PC or Workstation (FTP Server Function)."
8. Click OK. The instrument is registered as a network drive.
9. To cancel the registration as a network drive, select Disconnect Network Drive under Tools on the menu bar. The disconnect network drive dialog box opens.
10. Select the network drive you wish to disconnect, and click OK.

Explanation

Network Drive

When the instrument is registered as a network drive, the files on the DL750/DL750P drive can be view using a software application running on a PC.

Note

- • The DL750/DL750P can be mapped as a network drive only on Windows XP.
- • When manipulating files using the network drive function, do not perform other network functions such as the FTP client/server function or Web server function. If you do, the DL750/DL750P or the PC may become unstable.
- • Do not change the contents of the DL750/DL750P drive (including the contents of the drives connected via the SCSI) from the PC. Reading the contents of the drive is allowed.
- • Never perform the following operations.
  - • Delete files on the DL750/DL750P drive from the PC.
  - • Add files on the DL750/DL750P drive from the PC.
  - • Change the directory structure of the DL750/DL750P drive from the PC.
- • If you attempt to move a large file from the PC to the DL750/DL750P, the file may be lost due to the limitations of Windows.
- • You cannot manipulate the files simultaneously from multiple PCs.
- • You cannot view a directory containing 1000 or more files.
- • You cannot use the WebDAV function simultaneously with the Web server function.

Available Characters

This function uses the Windows WebDAV client function and the instrument's WebDAV server function . The characters that can be used with the WebDAV server function on this instrument are as follows.

    0 to 9
    A to Z, a to z
    %, (,) , _

Therefore, please make note of the following.

- • Files and folders whose names contain characters other than the ones indicated above cannot be saved on the DL750/DL750P's drive. Also, these files cannot be copied or moved.
- • Files in the instrument' drive containing characters other than those listed above are not displayed in the file list using WebDAV.
  Also, these files and folders are not taken into account in the calculation of used disk space. Therefore, the actual amount of used disk space is different from the calculated amount of space.

File Information

If you copy files or folders from the instrument's drive to a Windows local disk, the creation date and time of the file or folder changes to that of the date and time copied. Likewise if you copy files or folders from a Windows local disk to the instrument's drive, the creation and modified dates and times of the file or folder changes to that of the date and time when copied.

16

Ethernet Interface (Optional)

17.1 Changing the Menu/Message Language and Turning the Click Sound ON/OFF

Procedure
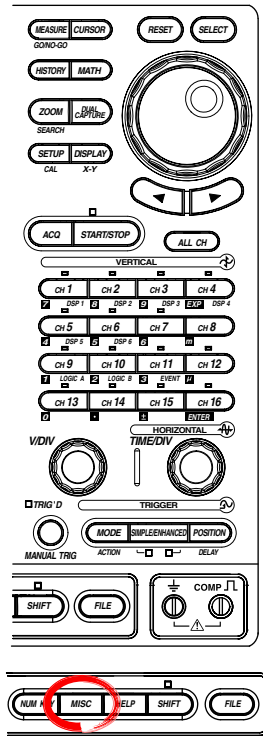
1. Press **MISC**.
2. Press the **System Config** soft key.

Setting the Menu Language

3. Press the **Menu Language** soft key and press the soft key corresponding to the language you wish to use.

Setting the Message Language

4. Press the **Message Language** soft key and press the soft key corresponding to the language you wish to use.

Setting the Click Sound

5. Press the **Click Sound** soft key to select ON or OFF.
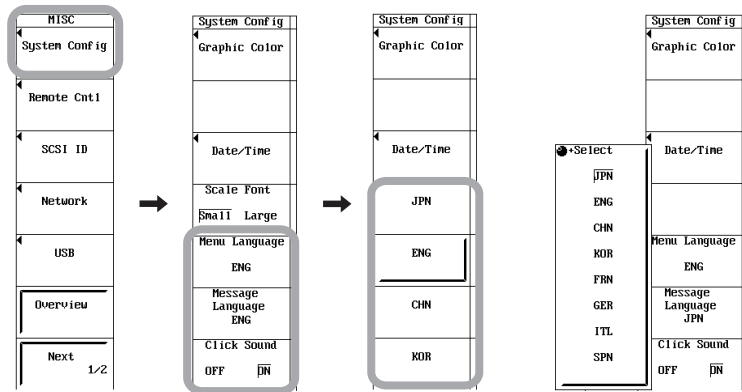
Explanation

Setting the Menu Language

You can set the menu screen to English (ENG), Japanese (JPN), Chinese (CHN), or Korea.

Setting the Message Language

A message appears when an error occurs or when you press the HELP key. You can set the language of the messages to English (ENG), Japanese (JPN), Chinese (CHN), Korea(KOR), German(GER), French(FRN), or Italian(ITL). The messages codes are common in all languages. For a description of the messages, see section 18.2.

Note

- Spanish (SPN) is displayed in the message language menu, but it is not supported in version 6.20. The message language will be set to English even if you select Spanish (SPN).
- If you specify Japanese, Chinese, or Korean for either the menu or message language, the other language specified must be either the same language, or English, German, French, or Italian.
  For example, if you specify Japanese for the menu language, you must specify Japanese, English, German, French, or Italian for the message language. In this example, if you were to select Korean for the message language, the menu language would be automatically reset to Korean.

Turning ON/OFF the Click Sound

You can set whether to make click sounds when the jog shuttle is turned. The default setting is ON.

17.2 Switching the Screen Display Font Size

Procedure
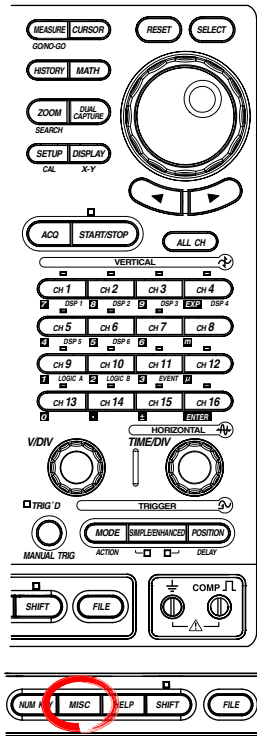
1. Press **MISC**.
2. Press the **System Config** soft key.
3. Press the **Scale Font** soft key to select Small or Large.
   If Large is selected, the waveform labels displayed at the upper left of the waveform display area, the scale values of the vertical axis, and the trace labels (waveform labels) are shown using a large font.

When Scale Font is set to Small
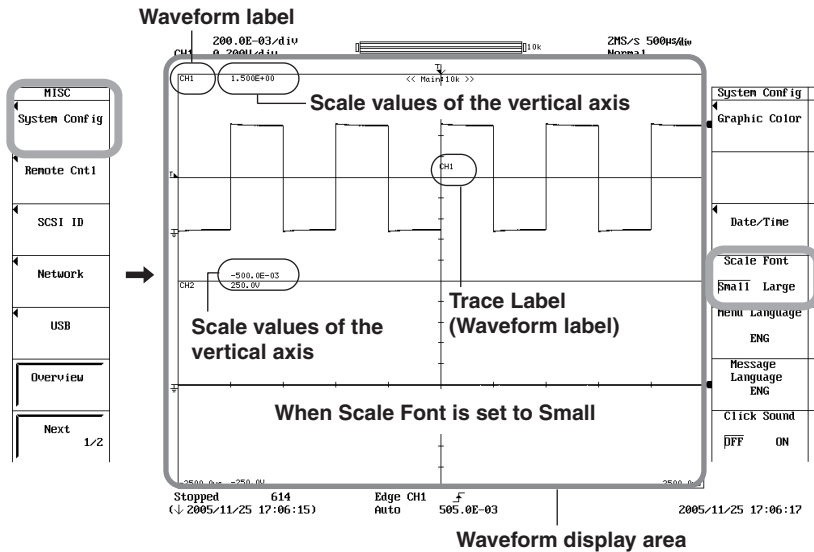
The font size in the area enclosed by ◯ changes.

When Scale Font is set to Large
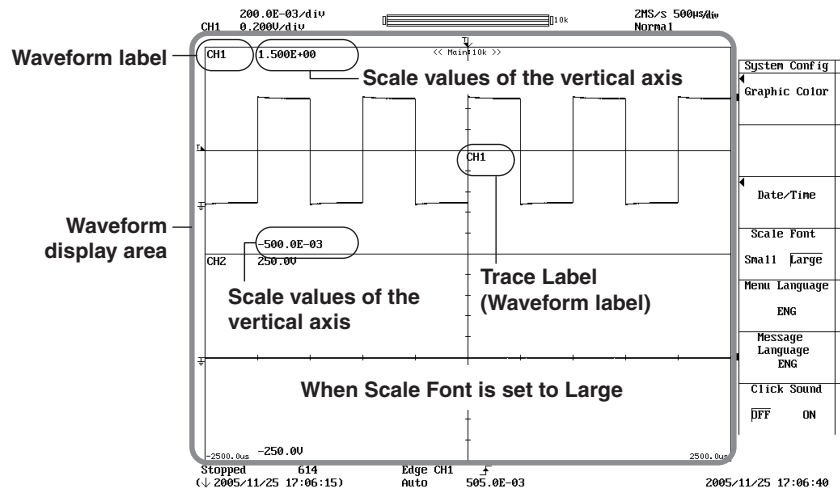
Explanation

The screen display font size can be set to small or large. The default setting is Small. The font size changes for the waveform labels displayed at the upper left of the waveform display area, the scale values of the vertical axis, and the trace labels (waveform labels). If Large is selected and there are numerous waveforms displayed on the screen, the scale values of the vertical axis may overlap.

17.3 Changing the USB Keyboard Language

Procedure
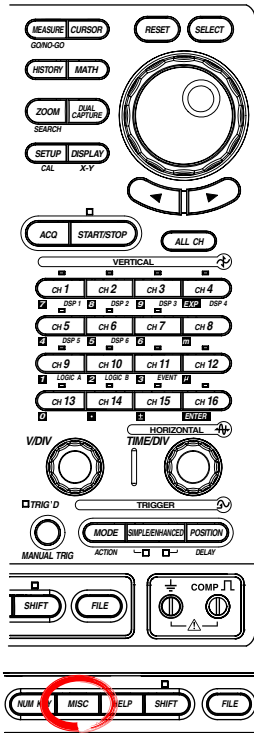
1. Press **MISC**.
2. Press the **USB** soft key.
3. Press the **USB Keyboard** soft key to select ENG or JPN.
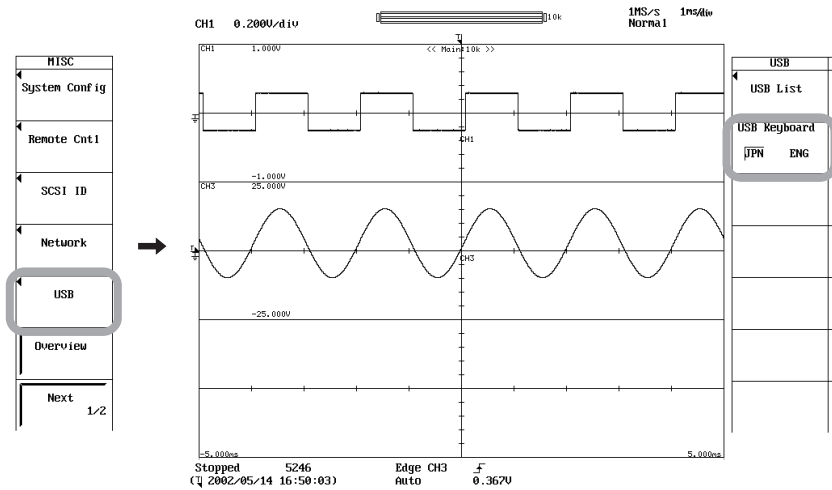
Explanation

Setting the USB Keyboard Language

The language of the USB keyboard that is used to enter items such as file names and comments (see section 4.2) is specified. The following keyboards conforming to USB Human Interface Devices (HID) Class Ver1.1 can be used.
• ENG: 104 keyboard and 89 keyboard
• JPN: 109 keyboard and 89 keyboard

The character that is entered through each key of the USB keyboard varies depending on the keyboard type. For details, see appendix 8.

Note

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

17.4 Setting the Screen Color and Brightness

Procedure
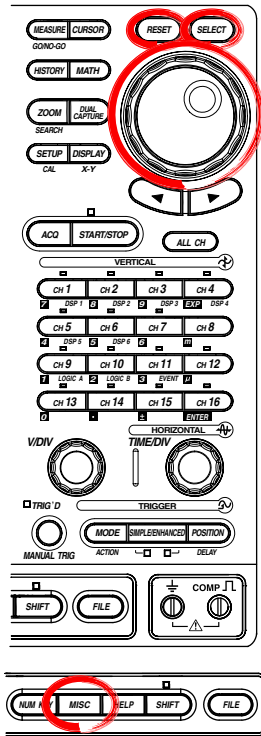
1. Press **MISC**.
2. Press the **System Config** soft key.
3. Press the **Graphic Color** soft key. The Graphic setup menu appears.

Setting the Color

4. Use the **jog shuttle** and **SELECT** to select the item you wish to change the color. The color selection menu appears.
5. Use the **jog shuttle** and **SELECT** to select the color.

Note

The items that you can change the color are as follows:
- CH1 to CH16
- DSP1 to DSP6 (optional)
- Math waveforms
- Logic A, Logic B
- Event
- Background
- Capture Area (sub waveform window of the dual capture function)
- Menu Base Color (menu screen)

In addition, the selectable colors are limited depending on the item.

Setting the Brightness

6. Use the **jog shuttle** and **SELECT** to select the item you wish to change the brightness.
7. Turn the **jog shuttle** to set the brightness in the range of 1 to 15.

Note

The items that you can change the brightness are as follows:
- Wave: Waveforms
- Menu
- Back Ground
- Capture Area: Sub waveform window of the dual capture function
- Snap/Zone: Snapshot waveforms/zones
- Grid
- Cursor
- Marker
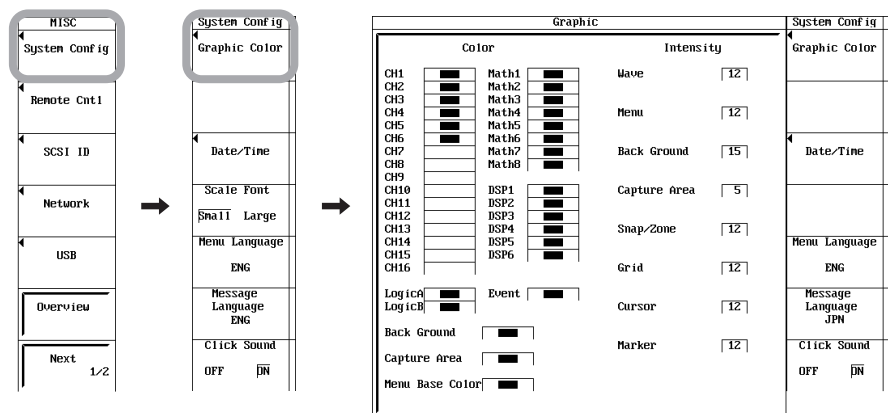
DSP1 to DSP6 are optional.

Explanation

Screen Color

You can set arbitrary colors for the following items.
The selectable colors vary depending on the item. See the color selection menu of each item.

CH1 to CH16:	Waveform color
DSP1 to DSP6 (optional):	Waveform color
Math1 to Math8:	Waveform color
Logic A, Logic B:	Waveform color
Event:	Waveform color
Back Ground:	Background color of the waveform display area
Capture Area:	Sub waveform window of the dual capture function
Menu Base Color:	Menu

Brightness: Intensity

You can set the brightness for the following items from 1 to 15 steps.

Wave:	Waveform
Menu	
Back Ground:	Background
Capture Area:	Sub waveform window of the dual capture function
Snap/Zone:	Snapshot waveforms/zones
Grid	
Cursor	
Marker	

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Other Operations

17.5 Turning OFF the Backlight and Setting the Brightness of the Backlight

Procedure
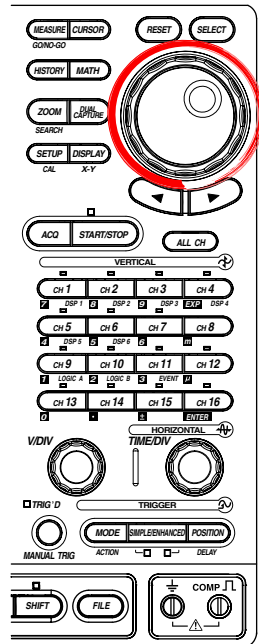
1. Press **MISC**.
2. Press the **Next 1/2** soft key.
3. Press the **LCD** soft key. The LCD setup menu appears.

Setting Backlight Auto Off

4. Press the **Auto OFF** soft key to select ON or OFF.
   If you set Auto OFF to ON, proceed to step 5.
5. Press the **Auto OFF Time** soft key.
6. Turn the **jog shuttle** to set the time when the backlight will automatically turn OFF.

Setting the Backlight Brightness

7. Press the **Brightness** soft key.
8. Turn the **jog shuttle** to set the backlight brightness.

Turning ON/OFF the Backlight

9. Press the **LCD OFF Exec** soft key. The backlight turns OFF.
   Press any key to return to the measurement screen.
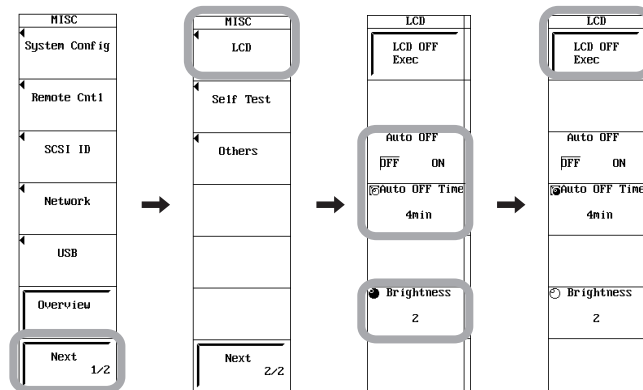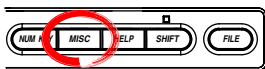
Explanation

Turning ON/OFF the Backlight: LCD OFF Exec

Turns ON/OFF the LCD backlight. If a key is pressed when the backlight is OFF, the screen returns to the measurement screen.

Setting the Backlight Auto OFF: Auto OFF, Auto OFF Time

The backlight automatically turns OFF, if there is no key operation for the specified time.

Setting the Backlight Brightness

You can change the brightness of the backlight. Set the brightness in the range of 0 (darkest) to 7 (brightest).
The lifetime of the backlight can be prolonged by dimming the backlight or turning OFF the backlight when it is not necessary.

17.6   Locking the Keys
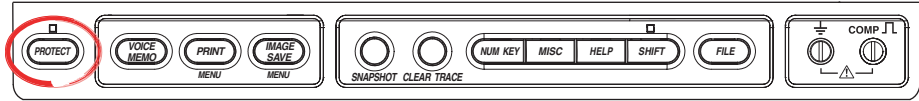
1.   Press **PROTECT**. The LED above the key illuminates, and the keys are locked.
2.   To release the lock, press **PROTECT** again.

Explanation

This function locks the operation keys so that the current DL750/DL750P condition is not changed accidentally. When keys are locked, all keys other than the PROTECT key cannot be used.

Note

When keys are locked, operations using the USB mouse and USB keyboard are also disabled.

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Other Operations

18.1 Troubleshooting

Troubleshooting

- If a message is displayed on the screen, read the succeeding pages.
- If servicing is necessary, or if the instrument is not operating correctly after performing the corrective actions below, contact your nearest YOKOGAWA dealer.

Problem	Probable Cause	Corrective Action	Reference Section
The power cannot be turned ON.	Using a power supply outside the ratings.	Use a correct power supply.	3.4
Nothing is displayed.	The backlight is turned OFF.	Press any key.	17.5
	The screen colors are not appropriate.	Power cycle the DL750/DL750P while holding down the **RESET** key.	17.4
The display is odd.	The system is abnormal.	Power-cycle the DL750/DL750P.	3.4
Keys do not work.	The DL750/DL750P is in the remote mode.	Press **SHIFT + CLEAR TRACE** enable local mode.	–
	Other causes.	Perform a key test. If the test fails, servicing is required.	18.3
	Protected.	Press the **PROTECT** key.	17.6
Trigger does not activate.	The trigger settings are not appropriate.	Set the trigger conditions correctly.	Chapter 6
Measured values are not correct.	Insufficient warm-up.	Warm up the DL750 for 30 minutes after turning on the power.	—
	Not calibrated.	Perform a calibration.	4.6
	The probe's phase has not been corrected.	Correct the phase properly.	3.7
	The probe attenuation is not correct.	Set an appropriate value.	5.6
	An offset voltage is added.	Set the offset voltage to 0 V.	5.10
	Other causes.	Perform a calibration. In addition, select Test Item: Carib.Inf. for the self test item and execute the self test. If the measured value is still odd, servicing is required.	4.6 18.3
Cannot output to built-in printer.	The printer head is damaged or worn out.	Servicing required.	–
Cannot save to the specified medium.	The medium is not formatted.	Format the medium.	13.5
	The medium is write-protected.	Release the medium's write-protect.	–
	No more free space on the medium.	Delete unneeded files or use a new medium.	13.15
Cannot change settings or control the operation of the DL750/DL750P via the communication interface.	The address of the DL750/DL750P used by the program is different from the specified address.	Match the address used in the program to the address of the DL750/DL750P.	Communication Interface User's Manual (IM701210-18E)
	The interface is not used in a way that conforms to the electrical or mechanical specifications.	Use it in a way that conforms to the specifications.	

Troubleshooting, Maintenance, and Inspection

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18.2 Messages and Corrective Actions

Error Message

A message may appear during operation. This section describes the meanings of the messages and their corrective actions. The messages can be displayed either in English or Japanese (see section 17.1). If the corrective action requires servicing, contact your nearest YOKOGAWA dealer for repairs.

In addition to the error messages below, there are communication error messages. These messages are described in the *Communication Interface User's Manual IM 701210-18E* (separate manual).

Status Messages

Code	Message and Corrective Action	Section
51	File access is aborted.	Chapter 13
54	Exit from GO/NO-GO mode.	11.8, 11.9
55	Image printing was aborted.	Chapter 12
56	Cannot set all about zone.	11.9
57	Write to the EEPROM complete. Wrote module-specific information to the module.	–
58	Calibrating the temperature module.	–
59	Temperature module calibration complete.	–
60	The instrument is set to remote mode by the communication control. Press the SHIFT + CLEAR TRACE key to change to local mode.	–
62	Terminating...	–
63	Turned on pressing the RESET key. Will initialize.	4.4
64	A strain module is installed. Carry out automatic balancing before use.	–
65	The setting of the excitation voltage or the gauge factor was changed. Carry out automatic balancing before use.	–
66	Automatic balancing is running...	–
67	Automatic balancing is complete.	–
68	Test: SUCCESS	–
69	Calibration is running...	4.6
70	Calibration is complete.	4.6
71	Completed action-on-trigger.	6.17
73	Release the Preview mode.	12.2
75	Aborted the search.	11.2 to 11.4
76	Executed the search, but no record was found that matched the conditions.	11.2
77	Executed the search, but no record was found that matched the pattern.	11.4
78	Pattern contains points that are between Thr Lower and Thr Upper.	11.4
82	Aborted the statistical measurement.	–
83	This model does not have the DSP option installed.	–
84	Averaging is in progress.	11.1
85	Averaging has been completed.	11.1
86	Input module configuration was changed. Relevant settings have been initialized.	–
87	Parameter block has been set. Restart to update the instrument configuration information.	–
88	There is no dry cell. Insert batteries or turn the backup switch OFF.	7.10
89	All operation was aborted due to a power disruption. The data before the disruption is stored. No data was acquired during the disruption.	7.10
90	When history is set to "All," data of math channels is not saved. To store the data of math channels, set history to "One." * Data of channels other than math is saved.	11.1
91	This model does not have computation option installed.	–
92	This model does not have the HDD option installed.	–

Code	Message and Corrective Action	Section
93	Realtime recording is being prepared.	7.7
94	Media information is being read.	13.5
95	Failed to retrieve the data. Execute again.	Chapter 11
96	This setting not possible on DSP channels.	Chapter 15
97	The maximum sampling rate when using DSP channels is 5 MS/s. Slower sample rate than 2MS/s when set a DSP display.	Chapter 15
279	This command cannot be used in the current mode.	Chapter 9

Errors in Execution (700 to 799)

Code	Message and Corrective Action	Section
701	Long copy is not possible when waveform acquisition is in progress. Press the START/STOP key to stop the waveform acquisition first.	7.1, 12.2
703	Undo is not possible since data that existed immediately before initialization and auto setup is not available.	4.4, 4.5
704	Can not be executed while running. Press START/STOP key to stop acquisition.	7.1
707	Can not Start while data out. Wait until output is completed.	7.1
708	Can not data out while running. Press START/STOP key to stop acquisition.	7.1
709	Can not detect listener. Check GP-IB connector.	–
710	File not found. Check the file.	Chapter 13
711	Cannot manipulate files while image printing is in progress. Wait until image printing is complete.	Chapter 13
712	Can not compress this hardcopy image. Turn off compression switch.	13.11
713	Calibration failure. Disconnect the input and execute again. If it fails again, servicing is necessary.	4.6
714	Temperature module calibration failed. Calibration value is invalid. Check the input signal.	4.6
716	Realtime recording to the internal hard disk is valid when the sampling rate is slower than the values shown below. 1~2 CH : 100 kS/s, 3CH : 50 kS/s, 4~5CH : 20 kS/s, 6~11CH : 10 kS/s, 12~18CH : 5 kS/s	7.7
717	Too many channels for the current T/div setting to realtime record. Decrease the number of channels by turning them OFF.	7.7
718	Too many channels to realtime record at the current record length. Turn OFF channels to reduce the number of channels or shorten the record length.	7.7
721	Can not operate while data out. Wait until output is completed.	7.7
723	Cannot load the realtime record.	7.7,13.14
724	Balancing failed. * indicates the channel number of the channel for which automatic balancing failed.	–
725	Cannot be executed. Acquisition not active.	7.1
727	Insufficient output data. Increase Mag or widen the Time Range interval.	12.2
728	Image is being printed. Abort or wait until printing is complete.	Chapter 13
730	Pattern is not specified.	11.4
732	Cannot be executed while computation is in progress.	Chapter 10
733	Failed to measure statistics. Waveform data may be missing. If Cycle Statistics is specified, the instrument may be configured in a way that fails to detect the cycle.	11.7
735	Executing file Load, Save, or Format. Abort or wait until it is complete.	Chapter 13
736	Image is being printed or saved. Abort the operation or wait until the execution of the command is complete.	Chapter 13
737	A setup of an action trigger can't be carried out under the state of on.	6.18
738	Cannot be executed when the dual capture setting is ON.	7.6
739	Cannot be executed when realtime record or print setting is ON.	7.7
740	A time base can't be carried out under the state of the outside clock.	5.14
741	A start by the START key can't be done in the GO-NOGO mode.	11.8, 11.9

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Code	Message and Corrective Action	Section
742	Because there are too many channels, it can't start in the length of the present record.	7.2
743	The indication mode of the history can't be carried out except for "Average".	11.1
744	Average practice can't be done because the record length of the history exceeds the record length that it can be carried out.	11.1
745	Set the trigger mode to Auto or Log for realtime hard disk recording. If the number of actions is set to Continuous, the only valid trigger mode is Log.	6.1, 7.7
746	Dual capture is not possible at the current record length. Shorten the memory length.	7.6
747	Dual capture is not possible if the main sample rate is faster than 100 kS/s or T/div is faster than 100 msec/div. Meet either of the conditions below. • Shorten the record length (slower sample rate). • Decrease T/Div.	5.2, 7.2, 7.6
748	Cannot start at the current record length. Shorten the record length or meet the following condition. • Set the trigger mode to Auto, decrease T/Div to less than 100 msec/div to enable roll mode. • Set the trigger mode to Single or Log.	5.2, 6.1, 7.2
749	Averaging mode is not possible when the trigger mode is Single, SingleN, or Log. Change the trigger mode.	6.1
751	A trigger can't start in case of dual capture in case of the one except for Auto or Log. Please change the trigger mode.	6.1, 7.6
752	Dual capture is not possible when set to average. Change the acquisition mode.	7.3, 7.6
753	Cannot start when the HISTORY or SEARCH menu is being displayed. Press the ESC key to clear the menu before starting.	11.2
754	Dual capture is not possible when set to X-Y or T-Y&X-Y. The capture window connot be opened when set to X-Y or T-Y&X-Y.	7.6, 8.6
755	Time base cannot be set to external clock when set to envelope or box average.	5.14, 7.3
756	Cannot set accumulate during roll mode display. Turn Off accumulate.	5.2, 8.4
757	Cannot be executed when the acquisition mode is set to average. Change the mode.	7.3
758	Cannot copy if 50 pages is exceeded. Change the multiplier or range.	12.2
759	Realtime recording to the internal hard disk is valid when the record length is longer than 1 M.	7.2, 7.7
760	Cannot set the current drive on a realtime partition using communication commands.	7.7
761	Cannot be executed on realtime recorded waveforms.	7.7
762	Cannot be executed on waveforms in dual capture mode.	7.6
763	Long copy is not possible when X-Y display is present.	8.6
764	File recorded in realtime is currently being analyzed. Files being analyzed cannot be deleted.	7.7, 13.4
765	File recorded in realtime is currently being analyzed. The name of files being analyzed cannot be changed.	7.7, 13.17
766	File recorded in realtime is currently being analyzed. Partitions containing files that are being analyzed cannot be formatted.	7.7, 13.5
767	128 and more file can't be formed in the real-time area.	7.7
768	The file which failed in the real-time record can't be read.	7.7
769	Cannot start Single(N) when accumulate is On. Change the accumulate to Off.	6.1, 8.4
770	Cannot be executed when GO/NO-GO Mode is Zone.	11.9
771	Cannot play voice memo in the following situations: * while waveforms are being read * when history display mode is not One * when the latest history record is not displayed	7.9
772	Cannot record a voice memo when not in roll mode.	7.9
773	The measuring range is up to 10 MWords from measure start (TimeRange1).	6.17
774	Synchronizing signal not detected.	6.17
775	Set acquisition mode to Normal when using a wave window trigger.	6.17
776	The wave window trigger cannot be used if the sampling rate is faster than 500 kS/s or slower than 10 kS/s.	6.17
777	Range over. Change to an appropriate range then retry shunt calibration.	5.17
778	Statistical processing cannot be performed on waveforms recorded in real time.	11.7
779	Cannot detect a effective input signal at a Sync. channel.	6.17

Code	Message and Corrective Action	Section
780	Firmware was not overwritten in the following slots, since the version of the firmware in the module and that of the replacement firmware were the same. Check the versions on the overview screen. SLOT: XX	–
781	Cannot start while the following setup menus are displayed. Press the ESC key to clear the menu, and then start. (ALL CH, ZOOM, MEASURE, CURSOR, PrintSetup)	–
782	Firmware was not overwritten, since the version of the firmware in the printer and that of the replacement firmware were the same.	18.4
783	Checksum error in the printer control program. Recycle the power. If the error occurs again, maintenance service is required.	3.4
784	Failed to transmit the printer control program. Recycle the power. If the error occurs again, maintenance service is required.	3.4
785	Failed to write the printer control program. Recycle the power. If the error occurs again, maintenance service is required.	3.4
786	Cannot perform numeric recording when the floppy disk drive is specified. Select another drive with FileList and execute it again.	13.7
787	Cannot be carried out during recording. Press the START/STOP key to stop the waveform acquisition first.	7.1
788	Cannot start while the alert dialog box is open. Press the ESC key to clear the dialog box, and then start.	–
789	Cannot copy if 100 pages is exceeded. Change the multiplier or range.	9.8, 12.2
790	Fine Print or Zoom Print is not possible when X-Y display is present.	8.6, 12.2

Errors in Setting (800 to 899)

Code	Message and Corrective Action	Section
800	Illegal date-time. Set the correct date and time.	3.5
801	Illegal file name. The file name contains characters which are not allowed or the file name is not a valid MS-DOS file name. Enter another file name.	Chapter 13
803	Turn off accumulate mode to enter history menu. It is not possible to activate the history menu by pressing the HISTORY key during accumulation.	8.4
804	Cannot change this parameter while running. Press the START/STOP key to stop acquisition.	7.1
806	Cannot change settings during GO/NO-GO. Stop the GO/NO-GO.	11.8, 11.9
808	Can not change display points with this T/div setting.	5.2
809	Cannot change edge for status other than X. Set the state of the channel corresponding to condition A to 'X'.	Chapter 6
811	Cannot change display points in roll mode.	5.2
813	Set Items in measure menu. Set appropriate measurement items.	11.6
814	Duplicated Name. Change the label string.	8.10
816	Cannot turn off with the current record length. Please Change record length.	7.2
817	Cannot change. Please change X Trace in the X-Y menu.	8.6
818	Cannot change when GO/NO-GO Mode is Zone.	11.9
819	Cannot change when Channel Display is OFF or Math settings are invalid. Set the channel display ON or make appropriate Math settings.	5.1, Chapter 10
821	Cannot change when External Clock is active.	5.14
823	Cannot change while running.	7.1
824	Cannot change with the current acq mode. Set the acquisition mode to Normal.	7.3
827	Illegal math expression. Input a correct computing equation.	10.5
829	Cannot change when Logic Mode is OFF or all bits of Logic Display are OFF.	5.20
830	Cannot set anything other than Low Pass for a Gaussian filter. Change the Filter Type to another filter besides Gaussian.	10.5
834	Duplicate SCSI ID. Set different ID numbers.	13.6
835	Cannot change settings while realtime printing or realtime recording. Stop printing or recording.	11.2

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Code	Message and Corrective Action	Section
836	Cannot change settings during Action On Trigger. Stop the Action On Trigger.	6.18
837	Cannot set the channels which do not have modules installed.	–
838	Cannot set the channels which do not have the strain module installed.	–
839	Cannot Set or Execute.	11.10
840	If the trigger mode is set to Single, Single (N), or LOG, the acquisition mode cannot be set to Average.	6.1, 7.3
843	If the acquisition mode is Average, the trigger mode cannot be set to Single, Single (N), or Log.	6.1, 7.3
844	It can't be set at the time of the roll mode.	5.2
845	The trigger mode cannot be set to Single(N) during the roll mode.	5.2, 6.1
850	The acquisition mode cannot be set in the current record length.	7.2
851	Computation cannot be carried out at the current record length.	7.2
853	Cannot be configured or executed during the search operation.	11.2 to 11.4
855	Cannot be configured or executed during the history search operation.	11.2, 11.3
856	The record cannot be selected.	11.1 to 11.3
857	History record does not exist.	11.1 to 11.3
858	Cannot be configured or executed while computation is in progress. Aborted when history display mode is set to One.	11.1 to 11.3
859	It can't be set up or be carried out in the Preview mode. Choose Quit, and cancel the Preview mode.	12.2
860	Cannot be configured or executed while updating the history all display. Aborted when history display mode is set to One.	11.1 to 11.3
861	This format cannot output with color.	12.3, 12.4
862	Zones cannot be edited in the following cases: When the main window is not displayed. When the relevant waveform is not displayed.	11.9
863	The zone waveform does not exist.	11.9
865	Zones determination is not possible in the following cases: When the main window is not displayed. When the relevant waveform is not displayed. When the zone waveform does not exist.	11.9
867	Conflict in the waveform display plane. Set the Mode to something other than Zone using the GO/NO-GO menu.	11.9
868	Processing statistics. To perform other operations, abort the statistical processing.	11.7
869	The channel which couldn't be set up was specified.	Chapter 11, 13.7
870	Cannot be set when the acquisition mode is set to average.	7.3
871	Cannot be set in the dual capture mode.	7.6
872	Cannot be set during realtime recording.	7.7
873	It is an unacceptable parameter to set up to the present module.	Chapter 5
874	It can't be set up during the dual capture practice.	7.6
875	Cannot be set to a range of 20 sec/div to 3 day/div during roll display.	5.2
876	Because a record length is too long, it can't be set up by the present number of indication channels.	7.2
877	Cannot be set because there are too many display channels at the current record length. Shorten the record length.	7.2
878	Zooming is not available when the number of displayed points of the FFT waveform is less than 50 in the Zoom window. Aborted when history display mode is set to One.	10.3
879	It is the dual capture record length which can't be set up.	7.6
880	Cannot change this setting during realtime recording.	7.7
881	The time base cannot be set to external clock when the acquisition mode is set to envelope or box average.	7.3, 5.14
882	Spaces are not allowed for trace labels.	8.10
883	Cannot set accumulate during roll mode display.	5.2, 8.4
884	Cannot change the History parameter when accumulate is ON. Turn OFF accumulate first.	8.4
885	P-P compression cannot be used to save when a record length is 1 K.	13.7
886	Event channels cannot be displayed at the current record length.	7.2, 5.21

Code	Message and Corrective Action	Section
887	A sampling speed was too fast, and it could be folded, and a real-time queue was needed. Slow down a sampling speed.	7.7
888	A sampling speed was too fast, and it could be folded, and a real-time buffer was needed. Slow down a sampling speed.	7.7
889	Cannot set On this module.	6.17
890	Settings can not be entered for channels on which no strain module is mounted.	–
891	Cannot be changed when Variable is turned ON.	Chapter 15
892	A DSP channel cannot be specified for this trigger type.	Chapter 15
893	Cannot be set if Operation is set to something other than KnockFlt.	Chapter 15
894	Cannot set this module when Operation is set to KnockFlt.	Chapter 15
895	Cannot be set when the trace is set to a frequency module.	Chapter 15
896	Cannot be set when the trace is set to a DSP channel.	Chapter 15
897	The capture window cannot be changed while the dual capture is in progress, and while the measuring is in progress.	7.6
898	Cannot be set while the capture window is opened.	7.6

System Operation Errors (900 to 999)

Code	Message and Corrective Action	Section
901	Failed to backup setup data. Will initialize. Backup battery may be low.	7.10
902	System RAM failure. Maintenance service is required.	–
903	System ROM failure. Maintenance service is required.	–
906	Fan stopped. Power off immediately. Maintenance service is required.	–
907	Backup battery is flat. Maintenance service is required to replace the back-up battery.	3.4
908	Internal temperature is too high. Power off immediately. Maintenance service is required.	3.4
909	Illegal SUM value. Maintenance service is required.	3.4
910	RAM read/write error. Maintenance service is required.	–
911	Memory bus error. Maintenance service is required.	–
912	Communication driver error.	–
914	Time out occurs in Communication.	–
915	EEPROM read error. EEPROM may be damaged. Maintenance service is required.	–
916	EEPROM write error. EEPROM may be damaged. Maintenance service is required.	–
917	No module installed. Install the module.	3.3
918	Turn ON the internal hard disk motor.	13.2
919	The current module installation condition and the setup data are inconsistent. Will initialize.	–
922	Cannot back up the acquisition memory. Memory will be initialized. The battery for acquisition memory backup may be flat.	7.10
928	Battery for waveform memory is flat. Waveform memory was initialized.	7.10
929	MS bus error occurred.	–
930	Slot 1 EEPROM error.	–
931	Slot 2 EEPROM error.	–
932	Slot 3 EEPROM error.	–
933	Slot 4 EEPROM error.	–
934	Slot 5 EEPROM error.	–
935	Slot 6 EEPROM error.	–
936	Slot 7 EEPROM error.	–
937	Slot 8 EEPROM error.	–
938	Key protect is enabled. To release the protection, press the PROTECT key.	17.6
939	This firmware is for the DL750P. It cannot be used on the DL750.	17.6
940	The USB device's power consumption exceeded the capacity of the USB hub.	19.8

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File Operation Errors (1000 to 1199)

Code	Message and Corrective Action	Section
1001	Invalid file name. * Duplicate file name or incorrect SCSI ID.	Chapter 13
1002	Cannot detect the medium. * Check the presence of the medium or the SCSI device connection.	Chapter 13
1003	Cannot detect the medium. * Check the presence of the medium or the SCSI device connection.	Chapter 13
1004	Media failure. Check the storage medium.	Chapter 13
1005	File not found. Check the file name and the storage medium.	Chapter 13
1006	Invalid file name. * Duplicate file name or incorrect SCSI ID.	Chapter 13
1007	Media failure. Check the storage medium.	Chapter 13
1008	Invalid file name. * Duplicate file name or incorrect SCSI ID.	Chapter 13
1009	Invalid file name. * Duplicate file name or incorrect SCSI ID.	Chapter 13
1010	Invalid file name. * Duplicate file name or incorrect SCSI ID.	Chapter 13
1011	The maximum number of files that can be stored in a single directory was exceeded. Save the file to another directory or medium.	Chapter 13
1012	Media full. Delete unnecessary file(s) or use another disk.	Chapter 13
1013	Cannot delete a directory if there are files in the directory.	13.15
1014	File is protected.	13.15
1015	Physical format error. Reformat the medium. If the same error occurs, the instrument is probably unable to execute a format on this medium.	13.5
1016	File system failure.	Chapter 13
1017	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1018	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1019	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1020	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1021	File is damaged. Check the file.	Chapter 13
1022	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1023	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1024	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1025	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1026	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1027	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1028	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1029	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1030	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1031	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1032	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13

Code	Message and Corrective Action	Section
1033	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1034	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1035	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1036	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1037	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1038	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1039	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1040	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1041	File system failure. Check using another disk. If the same message still appears, maintenance service is required.	Chapter 13
1042	No media exists in SCSI device. Check that the storage medium is correctly inserted in the SCSI device.	13.4
1046	Media failure. Check the medium.	Chapter 13
1047	Media failure. Check the medium.	Chapter 13
1048	Media failure. Check the medium.	Chapter 13
1049	Media failure. Check the medium.	Chapter 13
1050	Media failure. Check the medium.	Chapter 13
1051	Media failure. Check the medium.	Chapter 13
1052	Media failure. Check the medium.	Chapter 13
1053	Media failure. Check the medium.	Chapter 13
1054	Media failure. Use a floppy disk of a format supported by the instrument.	13.1, 13.5
1055	Turn the HDD motor ON.	13.2
1100	Invalid record number.	Chapter 13
1101	File system failure.	Chapter 13
1102	File system failure.	Chapter 13
1103	File system failure.	Chapter 13
1104	File system failure.	Chapter 13
1105	File system failure.	Chapter 13
1106	File system failure.	Chapter 13
1107	File system failure.	Chapter 13
1108	File system failure.	Chapter 13
1109	Invalid media format.	Chapter 13
1110	Cannot load this file format. Files stored on other models (DL/AG series) cannot be loaded.	Chapter 13
1111	File is now being accessed. Execute after access is made.	Chapter 13
1112	Cannot be executed while running. Press the START/STOP key to stop acquisition.	7.1
1113	Cannot find '.HDR' file. Check the file.	13.7
1114	The specified file cannot be loaded on this ROM version or this model.	Chapter 13
1115	No ch is displayed. Turn ON the display of the appropriate channel.	5.1
1116	Save data not found. Check for presence of data.	Chapter 13
1118	SCSI controller failure. Maintenance service is required.	–
1119	HDD overrun error. Due to spare sectors, the recording could not be finished within assigned time. The operation is aborted.	–
1120	HDD error. An error occurred in the HDD. The operation is aborted.	–
1121	Unknown file format. Check the file.	Chapter 13
1124	Data that have been P-P compressed and saved cannot be loaded.	13.7

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Code	Message and Corrective Action	Section
1125	Cannot directly load the sub waveform file (for example 0003DC.WVF). Specify and load the main waveform file (for example 0003.WVF).	7.6, 13.7
1126	Cannot save in this format at the current record length. Specify a range and save a section of the data. * Cannot create a file of size 2 GB or larger.	7.2
1127	Cannot load because the medium is selected. Select a setup file (SET).	13.8
1128	Cannot load because a directory is selected. Select a setup file (SET).	13.8
1129	Cannot load because the medium is selected. Select a binary file (.WVF).	13.7
1130	Cannot load because a directory is selected. Select a binary file (.WVF).	13.7
1131	Cannot load files larger than 50 MB on a network drive. Copy the file to the local drive before loading it.	Chapter 13
1132	Cannot load a HistoryAll binary file on a network drive.	13.7
1133	Turn the HDD motor ON.	Chapter 13
1134	If the realtime recorded file is converted to binary format, the converted file cannot be loaded.	13.7, 13.14
1135	Cannot save the waveform by specifying Z1 (Z2) for the range to be saved, if the zoom rate is set to x1. Save the waveform by specifying Main for the range to be saved.	13.7
1136	The file saved on the DL750P when the recorder mode is set to chart or X-Y cannot be loaded in the DL750.	Chapter 9
1137	Cannot make a directory or a file in the real-time area of the internal hard disk. Change the current directory.	7.7, Chapter 13
1138	Cannot save at the current PDF setting. Change the settings. * A file of size exceeding 2 GB cannot be created.	9.9, 13.13
1139	Cannot create PDF files on the network drive when the history waveform display format is set to All. Create the file on the local drive, and then copy it to the network drive.	9.9, 13.13

Printer Errors (1200 to 1299)

Code	Message and Corrective Action	Section
1200	Move the release arm to the "HOLD" position.	12.1
1201	Paper empty. Load a roll chart.	12.1
1202	The printer head temperature is high. Printing will be aborted. Printing will not be possible until the printer head temperature comes down.	12.1
1203	Printer over heat. Power off immediately.	12.1
1204	Printer power supply error. Maintenance service is required.	12.1
1205	Printer time out. Maintenance service is required.	12.1
1206	USB printer error. Turn the power of the printer from OFF to ON.	12.3
1207	USB printer off-line.	12.3
1208	No paper.	12.3
1209	USB printer is in use.	12.3
1210	Cannot detect printer. Turn ON the printer. Check connectors.	12.3
1211	Printer is out of order. Maintenance service is required.	12.4
1212	Printer error. Turn the power of the printer from OFF to ON.	12.4
1213	Printer offline.	12.4
1214	Out of paper.	12.4
1215	Printer is in use.	12.4
1216	Cannot detect printer. Turn ON the printer. Check connectors.	12.4
1217	No applicable files for showing thumbnails.	13.12
1218	Print head temperature detection thermister is broken.	–
1219	Print head temperature detection thermister is shorted.	–
1220	Thumbnail execution is not possible when the floppy drive is specified. Select the image file from the file list and confirm with the SELECT key.	13.12

Network Errors (1300 to 1399)

Code	Message and Corrective Action	Section
1300	Cannot connect with ftp server. Confirm the network settings and connection.	Chapter 16
1301	Has not connect with ftp server yet. Confirm the network settings and connection.	Chapter 16
1302	This ftp function in not supported.	Chapter 16
1303	FTP Error: Pwd Confirm the network settings and connection.	Chapter 16
1304	FTP Error: Cwd Confirm the network settings and connection.	Chapter 16
1305	FTP Error: Rm Confirm the network settings and connection.	Chapter 16
1306	FTP Error: List Confirm the network settings and connection.	Chapter 16
1307	FTP Error: Mkdir Confirm the network settings and connection.	Chapter 16
1308	FTP Error: Rmdir Confirm the network settings and connection.	Chapter 16
1309	FTP Error: Get Confirm the network settings and connection.	Chapter 16
1310	FTP Error: Put Confirm the network settings and connection.	Chapter 16
1311	FTP Error: GetData Confirm the network settings and connection.	Chapter 16
1312	FTP Error: PutData Confirm the network settings, connection, and disk capacity.	Chapter 16
1313	FTP Error: AppendDataa Confirm the network settings, connection, and disk capacity.	Chapter 16
1314	FTP Error: Client Handle Confirm the network settings and connection.	Chapter 16
1315	FTP Error: Others Confirm the network settings and connection.	Chapter 16
1335	Cannot send data to a network printer. Confirm the network settings and connection.	12.4, 16.4
1336	Cannot send a mail. Confirm the network settings and connection.	16.5
1345	Test Error.	Chapter 16
1346	Test Success.	Chapter 16
1348	Failed to initialize network. Confirm the network settings.	Chapter 16
1349	The password entered the first time is different from the password entered the second time. Reenter the password for the second time.	Chapter 16
1350	Failed to acquire time from SNTP server. Confirm the network settings and connection.	16.8
1500	Cannot set when source channel is not a Volt Input.	Chapter 15
1501	Changed the network information. To apply the changes, power-cycle the DL750/DL750P.	Chapter 16
1502	Executed the firmware overwriting of the frequency module.	Chapter 16
1503	Overwriting firmware of the frequency module...	Chapter 16
1505	Executed the firmware overwriting of the built-in printer.	18.4
1506	Overwriting the printer firmware...	–
1600	This function can be used only when the recorder mode is Off.	Chapter 9
1601	Can be specified only when the recorder mode is Off.	Chapter 9
1602	Can be configured only when the recorder mode is Off. Print from the Reprint menu.	Chapter 9
1603	This function cannot be used when the recorder mode is set to X-Y.	9.7
1604	Cannot be configured or executed when the recorder mode is Off.	Chapter 9

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Code	Message and Corrective Action	Section
1605	Repeat trigger cannot be specified. Repeat trigger is valid only during chart recorder mode when the print style is waveform and shot recording is not OFF.	Chapter 9
1606	Cannot be changed during X-Y recording.	9.7
1607	Cannot use wave window trigger when the recorder mode is set to chart or X-Y.	Chapter 9
1608	Cannot be specified when the print style is Numeric.	9.6
1609	Cannot Set or Execute on the DL750.	Chapter 9

Other Errors (9999)

Code	Message and Corrective Action	Section
9999	This error No. is not defined.	–

Note

If servicing is required, initialize the instrument once for confirmation.

18.3 Self-Diagnostic Test (Self Test)

Procedure
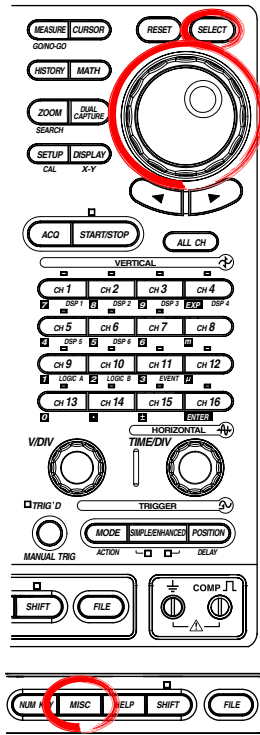
Displaying the Self Test Menu

1. Press **MISC**.
2. Press the **Next 1/2** soft key.
3. Press the **Self Test** soft key.
4. Press the **Test Item** soft key. The test item selection menu appears. Use the **jog shuttle** and **SELECT** to select the item to be tested.

   Proceed to step 5 for the memory test, step 7 for the key test, step 12 for the printer test, and step 14 for the floppy disk drive test, Zip disk drive test, PC card drive test, internal HDD test, or SCSI test.

Executing the Memory Test

5. In step 4, select Memory.
6. Press the **Test Exec** soft key to execute the memory test.

Executing the Key Test

7. In step 4, select Key Board.
8. Press the **Test Exec** soft key to execute the key test.
9. Press all the keys or press **ESC** twice to end the key test.

- **Testing the soft keys**
  10. Press the **Soft Key** soft key. A soft keyboard appears.
  11. Use the **jog shuttle** and **SELECT** to check that all the characters on the keyboard can be entered correctly.

				Memory test	Key test
MISC	MISC	●▸Select	Self Test / Test Item	Self Test / Test Item	Self Test / Test Item
System Config	LCD	Key Board	Key Board	Memory	Key Board
Remote Cntl	Self Test	Memory			
		FDD			
SCSI ID	Others	PC CARD	Soft Key		Soft Key
		ZIP	WING123		KEYTEST
Network		HDD			
		SCSI			
USB		Printer			
		Calib.Inf.			
Overview		FREQ VerUp	Test Exec	Test Exec	Test Exec
Next 1/2	Next 2/2	PRINTER VerUp			
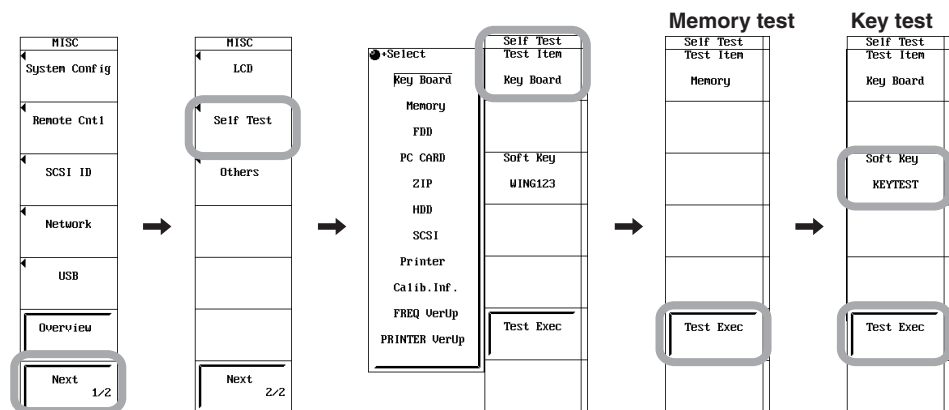
Note

"FREQ VerUp" and "PRINTRE VerUp" that are displayed with the Test Item soft key are used when updating the frequency module firmware and the DL750P built-in printer firmware. For details on updating the firmware, see the following Web page.
http://www.yokogawa.com/tm/DL750/

Executing the Printer Test

12. In step 4, select Printer.

13. Press the **Test Exec** soft key to execute the printer test.

Executing the Floppy Disk Drive, Zip Disk Drive, PC Card Drive, Internal HDD, or SCSI Test

14. In step 4, select FDD, ZIP, PC CARD, HDD, or SCSI.

15. Press the **Test Type** soft key.

16. Turn the **jog shuttle** to set Test Type to #1.

17. Press the **Test Exec** soft key to execute the test selected in step 14.

Note

- Insert a floppy disk, a Zip disk, or a PC card before executing the floppy disk drive, Zip disk drive, or PC card drive test.
- Note the following points when performing a SCSI test.
  - Connect the SCSI device.
  - Only test unpartitioned SCSI devices.
  - Set the SCSI ID to 1.
- Test Item > Calib.Inf. is a menu for the service personnel (maintenance).

Printer test	FDD test	Zip drive test	PC card drive test	Internal HDD test	SCSI test
Self Test	Self Test	Self Test	Self Test	Self Test	Self Test
Test Item	Test Item	Test Item	Test Item	Test Item	Test Item
Printer	FDD	ZIP	PC CARD	HDD	SCSI
	Test Type #1	Test Type #1	Test Type #1	Test Type #1	Test Type #1
Test Exec	Test Exec	Test Exec	Test Exec	Test Exec	Test Exec
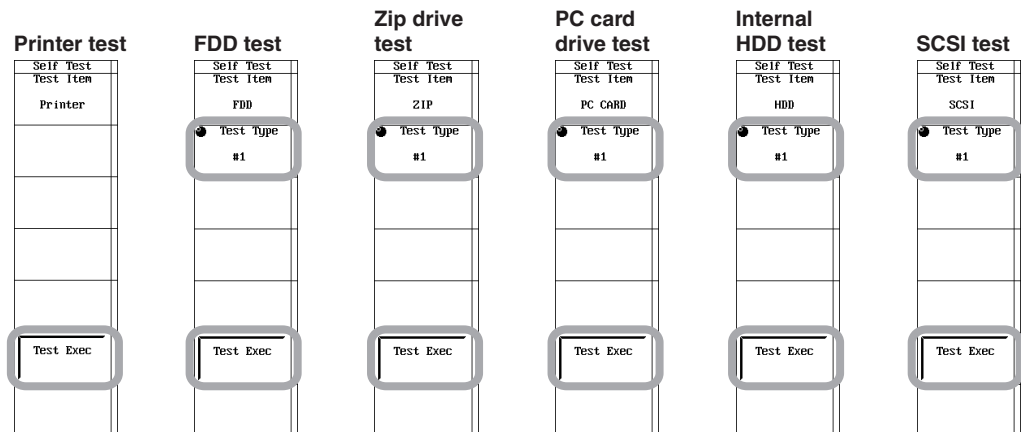
Explanation

Memory Test

Tests whether the RAM/ROM of the internal CPU board is operating correctly. If Pass is displayed, it is operating correctly.
If there is an error, Fail is displayed.

Key Test: Key Board

Tests whether the front panel keys are operating properly. If the name of the key being pressed appears highlighted, it is operating correctly. If there is an error, the name of the key will not appear highlighted.
Press the ESC key twice to quit the key test.

Floppy Disk Drive, Zip Drive, or PC Card Drive Test: FDD, ZIP, PC CARD

Tests whether the floppy disk drive, Zip drive, or PC card is operating properly. If there is an error, Fail is displayed after the test execution.

Internal Hard Disk Drive (Optional) or SCSI Test: HDD, SCSI

Tests whether the internal hard disk drive or SCSI is operating correctly. If there is an error, Fail is displayed after the test execution.

Printer Test

Tests whether the built-in printer is operating properly. If the tint is printed correctly, the operation is normal. If there is an error, the printing will not be correct.

If an Error Occurs during the Self Test

If the error remains after carrying out the following procedure, contact your nearest YOKOGAWA dealer.
- Perform the self test several more times.
- Check whether the medium to be tested is inserted.
- Check whether the internal hard disk (optional) motor is turned ON. (Section 13.2)
- Check whether the paper is properly set in the built-in printer. Check for paper jams (section 9.1 (section 12.1 for the DL750P)).
- Check whether the external SCSI device is connected properly. (Section 13.4)

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18.4 Checking the System Conditions (Overview)

Procedure

1. Press **MISC**.
2. Press the **Overview** soft key. The overview screen appears.
   Press any key to clear the overview screen.

```
                                                      MISC
              System Overview
                                                   System Config
Model          :  701230
Record Length  :  Max1GW(50MW/CH)
Module(Slot)
  1: HS10M12    (701250)     5: TEMP/HPV(701265-1.01)
  2: HV/RMS     (701260)     6: STRAIN_NDIS (701270)     Remote Cntl
  3: STRAIN_DSUB (701271)    7: ACCL      (701275)
  4: UNIV_AAF(701262-1.08)   8: FREQ     (701280-0.41/1.01)
FDD;Zip;PC_Card :  PC CARD  (0)
                                                     SCSI ID
Option
    HDD  : Yes         Math : Yes
    Dsp  : Yes         Ether : Yes  MAC :000064_839_030   Network

Default Language :  JPN
                                                       USB
Soft Version   :  4.83BB    ROM Sum : AC9FH
USB Storage    :  Yes
Linkage Date   :  05/01/18 Tue 17:35
                                                     Overview

Printer Rank   :  5        Version : 0.19/0.20
Product ID     :  1hA377FU                            Next
                                                         1/2
```

Explanation

The following information can be confirmed on the Overview screen.

- Model: Model
- Record Length: Record length
- Module(Slot):   Name of the Module[1] in the slot
- FDD|Zip|PC_Card: Type of built-in medium drive
- Option: Presence of options (Yes/No)
- Default Language: Default language
- Soft Version: Version number of the software
- USB Storage: USB storage support (Yes: Supported, No: Not supported)
- Linkage Date: Version date of the software
- Printer Rank/Version: Printer firmware version (DL750P only)
- Product ID: Unique number attached to each instrument
                    (Required when expanding the instrument with options sold
                    separately.)

1. The 701265 (TEMP/HPV) and the 701280 (FREQ) are equipped with a CPU and firmware inside the modules. On the channels in which these modules are inserted, the version of the firmware installed in the module is also displayed on the screen.

   - **701265 (TEMP/HPV)**
     TEMP/HPV (701265-X.XX)
     X.XX: Version of the software installed in the module.
           It is 1.01 in the screen above.

   - **701280 (FREQ)**
     FREQ (701280-X.XX/Y.YY)
     X.XX: Version of the software installed in the module.
           It is 0.27 in the screen above.
     Y.YY: Version of the software in the DL750/DL750P that can be installed into the 701280 (FREQ). It is 0.41 in the screen above.

   When the two versions above match, you do not have to upgrade the 701280 (FREQ). If they do not, check the upgrading procedure on the following Web page.

   http://www.yokogawa.com/tm/DL750/

18.5 Recommended Replacement Parts

The three-year warranty applies only to the main unit of the instrument (starting from the day of delivery) and does not cover any other items nor expendable items (items which wear out).

Contact your nearest YOKOGAWA dealer for replacement parts.

Parts Name	Replacement Period
Built-in printer	[DL750] Under normal usage, 500 rolls of paper (part No.: B9988AE)
Built-in printer	[DL750P] Under normal usage, 1500 rolls of paper (part No.: 701966)
LCD backlight Approx. 55000 hours under normal use	

Parts Name	Warranty Period
Internal hard disk	One year after purchase (data is excluded))

The following items are expendable items. It is recommended that the parts be replaced according to the period indicated below. Contact your nearest YOKOGAWA dealer for replacement parts.

Parts Name	Recommended Replacement Period
Cooling fan	3 years
Backup battery (lithium battery)	5 years

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19.1 Input Section

Item	Specifications
Number of input channels	16 channels + 16-bit log (8 bits ×2)
Type	Plug-in input unit
Number of slots	8 (2 channels per slot)
Maximum Record Length	Standard 2.5 MW/CH (16 analog channels + 6 DSP channels + 16-bit logic), 50 MW/CH max. /M1 option 10 MW/CH (16 analog channels + 6 DSP channels + 16-bit logic), 250 MW/(1CH) max. /M2 option 25 MW/CH (16 analog channels + 6 DSP channels + 16-bit logic), 500 MW/(1CH) max. /M3 option 50 MW/CH (16 analog channels + 6 DSP channels + 16-bit logic), 1 GW/(1CH) max.
DSP channel (optional)	6 dedicated computation channels (DSP channels) provided internal to the DL750/DL750P. Performs realtime computation of addition, subtraction, multiplication, and division (with or without coefficients), filtering, differentiation, integration, and knocking filtering using the 16 analog input channels as computation sources. (For detailed specifications of the computation function of the DSP channels, see section 19.5, "Function.") Below are the characteristics of the DSP channels • The allocation of the acquisition memory of DSP channels is the same as analog input channels. • Can be used in all acquisition modes. • Can be set as a trigger source of simple triggers, the OR trigger of enhanced triggers, and window triggers. • Computed waveform can be displayed in realtime even during roll mode display. • Can be used as a target waveform of cursor measurements and automated measurement of waveform parameters. • Can be used as a target channel for the dual capture function.

19.2 Trigger Section

Item	Specifications
Trigger mode	Auto, auto-level, normal, single, single(N), log, and repeat (only during Chart Recorder mode on the DL750P)
Trigger level range	CH1 to CH16: ±10 div around 0
Trigger hysteresis	When observing voltage: Select ±0.1 div, ±0.5 div, or ±1 div of the trigger level When observing temperature: When observing temperature: Select ±0.5° C, ±1.0° C, or ±2.0° C.
Trigger position	Can be set in 0.1% increments of the display record length
Trigger delay range	0 to 10 s (resolution is 100 ns)
Hold off time range	0 to 10 s (resolution is 100 ns)
Manual trigger key	Dedicated manual trigger key is available

Simple trigger
  Trigger source
 	
  Trigger slope
 	
  Time trigger
	
	CH1 to CH16, EXT (signal input from the TRIG IN terminal), LINE (commercial power supply signal that is connected), Logic A, Logic B, Time, and DSP1 to DSP6
	CH1 to CH16 and DSP1 to DSP6: Rising, falling, or rising/falling
	EXT, LOGIC A, LOGIC B: Rising or falling
	Date (year/month/day), time (hour/minute), time interval (1 minute to 24 hours)

Enhanced trigger
  Trigger source
  Trigger type
	
	CH1 to CH16, Logic A, and Logic B (AND and OR possible on each logic bit)
	A -> B(N): Trigger occurs nth time condition B becomes true after condition A becomes true.
	                  Count: 1 to 255
	                  Condition A: Enter/Exit
	                  Condition B: Enter/Exit
	A Delay B: Trigger occurs first time condition B becomes true after specified delay following condition A true.
	                  Delay: 0 to 10 s (resolution is 100 ns)
	                  Condition A: Enter/Exit
	                  Condition B: Enter/Exit

Item	Specifications	
	Edge on A:	Trigger occurs on the OR condition of the edge while condition A is true.
	Condition A:	True/False
	OR:	Trigger occurs on the OR of trigger conditions that are specified on multiple trigger sources. The OR condition can also be specified on each logic bit.
	B > Time:	Trigger occurs when time of satisfaction of (pulse width trigger) condition B (time during which the condition is satisfied) is greater than or equal to a specified time.
		Specified time: 100 ns to 10 s (resolution is 100 ns)
	B < Time:	Trigger occurs when time of satisfaction of (pulse width trigger) condition B is less than or equal to a specified time.
		Specified time: 100 ns to 10 s (resolution is 100 ns)
	B Time Out:	Trigger occurs when the satisfaction of (timeout trigger) condition B reaches a specified time.
		Specified time: 100 ns to 10 s (resolution is 100 ns)
	Period:	Periodic trigger. The following four types are available.
	T > Time:	Trigger occurs when the period of condition T is greater than or equal to a specified time.
		Specified time: 100 ns to 10 s (resolution is 100 ns)
	T < Time:	Trigger occurs when the period of condition T is less than or equal to a specified time.
		Specified time: 100 ns to 10 s (resolution is 100 ns)
	T < T1 < T2:	Trigger occurs when the period of condition T is within a specified time range.
		Specified time: Time1: 100 ns to 10 s
		Time2: 200 ns to 10 s (resolution is 100 ns)
	T < T1, T2 < T:	Trigger occurs when the period of condition T is outside a specified time range.
		Specified time: Time1: 100 ns to 10 s
		Time2: 200 ns to 10 s (resolution is 100 ns)
	Window:	Trigger occurs when the trigger source enters or exits the range specified by two points. Window OR of multiple channels is possible. Logic bits can also be included in the edge OR condition.
	Wave Window:	Trigger for monitoring the power supply. A realtime template is created by setting a tolerance (window width) to a waveform derived by averaging 1 to 4 cycles of waveforms before the current waveform. The current waveform is compared against the realtime template. If the current waveform falls outside the realtime template, a trigger is activated.

- Conditions A and B are parallel pattern conditions that are set separately to High, Low, or "Don't Care" for each channel (CH1 to CH16), Logic A, and Logic B.
- OR conditions can be set to ⌐, ⌐, or "Don't Care" for CH1 to CH16, Logic A, and Logic B.
- Hold off time cannot be specified for period triggers.

19.3 Time Axis

Item	Specifications	
Time axis range	Displayed using s/div, min/div, h/div, day/div.	
	500 ns/div to 1 s/div (in 1-2-5 steps), 2 s/div, 3 s/div, 4 s/div, 5 s/div, 6 s/div, 8 s/div, 10 s/div, 20 s/div, 30 s/div, 1 min/div to 10 min/div (in 1 min steps), 12 min/div, 15 min/div, 30 min/div, 1 h/div to 10 h/div (in 1 h steps), 12 h/div, 1 day/div, 2 day/div, 3 day/div	
Time axis accuracy[1]	±(0.005%)	
External clock input	Connector type:	RCA jack
	Input level:	TTL level (0 to 5 V)
	Valid edge:	Rising edge
	Frequency range:	1 MHz or less
	Minimum pulse width:	400 ns or more for high and low

1. Under standard operating conditions (see section 19.11) after the warm-up

19.4 Display

Item	Specifications
Display	10.4" color TFT LCD monitor
Display screen size	211.2 × 158.4 mm
Display resolution[1]	SVGA 800×600 dots
Display resolution of the waveform display	650×512 (normal waveform display) or 750×512 (wide waveform display) selectable
Display format	Windows: Zoom: MAIN/MAIN&Z1/MAIN&Z2/MAIN&Z1&Z2/Z1only/Z2only Z1&Z2 X-Y: TY/XY/TY&XY
Maximum display update rate	30 times/s when a single waveform is displayed

1. Liquid crystal display may include few defective pixels.(Within 5 ppm (6 points) of the total number of pixels (including RGB) The LCD is a high technology device made up of more than 1.44 million pixels There may be pixels that do not turn ON or those that remain ON at all times. However, these cases are not malfunction.

19.5 Function

Acquisition and Display

Item	Specifications
Acquisition mode	Normal: Normal waveform acquisition Envelope: Maximum sampling rate regardless of the T/div setting, holds the peak value Averaging: Average count 2 to 65536 (2^n steps) Box average: Increase the A/D resolution up to 4 bits (16 bits max.)
Record length	1 kW, 2.5 kW, 5 kW, 10 kW, 25 kW, 50 kW, 100 kW, 250 kW, 500 kW, 1 MW, 2.5 MW, 5 MW, 10 MW, 25 MW, 50 MW, 100 MW (/M1, /M2, or /M3 option), 250 MW (/M1, /M2, or /M3 option), 500 MW (/M2 or /M3 option), 1000 MW (/M3 option)
Zoom	Expand the displayed waveform along the time axis (up two locations using separate zoom rates)
Display format	1, 2, 3, 4, 8, 16 analog waveform windows
Display interpolation	Display samples using dot display, sine interpolation, or linear interpolation.
Graticule	Select from three graticule types.
Auxiliary display ON/OFF	Turn ON/OFF scale values, waveform labels, extra window, level indicator/numeric display.
X-Y display	Select the X axis and Y axis from CH1 to CH16, DSP1 to DSP6, MATH1 to MATH8 (up to 4)
Accumulation	Accumulates waveforms on the display (persistence mode)
Snapshot	Retains the current displayed waveform on the screen. Snapshot waveforms can be saved and loaded.
Clear trace	Clears the displayed waveform.

Dual capture
  Main waveform
  (low speed)
  Sub waveform
  (high speed)
	Performs data acquisition on the same waveform at two different sampling rates.
	Maximum sample rate: 100 kHz (roll mode region)
	Maximum memory length: 100 MW
	Maximum sample rate: 10 MS/s
	Maximum memory length: 10 kW (fixed)

Realtime hard disk recording	Maximum sample rate: 100 kS/s (for 1 CH) max. Capacity: Up to 1 GW per operation Action count: Select Single or Continue. If Continue is selected, set the count in the range of 2 to 128. Features: Restore process not required. Saved to a format that can be loaded directly.
Voice memo	Records a voice as a memo while waveforms are being acquired (when in roll mode display). The recorded voice memo can be saved along with the waveform data. Maximum record time is 100 s.
Voice comment	Saves screen image data by attaching a voice comment (separate data from screen image data). The maximum length of voice comment that can be attached to a single screen image data is 10 s. Plays the voice comment from the File List window.

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Vertical/Horizontal Axis Settings

Item	Specifications
Channel ON/OFF	Independently turn ON/OFF CH1 to CH16, DSP1 to DSP6, LOGIC A, LOGIC B, and EVENT.
ALL CH menu	Set all channels while displaying waveforms. Operation using the USB keyboard is possible.
Vertical axis expansion/ reduction	Expand or reduce the vertical axis for each channel.
Variable	Upper/Lower limit scaling when variable is ON.
Input filter	Set for each channel.
Vertical position setting	Waveforms can be moved vertically in the range of ±5 div from the center of the waveform display frame.
Linear scaling	Set AX+B mode or P1-P2 mode independently for CH1 to CH16.
Roll mode	The roll mode is enabled when the trigger mode is set to auto, auto-level, single, or log, and the time axis setting is greater than or equal to 100 ms/div.

Analysis

Item	Specifications
Search & zoom function Edge: Auto scroll:	Search for, then expand and display a portion of the displayed waveform. Choose from the following two search methods. Counts the rising and falling edges and automatically searches an arbitrary edge Automatically scrolls the zoom position.
History search function Zone search:	Search for and display waveforms from the history memory that satisfy specified conditions. Set an area on the screen, then extract and display only those waveforms that pass through the area (Pass mode), or do not pass through the area (By Pass mode).
Cursor measurement	The following cursors are selectable. Horizontal, Vertical, H&V (only during X-Y waveform display), Degree (only during T-Y waveform display), and Marker
Automated measurement of waveform parameters	Capable of performing automated measurement of waveform parameters. Automated measurement of waveform parameters within one period (P-P through Int2XY). Up to 24 items can be displayed. P-P, Amp, Max, Min, High, Low, Avg, Mid, Rms, Sdev, +OvrShoot, –OvrShoot, Rise, Fall, Freq, Period, +Width, –Width, Duty, Pulse, Burst1, Burst2, AvgFreq, AvgPeriod, Int1TY, Int2TY, Int1XY, Int2XY, Delay (between channels)
Statistical processing Normal statistical processing Cycle statistical processing Statistical processing of the history data	Applicable items: Automated measured values of waveform parameters described above. Statistics: Max, Min, Avg, Sdv, and Cnt Maximum number of cycles: 48000 cycles (when the number of parameters is 1) Maximum total number of parameters: 48000 (total number of results) Maximum measurement range: 10 MW Performs statistical processing on all acquired waveforms while acquiring waveforms. Performs statistical processing per cycle (cycle statistical computation). Extracts a periodic waveform (cycle) from the acquisition memory and automatically calculates waveform parameters per cycle. Performs automated measurement of waveform parameters on the waveform that is acquired using the history memory function and performs statistical processing. Statistical processing is performed from the oldest data.
Computation (standard)	Operators: +, –, ×, /, binary computation, phase shift, and power spectrum
User-defined computation(optional)	Equations obtained by arbitrarily combining the following operators. ABS, SQRT, LOG, EXP, NEG, SIN, COS, TAN, ATAN, PH, DIF, DDIF, INTG, IINTG, BIN, P2, P3, F1, F2, FV, PWHH, PWHL, PWLH, PWLL, PWXX, DUTYH, DUTYL, FILT1, FILT2, HLBT, MEAN, LS-, PS-, PSD-, CS-, TF-, CH-, MAG, LOGMAG, PHASE, REAL, IMAG
Phase shift	Monitor waveforms by shifting the phase of CH1 to CH16. Computation is performed on the phase-shifted result.
GO/NO-GO determination	The following two types of GO/NO-GO determination are available • Determination using zones on the screen • Determination using the result of the automated measurement of waveform parameters Specify an action for GO or NO-GO result. Possible actions are screen image data output, waveform data storage, buzzer notification, and e-mail transmission.[1]

1. When the Ethernet interface option is installed

DSP Channel Computation (Optional)

Item	Specifications
Maximum computation rate	100 kS/s (6 channels simultaneously)
Computed result	16 bits (2400 LSB/div: reference range)
Applicable modules	All modules
Computation types	

Addition, subtraction, multiplication, and division between channels
$+$, $-$, $\times$, and $\div$ (without coefficients)

Filters

- Sharp filter
  Filter format: FIR
  Filter type: LPF/HPF/BPF
  Filter order: 8 to 194 orders (varies depending on the type and cutoff frequency. For details, see appendix 6.)
  Characteristics: Steep cutoff, linear phase, and little overshoot
    LPF: Cutoff frequency: 2% to 30% of fs (0.2% resolution)   (fs = sampling frequency)
    HPF: Cutoff frequency: 2% to 30% of fs (0.2% resolution)
    BPF: Center frequency: 3% to 30% of fs (0.2% resolution),   Bandwidth: 2% of fs
        4.6% to 30% of fs (0.2% resolution),   Bandwidth: 5% of fs
        7% to 30% of fs (0.2% resolution),   Bandwidth: 10% of fs
        9.6% to 30% of fs (0.2% resolution),   Bandwidth: 15% of fs
        12% to 30% of fs (0.2% resolution),   Bandwidth: 20% of fs
  Cutoff characteristics: −40 dB at 2fc (LPF), −40 dB at 0.5fc (HPF)   (fc = cutoff frequency)
  Phase: Linear phase characteristics

- Gauss filter
  Filter format: FIR
  Filter type: LPF
  Filter order: 5th to 49th order (varies depending on the type and cutoff frequency. For details, see appendix 6.)
  Characteristics: Smooth cutoff characteristics, linear phase, and no overshoot
    LPF: Cutoff frequency: 2% to 30% of fs (0.2% resolution)   (fs = sampling frequency)
  Cutoff characteristics: $-3.0 \times (f/fc)^2$ dB (f: frequency, fc: cutoff frequency)
  Phase: Linear phase characteristics

- IIR (Butterworth) filter
  Filter format: IIR (Butterworth)
  Filter type: LPF/HPF/BPF
  Filter order: 4th order
  Characteristics: Characteristics close to an analog filter, flat pass band, and overshoot
    LPF: Cutoff frequency: 0.2% to 30% of fs (0.2% resolution)   (fs = sampling frequency)
    HPF: Cutoff frequency: 0.2% to 30% of fs (0.2% resolution)
    BPF: Center frequency 0.6% to 30% of fs (0.2% resolution)   Bandwidth: 1% of fs
        1.2% to 30% of fs (0.2% resolution)   Bandwidth: 2% of fs
        2.6% to 30% of fs (0.2% resolution)   Bandwidth: 5% of fs
        5.2% to 30% of fs (0.2% resolution)   Bandwidth: 10% of fs
        7.6% to 30% of fs (0.2% resolution)   Bandwidth: 15% of fs
        10.2% to 30% of fs (0.2% resolution)   Bandwidth: 20% of fs
  Cutoff characteristics: −24 dB/Oct
  Phase: Nonlinear phase characteristics

- MEAN (moving average)
  Filter format: FIR (moving average)
  Filter type: LPF
  Filter order: Select from 2, 4, 8, 16, 32, 64, and 128
  Characteristics: Comb-shaped cutoff characteristics, high noise suppression effect, and no overshoot

Differentiation

LPF (bandwidth limit) ON/OFF possible
LPF (sharp): Cutoff frequency: 2% to 30% of fs (0.2% resolution)

Integration/Summation

Reset condition of integration: Acquisition start and ON/OFF of the channel
Selectable reset conditions
    Over Limit (±10div):   When the computed value exceeds +10 divisions or −10divisions of the Value/Div setting
    Zero Cross to Positive: When the source signal produces a positive edge at the zero-crossing point
    Zero Cross to Negative: When the source signal produces a negative edge at the zero-crossing point

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Item	Specifications
	Addition, subtraction, multiplication, and division between channels with coefficients
	Expression: +, −, ×, and ÷
	Computation format: A, B, C can be defined
	Addition: (A*S1)+(B*S2)+C
	Subtraction: (A*S1)−(B*S2)+C
	Multiplication: (A*S1)×(B*S2)+C
	Division: (A*S1)÷ (B*S2)+C
	Selectable range of coefficients A, B, and C: ±9.9999E+30 to ±9.9999E−30
Knocking filter	Filter that sets the output to 0 when the source channel signal is less than or equal the elimination level.
	Selectable filter FIR: HPF/BPF
	IIR: HPR/BPF
	Differentiation: LPF (bandwidth limit) ON/OFF possible
Variable ON/OFF	When variable is set to OFF (zooming in or out by setting the zoom rate)
	Value/Div: 123 Value/Div settings can be specified using the V/DIV knob (1-2-5 steps). 10.00E−21 [Value/Div] to 500.0E+18 [Value/Div]
	When variable is set to ON (vertical zoom/expand according to the upper and lower limits of the display range)
	Upper and lower limits: ±5.0000E+22 [Value/Div]/±1.0000E−23 [Value/Div]
	Display range: Up to ±5.0000E+21.(500.0E+18 [Value/Div]×10 [Div]) The display will be clipped at higher values.
	Computation delay: [4 samples + the computation delay of the digital filter] (For details, see appendix 6.) The computation time of filters is proportional to the sample rate of the DSP channel. If the output result is specified as a source of another DSP channel, the computation delay increases.
	Can specify analog channels (CH1 to CH16) as computation sources. The computed result of a DSP channel can also be specified as a computation source of another DSP channel. However, only DSP channels with a channel number smaller than itself can be specified. The maximum sample rate of analog channels is 5 MS/s when a DSP channel is turned ON.

Recorder Mode (DL750P only)

Item	Specifications	
Realtime recording on the built-in printer	T-Y waveform recording/numeric value recording:	Output to the chart in realtime.
	X-Y waveform recording:	Starts data acquisition with START and generates X-Y waveforms in realtime. Outputs X-Y waveforms to the chart with STOP.
Length of data saved to memory while realtime recording	T-Y waveform recording: Fixed to 2.5 MW Automatically saves up to 1000 divisions of data (depending on the chart speed). X-Y waveform recording: Fixed to 1 MW	
Recording start trigger	Recording can be started using a trigger by setting the trigger mode.	
	Auto: Trigger disabled. Continuous recording. Recording starts with measurement start.	
	Log: Trigger disabled. Recording stops when the memory storage length of data is acquired. When short recording is specified, recording stops when shot recording ends.	
	Single: Trigger enabled. Recording starts after a trigger detection. When short recording is specified, recording stops when shot recording ends.	
	Repeat: Trigger enabled. Recording starts after a trigger detection. Selectable only when shot recording is specified. Reenters trigger-wait state after short recording.	
Chart speed (T-Y waveform recording)	20 mm/s, 10 mm/s, 5 mm/s, 2 mm/s, 1 mm/s, 100 mm/min, 50 mm/min, 25 mm/min, 20 mm/min, 10 mm/min, 5 mm/min, 2 mm/min, 1 mm/min, 100 mm/h, 50 mm/h, 25 mm/h, 20 mm/h, or 10 mm/h	
Output interval (Numeric value recording)	1 s, 2 s, 5 s, 10 s, 15 s, 20 s, 30 s, 1 min, 2 min, 5 min, 10 min, 15 min, 20 min, 30 min, or 60 min	
Sample rate during X-Y waveform recording	5 kS/s, 2 kS/s, 1 kS/s, 500 S/s, 200 S/s, 100 S/s, 50 S/s, 20 S/s, 10 S/s, or 5 S/s	

Item	Specifications		
Recording format	T-Y waveform recording:	1 division recording	200 mm/zone or 160 mm/zone (flexible zone is selectable for 1 division recording)
		2 division recording	80 mm/zone or 100 mm/zone
		3 division recording	60 mm/zone or 65 mm/zone
		4 division recording	40 mm/zone or 50 mm/zone
		8 division recording	20 mm/zone
		16 division recording	10 mm/zone
	Numeric value recording: Print direction selectable from standard and 180° rotation.		
	X-Y waveform recording: Records up to 4 waveforms simultaneously. Assignment of X and Y channels on the 4 waveforms is arbitrary.		
Graticule	Width: Selectable from 1 div and 10 mm. Type: Selectable from two types and OFF. Density: Dark/Light selectable.		

Recorded contents	Simultaneously prints, scale, channel label, graticule, timestamp, gauge, annotation, etc.
	During T-Y waveform recording
	  Scale: Prints the scale value for each channel. Select the print interval from OFF, 200, 400, and 800 mm.
	  Channel label: Prints channel labels near the waveforms. Select the print interval from OFF, 200, 400, and 800 mm.
	  Time print: Prints the recording start time and timestamps. Select the print interval from OFF, 200, 400, and 800 mm.
	  Gauge: Prints the scale value for each channel and the end of printing.
	  Annotation: Select channel information, channel message, or Data to be printed.
	    Channel information: Prints information such as V/div, filter, etc.
	    Message: Prints a preset message string.
	    Data: Prints numeric measured values.
	    Select the print interval from OFF, 200, 400, and 800 mm.
	During X-Y waveform recording Prints the scale value.		

Shot recording	Automatically stops when the specified length is recorded after the start of measurement or after the trigger condition is met. Shot recording length: Continuous, 20 cm, 50 cm, 1m, or 2 m		
External start/stop	Shared with the GO/NOGO start terminal. Prints on a low signal. Stops printing on a high signal.		
Reprint function	An arbitrary section of the recorded data saved to the memory simultaneously with realtime print can be reprinted in an arbitrary format.		
Print image output	When performing reprint or fine print during T-Y waveform recording, the print image can be converted and output to a PDF file.		

Screen Image Data Output

Item	Specifications
Built-in printer	Outputs a hard copy of the screen
External printer	Outputs the screen image to an external printer via the USB PERIPHERAL terminal or the Ethernet network[1]. Supports ESC-P, ESC-P2, LIPS3, PCL5, BJ commands, and PostScript (only via the Ethernet network[1])
Floppy disk, Zip disk, PC card, SCSI, internal HDD (optional), Network drive[1]	Output data format: PNG, JPEG, BMP, and PostScript

1. When the Ethernet interface option is installed (against a printer server supporting TCP/IP)

Data Storage

Item	Specifications
History memory	Automatically holds up to 2000 pages of waveforms (depending on the memory length)
Floppy disk, Zip disk, PC card, SCSI, internal HDD (optional), Network drive[1]	Saves waveform data, setup data, and various data

1. When the Ethernet interface option is installed

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Acquisition Memory Backup

Item	Specifications
Batteries	4 AAA alkaline dry cells (AA/R6) (JIS, IEC model: LR6) 4 nickel hydride rechargeable batteries
Backup time (reference value)	Reference value for A1070EB (LR6JE CPT alkaline battery by Toshiba) × 4 at an ambient temperature of 23° C On models with the /M3 option Approx. 10 h On models with the /M2 option Approx. 15 h On models with the /M1 option Approx. 32 h On the standard model Approx. 150 h
Backup function	Enable/Disable using the ON/OFF switch
Contents that are backed up	Acquisition memory waveform data (history memory data and sub waveform data of the dual capture function) and voice memo data

Other Functions

Item	Specifications
Initialization	Resets settings to the factory default (excluding date/time setting, communication interface settings, SCSI ID number setting, language setting, time difference from the GMT, and the ON/OFF setting of the internal hard disk motor)
Auto setup	Automatically sets the voltage axis, time axis, trigger level, etc.
Action-on-trigger	Outputs screen image data, saves waveform data, activates buzzer notification, or sends e-mail messages each time a trigger occurs.
Mail transmission function[1]	Sends the DL750/DL750P status periodically to a specified mail address via the Ethernet network. Also sends information as an action for GO/NO-GO determination and action-on-trigger.
Calibration	Auto calibration and manual calibration available
System settings	Sets the screen color, date/time, message language, and click sound ON/OFF
Probe compensation signal output	Outputs a signal (rectangular signal of approx. 1 V_{P-P} and approx. 1 kHz) from the probe compensation output terminal on the front panel
Overview	Shows system specifications
Self test	Memory test, key test, printer test, FDD/Zip drive/PC card drive test, internal HDD (optional) test, and SCSI test
Help function	Displays help concerning the settings (English/Japanese/Chinese switchable)
Thumbnail	Shows thumbnails of the screen image data
PROTECT key	Disables keys to prevent inadvertent errors in operation.
NUM key	Direct input of numeric values.

1. When the Ethernet interface option is installed

19.6 Built-in Printer

Item	Specifications
Printing system	Thermal line dot system
Paper width	DL750: 112 mm, DL750P: 210 mm
Effective printing width	DL750: 104 mm (832 dots), DL750P: 204 mm (1632 dots)
Dot density	8 dots/mm
Feeding direction resolution	DL750: For normal print: 13 dots/mm. For fine (long) print: 10 dots/mm DL750P: For normal print: 8 dots/mm. For fine (long) print: 10 dots/mm
Function	Normal print, fine print, zoom print, A4 print (DL750P only), realtime recording (DL750P only)
Maximum paper feeding speed	DL750: Approx. 10 mm/s during normal print (depends on the head temperature when normal printing is started and the print rate) DL750P: 20 mm/s

19.7 Storage

Built-in Storage
• Floppy Disk Drive

Item	Specifications
Number of drives	1
Size	3.5 inch
Capacity	720 KB or 1.44 MB

• Zip Drive (DL750 Only)

Item	Specifications
Number of drives	1
Capacity	100 MB or 250 MB

• PC Card Interface

Item	Specifications
Number of drives	1
Maximum capacity	5 GB
Supported cards	Flash ATA memory card (PC card TYPE II) PC card type, CF card + adapter card, and HDD PC card.

For details on the compatible cards, contact your nearest YOKOGAWA dealer.

Internal Hard Disk (Optional)

Item	Specifications
Number of drives	1
Size	2.5 inch
HDD capacity used	30 GB, FAT32, 2 partitions by factory default
File name	Supports long file names (ANK16 characters)
Function	Mount the internal HD via the SCSI port

External Storage Interface
• SCSI

Item	Specifications
Standard	SCSI (Small Computer System Interface).ANSIX3.131-1986
Connector	Half pitch 50 pins
Connector pin assignment	Unbalanced (single-ended)

USB Storage Device*

Item	Specifications
Compatible USB mass storage devices	USB (USB Mass Storage Class) hard disk drive, MO disk drive, and flash memory

For specification details, see the next section, "USB PERIPHERAL Interface."

* Model that can connect a USB storage device
  • DL750:   Check the overview screen by choosing MISC > Overview.
             If USB Storage: Yes and Soft Version: 6.02 (or later) are displayed, a USB storage device can be connected.
  • DL750P: All DL750Ps can connect to a USB storage device.

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19.8 USB PERIPHERAL Interface

Item	Specifications
Connector type	USB type A connector (receptacle)
Electrical and mechanical specifications	Conforms to USB Rev.1.1
Data rate	12 Mbps maximum
Supported keyboards[1]	104 keyboard/89 keyboard (US) and 109 keyboard/89 keyboard (Japanese) conforming to USB HID Class Ver.1.1
Supported printers[1]	ESC/P, ESC/P2, LIPS3, PCL5, and BJ (can be used on models that support the BJC-35V native commands) that support USB (USB Printer Class Ver.1.0)
Supported mouse[1]	Mouse (with wheel) that supports USB HID Class Ver.1.1
Supported USB mass storage devices	USB (USB Mass Storage Class) hard disk drive, MO disk drive, and flash memory
Power supply	5 V, 500 mA[2] (per port)
Number of ports	2

[1] For details on the compatible USB devices, contact your nearest YOKOGAWA dealer.
[2] Devices whose maximum current consumption exceeds 100 mA cannot be connected simultaneously to the two ports.

19.9 Auxiliary I/O Section

Logic Input

Item	Specifications
Number of inputs	8 bits $\times$2
Connector type	26-pin half-pitch connector $\times$2
Maximum sample rate	10 MS/s
Compatible probes	Non-isolated (700986 (8 bits)) or isolated (700987 (8 bits))

External Trigger Input

Item	Specifications
Connector type	RCA jack
Input level	TTL (0 to 5 V) input
Minimum pulse width	500 ns
Logic	Rising edge or falling edge selectable
Trigger delay time	Within 200 ns + 1 sample
Externally synchronized operation	Possible (by connecting TRIG IN and TRIG OUT on two DL750/DL750Ps)

Trigger Output (TRIG OUT)[1]

Item	Specifications
Connector type	RCA jack, shared with the external sampling clock
Output level	CMOS level (0 to 5 V) output
Logic	Falls when the trigger is activated, rises after completing acquisition
Output delay time	Within 1 μs + 1 sample
Output hold time	200 ns or more

[1] This terminal is also used as an external clock input terminal.

Video Signal Output (VIDEO OUT (SVGA))

Item	Specifications
Connector type	15-pin D-Sub receptacle
Output type	Analog RGB output
Output resolution	SVGA output 800 × 600 dots/60 Hz Vsync

GO/NO-GO Determination I/O (GO/NO-GO)

Item	Specifications
Connector type	Modular jack (RJ-11)
I/O level	START IN input: TTL (0 to 5 V), SW input possible GO-OUT/NOGO-OUT: CMOS (0 to 5 V)
Signal	START IN, GO-OUT, and NOGO-OUT
Compatible cable	Four-wire modular cable for telephone lines (GO/NO-GO cable (YOKOGAWA: 366973))

External Start/Stop[1]

Item	Specifications
Connector	Shared with the GO/NO-GO start terminal (used exclusively). Can be used as start/stop input when GO/NO-GO I/O is not used.
Input	TTL (0 to 5 V) or switch input Start on low, stop on high
Compatible cable	Four-wire modular cable for telephone lines (GO/NO-GO cable (YOKOGAWA: 366973))

1.   The terminal is also used as a GO/NO-GO Terminal.

COMP Output (Rectangular Signal Output for Probe Compensation)

Item	Specifications
Output frequency	1 kHz±1%
Output amplitude	1 V±10%

Voice Input/Output (VOICE IN/OUT/SW)[1]

Item	Specification
Compatible earphone microphone	
	Earphone microphone with a PUSH switch (YOKOGAWA: 701951)
	Dynamic inner earphone
	Input impedance: 32 Ω
	Frequency range: 100 to 20 kHz
	Maximum input: 40 mW
	Electric condenser microphone
	Output impedance: 1.6 kΩ
	Frequency characteristics: 100 to 10 kHz
	Directional characteristics: Omnidirectional
	Code: 1.2 m, φ2.5, with 4-pin plug
	Weight: Approx. 16 g
	Earphone microphone jack input/output
	Jack: 4-pin jack
	Microphone input: Electric condenser microphone, input impedance of approx. 5 kΩ
	Earphone output: Dynamic, impedance of 32 Ω
	Switch input: 10-kΩ pull-up (3.3 V)

1.   The specifications above apply to the optional earphone microphone with a PUSH switch (701951) that is sold separately. Operation of other earphone microphones are not guaranteed.

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Speaker Output[1]

Item	Specification
Connector	Shared with the GO/NO-GO Determination I/O (used exclusively). Can be used as speaker output when GO/NO-GO I/O is not used.
Compatible cable	External connection possible using the speaker cable (YOKOGAWA: 701952).
Compatible speaker	Impedance: 8 Ω

1. The terminal is also used as a GO/NO-GO Determination I/O terminal.

Probe Power Output (Optional)

Item	Specifications	
Number of output terminals	4	
Output voltage	±12 V 2 outputs (up to a total of 800 mA)	
Probes that can be used	Current probe (700937(15 A))	up to 4 probes
	Current probe (701930(150 A))	up to 2 probes
	Current probe (701931(500 A))	1 probe
	Current probe (701933(30 A))	up to 2 probes

For details on the usage conditions of each probe, see "Relationship between the current being measured and probe's current consumption" on the following Web page.
http://www.yokogawa.com/tm/probe/

19.10 Computer Interface

GP-IB[1]

Item	Specifications
Electrical and mechanical specifications	Conforms to IEEE St'd 488-1978 (JIS C 1901-1987)
Functional specifications	SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT0, and C0
Protocol	Conforms to IEEE St'd 488.2-1992
Code	ISO (ASCII) code
Mode	Addressable mode
Address	Specify a talker/listener address between 0 and 30
Clear remote mode	Remote mode can be cleared using SHIFT+CLEAR TRACE (except during Local Lockout).

Serial (RS-232)[1]

Item	Specifications
Connector type	9-pin D-Sub plug
Electrical Characteristics	Conforms to EIA-574 (9-pin EIA-232 (RS-232))
Connection	Point-to-point
Transmission mode	Full-duplex
Synchronization	Start-stop synchronization
Baud Rate	Select from the following rates. 1200, 2400, 4800, 9600, 19200, 38400, and 57600 If unstable, use 19200 or less.

USB-PC Connection[1]

Item	Specifications
Connector type	USB type B connector (receptacle)
Electrical and mechanical specifications	Conforms to USB Rev.1.1
Data rate	12 Mbps max.
Number of ports	1
Supported service	Remote control[2]
PC system supported	PCs with standard USB ports running Windows 98 SE or Windows 2000. (A separate driver[1] is required for connecting to a PC.)

Ethernet Connector (Optional)[1]

Item	Specifications
Number of communication ports	1
Electrical and mechanical specifications	Conforms to IEEE802.3
Transmission system	Ethernet (100BASE-TX/10BASE-T)
Transmission rate	100 Mbps max.
Communication protocol	TCP/IP
Supported services	FTP server, FTP client (network drive), LPR client (network printer), SMTP client (mail transmission), DHCP, DNS, Web server, and remote control
Connector type	RJ-45 connector

1. For details on the specifications, see the Communication Interface User's Manual (IM 701210-18E).
2. The DL750/DL750P can be controlled remotely from a host such as a PC. For details, see the Communication Interface User's Manual (IM 701210-18E). A separate driver is needed to use this function. The driver can be downloaded from the following Web site.
   http://www.yokogawa.com/tm/Bu/software.htm

19.11 General Specifications

Item	Specifications
Standard operating conditions	Ambient temperature: 23±5° C Ambient humidity: 55±10% RH Within 1% of the rated error of the power supply voltage and frequency After a 30-minute warm-up and after calibration
Recommended calibration period	1 year
Warm-up time	At least 30 minutes
Storage temperature	–20° C to 60° C
Storage humidity	20% to 85% RH (no condensation)
Storage altitude	3000 m or less
Operating temperature range	5° C to 40° C
Operating humidity range	20 to 85% RH (when not using the printer), 35 to 85% RH (when using the printer)
Operating altitude	2000 m or less
Rated supply voltage	100 to 120 VAC or 200 to 240 VAC (automatic switching)
Rated supply voltage frequency	50/60 Hz
Permitted supply voltage	90-132 VAC/180-264 VAC
Permitted supply voltage frequency range	48 to 63 Hz
Maximum power consumption	Approx. 200 VAMAX (Maximum power when the printer is OFF and 16 channels are running is 135 VA (reference value))
Withstand voltage	1500 VAC for 1 minute across the power supply and earth
Insulation resistance	10 MΩ or more at 500 VDC across the power supply and ground
External dimensions	355 mm (W) × 250 mm (H) × 180 mm(D) (excluding the handle and other projections)
Weight	DL750: Approx. 6.6 kg (only the DL750 with all options (/M3/C8/C10/P4) options, without the chart paper) Approx. 10.6 kg (DL750 + eight High-Speed 10 MS/s, 12-Bit Isolation Modules) DL750P: Approx. 7.8 kg (only the DL750P with all options (/M3/C8/C10/P4) options, without the chart paper) Approx. 11.8 kg (DL750P + eight High-Speed 10 MS/s, 12-Bit Isolation Modules) Module: Approx. 300 g (High-Speed 10 MS/s, 12-Bit Isolation Module)
Instrument's cooling method	Forced air cooling. Exhaust on the left side panel and top.
Battery backup	Setup parameters and clock are backed up with the internal lithium battery
Battery backup Battery life	Approx. 5 years (at ambient temperature of 25° C)
Fuse	Inside the power supply unit (cannot be replaced from the outside of the instrument)
Standard accessories for the DL750/DL750P	Front panel protection cover 1 B8023EA Soft case 1 B9946EB Cover panels 8 B8023EN Power cord 1 Printer roll paper (for the DL750) 3 B9988AE (10-m roll) Printer roll paper (for the DL750P) 1 701966 (20 m roll) AAA Alkaline batteries 4 A1070EB (LR6JECPT by Toshiba) (for waveform memory backup) Rubber hind feet 1 B9989EX(4 pieces (1 sheet)) User's Manual 1 Operation Guide 1 Communication Interface User's Manual 1 B8023YZ (CD-ROM)

DC Option (DL750 Only)

Item	Specifications
Supply format	Auto DC/AC switching (AC preferred), isolation between DC power input terminal and the DL750
Rated supply voltage	12 VDC
Permitted supply voltage	10 to 18 VDC
Power consumption	Approx. 40 VA (typical*1): When printer is OFF and two channels are used Approx. 60 VA (typical*1): When printer is OFF and eight channels are used Approx. 80 VA (typical*1): When printer is OFF and 16 channels are used
Maximum power consumption	Approx. 120 VA Max.
Standby power (during DC standby)	30 mW (typical*1, DC power consumption when power is supplied both to AC and DC power)
Voltage input protection circuit	Overcurrent detection: Breaker (15 A) Reverse connection protection: Breaker shutdown Undervoltage detection: Cut off at a voltage less than approx. 9.5 V Overvoltage detection: Cut off at a voltage greater than approx. 18 V
Withstand voltage	30 VAC for one minute between the DC power input terminal and earth terminal
Insulation resistance	10 MΩ or more at 500 VDC between the DC power terminal and earth
External dimensions	355 mm (W) $\times$ 250 mm (H) $\times$ 200 mm (D) (DL750 with the /DC option installed, excluding the handle and other projections)
Weight	Approx. 7.4 kg (only the DL750 with all options (/M3/C8/C10/P4/DC options) Approx. 9.8 kg (DL750 (with /DC option) + eight High-speed 10 MS/s, 12-Bit Isolation Modules) Weight increase by the DC power option Approx. 800 g
Indicator function	Indicates the status of the power supply to the DL750 using two LEDs
Accessories	The following items are added to the standard accessories. Soldering-type DC power connector (B8023WZ)

*   Same specifications as the standard model for standard operating conditions, storage temperature, storage humidity, storage altitude, operating temperature range, operating humidity range, operating altitude, and battery backup.
*1 Typical value represents a typical or average value. It is not a warranted value.

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Item	Specifications	
Safety standard[1]	Complying standard	EN61010-1 • Installation category (overvoltage category) II[1] • Measurement category II[2] • Pollution degree 2[3] Already certified (701210/701230/701250/701251/701255/701260/ 701261/701262/701265/700986/700987/701955/701956/701957/701958)
Emission[1]	Complying standard	EN61326 Already certified (701210/701230/701250/701251/701255/701260/ 701261/701262/701265/700986/700987/701955/701956/701957/701958) • This product is a Class A (for industrial environment) product. Operation of this product in a residential area may cause radio interference in which case the user is required to correct the interference.
	Test Item	1. Power supply terminal noise EN61326:ClassA 2. Electromagnetic radiation disturbance EN61326:ClassA 3. power supply harmonics restriction EN61000-3-2 4. Supply voltage fluctuation & flicker EN61000-3-3
	Cable condition	• Shared external trigger/external clock input terminal Use the BNC-RCA adapter (YOKOGAWA: 366928) and a BNC cable[4] and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (DL750/DL750P side). • Trigger output terminal Same as the external trigger input terminal above. • Video signal output (VIDEO OUT (SVGA)) terminal Use a 15-pin D-Sub VGA shielded cable[4]. • GP-IB interface connector Use shielded GP-IB cables[4]. • Serial (RS-232) interface connector Use an shielded RS-232 cable[3] and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (DL750/ DL750P side). • SCSI interface connector Use shielded SCSI cable[4] and attach a ferrite core (TDK: ZCAT2035- 0930A, YOKOGAWA: A1190MN) on one end (DL750/DL750P side). • USB peripheral connector Use shielded USB cables[4]. • USB interface connector When connecting a USB keyboard or mouse using a shielded cable or when connecting to a USB printer, use shielded USB cables4. • GO/NO-GO I/O terminal Use a dedicated GO/NO-GO cable (YOKOGAWA: 366937) sold separately. • Ethernet connector Use category 5 Ethernet cables[5] or better cables. • Probes connected to modules and wiring Use twisted pair cables when connecting items other than probes to the module. Attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) to the probes and cables that are connected to the modules. Wrap the cable around the ferrite core once. • Logic probe input Attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (DL750/DL750P side) of the cable to be connected to the logic probe input terminal. • Current probe (700937, 701930, 701931, 701933) When connecting a current probe to the input terminal and probe power terminal of the module, attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (DL750/DL750P side) of the two cables together. • Voice memo terminal Earphone microphone with a switch[4] (4-pin jack microphone connectable to NTT DOCOMO portable phones) (Cannot be used on the current software version that you are using.) • Bridge Head for the Strain Module When using the 701270, use the 701955 or the 701956; when using the 701271, use the 701957 or the 701958. • DC power cord Attach a ferrite core (TDK: ZCAT3035-1330A, YOKOGAWA: A1179MN) to the DC power cord.

Item	Specifications		
Immunity[1]	Complying standard	EN61326	
		Already certified (701210/701230/701250/701251/701255/701260/ 701261/701262/701265/700986/700987/701955/701956/701957/701958)	
		• Influence in the immunity environment (performance criterion A)	
		701250: ≤±5 mV (1:1 input, 5 mV/div conversion)	
		701251: ≤±3 mV (1:1 input, 1 mV/div conversion)	
		701255: ≤±25 mV (1:1 input, 5 mV/div conversion)	
		701260: ≤±30 mV (1:1 input, 20 mV/div conversion)	
		701261/701262: ≤±3 mV	
		701265: ≤±0.05 mV	
		701270: ≤±100 μSTR	
		(when equivalent to ±100 mV, gauge factor = 2, and bridge voltage = 2 V)	
		701271: ≤±100 μSTR	
		(when equivalent to ±100 mV, gauge factor = 2, and bridge voltage = 2 V)	
		701275: ≤±3 mV (1:1 input, 5 mV/div conversion)	
		701280: Within the specifications	
	Test condition	701250:	10 MS/s, envelope mode, 50 mV/div, no input filter, with the tip of the probe (700929 (10:1)) shorted
		701251:	1 MS/s, envelope mode, 10 mV/div, no input filter, with the tip of the probe (700929 (10:1)) shorted
		701255:	10 MS/s, envelope mode, 50 mV/div, no input filter, with the tip of the probe (701940 (10:1)) shorted
		701260:	100 kS/s, envelope mode, 20 mV/div, no input filter, with the tip of the probe (700929 (10:1)) shorted
		701261/701262:	100 kS/s, envelope mode, 5 mV/div, no input filter, with the end of the 3-m twisted-pair cable shorted
		701265:	100 kS/s, envelope mode, 0.1 mV/div, no input filter, With the end of the 3-m twisted-pair cable shorted
		701270:	100 kS/s, envelope mode, 500 μSTR, gauge factor: 2.0, no input filter, 701955 bridge voltage: 2 V, 701956 bridge voltage: 10 V
		701271:	100 kS/s, envelope mode, 500 μSTR, gauge factor: 2.0, no input filter, 701957 bridge voltage: 2 V, 701958 bridge voltage: 10 V
		701275:	100 kS/s, envelope mode, 50 mV/div, no input filter, with the tip of the probe (700929 (10:1)) shorted
		701280:	25 kS/s, envelope mode, Frequency, 0.1 Hz/div, no input filter, User (±1 V, threshold level: 0 V, hysteresis: ±1%), with the tip of the probe (700929 (10:1)) shorted
	Test Item	1. Electrostatic discharge	EN61000-4-2 Air discharge: ±8 kV, contact discharge: ±4 kV, criteria B
		2. Radiated immunity	EN61000-4-3 80 MHz to 1 GHz, 1.4 GHz to 2 GHz, 10 V/m Criteria A
		3. Conducted immunity	EN61000-4-6 3 V, criteria A
		4. Electrical fast transient/burst	EN61000-4-4 Power line: ±2 kV, signal line: ±1 kV, criteria B
		5. Power frequency magnetic field	EN61000-4-8 30 A/m, 50 Hz, criteria A
		6. Surge immunity	EN61000-4-5 Between lines: ±1 kV, common: ±2 kV, criteria B
		7. Voltage dip and interruption	EN61000-4-11 0.5 cycle, both polarities, 100%, criteria A
	Definitions of criteria A and B	• Criteria A	Aforementioned "Influence in the immunity environment" is met during the test.
		• Criteria B	This apparatus continues to operate without hang-up or falling into uncontrollable conditions during the test. No change of actual operating state or stored data is allowed.

1. The Overvoltage Category (Installation Category) is a value used to define the transient overvoltage condition and includes the impulse withstand voltage regulation. I applies to electrical equipment that is powered by a circuit with overvoltage control. II applies to electrical equipment that is powered by a fixed installation such as a distribution board.
2. Measurement category II (CAT II) applies to measurement of electrical equipment which is supplied from fixed installations such as a wall outlet wired from a distribution board, or of the wires themselves.
3. Pollution Degree: Applies to the degree of adhesion of a solid, liquid, or gas which deteriorates withstand voltage or surface resistivity. Pollution Degree 2 applies to normal indoor atmospheres (with only non-conductive pollution).
4. Use cables of length 3 m or less.
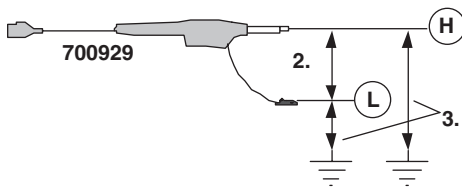5. Use cables of length 30 m or less.

Specifications

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19.12 Module Specifications

High-Speed 10 MS/s, 12-Bit Isolation Module (701250) Specifications

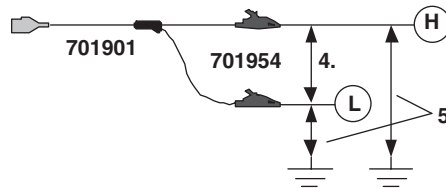| Item	Specifications
Standard operating conditions	Temperature: 23° C±5° C Humidity: 55%±10% RH After a 30-minute warm-up and after calibration
Effective measurement range	20 div (±10 div around 0 V, display range: 10 div, when Variable is OFF)
Number of input channels	2
Input coupling	AC, DC, and GND
Maximum sample rate	10 MS/s
Input format	Isolated unbalanced
Frequency characteristics[1]	(–3 dB point when sine wave of amplitude)DC to 3 MHz
Voltage-axis sensitivity setting	When using 10:1 probe attenuation: 50 mV/div to 200 V/div (1-2-5 steps) When using 1:1 probe attenuation: 5 mV/div to 20 V/div (1-2-5 steps)
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with the 700929 (10:1)[2]: 600 V (DC+ACpeak) Combined with the 701901+701954 (1:1)[4]: 250 V (DC+ACpeak) Direct input or cable not complying with the safety standard[6]: 250 V (DC+ACpeak)

Maximum allowable common mode voltage (at a frequency of 1 kHz or less)	Working voltage of safety standard
	Combined with the 700929 (10:1)[3] or combined with the 701901+701954 (1:1)[5]:
	   400 Vrms (CAT I), 300 Vrms (CAT II)
	Direct input or cable not complying with the safety standard[7]:
	   42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)

DC offset maximum selectable range	±5 div
Vertical (voltage) axis accuracy DC accuracy[1]	for 5 mV/div to 20 V/div: ±(0.5% of 10 div)
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ±1%, approx. 35 pF
–3 dB point when AC coupledlow frequency attenuation point	10 Hz or less (1 Hz or less when using the 700929)
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical[8])
Residual noise level (Input section shorted)	±400 μ V or ±0.06 div, whichever is greater (typical[8])
Withstand voltage	1500 Vrms for 1 minute (across each terminal and earth) (60 Hz)
Allowable transient surge voltage (instantaneous)	±2100 Vpeak (across each input terminal and earth)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
A/D conversion resolution	12 bit (150 LSB/div)
Temperature coefficient	Zero point: 5 mV/div to 20 V/div: ±(0.05% of 10 div)/° C (typical[8]) Gain: ±(0.02% of 10 div)/° C (typical[8])
Bandwidth limit	Select from OFF, 500 kHz, 50 kHz, 5 kHz, and 500 Hz Cut-off characteristics: –18 dB/OCT (typical[8])
Probe attenuation setting	Voltage probe: 1:1, 10:1, 100:1, 1000:1 Current probe: 10 A: 1 V (for the 700937/701933), 100 A: 1 V (for the 701930/701931)

Item	Specifications

Compatible probes/cables	Voltage probe (10:1 safety probe): Recommended
	    700929 (10:1 safety probe).20 to 45 pF: For measuring 600 Vpeak or less
	Current probe (power can be supplied from the DL750/DL750P)
	    700937 (15 A), 701930 (150 A), 701931 (500 A), 701933 (30 A)
	High voltage differential probe (connect the GND cable provided with the probe to the DL750/DL750P case)
	    700924 (1000:1, 100:1/1400Vpeak): For measuring 1400 Vpeak or less
	Connection cable (for high voltage 1:1)
	    701901 (isolated type BNC-safety alligator clip adapter ×2: For measuring 250 Vpeak or less), a separate alligator clip (701954) is required
	Connection cable (for low voltage 1:1)
	    366926 (non-isolated type BNC-alligator clip ×2: For measuring low voltage less than or equal to 42 Vpeak)

1.   Value measured under standard operating conditions (section 19.11).
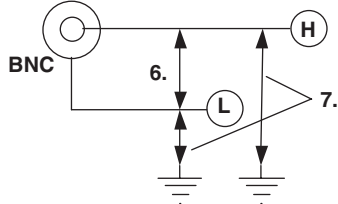
Combined with the 700929

700929   2.   H

L   3.

Combined with the 701901+701954

701901   **701954**   4.   H

L   5.

Direct input (cable not complying with the safety standard)

BNC   6.   H

L   7.

Withstand voltage: 1500 Vrms for 1 minute
Allowable transient surge voltage: ±2100 Vpeak
(between earth and input)

8.   The typical value is a representative or standard value. It is not strictly warranted.

WARNING

* Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.
* To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the DL750/DL750P.
* To prevent the possibility of electric shock, be sure to fasten the module screws. Otherwise, the electrical and mechanical protection functions will not be activated.
* Avoid continuous connection under an environment in which the allowable surge voltage or higher voltage may occur.
* To prevent the possibility of electric shock, be sure to connect the GND lead of the differential probe (700924/700925) to the DL750/DL750P.
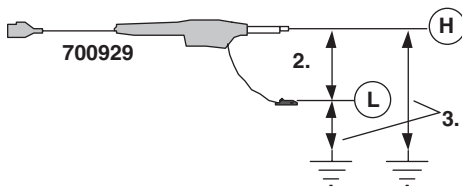
Specifications

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High-Speed High-Resolution 1 MS/s, 16-Bit Isolation Module (701251) Specifications

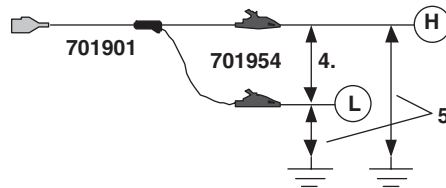| Item	Specifications
Standard operating conditions	Temperature: 23° C±5° C Humidity: 55%±10% RH After a 30-minute warm-up and after calibration
Effective measurement range	20 div (±10 div around 0 V, display range: 10 div, when Variable is OFF)
Number of input channels	2
Input coupling	AC, DC, and GND
Maximum sample rate	1 MS/s
Input format	Isolated unbalanced
Frequency characteristics[1]	(−3 dB point when a sine wave of amplitude ±3 divisions is input) For 5 mV/div to 20 V/div: DC to 300 kHz 2 mV/div, 1 mV/div: DC to 200 kHz
Voltage-axis sensitivity setting	When using 10:1 probe attenuation: 10 mV/div to 200 V/div (1-2-5 steps) When using 1:1 probe attenuation: 1 mV/div to 20 V/div (1-2-5 steps)
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with the 700929 (10:1)[2]: 600 V (DC+ACpeak) Combined with the 701901+701954 (1:1)[4]: 140 V (DC+ACpeak) Direct input or cable not complying with the safety standard[6]: 140 V (DC+ACpeak)

Maximum allowable common mode voltage (at a frequency of 1 kHz or less)	Working voltage of safety standard
	Combined with the 700929 (10:1)[3] or combined with the 701901+701954 (1:1)[5]:
	    400 Vrms (CAT I), 300 Vrms (CAT II)
	Direct input or cable not complying with the safety standard[7]:
	    42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)

DC offset maximum selectable range	±5 div
Vertical (voltage) axis accuracy DC accuracy[1]	For 5 mV/div to 20 V/div: ±(0.25% of 10 div) 2 mV/div: ±(0.3% of 10 div) 1 mV/div: ±(0.5% of 10 div)
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ±1%, approx. 35 pF
−3 dB point when AC coupled low frequency attenuation point	1 Hz or less (0.1 Hz or less when using the 700929)
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical[8])
Residual noise level (Input section shorted)	±100 μ V or ±0.01 div, whichever is greater (typical[8])
Withstand voltage	1500 Vrms for 1 minute (across each terminal and earth) (60 Hz)
Allowable transient surge voltage (instantaneous)	±2100 Vpeak (across each input terminal and earth)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
A/D conversion resolution	16 bit (2400 LSB/div)

Temperature coefficient	Zero point: 5 mV/div to 20 V/div: ±(0.02% of 10 div)/° C (typical[8])
	               2 mV/div: ±(0.05% of 10 div)/° C (typical[8])
	               1 mV/div: ±(0.10% of 10 div)/° C (typical[8])
	Gain: 1 mV/div to 20 V/div: ±(0.02% of 10 div)/° C (typical[8])

Bandwidth limit	Select from OFF, 40 kHz, 4 kHz, and 400 Hz Cut-off characteristics: −12 dB/OCT (typical[8])
Probe attenuation setting	Voltage probe: 1:1, 10:1, 100:1, 1000:1 Current probe: 10 A: 1 V (for the 700937/701933), 100 A: 1 V (for the 701930/701931)

Item	Specifications

Compatible probes/cables	Voltage probe (10:1 safety probe): Recommended
	    700929 (10:1 safety probe).20 to 45 pF: For measuring 600 Vpeak or less
	Current probe (power can be supplied from the DL750/DL750P)
	    700937 (15 A), 701930 (150 A), 701931 (500 A), 701933 (30 A)
	High voltage differential probe (connect the GND cable provided with the probe to the DL750/DL750P case)
	    700924 (1000:1, 100:1/1400 Vpeak): For measuring 1400 Vpeak or less
	Connection cable (for high voltage 1:1)
	    701901 (isolated type BNC-safety alligator clip adapter ×2: For measuring 250 V peak or less), a separate alligator clip (701954) is required
	Connection cable (for low voltage 1:1)
	    366926 (non-isolated type BNC-alligator clip ×2: For measuring low voltage less than or equal to 42 Vpeak)

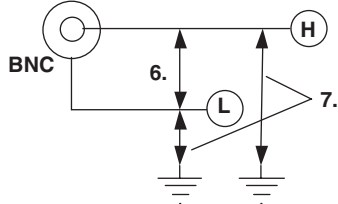1.   Value measured under standard operating conditions (section 19.11).

Combined with the 700929

Combined with the 701901+701954

Direct input (cable not complying with the safety standard)

**Withstand voltage: 1500 Vrms for 1 minute
Allowable transient surge voltage: ±2100 Vpeak
(between earth and input)**

8.   The typical value is a representative or standard value. It is not strictly warranted.

WARNING

-   Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.
-   To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the DL750/DL750P.
-   To prevent the possibility of electric shock, be sure to fasten the module screws. Otherwise, the electrical and mechanical protection functions will not be activated.
-   Avoid continuous connection under an environment in which the allowable surge voltage or higher voltage may occur.
-   To prevent the possibility of electric shock, be sure to connect the GND lead of the differential probe (700924/700925) to the DL750/DL750P.

Specifications

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High-Speed 10 MS/s, 12-Bit Non-Isolation Module (701255) Specifications

| Item	Specifications
Standard operating conditions	Temperature: 23° C±5° C Humidity: 55%±10% RH After a 30-minute warm-up and after calibration
Effective measurement range	20 div (±10 div around 0 V, display range: 10 div, when Variable is OFF)
Number of input channels	2
Input coupling	AC, DC, and GND
Maximum sample rate	10 MS/s
Input format	Non-isolated, unbalanced
Frequency characteristics[1]	(–3 dB point when a sine wave of amplitude ±3 divisions is input)　　DC to 3 MHz
Voltage-axis sensitivity setting	When using 10:1 probe attenuation:　　50 mV/div to 200 V/div (1-2-5 steps) When using 1:1 probe attenuation:　　5 mV/div to 20 V/div (1-2-5 steps)
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with 701940 (10:1)[2]:　　600 V (DC+ACpeak) Direct input (1:1)[3]:　　250 V (DC+ACpeak)
DC offset maximum selectable range	±5 div
Vertical (voltage) axis accuracy 　DC accuracy[1]	5 mV/div to 20 V/div: ±(0.5% of 10 div)
Input connector	BNC connector (metallic type)
Input impedance	1 MΩ±1%, approx. 35 pF
Lower –3 dB point when AC coupled	10 Hz or less (1 Hz or less when using the 701940)
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical[4])
Residual noise level	±400 mV or ±0.06 div, whichever is greater (typical[4]) (Input section shorted)
A/D conversion resolution	12 bit (150 LSB/div)
Temperature coefficient	Zero point:　　5 mV/div to 20 V/div: ±(0.05% of 10 div)/° C (typical[4]) Gain:　　±(0.02% of 10 div)/° C (typical[4])
Bandwidth limit	Select from OFF, 500 kHz, 50 kHz, 5 kHz, and 500 Hz Cut-off characteristics: –18 dB/OCT (typical[4])
Probe attenuation setting	Voltage probe:　　1:1, 10:1, 100:1, 1000:1 Current probe:　　10 A:1 V (for the 700937/701933), 100 A:1 V (for the 701930/701931)
Compatible probes/cables	Voltage probe (10:1 passive probe): Recommended 　701940, 17 to 46 pF: For measuring 600 V (DC+ACpeak) or less Current probe (power can be supplied from the DL750/DL750P) 　700937 (15A), 701930 (150A), 701931 (500 A), 701933 (30 A) High voltage differential probe (connect the GND cable provided with the probe to the DL750/DL750P case) 　700924 (1000:1, 100:1/1400 Vpeak): For measuring 1400 Vpeak or less Connection cable (for low voltage 1:1) 　366926 (non-isolated type BNC-alligator clip × 2: For measuring low voltage less than or equal to 42 Vpeak)

1.　Value measured under standard operating conditions (section 19.11).

Recommended:
Combined with the 10:1 passive probe (701940)
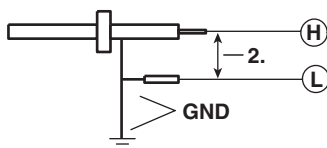
GND is connected to the case potential.

Direct input
(When a cable that does not comply with the safety standard is connected)
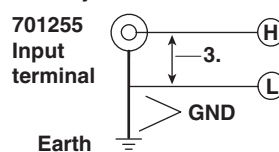
GND is connected to the case potential.

4.　Typical value represents a typical or average value. It is not strictly warranted.

⚠

WARNING

- Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.
- To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the DL750/DL750P.
- To prevent the possibility of electric shock, be sure to fasten the module screws.
- The module screws must be fastened for the module to function as a non-isolation module. In addition, all electrical and mechanical protection functions are activated only when the screws are fastened.
- The maximum input voltage of the module is valid only when all the screws are fastened, and the protection path of the metal BNC is secured.
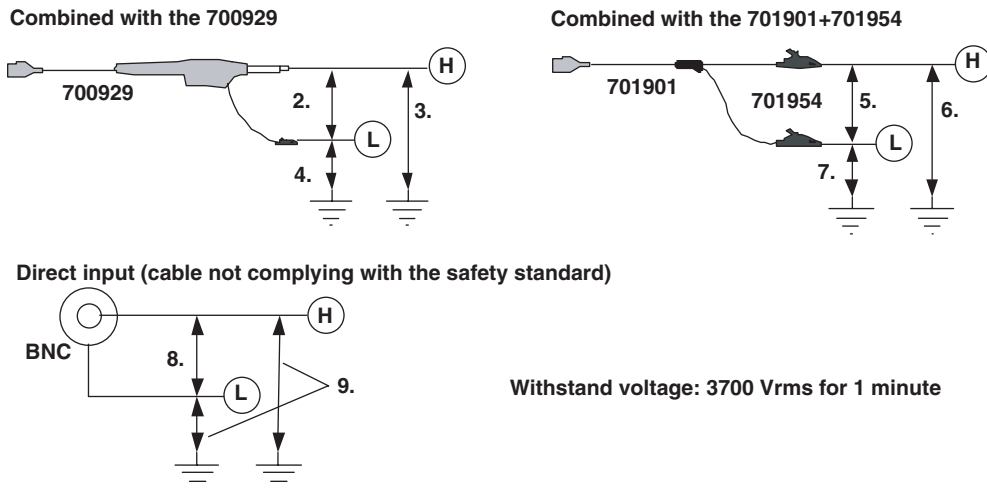
Specifications

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High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS) (701260) Specifications

Item	Specifications		
Standard operating conditions	Temperature: 23° C±5° C Humidity: 55%±10% RH After a 30-minute warm-up and after calibration		
Effective measurement range	20 div (±10 div around 0 V, display range: 10 div, when Variable is OFF)		
Number of input channels	2		
Input coupling	AC, DC, GND, AC-RMS, and DC-RMS		
Maximum sample rate	100 kS/s		
Input format	Isolated unbalanced		
Frequency characteristics[1]	(−3 dB point when a sine wave of amplitude ±3 divisions is input) Waveform observation mode: DC to 40 kHz RMS observation mode: DC, 40 Hz to 10 kHz		
Voltage-axis sensitivity setting	When using 10:1 probe attenuation: 200 mV/div to 2000 V/div (1-2-5 steps) When using 1:1 probe attenuation: 20 mV/div to 200 V/div (1-2-5 steps)		
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with 700929 (10:1)[2]: 1000 V (DC+ACpeak) Combined with 701901(1:1)+701954[5]: 850 V (DC+ACpeak) Direct input or cable not complying with the safety standard[8]: 850 V (DC+ACpeak)		
Maximum allowable common mode voltage (at a frequency of 1 kHz or less)	Working voltage of safety standard Combined with the 700929 (across probe tip H and earth[3]): 1000 Vrms (CAT II) (across probe tip L and earth[4]): 400 Vrms (CAT II) Combined with 701901(1:1)+701954 (across tip H and earth[6]): 700 Vrms (CAT II) (across tip L and earth[7]): 400 Vrms (CAT II) Direct input or cable not complying with the safety standard[9]: 30 Vrms (42 VDC+ACpeak) (across the input terminal, H or L, and earth)		
DC offset maximum selectable range	±5 div		
Vertical (voltage) axis accuracy[1]	Waveform observation mode DC accuracy ±(0.25% of 10 div) RMS observation mode DC accuracy ±(1.0% of 10 div) AC accuracy (when a sine wave is input) ±(1.5% of 10 div) } At frequency of AC accuracy (when the crest factor is 2 or less) ±(2.0% of 10 div) } 40 Hz to AC accuracy (when the crest factor is 3 or less) ±(3.0% of 10 div) } 1 kHz		
Input connector	BNC connector (isolated type)		
Input impedance	1 MΩ±1%, approx. 35 pF		
Lower −3 dB point when AC coupled	1 Hz or less (0.1 Hz or less when using the 700929)		
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical[10])		
Residual noise level (Input section shorted)	±1 mV or ±0.02 div, whichever is greater (typical[10])		
Withstand voltage	3700 Vrms for 1 minute (across each terminal and earth) (60 Hz)		
Allowable transient surge voltage (instantaneous)	±5200 Vpeak (across each input terminal and earth)		
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)		
A/D conversion resolution	16 bit (2400 LSB/div)		
Temperature coefficient (only when observing waveforms)	Zero point: ±(0.02% of 10 div)/° C (typical[10]) Gain: ±(0.02% of 10 div)/° C (typical[10])		
Response time (only when observing RMS)	Rising (0 to 90% of 10 div): 100 ms (typical[10]) Falling (100 to 10% of 10 div): 250 ms (typical[10])		
Bandwidth limit	Select from OFF, 10 kHz, 1 kHz, and 100 Hz Cut-off characteristics: −12 dB/OCT (typical[10])		
Probe attenuation setting	Voltage probe: 1:1, 10:1, 100:1, 1000:1 Current probe: 10 A:1 V (for the 700937/701933), 100 A:1 V (for the 701930/701931)		

Item	Specifications
Compatible probes/cables	Connection cable (for high voltage 1:1): Recommended 1 701901 (isolated type BNC-safety alligator clip adapter × 2: For measuring 850 V (DC+ACpeak) or less), 701954 (alligator clip (dolphin type) red/black 2-piece set) is required separately Voltage probe (10:1 safety probe): Recommended 2 700929 (10:1 safety probe) .20 to 45 pF: For measuring 1000 V (DC+ACpeak) or less Current probe (power can be supplied from the DL750/DL750P) 700937 (15 A), 701930 (150 A), 701931 (500 A), 701933 (30 A)

1. Value measured under standard operating conditions (section 19.11).

Combined with the 700929

Combined with the 701901+701954

Direct input (cable not complying with the safety standard)

Withstand voltage: 3700 Vrms for 1 minute

10. Typical value represents a typical or average value. It is not strictly warranted.

WARNING

- When applying high voltage using this module, use the 1:1 safety cable (combination of 701901 and 701954) or the isolated probe (700929).
- The Measurement Category of the direct input of this module is 400 Vrms-CAT II on the low side and 700 Vrms-CAT II on the high side. Use caution because the overvoltage category differs between the low and high sides.
- Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.
- To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the DL750/DL750P.
- To prevent the possibility of electric shock, be sure to fasten the module screws. Otherwise, the electrical and mechanical protection functions will not be activated.
- Avoid continuous connection under an environment in which the allowable surge voltage or higher voltage may occur.

Universal (Voltage/Temp.) Module (701261) Specifications
Universal (Voltage/Temp.) Module (with AAF) (701262) Specifications

Item	Specifications
Standard operating conditions	Temperature: 23° C±5° C Humidity: 55%±10% RH After a 30-minute warm-up and after calibration
Function	Temperature (thermocouple) or voltage measurement (switchable)
Effective measurement range	[Voltage measurement] 20 div (display range: 10 div)
Number of input channels	2 Input coupling TC, DC, AC, and GND TC: Temperature (thermocouple) measurement DC: Voltage measurement (DC coupling) AC: Voltage measurement (AC coupling)
Voltage measurement maximum sample rate	100 kHz
Temperature measurement data update rate	500 Hz
Input format	Isolated unbalanced
Measurement range	[Voltage measurement] Voltage sensitivity: 5 mV/div to 20 V/div (1-2-5 steps) [Temperature measurement] Thermocouple: K, E, J, T, L, U, N, R, S, B, W, and Au7Fe
Measurement range/accuracy[1]	[Voltage measurement] Voltage sensitivity: 5 mV/div to 20 V/div (1-2-5 steps) Voltage accuracy: ±(0.25% of 10 div) [Temperature measurement][2]

Type	Measurement Range	Accuracy
K E J T L U N	−200 to 1300° C −200 to 800° C −200 to 1100° C −200 to 400° C −200 to 900° C −200 to 400° C 0 to 1300° C	±(0.1% of reading + 1.5° C) Except ±(0.2% of reading + 1.5° C) for −200° C to 0° C
R S	0 to 1700° C 0 to 1700° C	±(0.1% of reading + 3° C) Except, 0 to 200° C: ±8° C 200 to 800° C: ±5° C
B	0 to 1800° C	±(0.1% of reading + 2° C) Except, 400 to 700° C: ±8° C Effective range is 400 to 1800° C
W	0 to 2300° C	±(0.1% of reading + 3° C)
Au7Fe[3]	0 to 300K	0 to 50K: ±4K 50 to 300K: ±2.5K

Frequency characteristics[1]	(−3 dB point when sine wave of amplitude equivalent to ±3 div is applied) [Voltage measurement] DC to 40 kHz [Temperature measurement] DC to 100 Hz
Maximum input voltage[4] (at a frequency of 1 kHz or less)	Both temperature and voltage input: 42 V (DC + ACpeak) (as a value that meets the safety standard) 150 V (DC + ACpeak) (maximum allowable voltage, as a value that does not damage the instrument when applied)
Maximum common mode voltage[5] (at a frequency of 1 kHz or less)	Both temperature and voltage input: 42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)
DC offset maximum selectable range	[Voltage measurement]: ±5 div
Vertical resolution	[Voltage measurement] During voltage input: 2400 LSB/div [Temperature measurement] When measuring temperature: 0.1° C
Lower −3dB point when AC coupled	[Voltage measurement] 0.5 Hz or less
Input connector	Binding post

Item	Specifications
Input impedance	Approx. 1 MΩ
Common mode rejection ratio	[Voltage measurement] 80 dB (50/60 Hz) or more (typical[6]) [Temperature measurement] 120 dB or more (50/60 Hz, with 2-Hz filter ON, signal source resistance of 500 Ω or less) (typical[6])
Residual noise level (Input section shorted)	[Voltage measurement]: ±100 μ V or ±0.01 div, whichever is greater (typical[6])
A/D conversion resolution	[Voltage measurement] 16 bits (2400 LSB/div)
Temperature coefficient	[Voltage measurement] Zero point: ±(0.01% of 10 div)/° C (typical[6]) Gain: ±(0.02% of 10 div)/° C (typical[6])

Reference junction compensation accuracy (when the input terminal temperature is balanced)
K, E, J, T, L, U, N: ±1° C
R, S, B, W: ±1.5° C
Au7Fe: ±1K

Bandwidth limit
[Temperature measurement] (Digital filter + analog filter)
Select from OFF, 30 Hz, 8 Hz, and 2 Hz + 150 Hz secondary analog filter
[Voltage measurement]   Select from OFF, AUTO, 4 kHz, 400 Hz, or 40 Hz.
Cutoff characteristics: –12 dB/OCT (typical[6], setting other than AUTO)
Cutoff frequency (fc) when set to AUTO (701262 only)

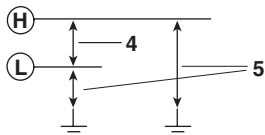| Sample Rate	Cutoff Frequency (fc)
100 kHz or higher	40 kHz
100 Hz to 50 kHz	40% of the sample rate
50 Hz or less	20 Hz

Cutoff characteristics for AUTO: –65 dB at 2 × fc (typical[6])

Table of cutoff frequency characteristics of the anti-aliasing filter (AAF)
When the filter is set to Auto, the anti-aliasing filter and low-pass filter are automatically set according to the sample rate.

Sample Rate	AAF	Low-Pass Filter
100 kS/s	40 kHz	OFF
50 kS/s	20 kHz	OFF
20 kS/s	8 kHz	OFF
10 kS/s	4 kHz	4 kHz
5 kS/s	2 kHz	4 kHz
2 kS/s	800 Hz	4 kHz
1 kS/s	400 Hz	400 Hz
500 S/s	200 Hz	400 Hz
200 S/s	80 Hz	400 Hz
100 S/s	40 Hz	40 Hz
50 S/s	20 Hz	40 Hz
20 S/s to 5 S/s	20 Hz	40 Hz
2 S/s or less	20 Hz	40 Hz
Ext sample	40 kHz	OFF

1.   Value measured under standard operating conditions (section 19.11).
2.   Does not include the reference junction temperature compensation accuracy.
3.   This module supports Au7Fe with 0.07% metal content with respect to gold.

6.   Typical value represents a typical or average value. It is not strictly warranted.

WARNING

- Do not apply input voltage exceeding the maximum input voltage or allowable common mode input voltage.
- To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the DL750/DL750P.
- To prevent the possibility of electric shock, be sure to fasten the module screws. Otherwise, the electrical and mechanical protection functions will not be activated.

Temperature, High Precision Voltage Isolation Module (701265) Specifications

Item	Specifications		
Standard operating conditions	Temperature: 23° C±5° C Humidity: 55%±10% RH After a 30-minute warm-up and after calibration		
Function	Temperature (thermocouple) or voltage measurement (switchable)		
Number of input channels	2		
Input coupling	TC, DC, and GND TC: Temperature (thermocouple) measurement DC: Voltage measurement (DC coupling)		
Data update rate	500 Hz		
Input format	Isolated unbalanced		
Measurement range	[Voltage measurement]	Voltage sensitivity: 100 μ V/div to 10 V/div (1-2-5 steps)	
	[Temperature measurement]	TC:	K, E, J, T, L, U, N, R, S, B, W, and Au7Fe
Measurement range/ accuracy[1]	[Voltage measurement]	Voltage sensitivity: 100 μ V/div to 10 V/div (1-2-5 steps) Voltage accuracy: ±(0.08% of 10 div + 2 μ V)	
	[Temperature measurement][2]		

Type	Measurement Range	Accuracy
K	−200 to 1300° C	±(0.1% of reading+1.5° C)
E	−200 to 800° C	However, for −200° C to 0° C:
J	−200 to 1100° C	±(0.2% of reading+1.5° C)
T	−200 to 400° C	
L	−200 to 900° C	
U	−200 to 400° C	
N	0 to 1300° C	
R	0 to 1700° C	±(0.1% of reading+3° C)
S	0 to 1700° C	However, for 0 to 200° C: ±8° C: 200 to 800° C: ±5° C
B	0 to 1800° C	±(0.1% of reading+2° C) However for 400 to 700° C: ±8° C Effective range is 400 to 1800° C
W	0 to 2300° C	±(0.1% of reading+3° C)
Au7Fe[3]	0 to 300 K	0 to 50K: ±4 K 50 to 300K: ±2.5 K

Item	Specifications		
Frequency characteristics[1]	(−3 dB point when a sine wave of amplitude of ±3 divisions is input) [Voltage measurement]: DC to 100 Hz [Temperature measurement]: DC to 100 Hz		
Maximum input voltage[4] (at a frequency of 1 kHz or less)			
	For both temperature and voltage input: 42 V (DC+ACpeak)		
Maximum common mode voltage[5] (at a frequency of 1 kHz or less)			
	For both temperature and voltage input: 42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)		
DC offset maximum selectable range	[Temperature measurement]: ±5 div		
Vertical Resolution	[Voltage measurement]: When applying voltage: 2400 LSB/div [Temperature measurement]: When measuring temperature: 0.1° C		
Input connector	Binding post		
Input impedance	Approx. 1 MΩ		
Common mode rejection ratio	[Voltage measurement]: 80 dB (50/60 Hz) or more (typical[6]) [Temperature measurement]: 120 dB or more (50/60 Hz, with 2-Hz filter ON, signal source resistance of 500 Ω or less) (typical[6])		
Residual noise level (input section shorted)	[Voltage measurement]: ±4 μ V or ±0.01 div, whichever is greater (typical[6])		
A/D conversion resolution	[Voltage measurement]: 16 bits (2400 LSB/div) 20 div (±10 div around 0 V, display range: 10 div, when Variable is OFF)		
Temperature coefficient [Voltage measurement]	Zero point: ±(0.01% of 10 div)/° C + 0.05 mV/° C (typical[6]) Gain: ±(0.02% of 10 div)/° C (typical[6])		

Specifications

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Item	Specifications
Reference junction compensation accuracy (when the input terminal temperature is balanced)	
	K, E, J, T, L, U, and N: ±1° C
	R, S, B, and W: ±1.5° C
	Au7Fe: ±1 K
Bandwidth limit (digital filter)	
	Select from OFF, 30 Hz, 8 Hz, and 2 Hz
Input bias current	20 nA or less
	The zero point appears to be offset when the input is open due to the effects of bias current on this module. However, this is not a malfunction.
	Connect the input to the object to be measured.

1. Value measured under standard operating conditions (section 19.11).
2. Does not include the reference junction temperature compensation accuracy.
3. This module supports Au7Fe with 0.07% metal content with respect to gold.
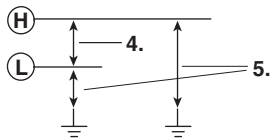
6. The typical value is a representative or standard value. It is not strictly warranted.

⚠

WARNING

- Do not apply input voltage exceeding the maximum input voltage or allowable common mode input voltage.
- To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the DL750/DL750P.
- To prevent the possibility of electric shock, be sure to fasten the module screws. Otherwise, the electrical and mechanical protection functions will not be activated.


Strain Module (NDIS) (701270) Specifications

Item	Specifications
Standard operating conditions	Temperature: 23° C±5° C Humidity: 55%±10% RH After a 30-minute warm-up and after calibration and auto balance
Effective measurement range	−FS to +FS (set using upper and lower limits)
Number of input channels	2
Maximum sample rate	100 kS/s
Input format	DC bridge (auto balancing), balanced differential input, and isolated
Auto balance type	Electronic auto balance
Auto balance range	±10000 µ STR (1 gauge method)
Bridge voltage	Select from 2 V, 5 V, and 10 V.
Gauge resistance	120 Ω to 1000 Ω (bridge voltage: 2 V) 350 Ω to 1000 Ω (bridge voltage: 2 V, 5 V, and 10 V)
Gauge factor	1.90 to 2.20 (set in 0.01 steps)
Frequency characteristics[1]	(−3 dB point when a sine wave of amplitude ±3 divisions is input)　　　DC to 20 kHz
mV/V range support	Supports the strain gauge transducer unit system. mV/V range = 0.5×(µ STR range/1000)
Measurement range (FS) and measurement range	When using STR range 　Measurement Range (FS)　　　Measurement Range 　500 µ STR　　　　　　　　　−500 µ STR to +500 µ STR 　1000 µ STR　　　　　　　　−1000 µ STR to +1000 µ STR 　2000 µ STR　　　　　　　　−2000 µ STR to +2000 µ STR 　5000 µ STR　　　　　　　　−5000 µ STR to +5000 µ STR 　10000 µ STR　　　　　　　−10000 µ STR to +10000 µ STR 　20000 µ STR　　　　　　　−20000 µ STR to +20000 µ STR When using mV/V range 　Measurement Range (FS)　　　Measurement Range 　0.25 mv/V　　　　　　　　　−0.25 mV/V to +0.25 mV/V 　0.5 mV/V　　　　　　　　　−0.5 mV/V to +0.5 mV/V 　1 mV/V　　　　　　　　　　−1 mV/V to +1 mV/V 　2.5 mV/V　　　　　　　　　−2.5 mV/V to +2.5 mV/V 　5 mV/V　　　　　　　　　　−5 mV/V to +5 mV/V 　10 mV/V　　　　　　　　　−10 mV/V to +10 mV/V
DC accuracy[1]	±(0.5% of FS+5 µ STR)
Maximum input voltage	Between Input+ and Input−　10 V (DC+ACpeak) (At 1 kHz or less)
Maximum allowable common mode voltage (At 1 kHz or less)	Between each terminal and earth ground 42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)
Input connector	NDIS connector (Recommended by JSNDI (The Japanese Society for Non-destructive Inspection)
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical[2])
A/D conversion resolution	16 bit (4800 LSB/div: Upper = +FS, Lower = −FS)
Temperature coefficient	Zero point:　　±5 µ STR/° C (typical[2]) Gain:　　　　±(0.02% of FS)/° C (typical[2])
Bandwidth limit	Select from OFF, 1 kHz, 100 Hz, and 10 Hz Cutoff characteristics:　　−12 dB/OCT (typical[2])
Function	mV/V support.　Supports the strain gauge transducer unit system.
Standard accessories	NDIS connector (for external connection: PRC03-12A10-7M10.5 by Tajimi) A1002JC: 2 pieces
Compatible accessories (sold separately)	Recommended bridge head 701955 (NDIS 120 Ω, enhanced shield version, comes with a 5-m cable) Recommended bridge head 701956 (NDIS 350 Ω, enhanced shield version, comes with a 5-m cable)

Specifications

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Item	Specifications
Precautions	• Highly sensitive measurements are made in the μ V level in strain measurements. Therefore, take measures against noise at the strain sensor perimeter, bridge head, and cable wiring.
	• Depending on the noise environment, an error may result in the balance. Check the influence before making measurements.
	• The bridge head specified by YOKOGAWA has high noise resistance.
	• Some of the strain gauge sensors and bridge heads made by other manufacturers do not have sensing wires connected. (No such problems with bridge heads made by YOKOGAWA.) If such products are used, an error may result in the bridge voltage leading to measurement errors, because sensing does not work effectively. If possible, it is desirable that sensing be done very close to the bridge. However, if this is not possible, use the NDIS conversion cable (DV450-001) that is sold separately by YOKOGAWA. Outline specifications of the DV450-001: Sensing cable, NDIS male-female, 30 cm in length, insert it as close to the bridge as possible
	• The connector shell is connected to the case potential.
	• When a bridge head (701955 or 701956) is used, the connector shell, cable shield, and the bridge head case are all connected to the case potential of the DL750/DL750P.
	• When a bridge head (701955 or 701956) is used, the floating GND is connected to the bridge head case inside the bridge head.
	• Be sure to execute balancing again when you change the range or the bridge voltage.

1. Value measured under standard operating conditions (section 19.11).
2. Typical value represents a typical or average value. It is not strictly warranted.

Module front View
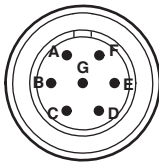
A: Bridge+ (positive bridge voltage)
B: Input- (negative measurement signal)
C: Bridge- (negative bridge voltage)
D: Input+ (positive measurement signal)
E: Floating common
F: Sense+ (positive bridge voltage sensing)
G: Sense- (positive bridge voltage sensing)

The connector shell is connected to the case potential.

WARNING

• Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.

• To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the DL750/DL750P.

• To prevent the possibility of electric shock, be sure to fasten the module screws. Otherwise, the electrical and mechanical protection functions will not be activated.

• Avoid continuous connection under an environment in which the allowable surge voltage may occur.

## Strain Module (DSUB, Shunt-Cal) (701271) Specifications

Item	Specifications
Standard operating conditions	Temperature: 23° C±5° C Humidity: 55%±10% RH After a 30-minute warm-up and after calibration and auto balance
Effective measurement range	−FS to +FS (set using upper and lower limits)
Number of input channels	2
Maximum sample rate	100 kS/s
Input format	DC bridge (auto balancing), balanced differential input, and isolated
Auto balance type	Electronic auto balance
Auto balance range	±10000 μ STR (1 gauge method)
Bridge voltage	Select from 2 V, 5 V, and 10 V.
Gauge resistance	120 Ω to 1000 Ω (bridge voltage: 2 V) 350 Ω to 1000 Ω (bridge voltage: 2 V, 5 V, and 10 V)
Gauge factor	1.90 to 2.20 (set in 0.01 steps)
Frequency characteristics[1]	(−3 dB point when a sine wave of amplitude ±3 divisions is input) DC to 20 kHz
mV/V range support	Supports the strain gauge transducer unit system. mV/V range = 0.5×(μ STR range/1000)

Measurement range (FS) and measurement range	When using STR range
	  Measurement Range (FS) Measurement Range
	  500 μ STR −500 μ STR to +500 μ STR
	  1000 μ STR −1000 μ STR to +1000 μ STR
	  2000 μ STR −2000 μ STR to +2000 μ STR
	  5000 μ STR −5000 μ STR to +5000 μ STR
	  10000 μ STR −10000 μ STR to +10000 μ STR
	  20000 μ STR −20000 μ STR to +20000 μ STR
	
	When using mV/V range
	  Measurement Range (FS) Measurement Range
	  0.25 mv/V −0.25mV/V to +0.25 mV/V
	  0.5 mV/V −0.5mV/V to +0.5 mV/V
	  1 mV/V −1mV/V to +1 mV/V
	  2.5 mV/V −2.5mV/V to +2.5 mV/V
	  5 mV/V −5mV/V to +5 mV/V
	  10 mV/V −10mV/V to +10 mV/V

DC accuracy[1]	±(0.5% of FS+5 μ STR)
Maximum input voltage	Between Input+ and Input− 10 V (DC+ACpeak) (At 1 kHz or less)
Maximum allowable common mode voltage (At 1 kHz or less)	Between each terminal and earth ground 42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)
Input connector	9-pin D-Sub connector (female)
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical[2])
A/D conversion resolution	16 bit (4800 LSB/div: Upper = +FS, Lower = −FS)
Temperature coefficient	Zero point: ±5 μ STR/° C (typical[2]) Gain: ±(0.02% of FS)/° C (typical[2])
Bandwidth limit	Select from OFF, 1 kHz, 100 Hz, and 10 Hz Cutoff characteristics: −12 dB/OCT (typical[2])
Function	mV/V support. Supports the strain gauge transducer unit system. Shunt calibration support. Built-in shunt calibration relay (1 gauge method).
Standard accessories	Connector shell set for soldering A1520JD (9-pin D-Sub): 2 pieces, A1618JD (connector shell): 2 pieces
Compatible accessories (sold separately)	Recommended bridge head 701957 (D-Sub 120 Ω , shunt-Cal, comes with a 5-m cable) Recommended bridge head 701958 (D-Sub 350 Ω , shunt-Cal, comes with a 5-m cable)

Specifications

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Item	Specifications
Precautions	• Highly sensitive measurements are made in the μ V level in strain measurements. Therefore, take measures against noise at the strain sensor perimeter, bridge head, and cable wiring. • Depending on the noise environment, an error may result in the balance. Check the influence before making measurements. • The bridge head specified by YOKOGAWA has high noise resistance. • When executing shunt calibration, be sure to calculate the shunt resistance in advance, and execute it in a range so that the measured values do not exceed the range even when the shunt resistance is ON. • Some of the strain gauge sensors and bridge heads made by other manufacturers do not have sensing wires connected. (No such problems with bridge heads made by YOKOGAWA.) If such products are used, an error may result in the bridge voltage leading to measurement errors, because sensing does not work effectively. Perform sensing as close to the bridge head as possible. (There is no conversion cable for sensing on D-Sub connector types.) • The connector shell is connected to the case potential. • When a bridge head (701957 or 701958) is used, the connector shell, cable shield, and the bridge head case are all connected to the case potential of the DL750/DL750P. • When a bridge head (701957 or 701958) is used, the floating GND is connected to the bridge head case inside the bridge head. • Be sure to execute balancing again when you change the range or the bridge voltage.

1. Value measured under standard operating conditions (section 19.11).
2. Typical value represents a typical or average value. It is not strictly warranted.

Module front View

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 5  4  3  2  1
  •  •  •  •  •
   •  •  •  •
   9  8  7  6
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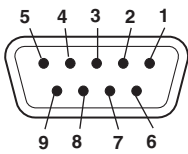
1: **Floating common**
2: **Sense- (positive bridge voltage sensing)**
3: **Shuntcal- (negative shunt signal)**
4: **Shuntcal+ (positive shunt signal)**
5: **Sense+ (positive bridge voltage sensing)**
6: **Bridge- (negative bridge voltage)**
7: **Input- (negative measurement signal)**
8: **Input+ (positive measurement signal)**
9: **Bridge+ (positive bridge voltage)**

⚠

WARNING

• Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.

• To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the DL750/DL750P.

• To prevent the possibility of electric shock, be sure to fasten the module screws. Otherwise, the electrical and mechanical protection functions will not be activated.

• Avoid continuous connection under an environment in which the allowable surge voltage may occur.

Acceleration/Voltage Module (with AAF) (701275) Specifications

Item	Specifications
Standard operating conditions	Temperature: 23° C±5° C Humidity: 55%±10% RH After a 30-minute warm-up and after calibration
Effective measurement range	20 div (display range: 10 div)
Number of input channels	2
Input coupling settings	AC, DC, ACCL (acceleration), and GND
Maximum sample rate	100 kS/s
Input format	Isolated unbalanced
Frequency characteristics[1]	(−3 dB point when a sine wave of amplitude ±3 divisions is input) Waveform measurement mode: DC to 40 kHz Acceleration measurement mode: 0.4 Hz to 40 kHz
Voltage-axis sensitivity setting	When using 1:1 probe attenuation: 5 mV/div to 10 V/div (1-2-5 steps) When using 10:1 probe attenuation: 50 mV/div to 100 V/div (1-2-5 steps) (combined with the recommended probe 701940) Acceleration (±5 V = ×1 range): ×0.1 to ×1 to ×100 (in 1-2-5 steps)
Maximum input voltage (at a frequency of 1 kHz or less) 42 V (DC+Acpeak)[2]	
Maximum allowable common mode voltage (at a frequency of 1 kHz or less) Working voltage of safety standard 30 Vrms (CAT I and CAT II)[3]	
DC offset Maximum selectable range ±5 div	
Vertical (voltage) axis accuracy	Waveform measurement mode DC accuracy: ±(0.25% of 10 div) Acceleration measurement mode: ±(0.5% of 10 div) at 1 kHz
Input connector	Metal BNC connector
Input impedance −3dB point when AC coupled Low frequency attenuation point	1 MΩ±1%, approx. 35 pF 0.4 Hz or less (0.04 Hz or less when using the 701940) (typical[4])
Common mode rejection ratio 80 dB (50/60 Hz) or more (typical[4])	
Residual noise level (Input section shorted)	±100 μ V or ±0.01 div, whichever is greater (typical[4])
A/D conversion resolution	16 bits (2400 LSB/div)
Temperature coefficient	When in waveform measurement mode (excluding AUTO filter) Zero point: ±(0.02% of 10 div)/° C (typical[4]) Gain: ±(0.02% of 10 div)/° C (typical[4])

Bandwidth limit	Select from OFF, Auto, 4 KHz, 400 Hz, and 40 Hz
	  Cutoff characteristics: −12 dB/OCT (typical[4], excluding AUTO)
	Cutoff frequency (fc) when set to AUTO
	  Sample rate of 100 kHz or higher: fc = 40 kHz
	  Sample rate of 100 Hz to 50 kHz: fc = 40% of the sampling rate
	  Sample rate of 50 Hz or less: fc = 20 Hz
	Cutoff characteristics when set to AUTO: −65 at 2×fc (typical[4])

Probe attenuation setting	Voltage probe 1:1, 10:1, 100:1, or 1000:1 Current probe 10 A:1 V (for the 700937/701933), 100 A:1 V (for the 701930/701931)

Compatible probes/cables	Connection cable (for low voltage 1:1)
	  366926 (non-isolated type BNC-alligator clip × 2: For measuring low voltage less than or equal to 42 Vpeak)
	Voltage probe (10:1 passive probe) 701940
	  17 to 46 pF: For measuring 600 V (DC+ACpeak) or less
	Current probe (power can be supplied from the DL750/DL750P)
	  700937 (15 A), 701930 (150 A), 701931 (500 A), 701933 (30 A)

Sensor supply current (voltage)	OFF or 4 mA±10% (approx. 22 VDC)
Applicable acceleration sensor	Built-in amplifier type Kistler Instrument Corporation: Piezotron, PCB Piezotronics Incorporated: ICP, ENDEVCO Corporation: ISOTRON, etc.

Specifications
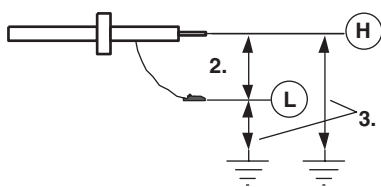
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Item	Specifications
Table of Cutoff Frequency Characteristics of the Anti-Aliasing Filter (AAF)	

When the filter is set to Auto, the anti-aliasing filter and low-pass filter are automatically set according to the sample rate.

Sample Rate	AAF	Low-pass filter
100 kS/s	40 kHz	OFF
50 kS/s	20 kHz	OFF
20 kS/s	8 kHz	OFF
10 kS/s	4 kHz	4 kHz
5 kS/s	2 kHz	4 kHz
2 kS/s	800 Hz	4 kHz
1 kS/s	400 Hz	400 Hz
500 S/s	200 Hz	400 Hz
200 S/s	80 Hz	400 Hz
100 S/s	40 Hz	40 Hz
50 S/s	20 Hz	40 Hz
20 S/s to 5 S/s	20 Hz	40 Hz
2 S/s or less	20 Hz	40 Hz
Ext sample	40 kHz	OFF

1   Value measured under standard operating conditions (section 19.11).

Combined with the 10:1 passive probe (701940)

Direct input (cable not complying with the safety standard)
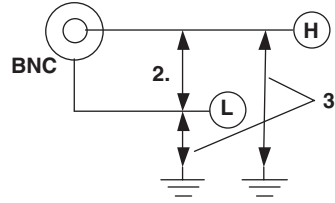
4   Typical value represents a typical or average value. It is not strictly warranted.

WARNING

- Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.
- To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the DL750/DL750P.
- To prevent the possibility of electric shock, be sure to fasten the module screws. Otherwise, the electrical and mechanical protection functions will not be activated.
- Avoid continuous connection under an environment in which the allowable surge voltage may occur.

Frequency Module (701280) Specifications

Item	Specifications
Standard operating conditions	Temperature: 23° C±5° C Humidity: 55% ±10% RH After the warm-up time of 30 minutes has elapsed
Measurement function	Frequency, RPMs, RPSs, period, duty cycle, power supply frequency, pulse width, pulse integration, and velocity
Effective measurement range	20 div (display range: 10 div)
Number of input channels	2
Data update rate	25 kHz (40 μ s)
Output delay time	Up to 2 computation periods
Input format	Isolated unbalanced
Input connector	BNC connector (isolated type)
Maximum input voltage	Module only (when 1:1 cable is connected, across input terminals H and L): 42 V (DC+ACpeak)[4] Combined with the 700929 (10:1) (across the probe tips, H and L[3]): 420 V (DC+ACpeak)[2]

Maximum allowable common mode voltage	Working voltage of safety standard
	Module only (when 1:1 cable is connected, across input terminal L and earth)
	  30 Vrms (CAT I and CAT II)[5]
	Combined with the 700929 (10:1) (across probe tip H or L and earth)
	  300 Vrms (CAT I and CAT II)[3]

Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
Minimum measurement resolution	50 ns
Measured data resolution	16 bits (2400 LSB/div)
Measurement accuracy[1]	• **When in frequency, RPM, RPS, or velocity measurement mode[6]** Measurement accuracy is specified according to the measurement range and input frequency [Definition of measurement accuracy] ±(0.05% of 10 div + accuracy dependent on the input frequency) [Accuracy dependent on the input frequency] When input frequency is 2 kHz or less: 0.05% of the input frequency + 0.001 Hz Input frequency of 2 kHz to 10 kHz: 0.1% of the input frequency Input frequency of 10 kHz to 20 kHz: 0.3% of the input frequency Input frequency of 20 kHz or higher: 0.5% of the input frequency • **When in power supply frequency mode[7]** When the center frequency is 50/60 Hz: ±0.03 Hz (0.01 Hz resolution) When the center frequency is 400 Hz: ±0.3 Hz (0.01 Hz resolution) (Input set to AC100V or AC200V with sine wave input) • **When in period measurement mode[6]** Measurement accuracy is specified according to the measurement range and input period [Definition of measurement accuracy] ±(0.05% of 10 div + accuracy dependent on the input period) [Accuracy dependent on the input period] Input period of 500 μ s or greater: 0.05% of the input period Input period of 100 μ s to 500 μ s: 0.1% of the input period Input period of 50 μ s to 100 μ s: 0.3% of the input period Input period of 50 μ s or less: 0.5% of the input period + 0.1 μ s • **When in duty cycle measurement mode[8]** Dependent on the input frequency Input frequency of 1 kHz or less: ±0.1% Input frequency of 1 kHz to 10 kHz: ±0.2% Input frequency of 10 kHz to 50 kHz: ±1.0% Input frequency of 50 kHz to 100 kHz: ±2.0% Input frequency of 100 kHz to 200 kHz: ±4.0% • **When in pulse width measurement mode[8]** Measurement accuracy is specified according to the measurement range and input pulse width [Definition of measurement accuracy] ±(0.05% of 10 div + accuracy dependent on the input pulse width) [Accuracy dependent on the input pulse width] Input pulse width of 500 μ s or greater: 0.05% of the input pulse width Input pulse width of 100 μ s to 500 μ s: 0.1% of the input pulse width Input pulse width of 50 μ s to 100 μ s: 0.3% of the input pulse width Input pulse width of 50 μ s or less: 0.5% of the input pulse width + 0.1 μ s

Specifications

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Item	Specifications
Input voltage range (±FS)	When using 1:1 probe attenuation: ±1 V, ±2 V, ±5 V, ±10 V, ±20 V, ±50 V (±FS) When using 10:1 probe attenuation: ±10 V, ±20 V, ±50 V, ±100 V, ±200 V, ±500 V (±FS) (combined with the recommended probe 700929)
Input impedance	1 MΩ ±1%, approx. 35 pF Pull-up function: 4.7 kΩ, approx. 5 V (pull-up can be turned ON only when the input is set to Pull-Up 5V)
Input coupling settings	AC and DC
Probe attenuation setting	10:1 and 1:1
Minimum voltage width for pulse detection	200 mV_{P-P}
Bandwidth limit	Select from Full, 100 kHz, 10 kHz, 1 kHz, and 100 Hz Cutoff characteristics: –12 dB/OCT (typical[9])
Threshold	Set within the FS of the voltage range. Set in units of 1% of the FS.
Hysteresis	Select ±1%, ±2.5%, or ±5% of the FS of the voltage range
Preset function	Logic (5V/3V/12V/24V), electromagnetic pickup, zero crossing, pull-up, AC100V, AC200V, and user-defined
Slope selection	Select rising or falling
Lower –3 dB point when AC coupled	0.5 Hz or less (0.05 Hz or less when using the 700929) (typical[9])
Chatter elimination function	OFF or 1 to 1000 ms (1 ms resolution) Eliminates the chatter that occurs such when the contact input is turned ON/OFF. Can discard the signal changes over the specified interval.
Input status indication function	Input status indication through the LEDs of each channel When in operation: Illuminates in green when pulse input is detected When overdriven: Illuminates in red when the input voltage exceeds the range
Compatible probes/cables	Connection cable (1:1): Recommended 1 366926 Voltage probe (10:1 safety probe): Recommended 2 700929 (10:1 safety probe) .20 to 45 pF: For measuring 1000 V (DC+ACpeak) or less

1   Value measured under standard operating conditions (section 19.11).

Combined with the 700929
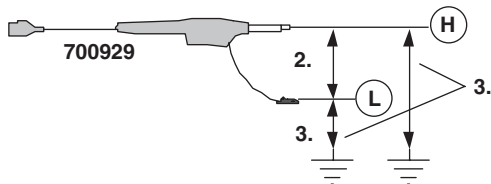
Direct input (cable not complying with the safety standard)
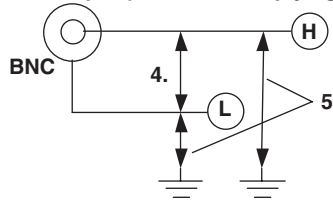
Withstand voltage: 1500 Vrms for 1 minute
Allowable transient surge voltage (between earth and input): ±2100 Vpeak

6   Input waveform of 1 Vpp, rectangular wave, rise/fall time within 1 ms (input range: ±10 V, bandwidth limit: Full, and hysteresis: ±1%)
7   Input waveform of 90 Vrms, sine wave (input range: AC100V, bandwidth limit 100 kHz, and hysteresis: ±1%)
8   Input waveform of 1 Vpp, rectangular wave, rise/fall time within 5 ns (input range: ±10 V, bandwidth limit: Full, and hysteresis: ±1%)
9   Typical value represents a typical or average value. It is not strictly warranted.

WARNING

- Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.
- To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the DL750/DL750P.
- To prevent the possibility of electric shock, be sure to fasten the module screws. Otherwise, the electrical and mechanical protection functions will not be activated.
- Avoid continuous connection under an environment in which the allowable surge voltage may occur.

Specifications by Measurement Modes

Item	Specifications
Frequency	
Measurable frequency range	0.01 Hz to 200 kHz
Selectable vertical axis sensitivity range	0.1 Hz/div to 50 kHz/div (1-2-5 steps)
Minimum resolution	0.00 1Hz
RPMs	
Measurable RPMs range	0.01 rpm to 100000 rpm (where the input frequency is DC to 200 kHz).
Selectable vertical axis sensitivity range	0.1 rpm/div to 10 krpm/div (1-2-5 steps)
Computing method	Computed from the frequency based on the number of pulses per rotation
	RPMs = Frequency/(pulse/rotate value) $\times$ 60
Selectable pulse/rotate range	1 to 99999
RPSs	
Measurable RPSs range	0.001 rps to 2000 rps (where the input frequency is DC to 200 kHz).
Selectable vertical axis sensitivity range	0.01 rps/div to 200 rps/div (1-2-5 steps)
Computing method	Computed from the frequency based on the number of pulses per rotation
	RPSs = Frequency/(pulse/rotate value)
Selectable pulse/rotate range	1 to 99999
Period	
Measurable period range	5 ms to 50 s (where the minimum pulse width is 2 μ s)
Selectable vertical axis sensitivity range	10 μ s to 500 μ s, 1 ms to 500 ms, 1 to 5 s/div (1-2-5 steps)
Minimum resolution	0.1 μ s
Duty cycle	
Measurable duty cycle range	0 to 100%
Selectable vertical axis sensitivity range	1 to 20% (1-2-5 steps)
Measurable frequency range	0.1 Hz to 200 kHz
Measurement pulse selection	Select positive or negative pulse
Minimum resolution	0.01%
Power supply frequency	
Measurable frequency range	30 Hz to 70 Hz (when the center frequency is 50 Hz), 40 Hz to 80 Hz (when the center frequency is 60 Hz), 380 Hz to 420 Hz (when the center frequency is 400 Hz)
Selectable vertical axis sensitivity range	0.1 Hz/div to 2 Hz/div (0.01 Hz resolution)
Center frequency setting	Select 50 Hz, 60 Hz, or 400 Hz
Minimum resolution	0.01 Hz
Pulse width	
Measurable pulse width	2 μ s to 50 s (where the input frequency is up to 200 kHz)
Selectable vertical axis sensitivity range	10 μ s to 500 μ s, 1 ms to 500 ms, 1 to 5 s/div (1-2-5 steps)
Measurement pulse selection	Select positive or negative pulse
Minimum resolution	0.1 μ s
Pulse integration	
Maximum pulse count	2×10^9 pulses
Selectable vertical axis sensitivity range	500.0E+18 value/div to 10.00E–21 value/div (1-2-5 range: total of 123 ranges)
Frequency measuring range	0.1 Hz to 200 kHz (where the minimum pulse width is 2 μ s)
Computation function	Set the physical amount per pulse and display by converting the values into physical values such as distance and flow rate.
Selectable Unit/Pulse range	–9.9999E+30 to +9.9999E+30
Counter reset	Manual reset and over-limit reset
Velocity	
Selectable vertical axis sensitivity range	500.0E+18 value/div to 10.00E–21 value/div (1-2-5 range: total of 123 ranges)
Computing method	Set the amount of displacement per pulse and compute the velocity from the frequency
	Automatic unit time conversion of s, min, and hour.
Selectable Distance/Pulse range	–9.9999E+30 to +9.9999E+30

Specifications

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Functional Specifications

Item	Specifications
Deceleration prediction	Computes the deceleration condition in realtime when the pulse input is cut off. Can be specified when measuring the frequency, RPMs, RPSs, period, and velocity
Stop prediction	Sets the frequency to 0 after a certain time elapses after the pulse input is cut off. Stop interval setting: Set in the range of 1.5 to 10 times (10 settings) the period of the pulse measured last Can be specified when measuring the frequency, RPMs, RPSs, period, and velocity
Smoothing	Computes the moving average of the measured data using the specified time Specified time: 0.1 to 1000 ms (0.1 ms resolution) Can be specified on all measurement parameters
Pulse average	Performs frequency measurement per specified number of pulses. When fluctuation exists periodically in the pulse interval, the fluctuation can be eliminated. Specified number of pulses: 1 to 4096 Can be specified when measuring the frequency, RPMs, RPSs, power supply frequency, period, pulse integration, and velocity
Offset function	Observe fluctuation with respect to the offset frequency Offset range: Can be set up to 1000 times the maximum value/div value • Frequency: 0 Hz to 200 kHz • RPMs: 0 rpm to 50 krpm • RPSs: 0 rps to 1000 rps • Period: 0 s to 50 s • Duty cycle: 0% to 100% • Pulse width: 0 s to 50 s • Pulse integration: -1.0000×10^{22} to 1.0000×10^{22} • Velocity: -1.0000×10^{22} to 1.0000×10^{22}

19.13 Logic Probe Specifications

High-Speed Logic Probe (700986) Specifications

Item	Specifications
Number of input points	8
Input format	Non-isolated (the earth of each bit are common, the earth of the DL750/DL750P and the earth of each bit are common)
Maximum input voltage	42 V (DC+ACpeak)(CAT I and CAT II, 30 Vrms), across probe tip and earth (at a frequency of 1 kHz or less)
Response time	1 μ s or less
Input impedance	100 kΩ or more
Threshold level	approx. 1.4 V

Isolation Logic Probe (700987) Specifications

Item	Specifications
Number of input points	8
Input format	Isolated (all bits are isolated)
Input connector	Safety terminal type (for banana plug) × 8
Input switching	Can switch between AC/DC input for each bit
Input signal display	Can confirm H/L with the LED for each bit (lights when H)
Applicable input range	During DC input: H/L detection of 10 VDC to 250 VDC During AC input: H/L detection of AC type of 80 VAC to 250 VAC 50/60 Hz
Threshold level	During DC input: 6 V ± 50% (Hi level: 10 to 250 VDC, Lo level: 0 to 3 VDC) During AC input: 50 VAC ± 50% (Hi level: 80 to 250 VDC, Lo level: 0 to 20 VAC)
Response time	During DC input: within 1 ms During AC input: within 20 ms
Input impedance	approx. 100 kΩ
Maximum input voltage (across H and L of each bit)	250 Vrms[1] (CAT I and II)
Maximum allowable common mode voltage (across input terminal H or L and earth)	250 Vrms[1] (CAT I and II)
Maximum allowable voltage between bits	250 Vrms[1] (CAT I and II)
Withstand voltage (across input terminal and earth)	2000 VAC for 1 minute
Isolation resistance (across input terminal and earth)	500 VDC, 10 MΩ or more

Fuse[2]	location	max. rated voltage	max. rated current	type	standard
	H side of input terminal	250 V	50 mA	time lag	VDE/SEMKO

1. Make sure the ACpeak voltage does not exceed 350 V and the DC voltage does not exceed 250 V when the frequency is 1 kHz or less.
2. Because the fuses used by this instrument are all inside the case, they cannot be exchanged by the user. If you believe the fuse inside the case is blown, please contact your nearest YOKOGAWA dealer.

19.14 External Dimensions

DL750

Unit: mm

DC Power Model
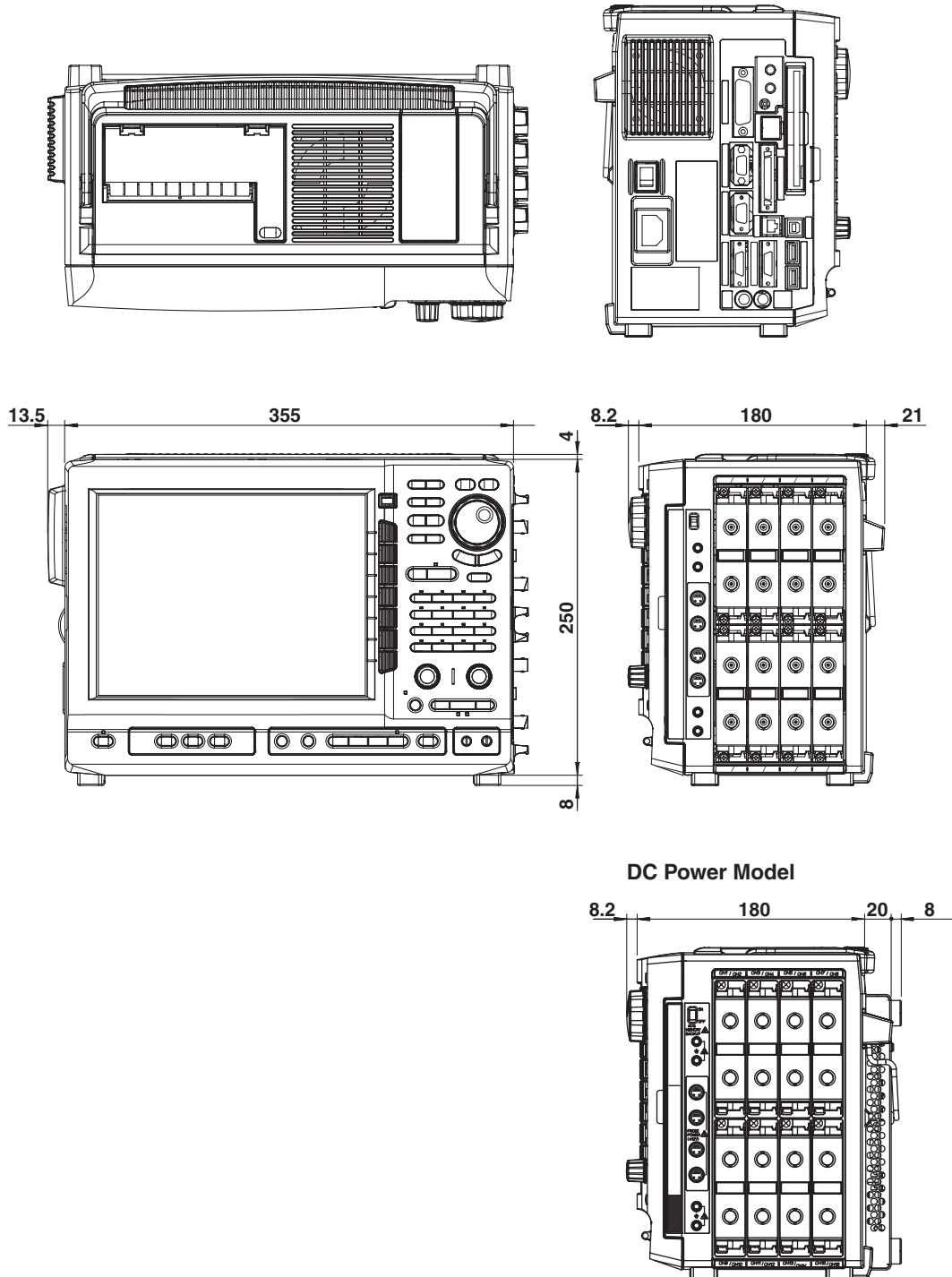
If not specified, the tolerance is ±3%. However, in cases of less than 10 mm, the tolerance is ±0.3 mm.

DL750P

Unit: mm
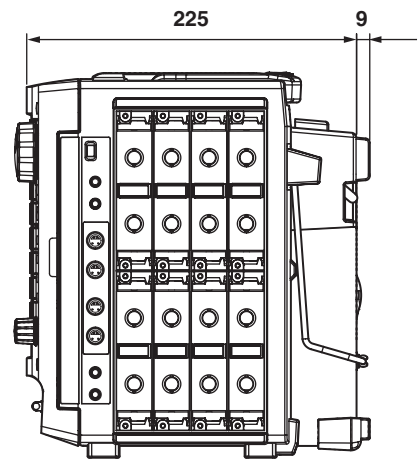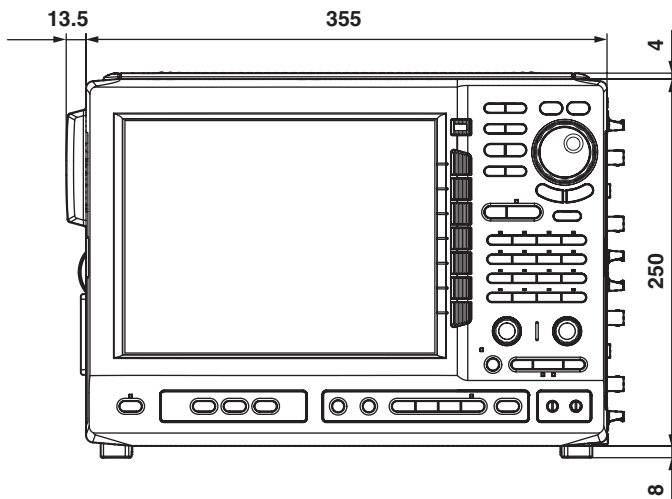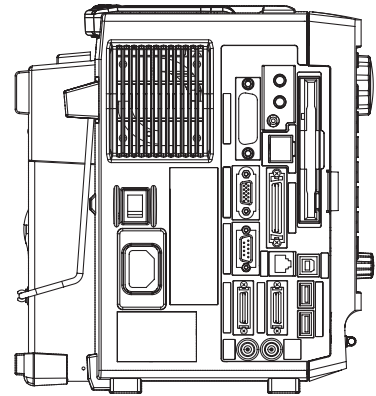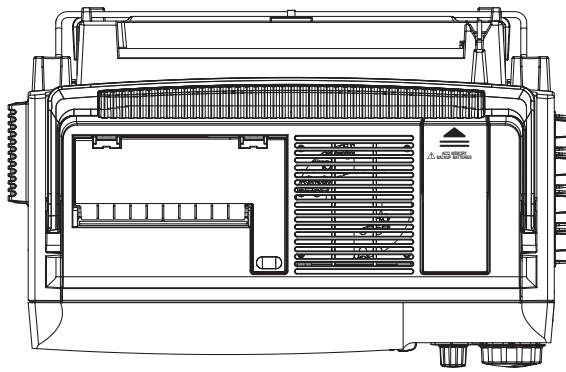
Rear View
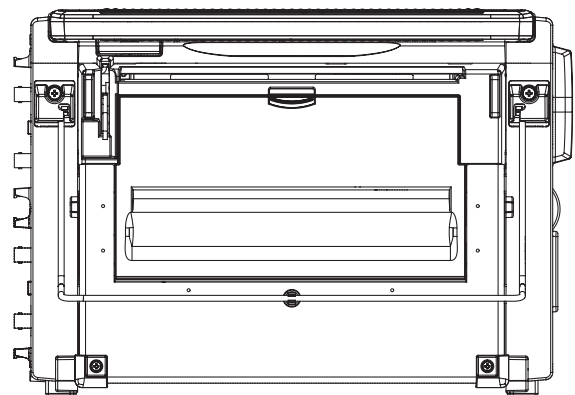
If not specified, the tolerance is ±3%. However, in cases of less than 10 mm, the tolerance is ±0.3 mm.

Specifications

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Modules

High-Speed 10 MS/s, 12-Bit Isolation Module (701250)
High-Speed High-Resolution 1 MS/s, 16-Bit Isolation Module (701251)
High-Speed 10 MS/s, 12-Bit Non-Isolation Module (701255)
High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS) (701260)
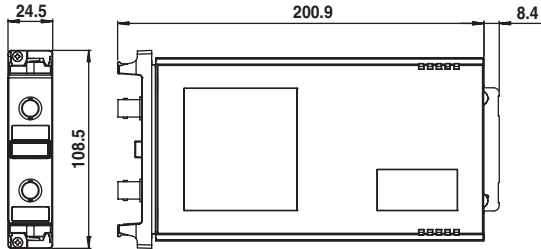
Universal (Voltage/Temp.) Module (701261)
Universal (Voltage/Temp.) Module (with AAF) (701262)
Temperature, High Precision Voltage Isolation Module (701265)
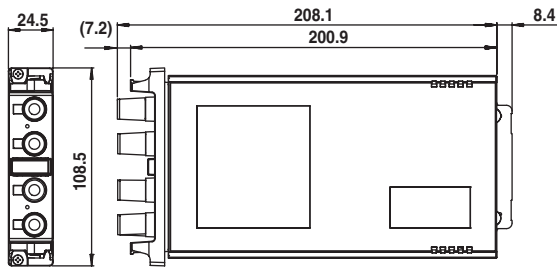
Strain Module (NDIS) (701270)
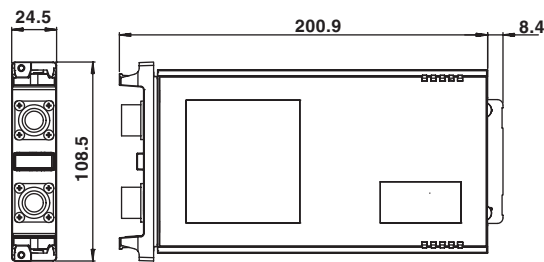
Strain Module (DSUB, Shunt-Cal) (701271)
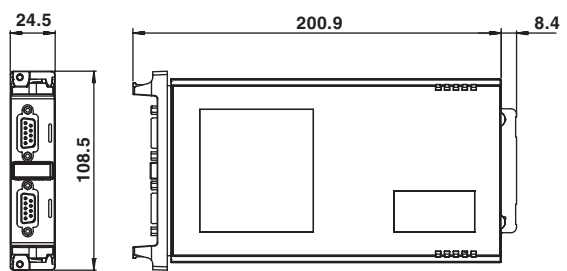
Acceleration/Voltage Module (with AAF) (701275)
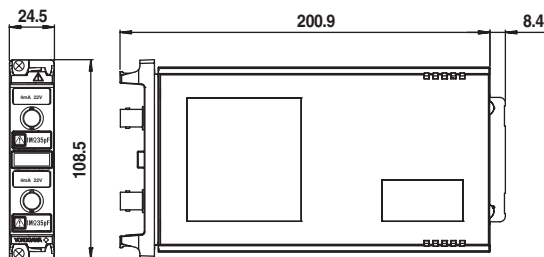
Frequency Module (701280)

Appendix 1 Relationship between the Time Axis Setting, Sample Rate and Record Length

T/div	Record Length									
	1 kW		2.5 kW		5 kW		10 kW		25 kW	
	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)
500ns	10 M	50	10 M	50	10 M	50	10 M	50	10 M	50
1 μs	10 M	100	10 M	100	10 M	100	10 M	100	10 M	100
2 μs	10 M	200	10 M	200	10 M	200	10 M	200	10 M	200
5 μs	10 M	500	10 M	500	10 M	500	10 M	500	10 M	500
10 μs	10 M	1 k	10 M	1 k	10 M	1 k	10 M	1 k	10 M	1 k
20 μs	5 M	1 k	10 M	2 k	10 M	2 k	10 M	2 k	10 M	2 k
50 μs	2 M	1 k	5 M	2.5 k	10 M	5 k	10 M	5 k	10 M	5 k
100 μs	1 M	1 k	2 M	2 k	5 M	5 k	10 M	10 k	10 M	10 k
200 μs	500 k	1 k	1 M	2 k	2 M	4 k	5 M	10 k	10 M	20 k
500 μs	200 k	1 k	500 k	2.5 k	1 M	5 k	2 M	10 k	5 M	25 k
1 ms	100 k	1 k	200 k	2 k	500 k	5 k	1 M	10 k	2 M	20 k
2 ms	50 k	1 k	100 k	2 k	200 k	4 k	500 k	10 k	1 M	20 k
5 ms	20 k	1 k	50 k	2.5 k	100 k	5 k	200 k	10 k	500 k	25 k
10 ms	10 k	1 k	20 k	2 k	50 k	5 k	100 k	10 k	200 k	20 k
20 ms	5 k	1 k	10 k	2 k	20 k	4 k	50 k	10 k	100 k	20 k
50 ms	2 k	1 k	5 k	2.5 k	10 k	5 k	20 k	10 k	50 k	25 k
100 ms	1 k	1 k	2 k	2 k	5 k	5 k	10 k	10 k	20 k	20 k
200 ms	500	1 k	1 k	2 k	2 k	4 k	5 k	10 k	10 k	20 k
500 ms	200	1 k	500	2.5 k	1 k	5 k	2 k	10 k	5 k	25 k
1 s	100	1 k	200	2 k	500	5 k	1 k	10 k	2 k	20 k
2 s	50	1 k	100	2 k	200	4 k	500	10 k	1 k	20 k
3 s	20	600	50	1.5 k	100	3 k	200	6 k	500	15 k
4 s	20	800	50	2 k	100	4 k	200	8 k	500	20 k
5 s	20	1 k	50	2.5 k	100	5 k	200	10 k	500	25 k
6 s	10	600	20	1.2 k	50	3 k	100	6 k	200	12 k
8 s	10	800	20	1.6 k	50	4 k	100	8 k	200	16 k
10 s	10	1 k	20	2 k	50	5 k	100	10 k	200	20 k
20 s	5	1 k	10	2 k	20	4 k	50	10 k	100	20 k
30 s			5	1.5 k	10	3 k	20	6 k	50	15 k
1 min					5	3 k	10	6 k	20	12 k
2 min							5	6 k	20	24 k
3 min							5	9 k	10	18 k
4 min									10	24 k
5 min									5	15 k
6 min									5	18 k
7 min									5	21 k
8 min										
9 min										
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6 h										
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8 h										
9 h										
10 h										
12 h										
1 day										
2 day										
3 day										

For the settings inside the thick frame, the waveform is displayed in roll mode when the trigger mode is set to auto or auto-level.

Appendix

App

Appendix 1 Relationship between the Time Axis Setting, Sample Rate and Record Length

T/div	Record Length									
	50 kW		100 kW		250 kW		500 kW		1 MW	
	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)
500 ns	10 M	50	10 M	50	10 M	50	10 M	50	10 M	50
1 µs	10 M	100	10 M	100	10 M	100	10 M	100	10 M	100
2 µs	10 M	200	10 M	200	10 M	200	10 M	200	10 M	200
5 µs	10 M	500	10 M	500	10 M	500	10 M	500	10 M	500
10 µs	10 M	1 k	10 M	1 k	10 M	1 k	10 M	1 k	10 M	1 k
20 µs	10 M	2 k	10 M	2 k	10 M	2 k	10 M	2 k	10 M	2 k
50 µs	10 M	5 k	10 M	5 k	10 M	5 k	10 M	5 k	10 M	5 k
100 µs	10 M	10 k	10 M	10 k	10 M	10 k	10 M	10 k	10 M	10 k
200 µs	10 M	20 k	10 M	20 k	10 M	20 k	10 M	20 k	10 M	20 k
500 µs	10 M	50 k	10 M	50 k	10 M	50 k	10 M	50 k	10 M	50 k
1 ms	5 M	50 k	10 M	100 k	10 M	100 k	10 M	100 k	10 M	100 k
2 ms	2 M	40 k	5 M	100 k	10 M	200 k	10 M	200 k	10 M	200 k
5 ms	1 M	50 k	2 M	100 k	5 M	250 k	10 M	500 k	10 M	500 k
10 ms	500 k	50 k	1 M	100 k	2 M	200 k	5 M	500 k	10 M	1 M
20 ms	200 k	40 k	500 k	100 k	1 M	200 k	2 M	400 k	5 M	1 M
50 ms	100 k	50 k	200 k	100 k	500 k	250 k	1 M	500 k	2 M	1 M
100 ms	50 k	50 k	100 k	100 k	200 k	200 k	500 k	500 k	1 M	1 M
200 ms	20 k	40 k	50 k	100 k	100 k	200 k	200 k	400 k	500 k	1 M
500 ms	10 k	50 k	20 k	100 k	50 k	250 k	100 k	500 k	200 k	1 M
1 s	5 k	50 k	10 k	100 k	20 k	200 k	50 k	500 k	100 k	1 M
2 s	2 k	40 k	5 k	100 k	10 k	200 k	20 k	400 k	50 k	1 M
3 s	1 k	30 k	2 k	60 k	5 k	150 k	10 k	300 k	20 k	600 k
4 s	1 k	40 k	2 k	80 k	5 k	200 k	10 k	400 k	20 k	800 k
5 s	1 k	50 k	2 k	100 k	5 k	250 k	10 k	500 k	20 k	1 M
6 s	500	30 k	1 k	60 k	2 k	120 k	5 k	300 k	10 k	600 k
8 s	500	40 k	1 k	80 k	2 k	160 k	5 k	400 k	10 k	800 k
10 s	500	50 k	1 k	100 k	2 k	200 k	5 k	500 k	10 k	1 M
20 s	200	40 k	500	100 k	1 k	200 k	2 k	400 k	5 k	1 M
30 s	100	30 k	200	60 k	500	150 k	1 k	300 k	2 k	600 k
1 min	50	30 k	100	60 k	200	120 k	500	300 k	1 k	600 k
2 min	20	24 k	50	60 k	200	240 k	200	240 k	500	600 k
3 min	20	36 k	50	90 k	100	180 k	200	360 k	500	900 k
4 min	20	48 k	20	48 k	100	240 k	200	480 k	200	480 k
5 min	10	30 k	20	60 k	50	150 k	100	300 k	200	600 k
6 min	10	36 k	20	72 k	50	180 k	100	360 k	200	720 k
7 min	10	42 k	20	84 k	50	210 k	100	420 k	200	840 k
8 min	10	48 k	20	96 k	50	240 k	100	480 k	200	960 k
9 min	5	27 k	10	54 k	20	108 k	50	270 k	100	540 k
10 min	5	30 k	10	60 k	20	120 k	50	300 k	100	600 k
12 min	5	36 k	10	72 k	20	144 k	50	360 k	100	720 k
15 min	5	45 k	10	90 k	20	180 k	50	450 k	100	900 k
30 min			5	90 k	10	180 k	20	360 k	50	900 k
1 h					5	180 k	10	360 k	20	720 k
2 h							5	360 k	10	720 k
3 h									5	540 k
4 h									5	720 k
5 h									5	900 k
6 h										
7 h										
8 h										
9 h										
10 h										
12 h										
1 day										
2 day										
3 day										

For the settings inside the thick frame, the waveform is displayed in roll mode when the trigger mode is set to auto or auto-level.

| | Record Length | | | | | | | | | |
| | 2.5 MW | | 5 MW | | 10 MW | | 25 MW | | 50 MW | |
T/div	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)
500ns	10 M	50	10 M	50	10 M	50	10 M	50	10 M	50
1 μs	10 M	100	10 M	100	10 M	100	10 M	100	10 M	100
2 μs	10 M	200	10 M	200	10 M	200	10 M	200	10 M	200
5 μs	10 M	500	10 M	500	10 M	500	10 M	500	10 M	500
10 μs	10 M	1 k	10 M	1 k	10 M	1 k	10 M	1 k	10 M	1 k
20 μs	10 M	2 k	10 M	2 k	10 M	2 k	10 M	2 k	10 M	2 k
50 μs	10 M	5 k	10 M	5 k	10 M	5 k	10 M	5 k	10 M	5 k
100 μs	10 M	10 k	10 M	10 k	10 M	10 k	10 M	10 k	10 M	10 k
200 μs	10 M	20 k	10 M	20 k	10 M	20 k	10 M	20 k	10 M	20 k
500 μs	10 M	50 k	10 M	50 k	10 M	50 k	10 M	50 k	10 M	50 k
1 ms	10 M	100 k	10 M	100 k	10 M	100 k	10 M	100 k	10 M	100 k
2 ms	10 M	200 k	10 M	200 k	10 M	200 k	10 M	200 k	10 M	200 k
5 ms	10 M	500 k	10 M	500 k	10 M	500 k	10 M	500 k	10 M	500 k
10 ms	10 M	1 M	10 M	1 M	10 M	1 M	10 M	1 M	10 M	1 M
20 ms	10 M	2 M	10 M	2 M	10 M	2 M	10 M	2 M	10 M	2 M
50 ms	5 M	2.5 M	10 M	5 M	10 M	5 M	10 M	5 M	10 M	5 M
100 ms	2 M	2 M	5 M	5 M	10 M	10 M	10 M	10 M	10 M	10 M
200 ms	1 M	2 M	2 M	4 M	5 M	10 M	10 M	20 M	10 M	20 M
500 ms	500 k	2.5 M	1 M	5 M	2 M	10 M	5 M	25 M	10 M	50 M
1 s	200 k	2 M	500 k	5 M	1 M	10 M	2 M	20 M	5 M	50 M
2 s	100 k	2 M	200 k	4 M	500 k	10 M	1 M	20 M	2 M	40 M
3 s	50 k	1.5 M	100 k	3 M	200 k	6 M	500 k	15 M	1 M	30 M
4 s	50 k	2 M	100 k	4 M	200 k	8 M	500 k	20 M	1 M	40 M
5 s	50 k	2.5 M	100 k	5 M	200 k	10 M	500 k	25 M	1 M	50 M
6 s	20 k	1.2 M	50 k	3 M	100 k	6 M	200 k	12 M	200 k	30 M
8 s	20 k	1.6 M	50 k	4 M	100 k	8 M	200 k	16 M	500 k	40 M
10 s	20 k	2 M	50 k	5 M	100 k	10 M	200 k	20 M	500 k	50 M
20 s	10 k	2 M	20 k	4 M	50 k	10 M	100 k	20 M	200 k	40 M
30 s	5 k	1.5 M	10 k	3 M	20 k	6 M	50 k	15 M	100 k	30 M
1 min	2 k	1.2 M	5 k	3 M	10 k	6 M	20 k	12 M	50 k	30 M
2 min	2 k	2.4 M	2 k	2.4 M	5 k	6 M	20 k	24 M	20 k	24 M
3 min	1 k	1.8 M	2 k	3.6 M	5 k	9 M	10 k	18 M	20 k	36 M
4 min	1 k	2.4 M	2 k	4.8 M	2 k	4.8 M	10 k	24 M	20 k	48 M
5 min	500	1.5 M	1 k	3 M	2 k	6 M	5 k	15 M	10 k	30 M
6 min	500	1.8 M	1 k	3.6 M	2 k	7.2 M	5 k	18 M	10 k	36 M
7 min	500	2.1 M	1 k	4.2 M	2 k	8.4 M	5 k	21 M	10 k	42 M
8 min	500	2.4 M	1 k	4.8 M	2 k	9.6 M	5 k	24 M	10 k	48 M
9 min	200	1.08 M	500	2.7 M	1 k	5.4 M	2 k	10.8 M	5 k	27 M
10 min	200	1.2 M	500	3 M	1 k	6 M	2 k	12 M	5 k	30 M
12 min	200	1.44 M	500	3.6 M	1 k	7.2 M	2 k	14.4 M	5 k	36 M
15 min	200	1.8 M	500	4.5 M	1 k	9 M	2 k	18 M	5 k	45 M
30 min	100	1.8 M	200	3.6 M	500	9 M	1 k	18 M	2 k	36 M
1 h	50	1.8 M	100	3.6 M	200	7.2 M	500	18 M	1 k	36 M
2 h	20	1.44 M	50	3.6 M	100	7.2 M	200	14.4 M	500	36 M
3 h	20	2.16 M	20	2.16 M	50	5.4 M	200	21.6 M	200	21.6 M
4 h	10	1.44 M	20	2.88 M	50	7.2 M	100	14.4 M	200	28.8 M
5 h	10	1.8 M	20	3.6 M	50	9 M	100	18 M	200	36 M
6 h	10	2.16 M	20	4.32 M	20	4.32 M	100	21.6 M	200	43.2 M
7 h	5	1.26 M	10	2.52 M	20	5.04 M	50	12.6 M	100	25.2 M
8 h	5	1.44 M	10	2.88 M	20	5.76 M	50	14.4 M	100	28.8 M
9 h	5	1.62 M	10	3.24 M	20	6.48 M	50	16.2 M	100	32.4 M
10 h	5	1.8 M	10	3.6 M	20	7.2 M	50	18 M	100	36 M
12 h	5	2.16 M	10	4.32 M	20	8.64 M	50	21.6 M	100	43.2 M
1 day			5	4.32 M	10	8.64 M	20	17.28 M	50	43.2 M
2 day					5	8.64 M	10	17.28 M	20	34.56 M
3 day							5	12.96 M	10	25.92 M

For the settings inside the thick frame, the waveform is displayed in roll mode when the trigger mode is set to auto or auto-level.

Appendix

App

T/div	Record Length							
	100 MW		250 MW		500 MW		1 GW	
	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)	Sample Rate (S/s)	Display Record Length (Word)
500ns	10 M	50	10 M	50	10 M	50	10 M	50
1 μs	10 M	100	10 M	100	10 M	100	10 M	100
2 μs	10 M	200	10M	200	10 M	200	10 M	200
5 μs	10 M	500	10 M	500	10 M	500	10 M	500
10 μs	10 M	1 k	10 M	1 k	10 M	1 k	10 M	1 k
20 μs	10 M	2 k	10 M	2 k	10 M	2 k	10 M	2 k
50 μs	10 M	5 k	10 M	5 k	10 M	5 k	10 M	5 k
100 μs	10 M	10 k	10 M	10 k	10 M	10 k	10 M	10 k
200 μs	10 M	20 k	10 M	20 k	10 M	20 k	10 M	20 k
500 μs	10 M	50 k	10 M	50 k	10 M	50 k	10 M	50 k
1 ms	10 M	100 k	10 M	100 k	10 M	100 k	10 M	100 k
2 ms	10 M	200 k	10 M	200 k	10 M	200 k	10 M	200 k
5 ms	10 M	500 k	10 M	500 k	10 M	500 k	10 M	500 k
10 ms	10 M	1 M	10 M	1 M	10 M	1 M	10 M	1 M
20 ms	10 M	2 M	10 M	2 M	10 M	2 M	10 M	2 M
50 ms	10 M	5 M	10 M	5 M	10 M	5 M	10 M	5 M
100 ms	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M
200 ms	10 M	20 M	10 M	20 M	10 M	20 M	10 M	20 M
500 ms	10 M	50 M	10 M	50 M	10 M	50 M	10 M	50 M
1 s	10 M	100 M	10 M	100 M	10 M	100 M	10 M	100 M
2 s	5 M	100 M	10 M	200 M	10 M	200 M	10 M	200 M
3 s	2 M	60 M	5 M	150 M	10 M	300 M	10 M	300 M
4 s	2 M	80 M	5 M	200 M	10 M	400 M	10 M	400 M
5 s	2 M	100 M	5 M	250 M	10 M	500 M	10 M	500 M
6 s	1 M	60 M	2 M	120 M	5 M	300 M	10 M	600 M
8 s	1 M	80 M	2 M	160 M	5 M	400 M	10 M	800 M
10 s	1 M	100 M	2 M	200 M	5 M	500 M	10 M	1000 M
20 s	500 k	100 M	1 M	200 M	2 M	400 M	5 M	1000 M
30 s	200 k	60 M	500 k	150 M	1 M	300 M	2 M	600 M
1 min	100 k	60 M	200 k	120 M	500 k	300 M	1 M	600 M
2 min	50 k	60 M	200 k	240 M	200 k	240 M	500 k	600 M
3 min	50 k	90 M	100 k	180 M	200 k	360 M	500 k	900 M
4 min	20 k	48 M	100 k	240 M	200 k	480 M	200 k	480 M
5 min	20 k	60 M	50 k	150 M	100 k	300 M	200 k	600 M
6 min	20 k	72 M	50 k	180 M	100 k	360 M	200k	720 M
7 min	20 k	84 M	50 k	210 M	100 k	420 M	200 k	840 M
8 min	20 k	96 M	50 k	240 M	100 k	480 M	200 k	960 M
9 min	10 k	54 M	20 k	108 M	50 k	270 M	100 k	540 M
10 min	10 k	60 M	20 k	120 M	50 k	300 M	100 k	600 M
12 min	10 k	72 M	20 k	144 M	50 k	360 M	100 k	720 M
15 min	10 k	90 M	20 k	180 M	50 k	450 M	100 k	900 M
30 min	5 k	90 M	10 k	180 M	20 k	360 M	50 k	900 M
1 h	2 k	72 M	5 k	180 M	10 k	360 M	20 k	720 M
2 h	1 k	72 M	2 k	144 M	5 k	360 M	10 k	720 M
3 h	500	54 M	2 k	216 M	2 k	216 M	5 k	540 M
4 h	500	72 M	1 k	144 M	2 k	288 M	5 k	720 M
5 h	500	90 M	1 k	180 M	2 k	360 M	5 k	900 M
6 h	200	43.2 M	1 k	216 M	2 k	432 M	2 k	432 M
7 h	200	50.4 M	500	126 M	1 k	252 M	2 k	504 M
8 h	200	57.6 M	500	144 M	1 k	288 M	2 k	576 M
9 h	200	64.8 M	500	162 M	1 k	324 M	2 k	648 M
10 h	200	72 M	500	180 M	1 k	360 M	2 k	720 M
12 h	200	86.4 M	500	216 M	1 k	432 M	2 k	864 M
1 day	100	86.4 M	200	172.8 M	500	432 M	1 k	864 M
2 day	50	86.4 M	100	172.8 M	200	345.6 M	500	864 M
3 day	20	51.84 M	50	129.6 M	100	259.2 M	200	518.4 M

For the settings inside the thick frame, the waveform is displayed in roll mode when the trigger mode is set to auto or auto-level.

Appendix 2   Relationship between the Record Length and Acquisition Mode

Selectable Maximum Record Length

When the Acquisition Mode Is Set to a Mode Other Than Average

The maximum record length for each model varies depending on the number if display channels as follows:

Model / Number of Displayed Channels	Standard	/M1 (10 M)	/M2 (25 M)	/M3 (50 M)
12 channels or more	2.5 M	10 M	25 M	50 M
10 to 11 channels	5 M	10 M	50 M	50 M
6 to 9 channels	5 M	10 M	50 M	100 M
4 to 5 channels	10 M	25 M	100 M	100 M
3 channels	25 M	50 M	100 M	250 M
2 channels	25 M	100 M	250 M	500 M
1 channel	50 M	250 M	500 M	1 G

Record length unit: Word

When the Acquisition Mode Is Set to Average

Model / Number of Displayed Channels	Standard	/M1 (10 M)	/M2 (25 M)	/M3 (50 M)
1 to 22 channels	1 M	2.5 M	5 M	10 M

Record length unit: Word

Maximum Number of Acquisitions of History Memory

The maximum number of acquisitions per model is as follows:

Model / Record Length	Standard	/M1 (10 M)	/M2 (25 M)	/M3 (50 M)
1 k	2000	2000	2000	2000
2.5 k	483	1454	2000	2000
5 k	324	976	2000	2000
10 k	241	728	1581	2000
25 k	121	369	803	1608
50 k	60	185	403	809
100 k	29	92	202	406
250 k	11	38	85	172
500 k	4	18	41	85
1 M	3	8	19	41
2.5 M	1	2	6	15
5 M	1	2	2	6
10 M	1	1	2	2
25 M	1	1	1	2
50 M	1	1	1	1
100 M	–	1	1	1
250 M	–	1	1	1
500 M	–	–	1	1
1 G	–	–	–	1

Record length unit: Word

Possible Time Axis Range, Maximum Record Length, and Maximum Sample Rate for Realtime Recording

Varies depending on the number of channels that are to be realtime recorded as follows:

Channels Used	Time Axis Range	Maximum Record Length	Maximum Sample Rate
18CH or more	20 s/div to 3 day/div	25 MW	5 kS/s
12 to 17CH	20 s/div to 3 day/div	50 MW	5 kS/s
6 to 11CH	10 s/div to 3 day/div	50 MW	10 kS/s
4 to 5CH	6 s/div to 3 day/div	100 MW	20 kS/s
3CH	3 s/div to 3 day/div	250 MW	50 kS/s
2CH	1 s/div to 3 day/div	500 MW	100 kS/s
1CH	1 s/div to 3 day/div	1 GW	100 kS/s

Appendix 3   How to Calculate the Area of a Waveform

Integ1TY

Total Area for Positive Side Only: $S_1 + S_2$
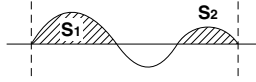
Integ2TY

Total Area for both Positive and Negative Sides: $S_1 + S_3 - S_2$
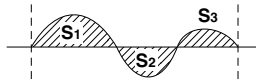
Integ1XY

(1) Multiple Loops

Area S= $n \times S_0$
n: Number of Loops

(2) Non-Closed Curve

Area S= S_0
Area Enclosed by a Curve Connecting the Start and Stop Points
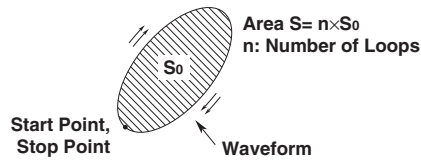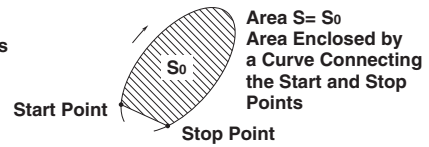
(3) Loop Tracing a Figure-Eight

Area S= $| S_0 - S_1 |$

(4) Spiral Loop

Area S= $S_0 \times 2 + S_1$
Number of Overlaps Varies According to the Number of Loops.

Appendix

App
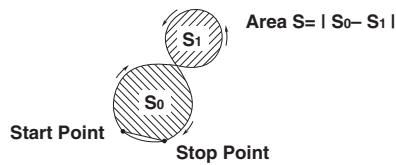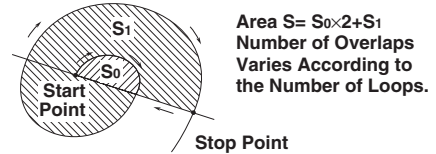
Integ2XY

(1) When Only One Y Data Corresponds to X Data

1

Start Point — Stop Point

S_0

Area S=S_0

X Axis (Y=0)

3

X Axis (Y=0)

S_0

Area S= $-S_0$

Start Point

Stop Point

2

Stop Point — Start Point

S_0

Area S= $-S_0$

X axis (Y=0)

4

X Axis (Y=0)

S_0

Area S=S_0

Stop Point

Start Point
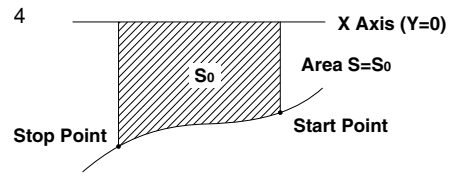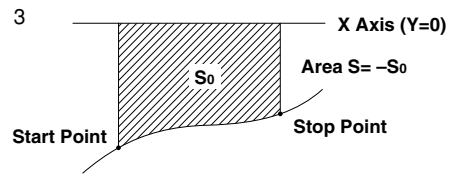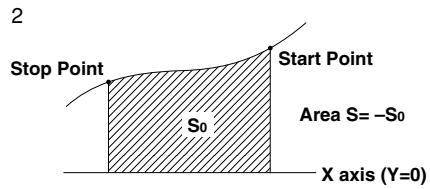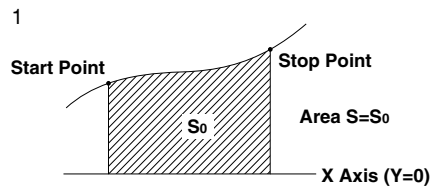
(2) When the Waveform Extends into the Negative Side

Start Point

S_0

S_1

X Axis (Y=0)

Area S=S_0-S_1

Stop Point
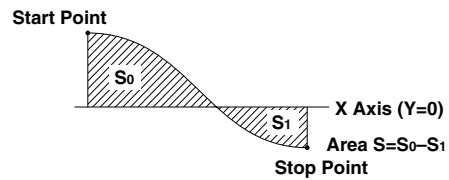
(2) When Two or more Y Data Correspond to X Data

Start Point

S_0

Area S=S_0

Stop Point

X Axis (Y=0)

Start Point

S_0

Stop Point

S_1

Area S=$S_0+2\times S_1+S_2$

S_2

X Axis (Y=0)
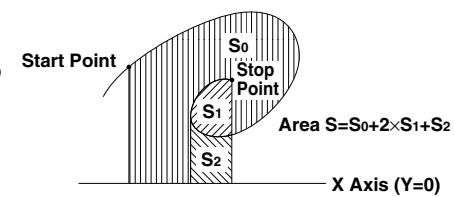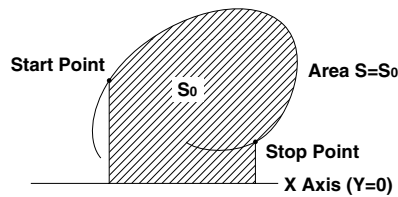
Appendix 4   ASCII Header File Format

//YOKOGAWA ASCII   FILE FORMAT

$PublicInfo

FormatVersion	1.11			
Model	DL750			
Endian	Big			
DataFormat	Trace			
GroupNumber	4			
TraceTotalNumber	13			
DataOffset	111548			

$Group1

TraceNumber	4			
BlockNumber	1			
TraceName	CH1	CH2	CH3	CH4
BlockSize	10010	10010	10010	10010
VResolution	4.1666667E-04	2.0833333E-02	2.0833333E-02	2.0833333E-02
VOffset	1.0000000E+00	0.0000000E+00	0.0000000E+00	0.0000000E+00
VDataType	IS2	IS2	IS2	IS2
VUnit	?	V	V	V
VPlusOverData	?	?	?	?
VMinusOverData	?	?	?	?
VIllegalData	-32768	-32768	-32768	-32768
VMaxData	32767	32767	32767	32767
VMinData	-32767	-32767	-32767	-32767
HResolution	2.0000000E-04	2.0000000E-04	2.0000000E-04	2.0000000E-04
HOffset	-2.0018000E+00	-2.0018000E+00	-2.0018000E+00	2.0018000E+00
HUnit	s	s	s	s
Date	2004/1/15	2004/1/15	2004/1/15	2004/1/15
Time	14:25:38.54	14:25:38.54	14:25:38.54	14:25:38.54

$Group2

TraceNumber	4			
BlockNumber	1			
TraceName	CH5	CH6	CH7	CH8
BlockSize	10010	10010	10010	10010
VResolution	2.0833333E-03	2.0833333E-03	2.0833333E-03	2.0833333E-03
VOffset	0.0000000E+00	0.0000000E+00	0.0000000E+00	0.0000000E+00
VDataType	IS2	IS2	IS2	IS2
VUnit	V	V	V	V
VPlusOverData	?	?	?	?
VMinusOverData	?	?	?	?
VIllegalData	-32768	-32768	-32768	-32768
VMaxData	32767	32767	32767	32767
VMinData	-32767	-32767	-32767	-32767
HResolution	2.0000000E-04	2.0000000E-04	2.0000000E-04	2.0000000E-04

HOffset	-2.0018000E+00	-2.0018000E+00	-2.0018000E+00	2.0018000E+00
HUnit	s	s	s	s
Date	2004/1/15	2004/1/15	2004/1/15	2004/1/15
Time	14:25:38.54	14:25:38.54	14:25:38.54	14:25:38.54

$Group3

TraceNumber	4			
BlockNumber	1			
TraceName	CH15	CH16	Math1	Math2
BlockSize	10010	10010	10010	10010
VResolution	4.1666667E-01	4.1666667E-01	2.0833333E-04	2.0833332E-05
VOffset	0.0000000E+00	0.0000000E+00	2.0000000E+00	0.0000000E+00
VDataType	IS2	IS2	IS2	IS2
VUnit	Hz	Hz	EU	EU
VPlusOverData	?	?	?	?
VMinusOverData	?	?	?	?
VIllegalData	-32768	-32768	-32768	-32768
VMaxData	32767	32767	32767	32767
VMinData	-32767	-32767	-32767	-32767
HResolution	2.0000000E-04	2.0000000E-04	2.0000000E-04	2.0000000E-04
HOffset	-2.0018000E+00	-2.0018000E+00	-2.0018000E+00	2.0018000E+00
HUnit	s	s	s	s
Date	2004/1/15	2004/1/15	2004/1/15	2004/1/15
Time	14:25:38.54	14:25:38.54	14:25:38.54	14:25:38.54

$Group4

TraceNumber	1
BlockNumber	1
TraceName	EVENT
BlockSize	10010
VResolution	1.0000000E+00
VOffset	0.0000000E+00
VDataType	B16
VUnit	?
VPlusOverData	?
VMinusOverData	?
VIllegalData	?
VMaxData	32767
VMinData	-32767
HResolution	2.0000000E-04
HOffset	-2.0018000E+00
HUnit	s
Date	2004/1/15
Time	14:25:38.54

$PrivateInfo				
DisplayPointNo.	1	1	1	1
	1	1	1	1
	1	1	1	1
	1			
MathBlockNo.	1			
ModelVersion	3.1			
PTraceName	CH1	CH2	CH3	CH4
	CH5	CH6	CH7	CH8
	CH15	CH16	Math1	Math2
	Voice,,,,,,,,	D-Cap,,,,,,,,		
PUpperScaleData	6.00E+00	250.0V	250.00V	250.00V
	25.000V	25.000V	25.000V	25.000V
	5000.0Hz	5000.0Hz	4.50000E+00EU	250.000E-03EU
PLowerScaleData	-4.00E+00	-250.0V	-250.00V	-250.00V
	-25.000V	-25.000V	-25.000V	-25.000V
	-5000.0Hz	-5000.0Hz	-500.000E-03EU	250.000E-03EU
POffsetName	0.00000V	0.00000V	0.00000V	0.00000V
	0.00000V	0.00000V	0.00000V	0.00000V
	0.00000Hz	0.00000Hz		

Note

The same header file format is used by all YOKOGAWA measuring instruments, so it may contain some data which are not necessary for the instrument.

Appendix

App

$PublicInfo (Common Information)

FormatVersion: Header file version No. (common to YOKOGAWA's header files)
Model: Model name
Endian: Endian mode when saving data (Big/Ltl)[*1]
DataFormat: Storage format of the binary waveform data (Trace/Block)[*2]
GroupNumber: The number of "$Group"s indicated below
TraceTotalNumber: Total number of selected waveforms
DataOffset: Start position of the binary waveform data[*3]

$Group1 (Group Information)

TraceNumber: Number of waveforms in this group
BlockNumber: Number of blocks in this group[*4]
TraceName: Name of each waveform
BlockSize: Number of data points in a single block of each waveform
VResolution: Value of coefficient VResolution of the Y-axis conversion equation
                    of each waveform[*5]
VOffset: Value of coefficient VOffset of the Y-axis conversion equation of
                    each waveform[*5]
VDataType: Type of binary file waveform data for each waveform[*6]
VUnit: Unit used on the Y-axis of each waveform (no effect on the data)
VPlusOverData: Error data when the binary data of each waveform is greater than
                    or equal to this value
VMinusOverData: Error data when the binary data of each waveform is less than or
                    equal to this value
VMaxData: Maximum value of binary data for each waveform
VMinData: Minimum value of binary data for each waveform
HResolution: Value of coefficient HResolution of the X-axis conversion equation
                    of each waveform[*7]
HOffset: Value of coefficient HOffset of the X-axis conversion equation of
                    each waveform[*7]
HUnit: Unit used on the X-axis of each waveform (no effect on the data)
Date: Date when a trigger is activated
Time: Time when a trigger is activated
    For details on *1 to *7, see the next page.

$PrivateInfo (Model-Specific Information)

ModelVersion: Version No. of the instrument
MathBlockNo.:   Block No. of block to be computed
DisplayPointNo.:   Value which indicates which point of the memory is the left end of
                    the display record length
PTraceName: Label for each waveform
PUpperScaleData: Scale value of the top edge of the screen
PLowerScaleData: Scale value of the bottom edge of the screen
POffsetName: Offset value

Creation of ASCII Header File

When waveform data (Waveform) is stored on a storage medium (such as a floppy disk, a Zip disk, or a PC card), the following two files will be created automatically in the DL_WAVE directory.
- Waveform display data file (.wvf)
- ASCII header file (.hdr)

The waveform data file can be recalled to the instrument using the file menu. The ASCII header files explained here cannot be viewed on the DL750/DL750P. Use the data such as when analyzing the waveforms on your PC.

*1 Endian Mode When Saving Data
Big: Motorola 68000-family data
Ltl: Intel 86 family data

*2 Storage Format of the Binary Waveform Data
Trace: Groups into blocks, each block for a single waveform.
Block: Groups into blocks, each block for a given time interval.
Trace is used on the DL750/DL750P.

*3 Binary File Start Position
Offset from the beginning of the file

*4 Maximum Number of Blocks in the Group
Maximum number of blocks applies if the number of blocks varies between waveforms.

*5 Y Axis Conversion Equation for Each Waveform
Y-axis value = VResolution × raw data + VOffset

*6 Data Type
ISn: n-byte signed integer
IUn: n-byte unsigned integer
FSn: n-byte signed real number
FUn: n-byte unsigned real number
Bm: m-bit data

*7 X Axis Conversion Equation for Each Waveform
X axis value = HResolution × (Data No. – 1) + HOffset

Appendix 5   User-Defined Computation

Digital Filter

Type

Type	Bandwidth
Gaussian	LowPass
Sharp	LowPass/HighPass/BandPass
IIR (Butterworth)	LowPass/HighPass/BandPass

Filter Order

See the following table for the filter orders

		2%	5%	10%	20%	30% (Cutoff)
Gauss	LowPass	49	21	9	5	5
Sharp	LowPass	88	36	18	9	8
	HighPass	159	65	33	17	13
IIR	LowPass	4	4	4	3	2
	HighPass	4	4	4	4	3

Filter Characteristics

Filter	Pass-band Ripple	Attenuation Slope	Attenuation at the Stop-band	Phase
Gauss	0dB	1	–	Linear phase
Sharp	±0.3 dB	−40 dB at 1 oct (Lowpass), −40 dB at −1oct (Highpass)	−40 dB	Linear phase
IIR	0 dB	−5 dB at 1/6 oct (Lowpass), −20 dB at −1 oct (Highpass)	–	Not linear phase

1. For Gaussian filter : $-3.0 \times$ (f/fc) 2 dB (f : frequency, fc : cutoff frequency)

Frequency Characteristics of Filters

f: Sampling frequency (Hz)
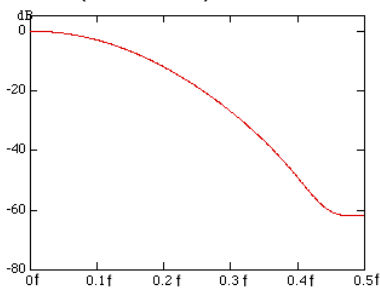
Gauss(Cutoff: 10%)   **Sharp(Low Pass, Cutoff: 10%)**   **IIR(Low Pass, Cutoff: 10%)**
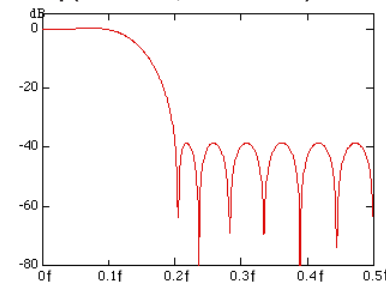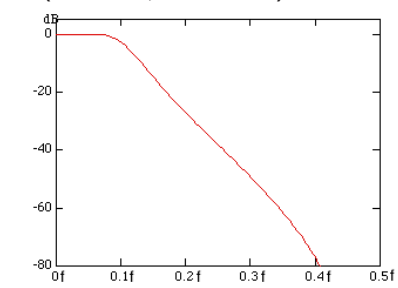
Note

The higher the filter order the longer it takes for computation.

Hilbert Function (HLBT)

Normally, when we analyze a real time signal, it is convenient to think of this signal as the real part of a complex function and do the actual analysis using the complex function. If the real time signal is considered to be the real part of the function, the imaginary part can be determined with the Hilbert transform of the real part.

The Hilbert transform does not change the order of the individual variables. Hilbert transform of a time signal results in another time signal.

Hilbert transform is described below.

When transforming a signal in the time domain, the signal is transformed into the frequency domain, first, using the Fourier transform. Next, the phase of each frequency component is shifted by –90 deg if the frequency is positive and +90 deg if negative. Lastly, taking the inverse Fourier transform completes the Hilbert transform.

Application Example

• Hilbert transform can be used to analyze an envelope waveform.
   AM (amplitude modulation): SQRT(C1*C1+HLBT(C1)*HLBT(C1))
   Demodulation of a FM signal: DIF(PH(C1,HLBT(C1)))

Phase Function (PH)

Phase function PH(X1,Y1) computes $\tan^{-1}(X1/Y1)$.

However, the phase function takes the phase of the previous point into consideration and continues to sum even when the value exceeds $\pm\pi$ (ATAN function reflects at $\pm\pi$).

The unit is radians.

$\theta2=\theta1+\Delta\theta2$ $\theta2=\theta1-\Delta\theta2$
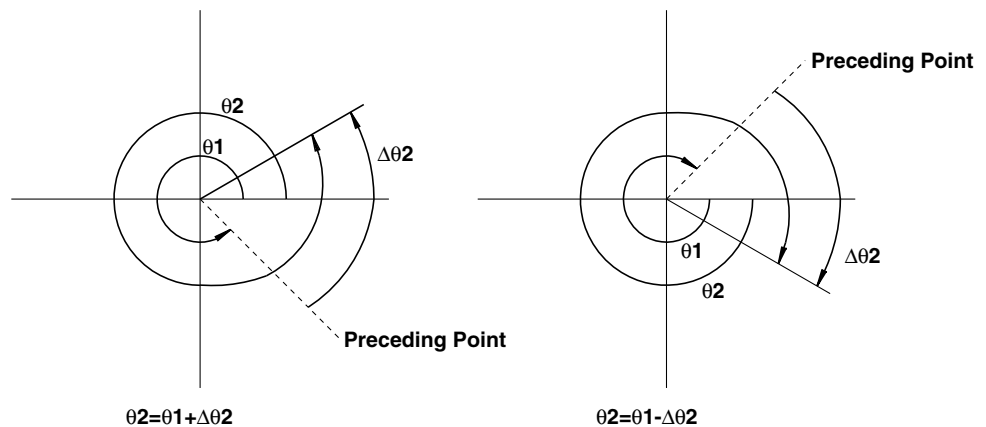
Differentiation and Integration (DIF, DDIF, INTG, and IINTG)

Differentiation (DIF, DDIF)

The computation of the first order and second order differentiation uses the 5th order Lagrange interpolation formula to derive a point of data from the 5 points around the point.

The figure below shows data f_0 to f_n with respect to sampling time x_0 to x_n. The derivative and integrated value corresponding to these data points are computed as follows:
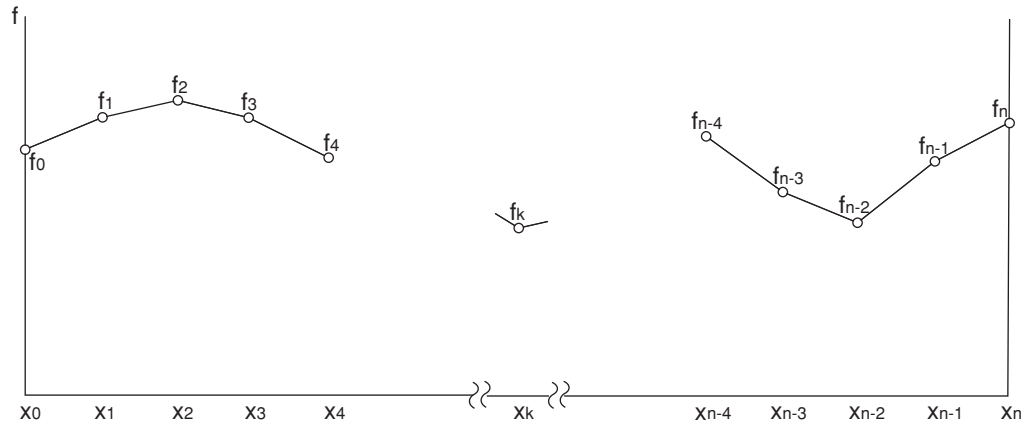
- **Equation for First Order Derivative**

  Point x_0 f_0' $= \dfrac{1}{12h} [-25f_0 + 48f_1 - 36f_2 + 16f_3 - 3f_4]$

  Point x_1 f_1' $= \dfrac{1}{12h} [-3f_0 - 10f_1 + 18f_2 - 6f_3 + f_4]$

  Point x_2 f_2' $= \dfrac{1}{12h} [f_0 - 8f_1 + 8f_3 - f_4]$

  Point x_k f_k' $= \dfrac{1}{12h} [f_{k-2} - 8f_{k-1} + 8f_{k+1} - f_{k+2}]$

  Point x_{n-2} f_{n-2}' $= \dfrac{1}{12h} [f_{n-4} - 8f_{n-3} + 8f_{n-1} - f_n]$

  Point x_{n-1} f_{n-1}' $= \dfrac{1}{12h} [-f_{n-4} + 6f_{n-3} - 18f_{n-2} + 10f_{n-1} + 3f_n]$

  Point x_n f_n' $= \dfrac{1}{12h} [3f_{n-4} - 16f_{n-3} + 36f_{n-2} - 48f_{n-1} + 25f_n]$

  $h = \Delta x$ is the sampling interval (s) (example $h = 200 \times 10^{-6}$ for 5 kHz)

- **Equation for Second Order Derivative**

  Point x_0 f_0'' $= \dfrac{1}{12h^2} [35f_0 - 104f_1 + 114f_2 - 56f_3 + 11f_4]$

  Point x_1 f_1'' $= \dfrac{1}{12h^2} [11f_0 - 20f_1 + 6f_2 + 4f_3 - f_4]$

  Point x_2 f_2'' $= \dfrac{1}{12h^2} [-f_0 + 16f_1 - 30f_2 + 16f_3 - f_4]$

  Point x_k f_k'' $= \dfrac{1}{12h^2} [-f_{k-2} + 16f_{k-1} - 30f_k + 16f_{k+2} - f_{k+2}]$

  Point x_{n-2} f_{n-2}'' $= \dfrac{1}{12h^2} [-f_{n-4} + 16f_{n-3} - 30f_{n-2} + 16f_{n-1} - f_n]$

  Point x_{n-1} f_{n-1}'' $= \dfrac{1}{12h^2} [-f_{n-4} + 4f_{n-3} + 6f_{n-2} - 20f_{n-1} + 11f_n]$

  Point x_n f_n'' $= \dfrac{1}{12h^2} [11f_{n-4} - 56f_{n-3} + 114f_{n-2} - 104f_{n-1} + 35f_n]$

Integration (INTG, IINTG)

The first and second order integrated values are derived using the trapezoidal rule.

- **Equation for First Order Integration (INTG)**

  Point x_0 I_0 $= 0$

  Point x_1 I_1 $= \dfrac{1}{2}(f_0 + f_1)h$

  Point x_2 I_2 $= \dfrac{1}{2}(f_0 + f_1)h + \dfrac{1}{2}(f_1 + f_2)h = I_1 + \dfrac{1}{2}(f_1 + f_2)$

  Point x_n I_n $= I_{n-1} + \dfrac{1}{2}(f_{n-1} + f_n)h$

- **Equation for Second Order Integration (IINTG)**

  Point x_0 II_0 $= 0$

  Point x_1 II_1 $= \dfrac{1}{2}(I_0 + I_1)h$

  Point x_2 II_2 $= \dfrac{1}{2}(I_0 + I_1)h + \dfrac{1}{2}(I_1 + I_2)h = II_1 + \dfrac{1}{2}(I_1 + I_2)h$

  Point x_n II_n $= II_{n-1} + \dfrac{1}{2}(I_{n-1} + I_n)h$

Binary Conversion (BIN)

Performs binary conversion with respect to the specified threshold level.
For the procedure in setting the threshold level, see section 10.2, "Binary Computation."
BIN(C1)

Upper threshold level
Lower threshold level

1
0
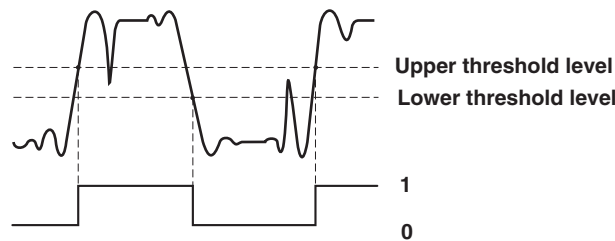
Pulse Width Computation

The signal is converted to binary values by comparing to a preset threshold level, and the time of the pulse width is plotted as the Y-axis value for that interval.
The following 4 intervals are available.
PWHH From the rising edge to the next rising edge.
PWHL From the rising edge to the next falling edge.
PWLH From the falling edge to the next rising edge.
PWLL From the falling edge to the next falling edge.
PWXX From the rising or falling edge to the next rising or falling edge.
FV Inverse of PWHH

Example When the Interval Is Set to PWHH
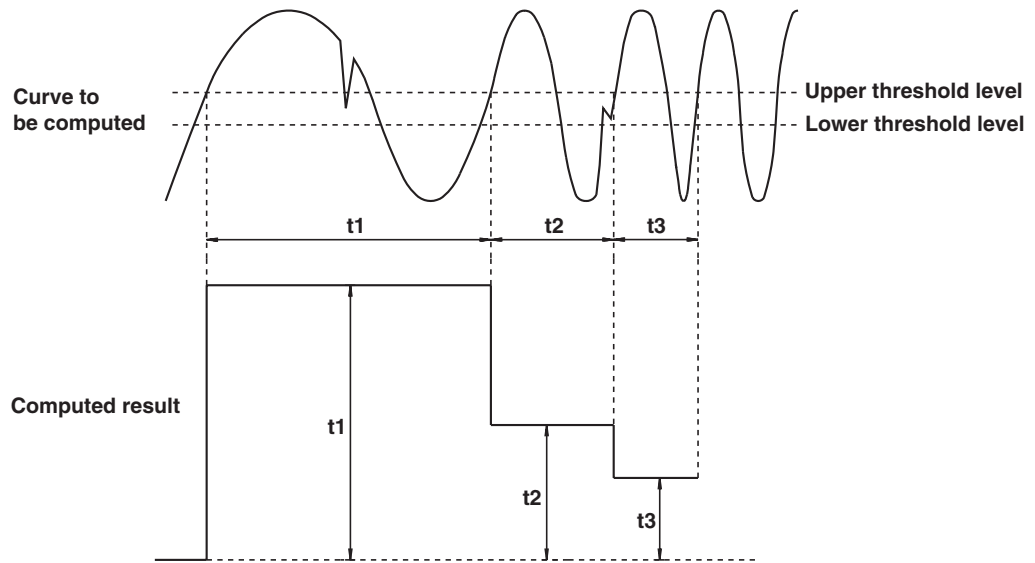
FFT Function

Each frequency component G of a linear spectrum is represented by
$G = R + jI$ (R: real part, I: imaginary part).

Linear Spectrum

Linear spectrum is a spectrum that can be directly determined with the FFT. The magnitude and phase of each frequency component included in the measured waveform can be found. The power spectrum and cross spectrum can also be determined from one or two linear spectrums.
Because the FFT is a complex function, the linear spectrum produces the real part and imaginary part of the frequency components. The magnitude and phase of the linear spectrum can also be determined from the result.
The following spectrums can be determined with this instrument.

Item	Equation	Computation
Real part	LS-REAL	R
Imaginary part	LS-IMAG	I
Magnitude	LS-MAG	$\sqrt{(R^2+I^2)}$
Log magnitude	LS-LOGMAG	$20 \times \log \sqrt{(R^2+I^2)}$
Phase	LS-PHASE	$\tan^{-1}(I/R)$

Log magnitude reference (0 dB): 1 Vpeak

Power Spectrum

Power spectrum expresses the power (squared value) of each frequency component included in the measured signal. It is determined by taking the product of the linear spectrum and its complex conjugate. It does not contain phase information.
The following spectrums can be determined with this instrument.

Item	Equation	Computation
Magnitude	PS-MAG	$(R^2+I^2)/2$
Log magnitude	PS-LOGMAG	$10*\log(R^2+I^2)/2$

Log magnitude reference (0 dB): 1 Vrms^2

Power Spectrum Density

Power spectrum density expresses the power spectrum per unit frequency. It is determined by dividing the power spectrum by the frequency resolution Δf found during the analysis of the power spectrum. The computation varies depending on the window function.
Power spectrum density is used to compare power spectrums analyzed at different frequency bands. However, it is not necessary for signals having a line spectrum such as sine waves.
The following spectrums can be determined with this instrument.

Item	Equation	Computation
Magnitude	PSD-MAG	PS-MAG/Δf (for rectangular window)
		PS-MAG/$1.5\Delta f$ (for Hanning window)
Log magnitude	PSD-LOGMAG	$10 \times \log$PS-MAG/Δf (for rectangular window)
		$10 \times \log$PS-MAG/$1.5\Delta f$ (for Hanning window)

Log magnitude reference (0 dB): 1 Vrms^2

Overall Value

The overall value is the total RMS value determined from the frequency spectrum included in the signal. The overall value is determined by summing the power spectrum of all frequencies and then taking the square root.

$$\text{Overall Value} = \sqrt{\frac{2 \times PS_0 + \sum PS_i}{k}} \text{ (Vrms)}$$

The k value varies depending on the selected time window as follows:

Time Window Type	k
Rect (Rectangular)	1
Hanning	1.5
Flattop	3.19693

If the channels (Math1 to Math8) on which power spectrum computation (PS or PSD*) is selected are in the middle of the automated measurement of waveform parameters (MEASURE: ON) and Rms is ON, the screen shows "Rms = overall value."
However, the overall value is not displayed when the time window is set to Exponential.

Cross Spectrum

Cross spectrum is determined from 2 signals. It is found by taking the product of the linear spectrum of one signal(Gx) and the complex conjugate (Gy*) of the linear spectrum of the other signal (Gy).

If the linear spectrums of the 2 signals are represented by

$Gx=Rx+jIx$

$Gy=Ry+jIy$

then the cross spectrum Gyx is

$Gyx=Gy \times Gx^*$

$=(Ry+jIy)(Rx–jIx)=Ryx+jIyx$

where $Ryx=RyRx+IyIx$

$Iyx=RxIy–RyIx$

The following spectrums can be determined with this instrument.

Item	Equation	Computation
Real part	CS-REAL	$Ryx/2$
Imaginary part	CS-IMAG	$Iyx/2$
Amplitude	CS-MAG	$\sqrt{(Ryx^2+Iyx^2)}/2$
Log magnitude	CS-LOGMAG	$10 \times \log(\sqrt{(Ryx^2+Iyx^2)}/2)$
Phase	CS-PHASE	$\tan^{-1}(Iyx/Ryx)$

Transfer Function

The transfer function expresses the frequency characteristics between the input to the transfer system and the output. The transfer function is determined by the ratio of the output linear spectrum (Gy) and the input spectrum (Gx) at each frequency. Also, as can be seen from the next equation, the transfer function can be defined as the ratio of the cross spectrum of the input and output (Gyx) and the input power spectrum (Gxx).

Transfer Function $= Gy/Gx = (Gy \times Gx^*)/(Gx \times Gx^*) = Gyx/Gxx$

$= (Ryx+jIyx)/(Rx^2+Ix^2)$

The following items can be determined with this instrument.

Item	Equation	Computation
Real part	TF-REAL	$Ryx/(Rx^2+Ix^2)$
Imaginary part	TF-IMAG	$Iyx/(Rx^2+Ix^2)$
Amplitude	TF-MAG	$\sqrt{(Ryx^2+Iyx^2)}/2/(Rx^2+Ix^2)$
Log magnitude	TF-LOGMAG	$20 \times \log/\sqrt{(Ryx^2+Iyx^2)}/2(Rx^2+Ix^2)$
Phase	TF-PHASE	$\tan^{-1}(Iyx/Ryx)$

The magnitude of the transfer function shows the ratio of the magnitudes of the output linear spectrum and the input linear spectrum while the phase shows the phase difference of the two.

Coherence Function

This expresses the ratio of the output power generated with the input signal to the transfer system and the total output power.

Coherence function $= Gyx \times Gyx^*/(Gxx \times Gyy)$

Item	Equation	Computation
Magnitude	CH-MAG	$(Ryx_2+Iyx^2)/(Gxx \times Gyy)$

If the output signal is due entirely to the input signal, the coherence function becomes 1. As the ratio decreases, it falls below 1. Thus, the coherence function always takes on a value between 0 and 1.

Note

On one data acquisition, the coherence function becomes 1 across all frequencies. Also, make sure to take the frequency average of the computation.

Time Windows

You can select rectangular, Hanning, flattop, or exponential for the time window. The rectangular window is best suited to transient signals, such as an impulse wave, 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, it is best suited to continuous signals. With the Hanning window, the frequency resolution is relatively high as compared with the flattop window. However, the flattop window has a higher level of accuracy. When the waveform being analyzed is a continuous signal, consider the above characteristics in selecting the proper window to be applied.

Rectangular 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   : $W(t)=\{0.54-0.46\cos(2\pi \frac{t}{T})\} \frac{\sin\{2\pi(1-2t/T)\}}{2\pi(1-2t/T)}$
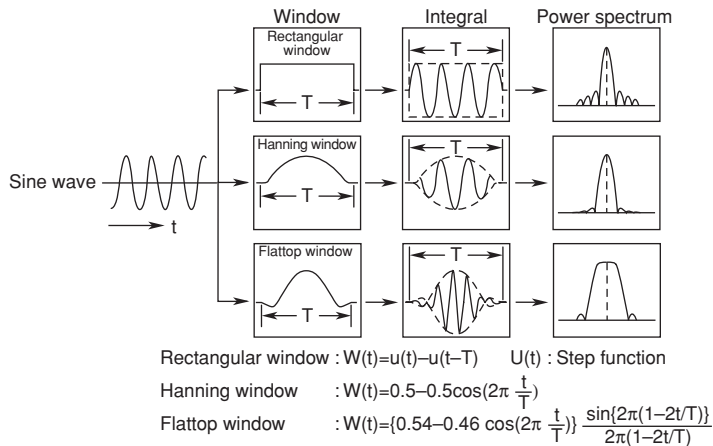
The exponential window is used to eliminate noise components from the signal. It is effective against signals such as the frequency response test signal generated through impulse excitation. On the DL750/DL750P, the exponential window and force window are activated simultaneously.

- **Exponential Window**
  The damping rate is set in terms of the weight of the last data point when taking the weight of the first data point in the specified number of FFT points to be 100% (= 1). The value is set in the range of 1 to 100% (1% resolution). The exponential window damps the signal exponentially along the time axis. It is effective when the signal does not attenuate all the way within the record length. If the damping rate is set to 100%, the window is equivalent to a rectangular window.
- **Force Window**
  Sets the area over which computation performed in terms of a percentage from the first FFT point when taking the specified number of FFT points to be 100%. The areas (force 1 and force 2) can be set in the range of 1 to 100% (1% resolution) of the input/output signal. If the area is set to 100%, the window is equivalent to a rectangular window. On the DL750/DL750P, the data outside the area is computed as an average value of the area.
  Force1: The setting applies to the input signal (first parameter) of the one-input FFT or two-input FFT.
  Force2: The setting applies to the output (response) signal (second parameter) of the two-input FFT.

Appendix

App
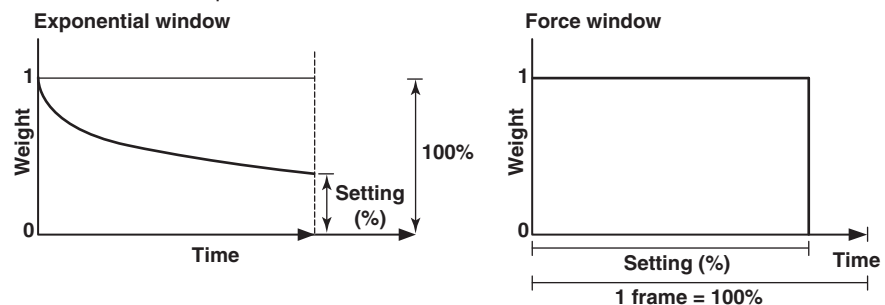
- **Combined Form of Exponential Window and Force Window**

  The DL750/DL750P applies a window function that combines the exponential window and force window for performing computations. The data outside the force window area are computed as an average value of the area.

When the force window area is set to 80% and the data outside the area is taken into account

A constant damping rate is applied to the data outside the area (80% to 100% of the record length).
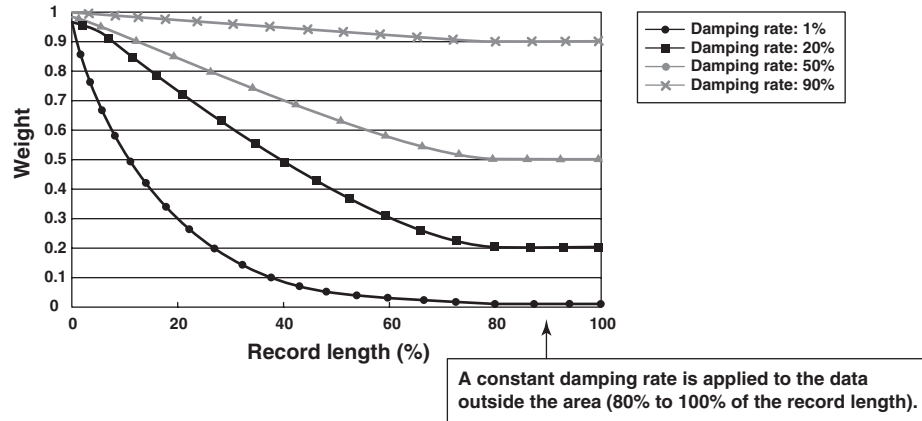
- **Application Example on the DL750/DL750P**

  When the damping rate is set to 20% and force 1 is set to 80%

The data outside the area (80% to 100% of the record length) is computed using an average value of the area at a constant damping rate.
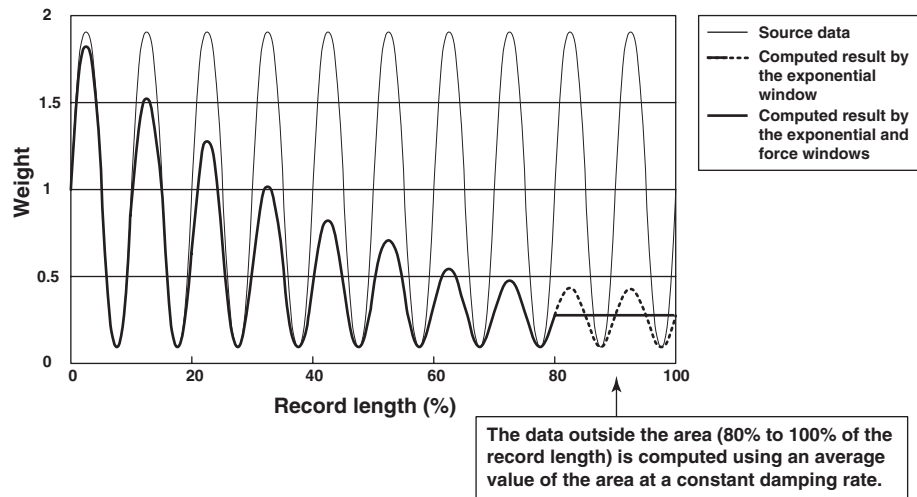
Notes When Executing the FFT Computation

Normally, computation is performed on the sampled data stored in the acquisition memory. However, for waveforms that have been acquired in envelope mode, computation is performed on the maximum/minimum values per acquisition interval.

Appendix 6 DSP Channel Computation (Optional)

Digital Filter Computation of DSP Channels

Filter Types

On DSP channels, the following two types of digital filter computation can be performed.
- FIR
- IIR

- **FIR**

  FIR digital filter. The signal block diagram of the computation is shown below. The characteristics of FIR filters are as follows.
  1. Achieves steep high-order filter within the allowed computation time.
     However, computation delay increases as the order increases.
  2. Group delay is constant due to its linear phase characteristics. Therefore, phase distortion is small.
     DSP channels can use the following FIR filters.
     - SHARP
     - GAUSS
     - MEAN (moving average)

Signal Block Diagram of an FIR Filter
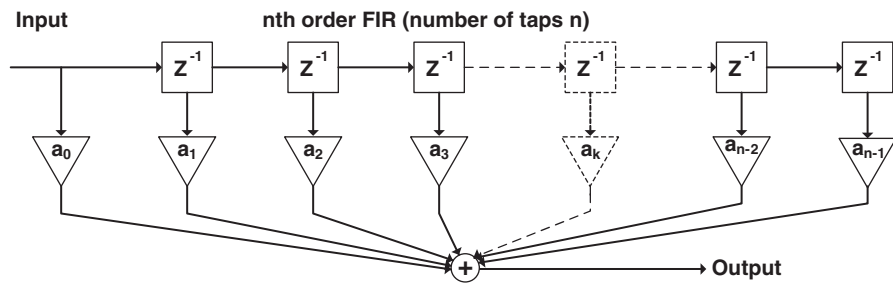
- **IIR**

  IIR digital filter. The signal block diagram of the computation is shown below. The characteristics of IIR filters are as follows.
  1. Sufficient cutoff characteristics are obtained even at a relatively low order. Therefore, the computation delay and group delay are smaller than those of FIRs.
  2. The frequency can be set lower than FIRs.
  3. Phase distortion is greater than FIR filters due to its non-linear phase characteristics.
     DSP channels can use IIR (Butterworth) as an IIR filter.

Signal Block Diagram of an IIR Filter
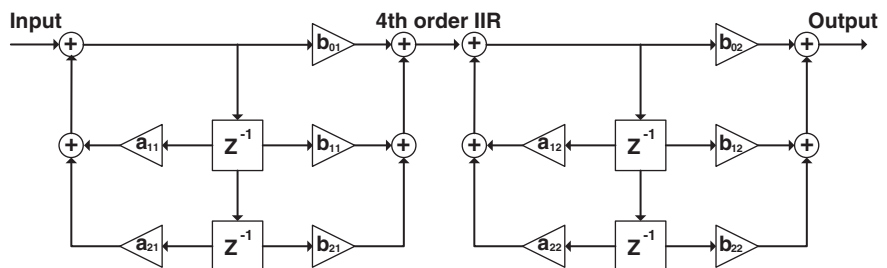
Filter Characteristics

The characteristics of each filter are indicated below.

Type	Characteristics	Bandwidth	Computation Type
SHARP	Steep attenuation slope (–40 dB per octave) Linear phase and constant group delay Ripple exists in the passband Stop band is comb-shaped	LowPass HighPass BandPass	FIR
GAUSS	Gentle attenuation slope Linear phase and constant group delay No ripple in the passband There is no overshoot in the step response. Low order and small delay	LowPass	FIR
MEAN (moving average)	Comb-shaped characteristics Linear phase and constant group delay There is no overshoot in the step response.	LowPass	FIR
IIR (Butterworth)	Attenuation slope is between SHARP and GAUSS Not linear phase and group delay not constant No ripple in either passband or stopband Cutoff frequency can be set lower than SHARP/GAUSS Close to the characteristics of an analog filter	LowPass HighPass BandPass	IIR

Type	Pass-band Ripple	Attenuation Slope	Attenuation at the Stop-band	Phase	Selectable Cutoff Range
SHARP	0 dB	–40 dB/OCT (Low Pass)			
		–40 dB/OCT (High Pass)	–40 dB	Linear phase	2 to 30%
GAUSS	±0.3 dB	$-3.0 \times (f/fc)^2$ dB	Linear phase		2 to 30%
MEAN (moving average)	0 dB	See characteristics diagram		Linear phase	-
IIR (Butterworth)	0dB	–24 dB/OCT (Low Pass)			
		–24 dB/OCT (High Pass)		Not linear phase	0.2 to 30%

Group Delay Characteristics

Group delay refers to the delay of the output frequency with respect to the input frequency (sine wave) due to the response characteristics of the filter. The group delay can be normalized using the sampling period (Ts), and the unit is s/Ts. The delay for each frequency can be derived from the equation (group delay of each frequency × sampling period).

Example

The group delay for moving average can be expressed as follows (constant regardless of the frequency).

Group delay for moving average [s/Ts] = (the number of moving average points – 1)/2

If the number of moving average points is 16,

Group delay [s/Ts] = (16-1)/2 = 15/2 = 7.5 [s/Ts]

If the sampling frequency (fs) is 100 [kHz],

Ts = 1/fs = 1/(100 [kHz]) = 10 [μs]

Therefore,

Delay = group delay × sampling period = 7.5 [s/Ts]×10 [μs] = 75 [μs]

Computation Delay

The processing time of the DSP channel inside the DL750/DL750P requires 4 sampling periods. Therefore, the delay of the actual digital filter is (4 sampling period) + (delay determined from the group delay characteristics).

SHARP Filter

Characteristics

- **Low-pass and high-pass**
  - The ripple in the pass band is within 0.3 dB.
  - The attenuation falls to –40 dB at twice (low-pass) and 1/2 (high-pass) the cutoff frequency.
  - The attenuation in the stop band is –40 dB or greater.
  - Has linear phase characteristics and constant group delay.

SHARP Low-pass Frequency Characteristics Example

SHARP High-pass Frequency Characteristics Example

(f: sampling frequency [Hz])

Appendix

App
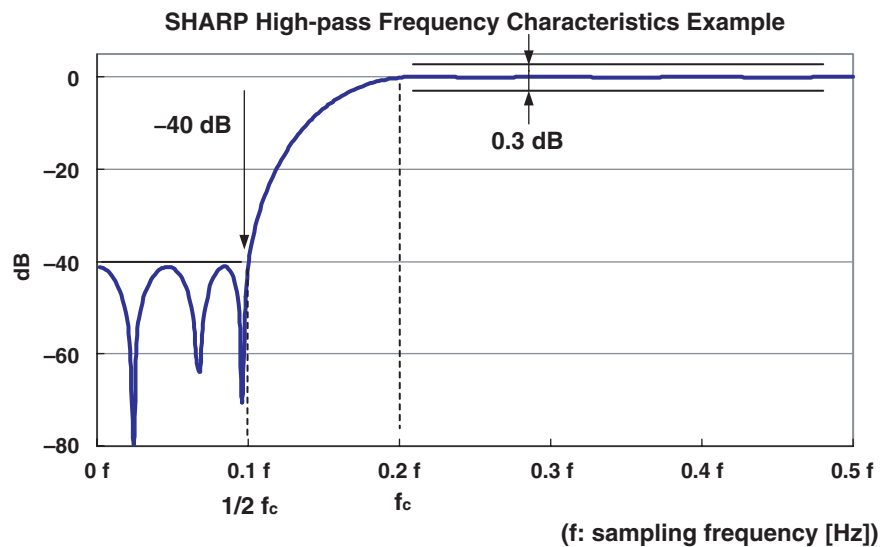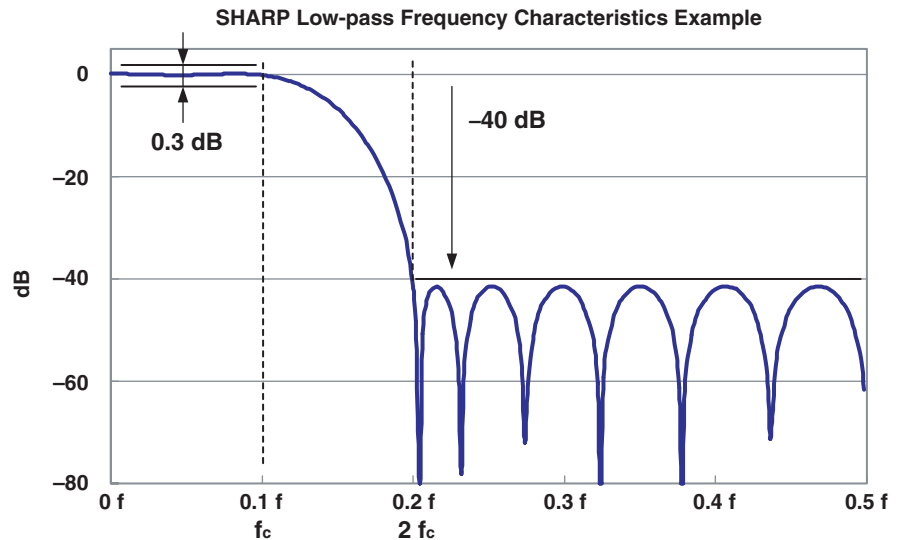
- **Bandpass**
  - The ripple in the pass band is within 0.3 dB.
  - In the low frequency region, the attenuation falls to –40 dB at 1/2 the frequency from the pass band edge f_{cl}.
  - The width of the transition region from the pass band edge in the high frequency region to the –40 dB point is equal to the width of the transition region in the low frequency region.
    $(f_{cl}–1/2f_{cl} = f_{cus}–f_{cu})$
  - The attenuation in the stop band is –40 dB or greater.
  - Has linear phase characteristics and constant group delay.

SHARP Band-pass Frequency Characteristics Example

$(f_{cl}–1/2\ f_{cl}) = (f_{cus}–f_{cu})$ (f: sampling frequency [Hz])
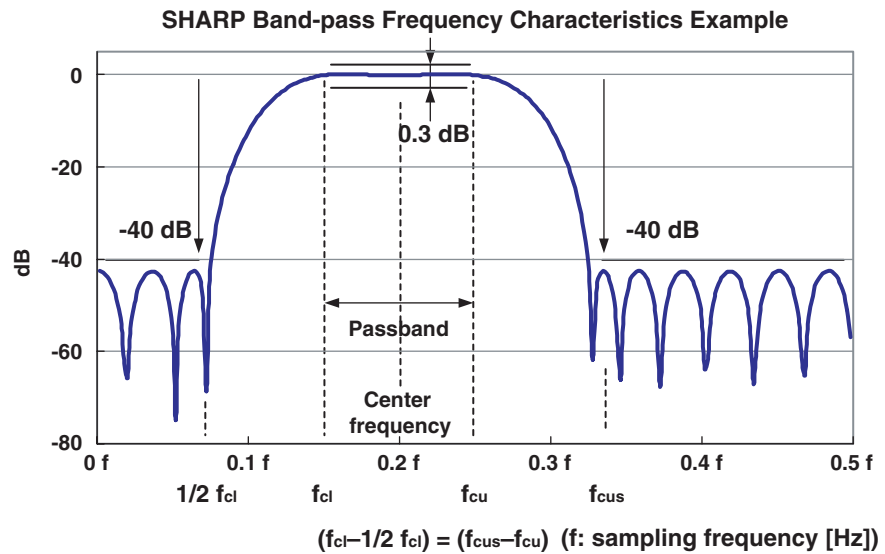
For SHARP band-pass filters, the center frequency that can be specified is limited by the pass-band width.

Selectable Range of SHARP Bandpass Filter Frequency

Passband Width Setting [%]	Lower Limit of Center Frequency [%] (Passband Region)	Upper Limit of Center Frequency [%] (Passband Region)
2	3 (2 to 4)	30 (29 to 31)
5	4.6 (2.1 to 7.1)	30 (27.5 to 32.5)
10	7 (2 to 12)	30 (25 to 35)
15	9.6 (2.1 to 17.1)	30 (22.5 to 37.5)
20	12 (2 to 22)	30 (20 to 40)

Order Table

See below for the SHARP filter orders.

SHARP Low-pass Filter Order

Cutoff frequency	2%	3%	4%	5%	6%	7%	8%	9%
Order	94	61	46	37	32	28	24	22
Cutoff frequency	10%	11%	12%	13%	14%	15%	16%	17%
Order	20	17	17	15	14	13	13	11
Cutoff frequency	18%	19%	20%	21%	22%	23%	24%	25%
Order	11	11	10	11	9	9	8	8
Cutoff frequency	26%	27%	28%	29%	30%			
Order	8	8	8	8	8			

SHARP High-pass Filter Order

Cutoff frequency	2%	3%	4%	5%	6%	7%	8%	9%
Order	191	127	97	77	65	55	49	45
Cutoff frequency	10%	11%	12%	13%	14%	15%	16%	17%
Order	39	37	33	31	29	27	25	25
Cutoff frequency	18%	19%	20%	21%	22%	23%	24%	25%
Order	23	23	21	21	19	19	19	17
Cutoff frequency	26%	27%	28%	29%	30%			
Order	17	17	15	15	15			

SHARP Band-pass Filter Order Pass-band Width 2%

Center frequency	3%	4%	5%	6%	7%	8%	9%	10%
Order	189	142	93	80	69	61	54	49
Center frequency	11%	12%	13%	14%	15%	16%	17%	18%
Order	45	41	37	34	32	27	20	18
Center frequency	24%	25%	26%	19%	20%	21%	22%	23%
Order	18	17	16	16	14	14	14	13
Center frequency	27%	28%	29%	30%				
Order	13	12	13	11				

SHARP Band-pass Filter Order Pass-band Width 5%

Center frequency	5%	6%	7%	8%	9%	10%	11%	12%
Order	154	112	93	72	64	58	51	40
Center frequency	13%	14%	15%	16%	17%	18%	19%	20%
Order	37	35	33	31	29	28	26	25
Center frequency	21%	22%	23%	24%	25%	26%	27%	28%
Order	24	23	22	21	20	19	19	18
Center frequency	29%	30%						
Order	17	18						

SHARP Band-pass Filter Order Pass-band Width 10%

Center frequency	7%	8%	9%	10%	11%	12%	13%	14%
Order	194	132	97	78	69	57	52	47
Center frequency	15%	16%	17%	18%	19%	20%	21%	22%
Order	39	37	35	33	31	30	28	27
Center frequency	23%	24%	25%	26%	27%	28%	29%	30%
Order	23	23	20	19	18	18	17	16

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SHARP Band-pass Filter Order Pass-band Width 15%

Center frequency	10%	11%	12%	13%	14%	15%	16%	17%
Order	155	110	89	73	62	52	49	41
Center frequency	18%	19%	20%	21%	22%	23%	24%	25%
Order	38	36	34	32	27	26	25	24
Center frequency	26%	27%	28%	29%	30%			
Order	23	22	21	21	21			

SHARP Band-pass Filter Order Pass-band Width 20%

Center frequency	12%	13%	14%	15%	16%	17%	18%	19%
Order	191	129	98	78	67	58	49	46
Center frequency	20%	21%	22%	23%	24%	25%	26%	27%
Order	40	38	36	31	29	28	27	26
Center frequency	28%	29%	30%					
Order	25	24	20					

Computation Delay

The group delay can be derived from the following equation. It is constant and depends on the filter order.

Group delay = (Filter order – 1)/2

Unit: s/T_s (where T_s is the sampling frequency [s])

The computation delay can be derived from the following equation.

Computation delay = {4 + (filter order – 1)/2}×sampling period

However, if the sampling frequency exceeds 100 kHz, it is fixed to 100 kHz (10 μs).
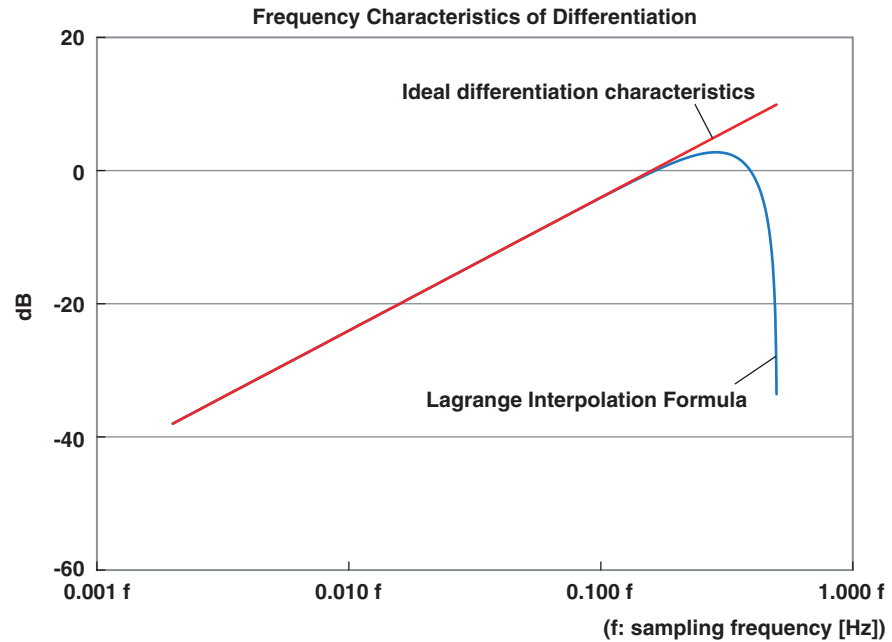It is also fixed to 100 kHz (10 μs) when in envelope mode.

Characteristics Examples

- **SHARP Low-pass**

SHARP Low-pass Frequency Characteristics

(f: sampling frequency [Hz])

• **SHARP High-pass**

SHARP High-pass Frequency Characteristics

• **SHARP Band-pass: Pass-band Width 2%**
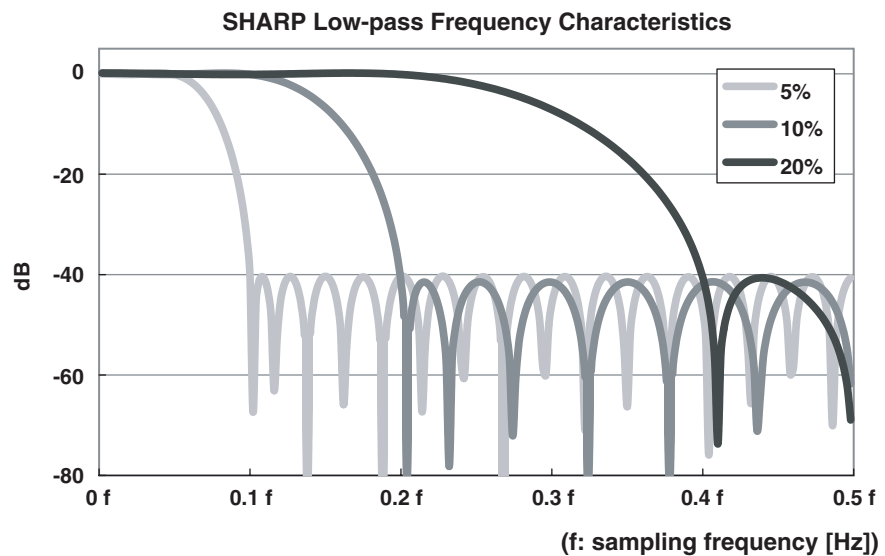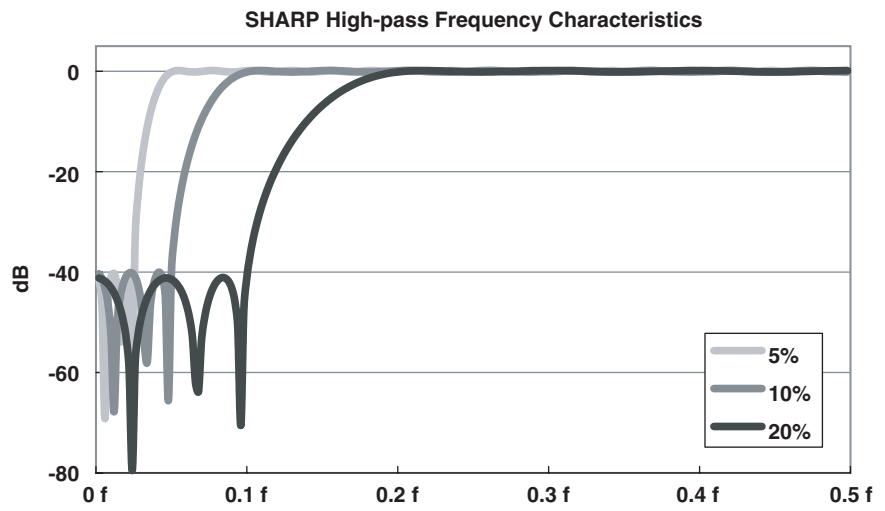
SHARP Band-pass Frequency Characteristics Pass-band Width 2%
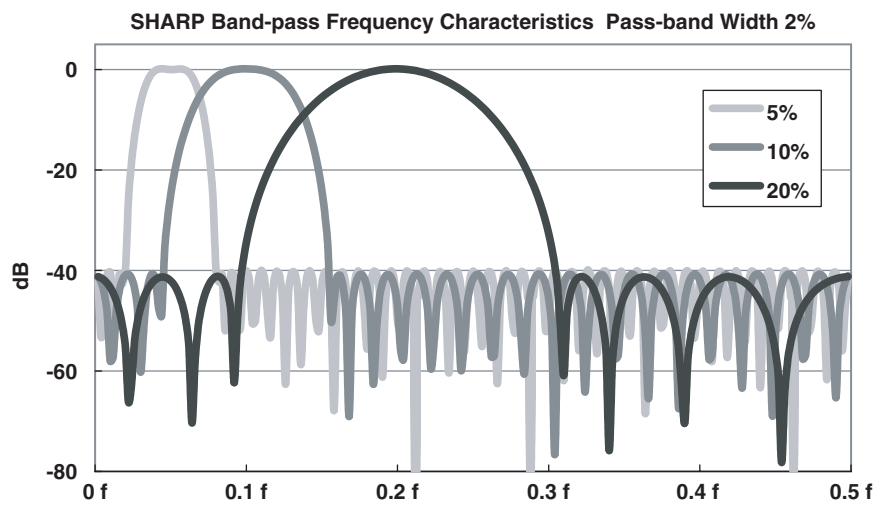
• **SHARP Band-pass: Pass-band Width 5%**

SHARP Band-pass Frequency Characteristics Pass-band Width 5%

(f: sampling frequency [Hz])

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• **SHARP Band-pass: Pass-band Width 10%**

SHARP Band-pass Frequency Characteristics Pass-band Width 10%

• **SHARP Band-pass: Pass-band Width 15%**

SHARP Band-pass Frequency Characteristics Pass-band Width 15%

• **SHARP Band-pass: Pass-band Width 20%**

SHARP Band-pass Frequency Characteristics Pass-band Width 20%

(f: sampling frequency [Hz])
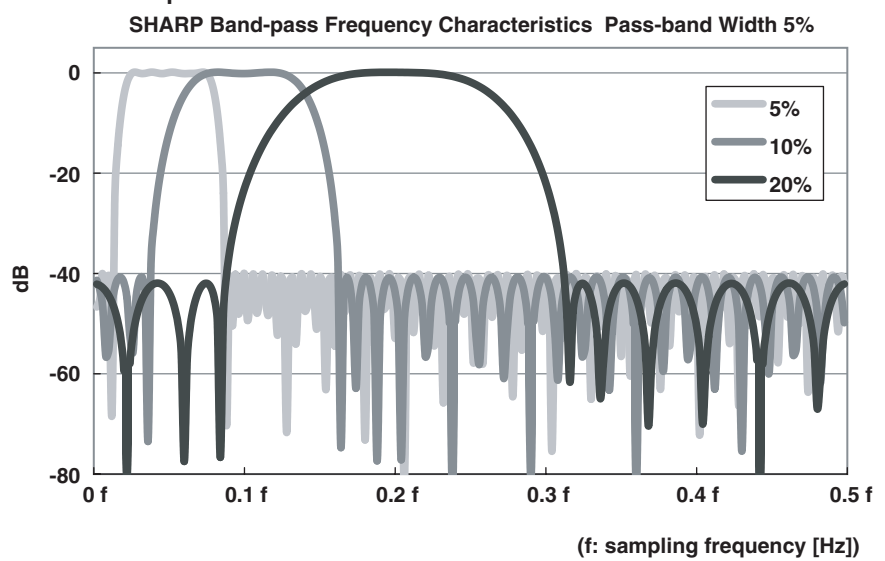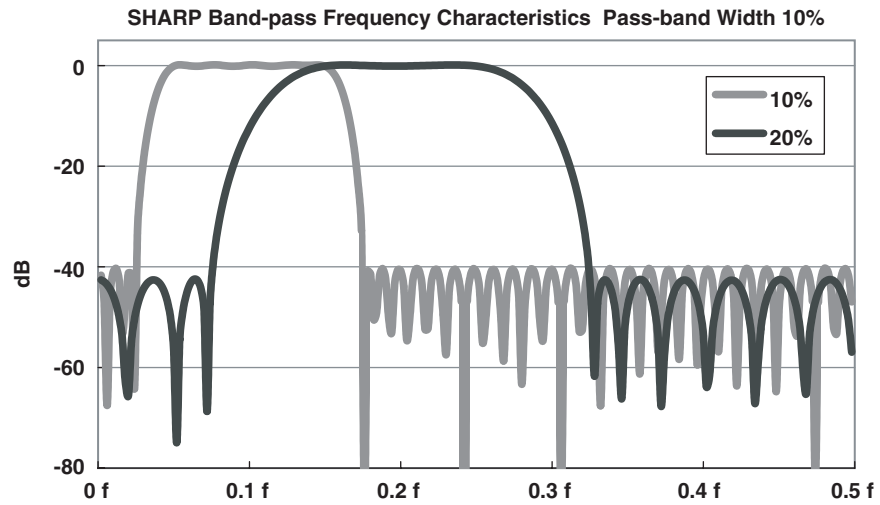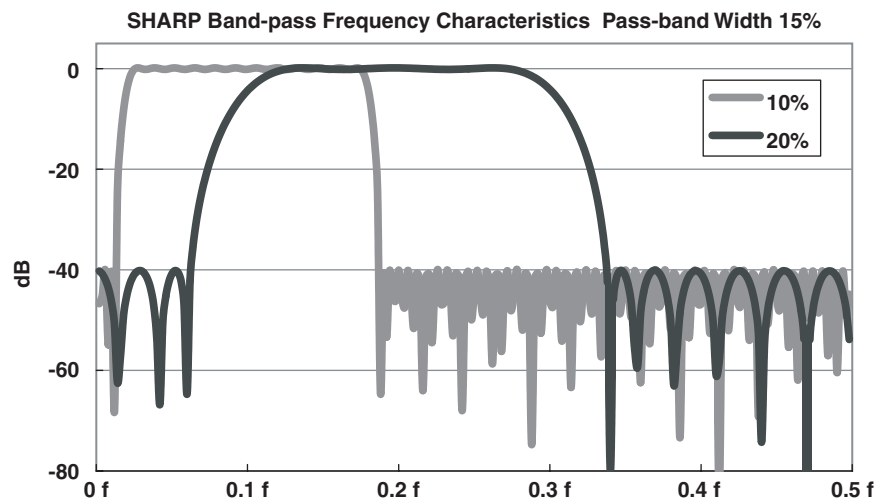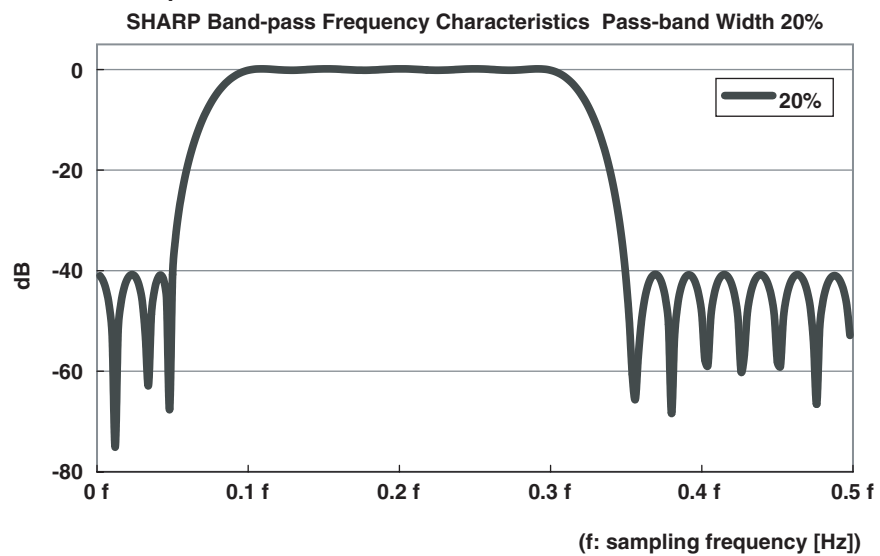
GAUSS Filter

Characteristics

- Pass band is flat.
- The attenuation is –3 dB at the cutoff frequency.
  Attenuation is equal to $-3.0 \times (f/f_c)^2$.
- Has linear phase characteristics and constant group delay.
- Only low-pass filter can be specified.

GAUSS Frequency Characteristics Example

(f: sampling frequency [Hz])
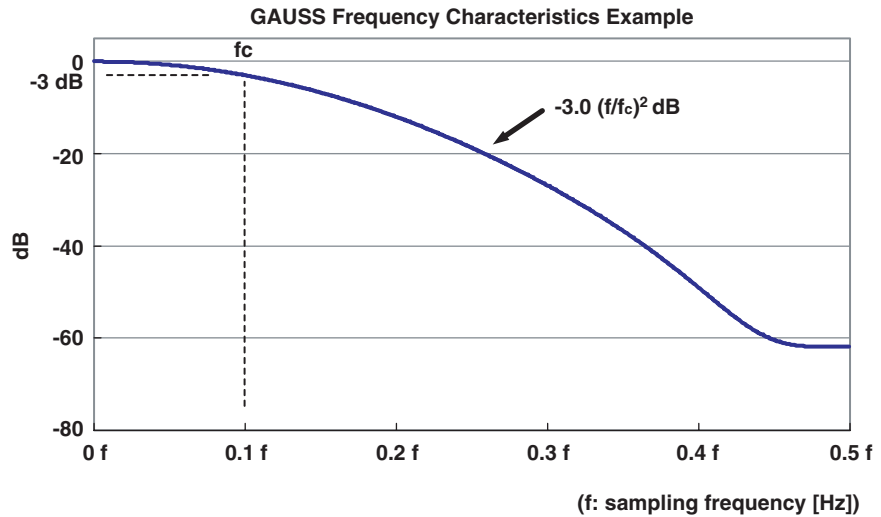
Order Table

See below for the GAUSS filter orders.

GAUSS Filter Order

Cutoff frequency	2%	3%	4%	5%	6%	7%	8%	9%
Order	49	33	25	21	17	17	13	13
Cutoff frequency	10%	11%	12%	13%	14%	15%	16%	17%
Order	9	9	9	9	9	9	9	5
Cutoff frequency	18%	19%	20%	21%	22%	23%	24%	25%
Order	5	5	5	5	5	5	5	5
Cutoff frequency	26%	27%	28%	29%	30%			
Order	5	5	5	5	5			

Computation Delay

The group delay can be derived from the following equation. It is constant and depends on the filter order.

Group delay = (Filter order – 1)/2

Unit: s/T_s (where T_s is the sampling frequency [s])

The computation delay can be derived from the following equation.

Computation delay = {4 + (filter order – 1)/2}×sampling period

However, if the sampling frequency exceeds 100 kHz, it is fixed to 100 kHz (10 μs). It is also fixed to 100 kHz (10 μs) when in envelope mode.

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Characteristics Examples

GAUSS Frequency Characteristics

(f: sampling frequency [Hz])
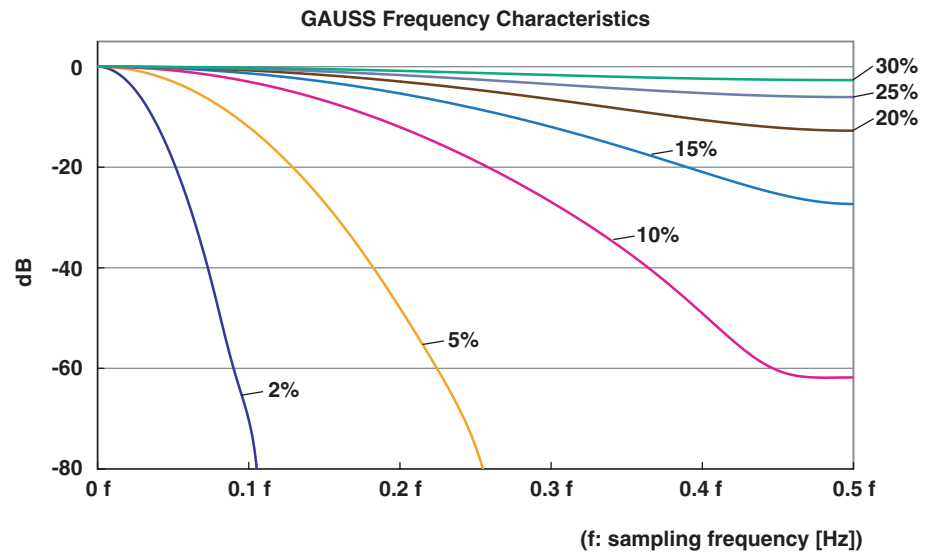
IIR (Butterworth) Filter

Characteristics

- **Low-pass and high-pass.**
  - 4th order Butterworth filter. Attenuation is approximately –24 dB/OCT.
  - Pass band is flat.
  - The attenuation falls to –3 dB at the cutoff frequency.
  - Has non-linear phase characteristics.
  - Lower frequencies can be specified as compared to other FIR filters.

IIR (Butterworth) Low-pass Frequency Characteristics Example

IIR (Butterworth) High-pass Frequency Characteristics Example

(f: sampling frequency [Hz])

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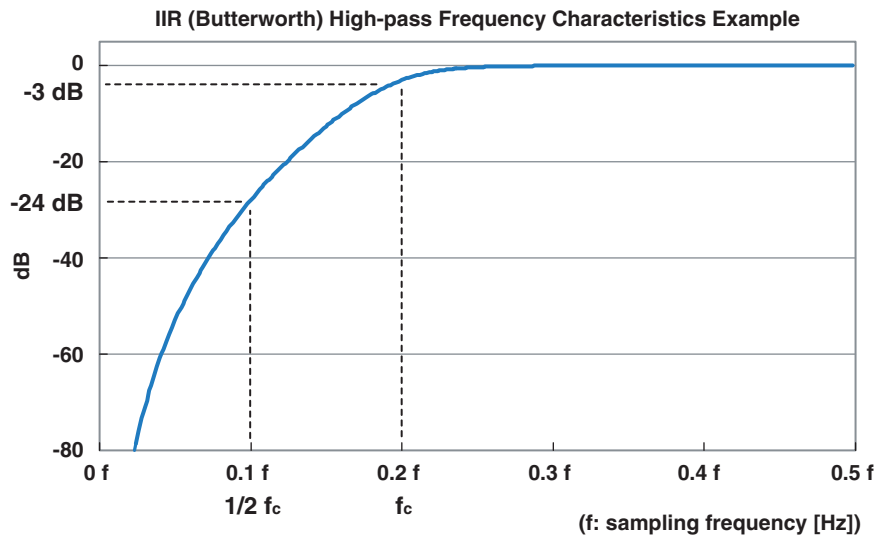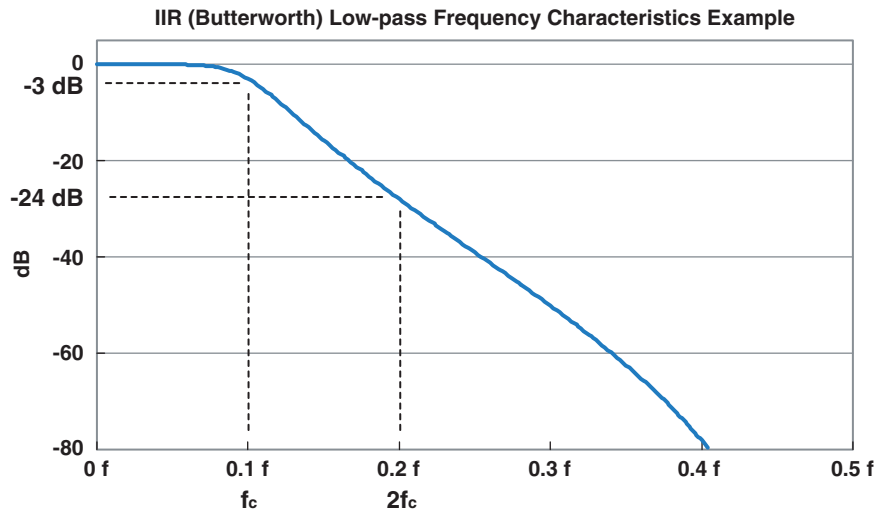
- **Band Pass**
  - Pass band is flat.
  - The attenuation falls to –3 dB at each end of the pass band.
  - 4th order Butterworth. No ripple in the stop band. For the cutoff characteristics, see the characteristics examples.
  - Has non-linear phase characteristics.
  - Lower frequencies can be specified as compared to SHARP filters.

IIR (Butterworth) Band-pass Frequency Characteristics Example

(f: sampling frequency [Hz])
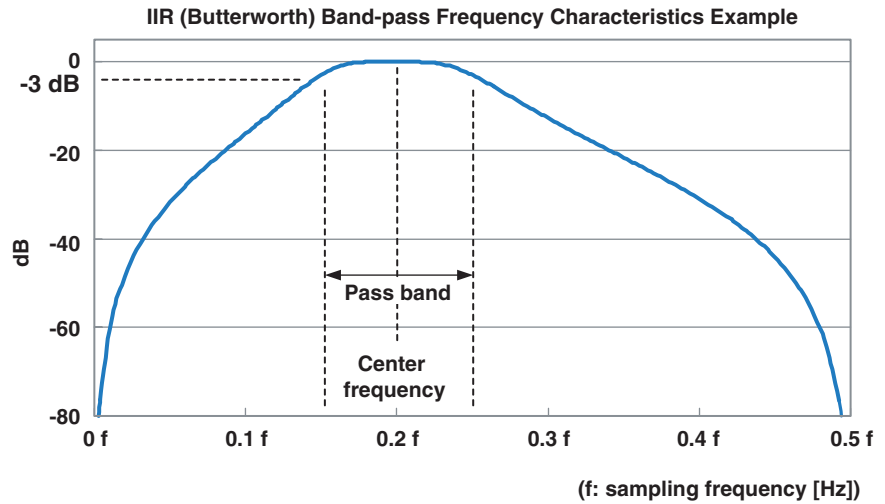
For IIR (Butterworth) band-pass filters, the center frequency that can be specified is limited by the pass-band width.

Selectable Range of IIR (Butterworth) Bandpass Filter Frequency

Passband Width Setting [%]	Lower Limit of Center Frequency [%] (Passband Region)	Upper Limit of Center Frequency [%] (Passband Region)
1	0.6 (0.1 to 1.1)	30 (29.5 to 30.5)
2	1.2 (0.2 to 2.2)	30 (29 to 31)
5	2.6 (0.1 to 5.1)	30 (27.5 to 32.5)
10	5.2 (0.2 to 10.2)	30 (25 to 35)
15	7.6 (0.1 to 15.1)	30 (22.5 to 37.5)
20	10.2 (0.2 to 20.2)	30 (20 to 40)

Computation Delay

In the case of IIR filters, the computation delay cannot be determined uniquely (unlike FIR filters). Because IIR filters do not have linear phase characteristics, the delay varies depending on the input frequency.

The group delay characteristics express the relationship between the input signal frequency and the delay. The computation delay is a value obtained by adding 4 sampling clock cycles to the delay time indicated by the group delay characteristics.

The computation delay can be derived from the following equation.

Computation delay = (4 + group delay) × sampling period

However, if the sampling frequency exceeds 100 kHz, it is fixed to 100 kHz (10 μs).
It is also fixed to 100 kHz (10 μs) when in envelope mode.

Characteristics Examples

- **IIR (Butterworth) Low-pass**

IIR (Butterworth) Low-pass Frequency Characteristics

IIR (Butterworth) Low-pass Group Delay Characteristics (1)

IIR (Butterworth) Low-pass Group Delay Characteristics (2)

(f: sampling frequency [Hz])

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- **IIR (Butterworth) High-pass**

IIR (Butterworth) High-pass Frequency Characteristics

0.20% 2% 5% 10% 15% 20% 25% 30%

IIR (Butterworth) High-pass Group Delay Characteristics (1)

IIR (Butterworth) High-pass Group Delay Characteristics (2)

(f: sampling frequency [Hz])

- **IIR (Butterworth) Band-pass: Pass-band Width 1%**

IIR (Butterworth) Band-pass Frequency Characteristics Pass-band Width 1%

IIR (Butterworth) Band-pass Group Delay Characteristics (1) Pass-band Width 1%

IIR (Butterworth) Band-pass Group Delay Characteristics (2) Pass-band Width 1%

(f: sampling frequency [Hz])

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- **IIR (Butterworth) Band-pass: Pass-band Width 2%**

  IIR (Butterworth) Band-pass Frequency Characteristics Pass-band Width 2%

  IIR (Butterworth) Band-pass Group Delay Characteristics (1) Pass-band Width 2%

  IIR (Butterworth) Band-pass Group Delay Characteristics (2) Pass-band Width 2%

  (f: sampling frequency [Hz])

• **IIR (Butterworth) Band-pass: Pass-band Width 5%**

IIR (Butterworth) Band-pass Frequency Characteristics Pass-band Width 5%

IIR (Butterworth) Band-pass Group Delay Characteristics (1) Pass-band Width 5%

IIR (Butterworth) Band-pass Group Delay Characteristics (2) Pass-band Width 5%

(f: sampling frequency [Hz])

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- **IIR (Butterworth) Band-pass: Pass-band Width 10%**

IIR (Butterworth) Band-pass Frequency Characteristics Pass-band Width 10%

IIR (Butterworth) Band-pass Group Delay Characteristics (1) Pass-band Width 10%

IIR (Butterworth) Band-pass Group Delay Characteristics (2) Pass-band Width 10%

(f: sampling frequency [Hz])

• **IIR (Butterworth) Band-pass: Pass-band Width 15%**

IIR (Butterworth) Band-pass Frequency Characteristics Pass-band Width 15%

IIR (Butterworth) Band-pass Group Delay Characteristics (1) Pass-band Width 15%

IIR (Butterworth) Band-pass Group Delay Characteristics (2) Pass-band Width 15%

(f: sampling frequency [Hz])

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- **IIR (Butterworth) Band-pass: Pass-band Width 20%**

IIR (Butterworth) Band-pass Frequency Characteristics Pass-band Width 20%

IIR (Butterworth) Band-pass Group Delay Characteristics (1) Pass-band Width 20%

IIR (Butterworth) Band-pass Group Delay Characteristics (2) Pass-band Width 20%

(f: sampling frequency [Hz])

MEAN (Moving Average) Filter

Characteristics

- Pass band is flat.
- Has linear phase characteristics and constant group delay.
- The characteristics are of low-pass filters.
- Has comb-shaped bandwidth characteristics.
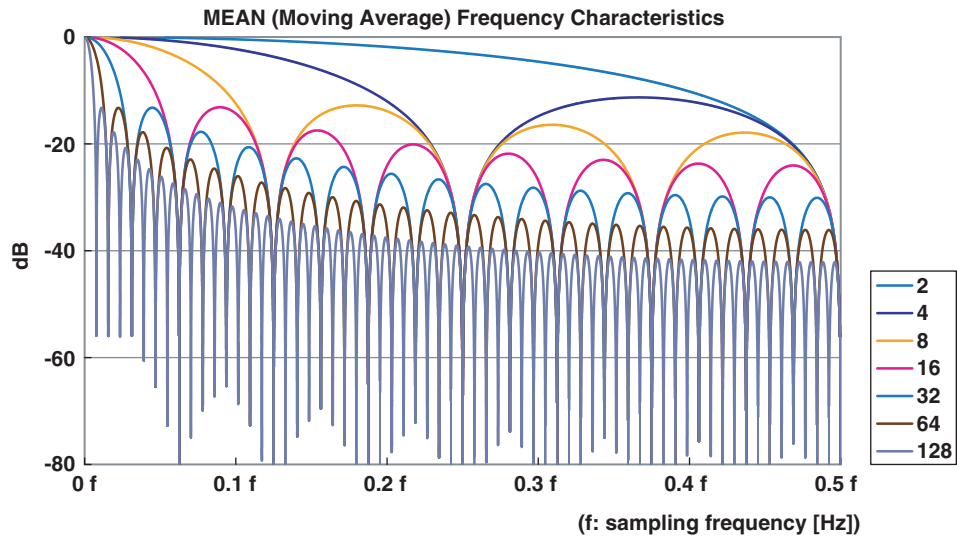
MEAN (Moving Average) Frequency Characteristics

(f: sampling frequency [Hz])

Computation Delay

The group delay can be derived from the following equation. It is constant and depends on the filter order.

Group delay = (Number of moving average points – 1)/2

Unit: s/T_s (where T_s is the sampling frequency [s])

The computation delay can be derived from the following equation.

Computation delay = {4 + (Number of moving average points – 1)/2}×sampling clock cycle

However, if the sampling frequency exceeds 100 kHz, it is fixed to 100 kHz (10 μs).
It is also fixed to 100 kHz (10 μs) when in envelope mode.

Appendix

App

Differentiation on DSP Channels

Differentiation Characteristics

In the differentiation on DSP channels, computation is performed using the 5th order Lagrange Interpolation Formula. The 5th order Lagrange Interpolation Formula is as follows. For details, see App-16 page.

$$f_n' = 1/(12T_s)\{f_{n-4}-8f_{n-3}+8f_{n-1}-f_n\}$$

The amplitude characteristics and the ideal differentiation characteristics when the 5th order Lagrange Interpolation Formula is used are indicated below.

Frequency Characteristics of Differentiation

The differentiation characteristics are approximately equal to the ideal differentiation characteristics until the input frequency is 20% of the sampling frequency. At higher frequencies, the high frequency characteristics of the Lagrange Interpolation Formula suppress the high frequency components.

Computation Delay

The computation delay is as follows.

   Computation delay = $(4 + 2^1) \times$ sampling period
   1. 2 = delay due to the Lagrange Interpolation

However, if the sampling frequency exceeds 100 kHz, it is fixed to 100 kHz (10 μs). It is also fixed to 100 kHz (10 μs) when in envelope mode.

Low-Pass Filter Function

In the differentiation on DSP channels, differentiation can be performed after passing the input signal through a low-pass filter. The low-pass filter used is a SHARP low-pass filter.

For the characteristics of the SHARP low-pass filter, see page app-25.

When the low-pass filter is turned ON, the computation delay increases. The computation time can be derived from the following equation.

   $\{$(Order of the SHARP low-pass filter $- 1)/2 \} \times$ sampling period

For the order corresponding to the specified cutoff frequency, see page app-27.

Computation Flow and Internal Computation Format of DSP Channels

The computation flow of DSP channels is indicated below. The input and output of DSP channels are 16-bit binary data (if the input is 12 bits, it is converted to 16 bits). Since calculation is performed in 32-bit floating-point decimal format inside the DSP channels, both input and output are converted with 1 LSB weight.

Note that the 16-bit binary data of the output is converted with 1 LSB weight that is determined by the Value/DIV setting.

Both input and output are displayed after being normalized at 2400 LSB/DIV.

Computation Input: Conversion from 16-Bit Binary to Floating-Point

The computation source data is converted to floating-point decimal format with 1 LSB weight at the same time the DSP acquires the data.

A (Float) = A (Binary)×(1 LSB weight)
B (Float) = B (Binary)×(1 LSB weight)

Internal Computation

All calculations are performed using floating-point decimal format inside the DSP.
Example: C (Float) = A (Float) + B (Float)

Calculation of the 1 LSB Weight of the Output

The 1 LSB weight of the output is determined from the DSP range (Value/DIV).
Since 1 DIV = 2400 LSB,
1 LSB weight of the output = [Value/DIV]/2400

Computation Output: Conversion from Floating-Point to 16-Bit Binary

The output is converted into 16-bit data according to the following calculation.

C (Binary) = C (Float)÷(1 LSB weight of the output)
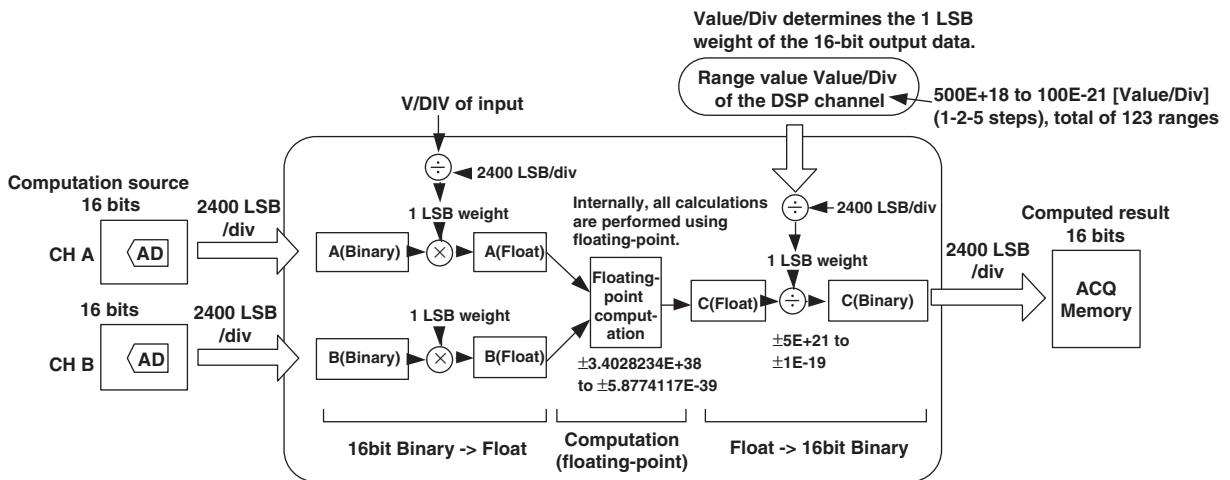
Appendix 7   List of Defaults

Key	Soft Key	Default Setting
CH1 to 16 (HS10M12 (701250))		
	V/div	50.0 V/div
	Variable	OFF
	Position	0.00 div
	Coupling	DC
	Probe	10:1
	BandWidth	Full
	V Zoom	×1
	Offset	0.0 V
	Linear Scale	OFF
	Invert	OFF
	Label	Channel number
CH1 to 16 (HS1M16 (701251))		
	V/div	50.00 V/div
	Variable	OFF
	Position	0.00 div
	Coupling	DC
	Probe	10:1
	BandWidth	Full
	V Zoom	×1
	Offset	0.00 V
	Linear Scale	OFF
	Invert	OFF
	Label	Channel number
CH1 to 16 (NONISO_10M12(701255))		
	V/div	50.0 V/div
	Variable	OFF
	Position	0.00 div
	Coupling	DC
	Probe	10:1
	BandWidth	Full
	V Zoom	×1
	Offset	0.0 V
	Linear Scale	OFF
	Invert	OFF
	Label	Channel number
CH1 to 16 (HV(with RMS)(701260))		
	V/div	5.000 V/div
	Variable	OFF
	Position	0.00 div
	Coupling	DC
	Probe	1:1
	BandWidth	Full
	V Zoom	×1
	Offset	0.000 V
	Linear Scale	OFF
	Invert	OFF
	Label	Channel number
CH1 to 16 (UNIVERSAL (701261)/UNIVERSAL (AAF) (701262))		
	V/div	5.000 V/div
	Variable	OFF
	Position	0.00 div
	Coupling	DC
	BandWidth	Full
	V Zoom	×1
	Offset	0.000 V
	Linear Scale	OFF
	InVert	OFF
	Label	Channel number

Key	Soft Key	Default Setting
CH1 to 16 (TEMP/HPV (701265))		
	V/div	5.000 V/div
	Variable	OFF
	Position	0.00 div
	Coupling	DC
	BandWidth	Full
	V Zoom	×1
	Offset	0.000 V
	Linear Scale	OFF
	Invert	OFF
	Label	Channel number
CH1 to 16 (STRAIN_NDIS(701270)/ STRAIN_DSUB(701271))		
	Range Unit	μSTR
	Range	20000 μSTR
	Upper	20000 μSTR
	Lower	-20000 μSTR
	Excitation	2 V
	Gauge Factor	2.00
	BandWidth	Full
	Linear Scale	OFF
	Label	Channel number
CH1 to 16 (ACCL/VOLT(701275))		
	V/div	50.00 V/div
	Variable	OFF
	Position	0.00 div
	Coupling	DC
	Probe	10:1
	BandWidth	Full
	V Zoom	×1
	Offset	0.00 V
	Linear Scale	OFF
	Invert	OFF
	Label	Channel number
CH1 to 16 (FREQ(701280))		
	V/div	1 kHz/div
	Variable	OFF
	Position	0.00 div
	FV Setup	Frequency
	Input Setup	User
	V Zoom	×1
	Offset	0.000 Hz
	Linear Scale	OFF
	Label	Channel number
Logic A, Logic B		
	Display	OFF
	Position	0 div
	VZoom	×1
	Label	LogicA or LogicB
	Display Bits	ON
	Bit Label	A–1 to A–8, B–1 to B–8
	Bit Mapping	Auto
EVENT		
	Display	OFF
	Position	0 div
	V Zoom	×1
	Label	Event
	Display Bits	ON

Key	Soft Key	Default Setting
START/STOP		
		STOP
TIME/DIV		
		1 ms/div
ACQ		
	Record Length	10 k
	Mode	Normal
	Count	Infinite
	RealTime Out	OFF
	Time Base	Int
SIMPLE/ENHANCED		
	Type	Simple
	Slope	Rising edge
	Source	CH1
	Level	0 V
	Hysteresis	⤸
	Hold Off	0 µs
MODE		
		Auto
HISTORY		
	Select Record	0
	Display Mode	One
	Start Record	0
	End Record	Oldest number
	Search Mode	OFF
MEASURE		
	Mode	OFF
	Item Setup:Trace	CH1
	Item Setup:Item	OFF
	Delay Setup:Trace	CH1
	Delay Setup:Mode	OFF
	1cycle Mode	OFF
	Time Range1	–5 div
	Time Range2	5 div
	Trace	CH1
	Dist/Prox Mode	%
	Distal	90%
	Mesial	50%
	Proximal	10%
	High/Low Mode	Auto
CURSOR		
	Type	OFF
DISPLAY		
	Format	Quad
	Interpolation	Line
	Graticule	Grid
	Mapping	Auto
	Tranclucent	OFF
	Extra Window	OFF
	Scale Value	ON
	Trace Label	OFF
	Accumlate	OFF
	Monitor	Both
X-Y		
	Mode	T-Y
	W1:XTrace	
	W1:YTrace	
	W2:XTrace	
	W2:YTrace	
	W3:XTrace	
	W3:YTrace	
	W4:XTrace	
	W4:YTrace	
	Start Point	–5 div
	End Point	5 div

Key	Soft Key	Default Setting
MATH		
	Mode	OFF
	Operation:Math1	OFF
	Operation:Math2	OFF
	Operation:Math3	OFF
	Operation:Math4	OFF
	Operation:Math5	OFF
	Operation:Math6	OFF
	Operation:Math7	OFF
	Operation:Math8	OFF
	Start Point	–5 div
	End Point	5 div
	Threshold:Trace	CH1
	Threshold:Upper	0.0 V
	Threshold:Lower	0.0 V
	Average:Mode	OFF
	Phase Shift	0.000 msec
	Filter:Select	FILT1
	Filter:Type	Gauss
	Filter:Band	Low-Pass
	Filter:CutOff	10.0%
	FFT Point	1 k
	FFT Window	Hanning
	Constant:K1 to K8	1.0000E+00
DSP1 to 6(optional)		
	Display	OFF
	Variable	OFF
	Position	0.0 div
	Setup	C1+C2
	Value/Div	10.00E+00
	V Zoom	×1
	Label	DSP Channel number
ZOOM		
	Mode	Main
	Format	Main
	Allocation	0 to 3 from 1CH
	Z1 Mag	500 µs/div
	Z2 Mag	500 µs/div
	Z1 Position	0 div
	Z2 Position	0 div
SEARCH		
	Type	Edge
	Result Window	Z1
	Setup:Source	CH1
	Setup:Level	0 V
	Setup:Polarity	Rising edge
	Setup:Hysteresis	⤸
	Setup:Count	1
	Setup:Start Point	–5 div
DUAL CAPTURE		
	Mode	OFF
	Time/Div	100 µs/div
	Capture Num	Current
	Window	OFF
	Window Mag	100 µs/div
	Window Pos	0 div
	Event Display	OFF
POSITION/DELAY		
	Position	50%
	Delay	0.0 µs

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Key	Soft Key	Default Setting
GO/NO-GO		
	Mode	OFF
	Logic	AND
	ActCondition	Fail
	Time Range1	–5 div
	Time Range2	5 div
	Sequence	Cont
	ACQ Count	Infinite
	Action:Buzzer	OFF
	Action:Image	OFF
	Action:PRINT	OFF
	Action:Save to File	OFF
	Action:Send Mail	OFF
	Action:Mail Count	100
	Remote	OFF
ACTION		
	Mode	OFF
	Buzzer	OFF
	Image	OFF
	PRINT	OFF
	Save to File	OFF
	Send Mail	OFF
	Mail Count	100
	Sequence	Cont
FILE		
	File Item	Setup
	Auto Naming	Numbering
PRINT MENU		
	Print to	Printer
	Format	Normal
	Time Range1	–5 div
	Time Range2	5 div
	(LongCopy) Mag	500 µs/div
SETUP		
	Auto Setup	0 V
	Trace	All
CAL		
	Auto Cal	ON
MISC		
	System Config:Date/Time	
		2002,01,01
	System Config:Menu Language	
		Eng
	System Config:Message Language	
		Eng
	System Config:Click Sound	
		ON
	SCSI ID:Own ID	6
	SCSI ID:Internal ID	4
	Others:Video Out	ON
	Others:HDD Motor	ON
	Others:Start Mode	OFF
	Others:Action Mode	OFF
	Others:Offset Cancel Mode	
		OFF
	LCD:Auto Off	OFF
	LCD:Auto Off Time	1 min
	LCD:Brightness	5
	Remote Cntl:Device	GP-IB
	Remote Cntl:Address	1

Appendix 8   Assignment of Keys on the USB Keyboard

104 Keyboard (US)

Key	With the Ctrl Key Held Down on the USB Keyboard		When the Soft Keyboard Is Displayed on the DL750/DL750P		Other	
		When SHIFT Is ON on the DL750/DL750P		+Shift on the USB Keyboard		When SHIFT Is ON on the DL750/DL750P
A	ACQ menu	Same as left	*1	*1		
B	MATH menu	Same as left	*1	*1		
C	Execute PRINT	PRINT menu	*1	*1		
D	DISPLAY menu	X-Y menu	*1	*1		
E			*1	*1		
F	FILE menu	Same as left	*1	*1		
G			*1	*1		
H	HISTORY menu	Same as left	*1	*1		
I	Execute IMAGE SAVE	IMAGE SAVE menu	*1	*1		
J			*1	*1		
K			*1	*1		
L	ALL CH menu	Same as left	*1	*1		
M	MEASURE menu	GO/NO-GO menu	*1	*1		
N			*1	*1		
O			*1	*1		
P	POSITION menu	DELAY menu	*1	*1		
Q	Execute CLEAR TRACE		*1	*1		
R	Execute RESET	Same as left	*1	*1		
S	SHIFT condition	Clear SHIFT condition	*1	*1		
T	TRIGMODE menu	ACTION menu	*1	*1		
U	CURSOR menu	Same as left	*1	*1		
*2 V	VOICE MEMO menu	Same as left	*1	*1		
W	SIMPLE/ENHANCED menu	Same as left	*1	*1		
*2 X	DUAL CAPTURE menu	Same as left	*1	*1		
Y			*1	*1		
Z	ZOOM menu	SEARCH menu	*1	*1		
1	CH1 menu	DSP1 menu	*1	*1		
2	CH2 menu	DSP2 menu	*1	*1		
3	CH3 menu	DSP3 menu	*1	*1		
4	CH4 menu	DSP4 menu	*1	*1		
5	CH5 menu	DSP5 menu	*1	*1		
6	CH6 menu	DSP6 menu	*1	*1		
7	CH7 menu	Same as left	*1	*1		
8	CH8 menu	Same as left	*1	*1		
9	CH9 menu	Logic A menu	*1	*1		
0	CH10 menu	Logic B menu	*1	*1		
Enter	Return(Enter), Select	Same as left	*1	*1		
Esc	Escape	Same as left	*1	*1		
Back Space			*1	*1		
Tab						
Space Bar			*1	*1		
-			*1	*1		
=			*1	*1		
[			*1	*1		
]			*1	*1		
\	SETUP	CAL menu	*1	*1		
;			*1	*1		
'			*1	*1		
,			*1	*1		
.			*1	*1		
/	MISC menu	Same as left	*1	*1		
Caps Lock			*1	*1		

*1   Character or symbol similar to the normal PC keyboard is entered.
  (Example) 1 key: 1 is entered if the USB keyboard is not +shift. ! is entered if the USB keyboard is +shift.
*2   The key assignments below differ from the table above for the DL750P.

V	FEED menu	VOICE MEMO menu	*1	*1		
X	RECORDER menu	DUAL CAPTURE menu	*1	*1		

Appendix

App

Key	With the Ctrl Key Held Down on the USB Keyboard		When the Soft Keyboard Is Displayed on the DL750/DL750P		Other	
		When SHIFT Is ON on the DL750/DL750P		+Shift on the USB Keyboard		When SHIFT Is ON on the DL750/DL750P
F1	CH11 menu	EVENT menu	Select Soft key1	Same as left	Select Soft key1	Same as left
F2	CH12 menu	Same as left	Select Soft key2	Same as left	Select Soft key2	Same as left
F3	CH13 menu	Same as left	Select Soft key3	Same as left	Select Soft key3	Same as left
F4	CH14 menu	Same as left	Select Soft key4	Same as left	Select Soft key4	Same as left
F5	CH15 menu	Same as left	Select Soft key5	Same as left	Select Soft key5	Same as left
F6	CH16 menu	Same as left	Select Soft key6	Same as left	Select Soft key6	Same as left
F7			Select Soft key7	Same as left	Select Soft key7	Same as left
F8	Escape	Same as left	Escape	Same as left	Escape	Same as left
F9						
F10						
F11			μ	Same as left		
F12	START/STOP	Same as left	Ω	Same as left	START/STOP	Same as left
Print Screen	Execute COPY	PRINT menu				
Scroll Lock	Execute IMAGE SAVE	IMAGE SAVE menu				
Pause	Execute SNAPSHOT	Clear SNAPSHOT				
Insert			Insert condition	Same as left		
Home	Increment V/div	Same as left			Increment V/div	Same as left
Page Up	Increment T/div	Same as left			Increment T/div	Same as left
Delete			*1	*1		
End	Decrement V/div	Same as left			Decrement V/div	Same as left
Page Down	Decrement T/div	Same as left			Decrement T/div	Same as left
→	Cursor to the right	Same as left	Cursor to the right	Same as left	Cursor to the right	Same as left
←	Cursor to the left	Same as left	Cursor to the left	Same as left	Cursor to the left	Same as left
↓	Jog shuttle down	Same as left	Select Soft key6	Same as left	Jog shuttle down	Same as left
↑	Jog shuttle up	Same as left	Select Soft key6	Same as left	Jog shuttle up	Same as left
(Numeric)						
Num Lock						
/			*1	*1		
*	START/STOP	Same as left	*1	*1	START/STOP	Same as left
-			*1	*1		
+			*1	*1		
Enter			*1	*1	Return(Enter), Select	Same as left
1	Decrement V/div	Same as left	*1			Decrement V/div
2	Jog shuttle down	Same as left	*1			Jog shuttle down
3	Decrement T/div	Same as left	*1			Decrement T/div
4	Cursor to the left	Same as left	*1			Cursor to the left
5			*1			
6	Cursor to the right	Same as left	*1			Cursor to the right
7	Increment V/div	Same as left	*1			Increment V/div
8	Jog shuttle up	Same as left	*1			Jog shuttle up
9	Increment T/div	Same as left	*1			Increment T/div
0			*1	Insert contidion		
.			*1	Delete		

*1 Character or symbol similar to the normal PC keyboard is entered.
(Example) 1 key: 1 is entered if the USB keyboard is not +shift. ! is entered if the USB keyboard is +shift.

109 Keyboard (Japanese)

Key	With the Ctrl Key Held Down on the USB Keyboard		When the Soft Keyboard Is Displayed on the DL750/DL750P		Other	
		When SHIFT Is ON on the DL750/DL750P		+Shift on the USB Keyboard		When SHIFT Is ON on the DL750/DL750P
A	ACQ menu	Same as left	*1	*1		
B	MATH menu	Same as left	*1	*1		
C	Execute PRINT	PRINT menu	*1	*1		
D	DISPLAY menu	X-Y menu	*1	*1		
E			*1	*1		
F	FILE menu	Same as left	*1	*1		
G			*1	*1		
H	HISTORY menu	Same as left	*1	*1		
I	Execute IMAGE SAVE	IMAGE SAVE menu	*1	*1		
J			*1	*1		
K			*1	*1		
L	ALL CH menu	Same as left	*1	*1		
M	MEASURE menu	GO/NO-GO menu	*1	*1		
N			*1	*1		
O			*1	*1		
P	POSITION menu	DELAY menu	*1	*1		
Q	Execute CLEAR TRACE		*1	*1		
R	Execute RESET	Same as left	*1	*1		
S	SHIFT condition	Clear SHIFT condition	*1	*1		
T	TRIGMODE menu	ACTION menu	*1	*1		
U	CURSOR menu	Same as left	*1	*1		
V *2	VOICE MEMO menu	Same as left	*1	*1		
W	SIMPLE/ENHANCED menu	Same as left	*1	*1		
X *2	DUAL CAPTURE menu	Same as left	*1	*1		
Y			*1	*1		
Z	ZOOM menu	SEARCH menu	*1	*1		
1	CH1 menu	DSP1 menu	*1	*1		
2	CH2 menu	DSP2 menu	*1	*1		
3	CH3 menu	DSP3 menu	*1	*1		
4	CH4 menu	DSP4 menu	*1	*1		
5	CH5 menu	DSP5 menu	*1	*1		
6	CH6 menu	DSP6 menu	*1	*1		
7	CH7 menu	Same as left	*1	*1		
8	CH8 menu	Same as left	*1	*1		
9	CH9 menu	Logic A menu	*1	*1		
0	CH10 menu	Logic B menu	*1	*1		
Enter	Return (Enter), Select	Same as left	*1	*1		
Esc	Escape	Same as left	*1	*1		
Back Space			*1	*1		
Tab						
Space Bar			*1	*1		
-			*1	*1		
^			*1	*1		
@			*1	*1		
[			*1	*1		
;			*1	*1		
:			*1	*1		
]			*1	*1		
,			*1	*1		
.			*1	*1		
/	MISC menu	Same as left	*1	*1		
Caps Lock			*1	*1		

*1 Character or symbol similar to the normal PC keyboard is entered.
   (Example) 1 key: 1 is entered if the USB keyboard is not +shift. ! is entered if the USB keyboard is +shift.
*2 The key assignments below differ from the table above for the DL750P.

V	FEED menu	VOICE MEMO menu	*1	*1		
X	RECORDER menu	DUAL CAPTURE menu	*1	*1		

Appendix 8 Assignment of Keys on the USB Keyboard

Key	With the Ctrl Key Held Down on the USB Keyboard		When the Soft Keyboard Is Displayed on the DL750/DL750P		Other	
		When SHIFT Is ON on the DL750/DL750P		+Shift on the USB Keyboard		When SHIFT Is ON on the DL750/DL750P
F1	CH11 menu	EVENT menu	Seletc Soft key1	Same as left	Seletc Soft key1	Same as left
F2	CH12 menu	Same as left	Seletc Soft key2	Same as left	Seletc Soft key2	Same as left
F3	CH13 menu	Same as left	Seletc Soft key3	Same as left	Seletc Soft key3	Same as left
F4	CH14 menu	Same as left	Seletc Soft key4	Same as left	Seletc Soft key4	Same as left
F5	CH15 menu	Same as left	Seletc Soft key5	Same as left	Seletc Soft key5	Same as left
F6	CH16 menu	Same as left	Seletc Soft key6	Same as left	Seletc Soft key6	Same as left
F7			Seletc Soft key7	Same as left	Seletc Soft key7	Same as left
F8	Escape	Same as left	Escape	Same as left	Escape	Same as left
F9						
F10						
F11			μ	Same as left		
F12	START/STOP	Same as left	Ω	Same as left	START/STOP	Same as left
Print Screen	Execute COPY	PRINT menu				
Scroll Lock	Execute IMAGE SAVE	IMAGE SAVE menu				
Pause	Execute SNAPSHOT	Clear SNAPSHOT				
Insert			Insert condition	Same as left		
Home	Increment V/div	Same as left			Increment V/div	Same as left
Page Up	Increment T/div	Same as left			Increment T/div	Same as left
Delete			*1	*1		
End	Decrement V/div	Same as left			Decrement V/div	Same as left
Page Down	Decrement T/div	Same as left			Decrement T/div	Same as left
→	Cursor to the right	Same as left	Cursor to the right	Same as left	Cursor to the right	Same as left
←	Cursor to the left	Same as left	Cursor to the left	Same as left	Cursor to the left	Same as left
↓	Jog shuttle down	Same as left	Seletc Soft key6	Same as left	Jog shuttle down	Same as left
↑	Jog shuttle up	Same as left	Seletc Soft key6	Same as left	Jog shuttle up	Same as left
\	SETUP menu	CAL menu	*1	*1		
\			*1	*1		
(Numeric)						
Num Lock						
/			*1	*1		
*	START/STOP	Same as left	*1	*1	START/STOP	Same as left
-			*1	*1		
+			*1	*1		
Enter			*1	*1	Return(Enter), Select	Same as left
1	Decrement V/div	Same as left	*1			Decrement V/div
2	Jog shuttle down	Same as left	*1			Jog shuttle down
3	Decrement T/div	Same as left	*1			Decrement T/div
4	Cursor to the left	Same as left	*1			Cursor to the left
5			*1			
6	Cursor to the right	Same as left	*1			Cursor to the right
7	Increment V/div	Same as left	*1			Increment V/div
8	Jog shuttle up	Same as left	*1			Jog shuttle up
9	Increment T/div	Same as left	*1			Increment T/div
0			*1	Insert condition		
.			*1	Delete		

*1 Character or symbol similar to the normal PC keyboard is entered.
(Example) 1 key: 1 is entered if the USB keyboard is not +shift. ! is entered if the USB keyboard is +shift.

Appendix 9 Waveform Acquisition Operation When the Power Supply Recovers after a Power Failure

The waveform acquisition operation when the power supply recovers after a power failure varies depending on the following two conditions.
- Start Mode (Power On)
  Whether to start waveform acquisition at power on.
- Acquisition memory backup switch
  Whether to back up the acquisition memory

- **When Start Mode (Power On) Is OFF**
  When the Backup Switch Is OFF
  The history memory is cleared.
  Waveform acquisition does not start regardless of whether measurement was in progress before the power failure.
  When the Backup Switch Is ON
  The history memory is held.
  If waveform acquisition was in progress before the power failure, the waveform acquisition is resumed.[1]
  Waveform acquisition does not start if measurement was stopped before the power failure.

Note

The behavior when the backup switch is ON but the batteries go flat while backing up the data is as follows:
- The history memory is cleared.
- Waveform acquisition does not start regardless of whether measurement was in progress before the power failure.

- **When Start Mode (Power On) Is ON**
  When the Backup Switch Is OFF
  The history memory is cleared.
  Waveform acquisition starts regardless of whether measurement was in progress before the power failure.
  When the Backup Switch Is ON
  The history memory is held.
  If waveform acquisition was in progress before the power failure, the waveform acquisition is resumed.[1] Waveform acquisition starts if measurement was stopped before the power failure.

Note

The behavior when the backup switch is ON but the batteries go flat while backing up the data is as follows:
- The history memory is cleared.
- Waveform acquisition starts regardless of whether measurement was in progress before the power failure.

1. • If the acquisition mode is set to average or if realtime recording is in progress, waveform acquisition is restarted. If a power failure occurs during realtime recording, the realtime recording file becomes an invalid file (this file cannot be loaded). Be sure that the power supply is not interrupted during realtime recording.
   • Acquisition of waveforms continues during roll mode display. If the display is not in roll mode, pre-trigger data is acquired from the beginning for pre-triggered waveforms. The data of post-trigger waveform up to the power failure is considered valid, and the acquisition of waveforms continues from that point.

Appendix 10 Basic Defining Equation of Strain

Definition of Strain

$\Delta L/L = \varepsilon$ (1)

     ε: Strain
     L: Initial length of the material
     ΔL: Amount of change due to external strain

Definition of the Gauge Factor

Gauge factor (K) refers to the ratio between the mechanical strain and the change in the resistance of the strain gauge resistor.

$$\varepsilon = \frac{\Delta L}{L} = \frac{\Delta R/R}{K} \qquad (2)$$

$(\Delta R/R) = K \times \varepsilon$ (3)

     R: G   auge resistance
     ΔR: Amount of change in resistance when a strain is received

Normally, K=2.0. However, the value varies depending on the strain gauge material.

General Equation of the Measured Voltage (V) and Strain (ε) of the Wheatstone Bridge (1 Gauge Method)

If we assume V to be the voltage measured on the bridge and E to be the voltage applied to the bridge,
$V = (1/4) \times E \times (\Delta R/R)$ (4)

From equation (3),
$(\Delta R/R) = K \times \varepsilon$

Thus, $V = (1/4) \times E \times K \times \varepsilon$ (5)

- **When Determining the Strain (ε) from the Measured Voltage (V) (Strain Gauge (1 Gauge Method))**
  If we derive ε from equation (5)
  $\varepsilon = (4/K) \times (V/E)$ (6)

- **When Determining the Measured Value of the Strain Gauge Sensor (e) from the Voltage Measured on the Bridge (V) (Strain Gauge Sensor)**
  Assuming e to be the measured value (measured value of the strain gauge sensor: mV/V unit) and substituting $\varepsilon = e$ in equation (6),
  $\varepsilon = (4/K) \times (V/E)$ (7)

  In the case of a strain gauge sensor, set the Gauge Factor (K) to 2 on the DL750/DL750P. If you change the value of K, conversion is made using the above equation.

Appendix 11 Shunt Calibration of the Strain Module

Shunt calibration is used to correct the gain of strain measurements by inserting a known resistance (shunt calibration resistance (shunt resistance)) in parallel with the strain gauge. The Strain Module (701271(STRAIN_DSUB)) supports shunt calibration and contains a built-in relay circuit for shunt calibration.

To execute shunt calibration, a bridge head that supports shunt calibration (701957/701958) is needed.
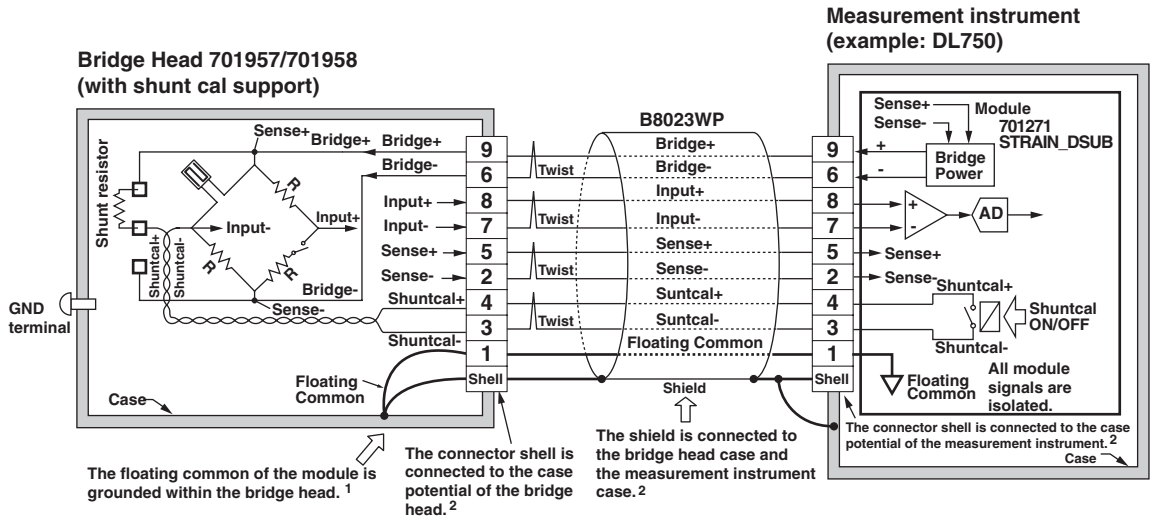
1. The GND (floating common) of the module is connected to the case potential inside the bridge box.
2. The bridge head case, the cable shield, and the measurement instrument case are connected as measures against noise.

• When correcting the gain on the negative side (normal)

Shunt calibration relay circuit (Built into the strain module. Turns ON/OFF automatically when shunt calibration is executed.)

Shunt resistor (Applied to the bridge head)
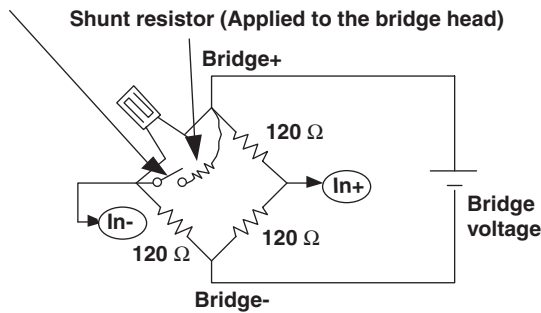
• When correcting the gain on the positive side

Shunt calibration relay circuit (Built into the strain module. Turns ON/OFF automatically when shunt calibration is executed.)

Shunt resistor, when correcting the positive side
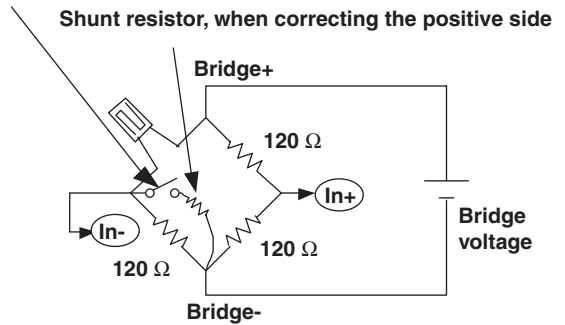
Shunt Calibration Procedure

1. Calculate the strain value (μSTR) corresponding to the shunt resistor to be used. For the calculation procedure, see "Calculating the Shunt Resistance" in the next section.
2. Execute balancing without applying a load to the strain gauge and correct the zero point.
3. Execute shunt calibration and correct the gain.
   Shunt calibration is executed using DL750/DL750P channel menu > Linear Scale > Mode. Usually, the negative gain is corrected. However, if you are correcting the positive gain, change the position of the shunt resistor as shown in the upper right figure.

• Balance

Strain

Before execution

After execution

Strain input

The zero point is corrected when balancing is executed.

• Shunt calibration

Strain

After execution Gain is corrected.

Before execution

Current measured value[1]

P2:X

Strain input

P2:Y

The strain value corresponding to the shunt resistor is set to P2:Y of the setup menu.
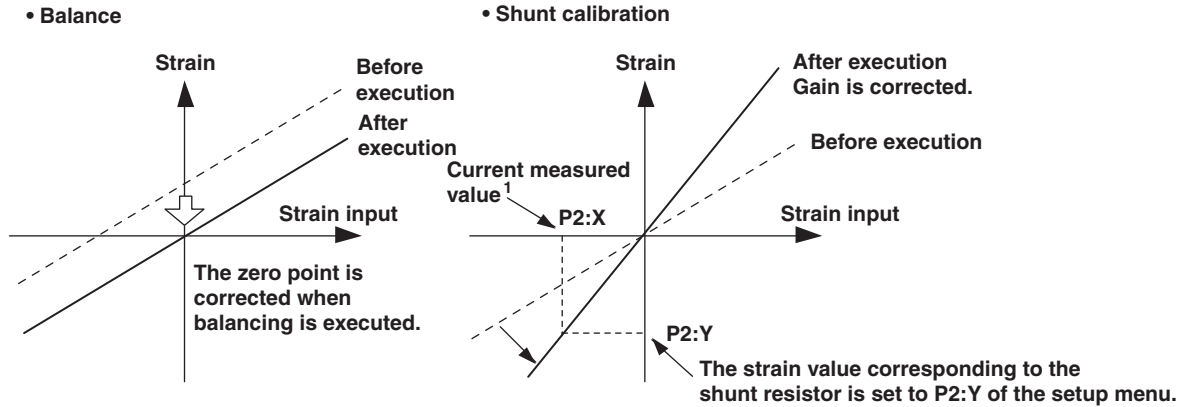
1. Automatically obtained when shunt calibration is executed.

Execution Menu of Shunt Calibration

The execution menu of shunt calibration is set using channel menu > Linear Scale > Mode. In normal shunt calibration, only P2:Y is set. In addition to the normal shunt calibration (when the shunt calibration relay circuit is ON), the DL750/DL750P allows the setting of a zero point when the relay circuit is OFF. This function is useful when the strain value is not 0 after the execution of balancing.

Items in the Execution Menu

(1) P1:X: If (Shunt Cal) Exec is executed, the input value when the relay circuit is OFF is applied.
(2) P1:Y: Sets the value (usually 0) when the relay circuit is OFF.
(3) P2:X: If (Shunt Cal) Exec is executed when the relay circuit is ON, the input value when the relay circuit is ON is applied.
(4) P2:Y: Set the strain value corresponding to the shunt resistance when the relay circuit is ON.
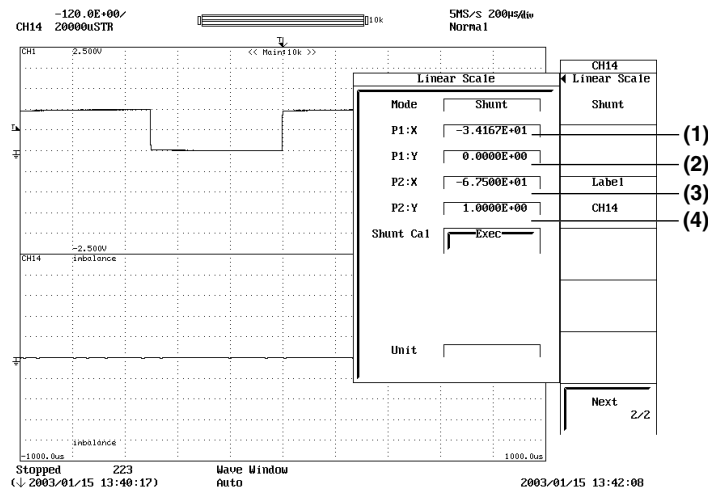
Note _____

- When executing shunt calibration, select an appropriate range so that the measured values do not exceed the range when the shunt calibration relay circuit is ON. The DL750/DL750P attempts shunt calibration within the current specified range.
- If shunt calibration fails (the measured value exceeds the range, for example), an error message is displayed. In such case, change the range and execute shunt calibration again.

Taking Measures against Noise

Because measurements are made at the μV level, the strain gauge is extremely susceptible to noise. If the execution of balancing or shunt calibration fails, it may be due to the effect of noise. Check the following points.

- Because the strain gauge is attached away from the bridge head, it is recommended that twisted wire be used for extension.
- Use a bridge head with high noise resistance. It is recommended that YOKOGAWA bridge head (701957/701958) with high noise resistance be used.

Calculation of the Shunt Resistance

To execute shunt calibration, the shunt resistance (Rs) and the expected strain (ε) need to be calculated in advance. Use ε as given in the equation below (normally a negative value). With the DL750/DL750P, enter the value into "P2-Y" under the shunt calibration execution menu. However, when using the general method given for shunt calibration (the easy method), an error of 1 to 2% can be introduced as the strain value (ε) increases. Therefore, calculate using the detailed method whenever possible. Also, you must select a setting range value that will not result in an overrange.

Equation for Rs and ε When Executing Shunt Calibration

- **General Equation**

  $\Delta R/R = K \times \varepsilon$ (1): Basic Equation of Strain

  $\Delta R = R - R//Rs$ (2): Equation of the change in resistance when the shunt resistance is ON

  In this manual, the parallel equation of resistors are expressed as follows:

  $$R//Rs = \cfrac{1}{\cfrac{1}{R} + \cfrac{1}{Rs}} = \frac{R \times Rs}{R + Rs}$$

  If ΔR is cancelled out from (1) and (2),

Rs=R×(1-K×ε)/(K×ε)   (Equation A): General equation used to calculate the shunt resistance (includes error)

  ε: Strain (strain you wish to generate when the shunt resistance is turned ON)
  K: Gauge factor
  R: Bridge resistance
  ΔR: Resistance change
  Rs: Shunt resistance (shunt resistance you wish to derive)

- **Detailed Equation**

$V_0 = E \times (R_1 \times R_3 - R_2 \times R_4) / \{(R_1 + R_2) \times (R_3 + R_4)\}$

(1): Basic Equation of Wheatstone Bridge

When shunt calibration is ON,

$V_0 = E \times (R_1 \times R_3 - R' \times R_4) / \{(R_1 + R') \times (R_3 + R_4)\}$

(2): Equation when turned ON

$R' = R_2 // Rs$ (3): Equation of combined resistance R'

$R_1 = R_2 = R_3 = R_4 = R$ (4): Since R_1 to R_4 are equal, we represent them as R

Also, from the basic equation of strain,

$V_0 / E = K \times \varepsilon / 4$ (5): Basic equation of strain

If V_0/E and R_1 to R_4 are cancelled out from (2), (3), (4), and (5),

---

Rs = R $\times$ (1 $-$ K $\times \varepsilon$ /2)/(K $\times \varepsilon$)   (Equation B): Detailed equation used to calculate the shunt resistance (no error)

E: Bridge voltage
V_0:   Bridge output voltage
R_1 to R_4:   Bridge resistance (except, $R_1 = R_2 = R_3 = R_4$)
Rs: Shunt resistance (shunt resistance you wish to derive)
R':   Combined resistance when the relay is turned ON (R'=R//Rs)
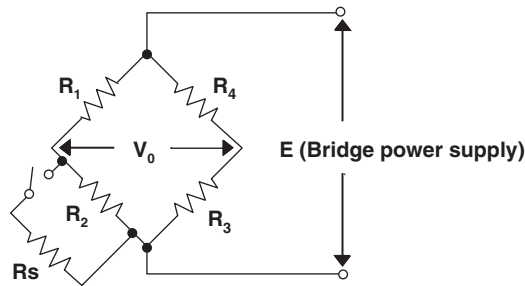
Calculation Example

- **When Determining the Corresponding Shunt Resistance (Rs) from the Strain (ε)**

  Given a gauge factor (K) of 2,

  Detailed equation $Rs = R\times(1-\varepsilon)/(2\times\varepsilon)$ (6)
  (equation B)

  General equation $Rs = R\times(1-2\times\varepsilon)/(2\times\varepsilon)$ (7): Error of 1 to 2% present
  (equation A)

Desired Strain ε (μSTR)	Derived by the Detailed Equation (6) Rs Value (Ω)		Rs value (Ω) Derived by the General Equation (7)	
	R=120 Ω	R=350 Ω	R=120 Ω	R=350 Ω
1,000	59,940	174,825	59,880	174,650
2,000	29,940	87,325	29,880	87,150
5,000	11,940	34,825	11,880	34,650
10,000	5,940	17,325	5,880	17,150

- **When Determining the Corresponding Strain (ε) from the Shunt Resistance (Rs)**

  If we derive e from equation (6) and (7),

  Detailed equation $\varepsilon = 1/(1+2\times Rs/R)$ (8)
  (equation B)

  General equation $\varepsilon = 1/\{2\times(1+Rs/R)\}$ (9): Error of 1 to 2% present
  (equation A)

When the Bridge Resistance R is 120 Ω

RS Value (Ω)	Strain ε (μSTR) Derived by the Detailed Equation (8)	Strain ε (μSTR) Derived by the General Equation (9)
60,000	999	998
30,000	1,996	1,992
12,000	4,975	4,950
6,000	9,901	9,804

When the Bridge Resistance R is 350 W

RS Value (Ω)	Strain ε (μSTR) Derived by the Detailed Equation (8)	Strain ε (μSTR) Derived by the General Equation (9)
180,000	971	970
90,000	1,941	1,937
36,000	4,838	4,814
18,000	9,629	9,537

Appendix

App

Appendix 12 Measurement Principles (Measurement Method and Update Rate) of the Frequency Module

Measurement Principles of the Frequency Module

The measurement principles of period, frequency, pulse width, and duty cycle on the frequency module (701280 (FREQ)) are described below.

Period and Frequency Measurement

The frequency module updates the waveform at a rate of 25 kHz (40-μs interval). The measurement method differs for frequencies above 25 kHz and below 25 kHz.

- When the input signal is less than or equal to 25 kHz, measurement is made as described in (1).
- When the input signal is greater than or equal to 25 kHz, measurement is made as described in (2).
- The sequence of processing described below is performed simultaneously through pipeline processing. Thus, the period (t) and frequency (f) are updated every 40 μs.

(1) When the input signal is less than or equal to 25 kHz

Measures the time of occurrence of the pulse edge (T1) in measurement interval A.
Measures the time of occurrence of the pulse edge (T2) in measurement interval B.
Calculates the period (t) = T2 – T1 in measurement interval C.
The frequency (f) is calculated as 1/period (t).
When the period of the input pulse spans over multiple measurement intervals, computation is performed at the measurement interval following the interval in which the edge is detected.
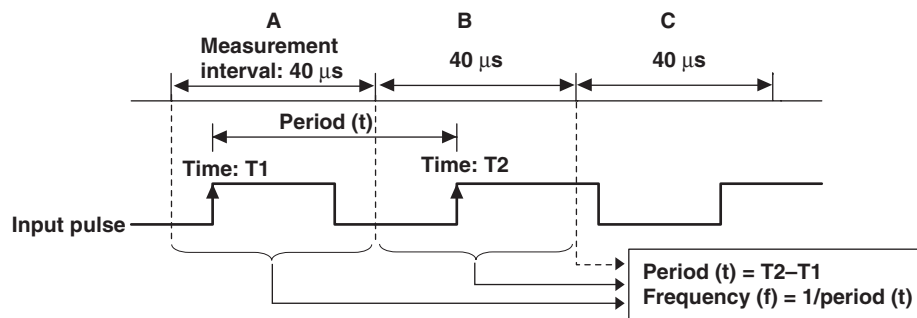
(2) When the input signal is greater than or equal to 25 kHz

Measures the time of occurrence of the last pulse edge (Te1) in measurement interval A.
Measures the time of occurrence of the last pulse edge (Te2) in measurement interval B.
Measures the number of pulses between the last pulse edge in measurement interval A and the last pulse edge of measurement interval B.
Calculates the period (t) = (Te2 – Te1)/the number of pulses in measurement interval C.
Period (t) is the average value of multiple pulses.
The frequency (f) is calculated as 1/period (t).
If the input pulse period is short, the DL750/DL750P automatically takes the average of multiple pulses and calculates the period and frequency. Therefore, the resolution does not degrade even when the input pulse period is short, and highly accurate measurement is possible.
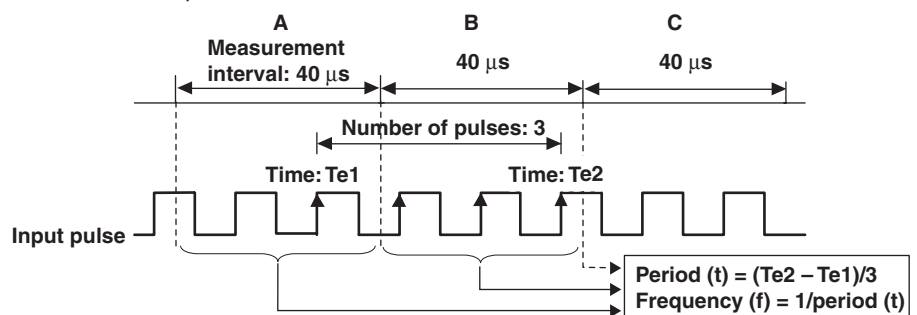
Pulse Width and Duty Cycle Measurement

- When the input signal is less than or equal to 25 kHz, measurement is made as described in (1).
- When the input signal is greater than or equal to 25 kHz, measurement is made from the last waveform in the measurement interval as described in (2).
- The sequence of processing described below is performed simultaneously through pipeline processing. Thus, the period (t) and frequency (f) are updated every 40 μs.

(1) When the input signal is less than or equal to 25 kHz

Measures the times of occurrences of pulse edges (T1, T2, and T3) in measurement intervals A and B.

In measurement interval C:

For pulse width: Calculates pulse width = T2 – T1.
For duty cycle: Calculates duty cycle = (T2 – T1)/(T3 – T1).
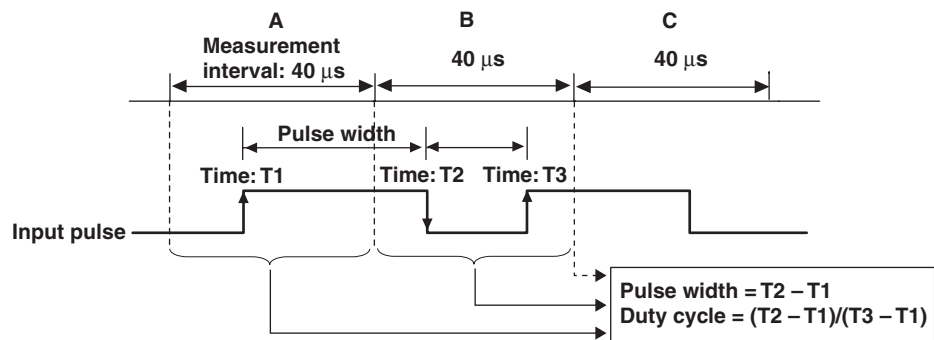
(2) When the input signal is greater than or equal to 25 kHz

Measures the times of occurrences of pulse edges (T1, T2, and T3) in measurement interval A.

In measurement interval B:

For pulse width: Calculates pulse width = T2 – T1.
For duty cycle: Calculates duty cycle = (T2 – T1)/(T3 – T1).

Appendix

App
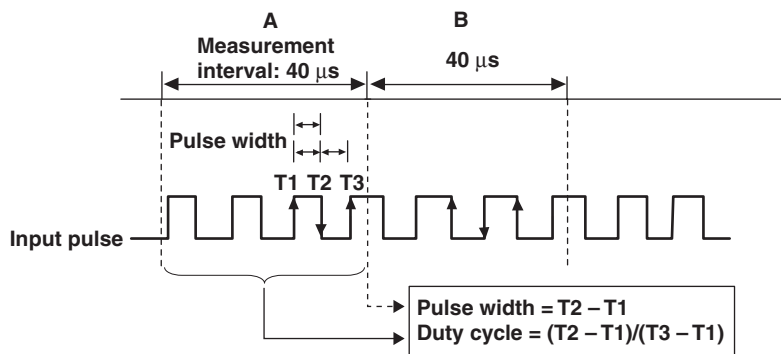
Computation Format (Resolution) of the Frequency Module

The computation flow on the frequency module is indicated below.
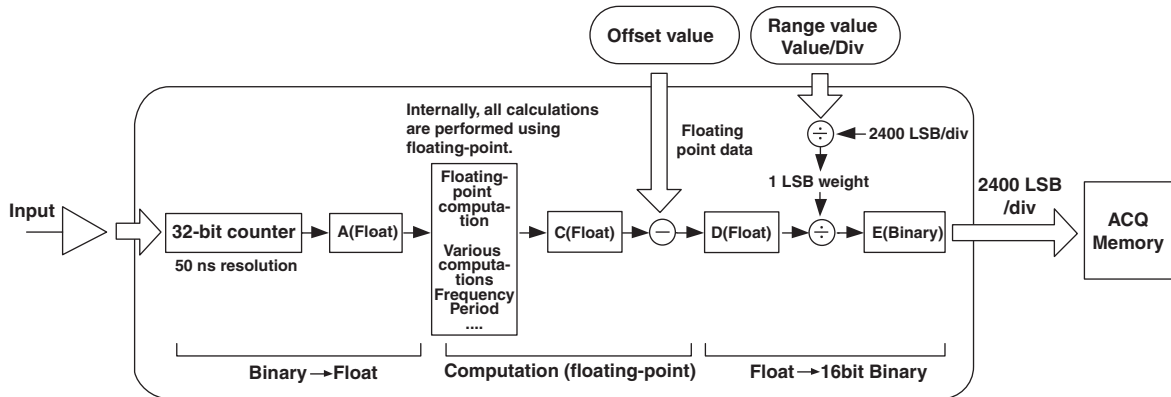
The frequency module measures the period of the input signal using a 32-bit counter of 50-ns resolution. Therefore, the minimum resolution of the counter values is 50 ns. Various computations are performed in floating point format. The data that is output from the frequency module and written to the acquisition memory (ACQ Memory) is 16-bit binary data. The data is converted using a weight of 1 LSB that is determined by Value/div. The data is normalized to 2400 LSB/div when displayed on the screen.

Input: Conversion from the 32-bit Counter Value to Floating Point

Converts the count value obtained using the 32-bit counter with 50-ns resolution to floating point format, and determines period A using the following equation.
Period: A (float) = (count value) $\times$ 50 ns

Computation

Various computations are performed in floating point format based on the settings.
Example)   Frequency: C (float) = 1/A (float)

Calculation of the 1 LSB Weight of the Output

The 1 LSB weight of the output is determined from the range (Value/div).
Since 1 div = 2400 LSB,
1 LSB weight of the output = (Value/div)/2400

Computation Output: Conversion from Floating Point to 16-bit Binary

(When Offset Is 0)

When the offset value is 0, offset calculation is not performed, and C (float) = D (float). The data is converted into 16-bit binary data and written to the acquisition memory (ACQ Memory).
16-bit binary data: E (binary) = D (float)/(1 LSB weight of the output)

Offset Computation

When the offset value is not 0, the offset value is computed in floating point format using the following equation and converted to 16-bit binary data.
D (float) = C (float) – offset value (float)
In offset computation, if the computed result C is equal to the offset value, the output is 0. If the computed result C (float) is less than the offset value, E (binary) is negative.

Filter Characteristics (Time Delay) of the Smoothing Filter

The smoothing filter is a moving average filter in which computation is performed in realtime. The computation interval of moving average is 40 μs (25 kHz). It is constant independent of the sampling rate of the DL750/DL750P.

The moving average order (the number of points of moving average) is specified in time. The maximum value is 25000 order (when set to 1000 ms).

The characteristics of the smoothing filter are as follows:

- The filter is a low-pass filter.
- Pass band is flat.
- Has linear phase characteristics and constant group delay by filter order.
  The group delay is derived using the following equation.
  Group delay = (the number of points of moving average − 1) × 40 μs/2
- Has comb-shaped bandwidth characteristics. (See page app-43.)

The figure below shows the result when the smoothing filter is applied to a waveform that changes in steps. The switching filter setup time follows the step change.

Smoothing filter setup time

Waveform after applying
the smoothing filter

Waveform before applying
the smoothing filter
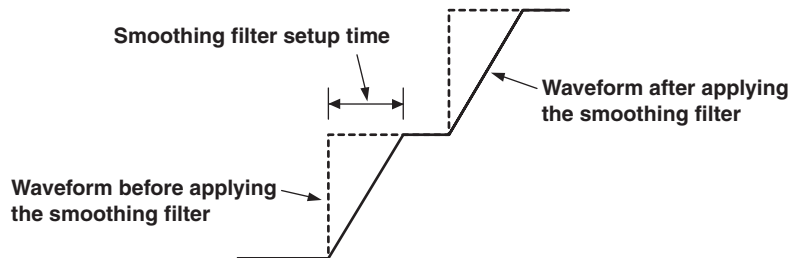
Appendix 13 List of Preset Settings of the Frequency Module

Logic 5V

Setup Item	Setting
V Range	±10 V
Coupling	DC
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	2.5 V
Hys	Yes[3]
Slope	Yes[4]
Chatter Elimination	Yes[5]
Pull Up	No

Logic 3V

Setup Item	Setting
V Range	±5 V (Probe = 1:1)
	±10 V (Probe = 10:1)
Coupling	DC
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	1.5 V
Hys	Yes[3]
Slope	Yes[4]
Chatter Elimination	Yes[5]
Pull Up	No

Logic 12V

Setup Item	Setting
V Range	±20 V
Coupling	DC
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	6 V
Hys	Yes[3]
Slope	Yes[4]
Chatter Elimination	Yes[5]
Pull Up	No

Logic 24V

Setup Item	Setting
V Range	±50 V
Coupling	DC
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	12 V
Hys	Yes[3]
Slope	Yes[4]
Chatter Elimination	Yes[5]
Pull Up	No

Pull-up 5V

Setup Item	Setting
V Range	±10 V
Coupling	DC
Probe	1:1
Bandwidth	Yes[2]
Threshold	2.5 V
Hys	Yes[3]
Slope	Yes[4]
Chatter Elimination	Yes[5]
Pull Up	Yes[6]

ZeroCross

Setup Item	Setting
V Range	Yes[7]
Coupling	AC
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	0 V
Hys	Yes[3]
Slope	Rising edge
Chatter Elimination	Yes[5]
Pull Up	No

When you select a preset, the setup items are automatically set to the settings in the table. The meaning of Yes and No in the table is as follows:

Yes: Item that can be set to an arbitrary value
No: Item that cannot be set (not displayed on the menu)

1. Probe type: Select 1:1 or 10:1.
2. Bandwidth limit: Select 100 Hz, 1 kHz, 10 kHz, 100 kHz, or Full. Full is not selectable for AC100V and AC200V.
3. Hysteresis: Select ±1%, ±2.5%, or ±5%.
4. Slope: Select rising or falling.
5. Chatter elimination: Select from 0 ms to 1000 ms.
6. Pull-up: Select ON or OFF. Selectable only for Pull-up 5V.
7. Voltage range:
     (Probe = 1:1) Select ±1 V, ±2 V, ±5 V, ±10 V, ±20 V, or ±50 V.
     (Probe = 10:1) Select ±10 V, ±20 V, ±50 V, ±100 V, ±200 V, or ±500 V.

AC100V

Setup Item	Setting
V Range	±200 V
Coupling	AC
Probe	10:1
Bandwidth	Yes[2](Full is not allowed)
Threshold	0V
Hys	Yes[3]
Slope	Rising edge
Chatter Elimination	Yes[5]
Pull Up	No

EM Pickup

Setup Item	Setting
V Range	±1 V
Coupling	DC
Probe	1:1
Bandwidth	Yes[2]
Threshold	0 V
Hys	Yes[3]
Slope	Rising edge
Chatter Elimination	Yes[5]
Pull Up	No

AC200V

Setup Item	Setting
V Range	±500 V
Coupling	AC
Probe	10:1
Bandwidth	Yes[2](Full is not allowed)
Threshold	0 V
Hys	Yes[3]
Slope	Rising edge
Chatter Elimination	Yes[5]
Pull Up	No

User

Setup Item	Setting
V Range	Yes[7]
Coupling	Yes[8]
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	Yes[9]
Hys	Yes[3]
Slope	Yes[4]
Chatter Elimination	Yes[5]
Pull Up	No

When you select a preset, the setup items are automatically set to the settings in the table. The meaning of Yes and No in the table is as follows:
Yes: Item that can be set to an arbitrary value
No: Item that cannot be set (not displayed on the menu)

1. Probe type: Select 1:1 or 10:1.
2. Bandwidth limit: Select 100 Hz, 1 kHz, 10 kHz, 100 kHz, or Full. Full is not selectable for AC100V and AC200V.
3. Hysteresis: Select ±1%, ±2.5%, or ±5%.
4. Slope: Select rising or falling.
5. Chatter elimination: Select from 0 ms to 1000 ms.
6. Pull-up: Select ON or OFF. Selectable only for Pull-up 5V.
7. Voltage range:
     (Probe = 1:1) Select ±1 V, ±2 V, ±5 V, ±10 V, ±20 V, or ±50 V.
     (Probe = 10:1) Select ±10 V, ±20 V, ±50 V, ±100 V, ±200 V, or ±500 V.
8. Coupling: Select DC or AC.
9. Threshold level: Set within the specified voltage range.

Appendix 14 TCP and UDP Port Number Used in Ethernet Communications

The TCP and UDP port numbers that are used on the Ethernet interface of the DL750/DL750P are as follows:

TCP Port Numbers

Port Number	Description	Function
20	File Transfer [Default Data]	FTP server, FTP client*, and a portion of the Web server
21	File Transfer [Control]	FTP server, FTP client, and a portion of the Web server
25	Simple Mail Transfer Protocol	SMTP client
80	World Wide Web HTTP	Web server and WebDAV server
515	-	LPR client
10001	-	Instrument control via the Ethernet interface

UDP Port Numbers

Port Number	Description	Function
67	Bootstrap Protocol Server	DHCP client
68	Bootstrap Protocol Client	(receive wait port)
123	Network Time Protocol	SNTP client

* The port number when FTP passive mode (see section 16.10) is turned OFF. If FTP passive mode is turned ON, the port number is arbitrary.
If FTP passive mode is OFF, connection is established from the server. If you are connecting the DL750/DL750P behind a firewall, turn FTP passive mode ON.
For the procedure of changing the FTP passive mode, see section 16.10.

Appendix 15 Relationship between the Chart Speed, Sample Rate, and Record Length during Recorder Mode

The relationship between the chart speed, sample rate, and record length during Chart Recorder mode (see chapter 9) is as follows:

Chart Speed	Sample Rate (S/s)	Record Length (Word)	Maximum Number of Divisions That Can Be Saved	Record Time
20 mm/s	5 k	2.5 M	1000	8.33 min
10 mm/s	2 k	2 M	1000	16.66 min
5 mm/s	1 k	2 M	1000	33.3 min
2 mm/s	500	2.5 M	1000	1.38 h
1 mm/s	200	2 M	1000	2.76 h
100 mm/min	200	1.2 M	1000	1.66 h
50mm/min	200	2.4 M	1000	3.33 h
25 mm/min	100	2.4 M	1000	6.66 h
20 mm/min	50	1.5 M	1000	8.33 h
10 mm/min	20	1.2 M	1000	16.6 h
5 mm/min	20	2.4 M	1000	1.38 day
2 mm/min	5	1.5 M	1000	3.47 day
1 mm/min	5	1.5 M	500	3.47 day
100 mm/h	5	1.8 M	1000	4.16 day
50 mm/h	5	1.8 M	500	4.16 day
25 mm/h	5	1.8 M	250	4.16 day
20 mm/h	5	1.8 M	200	4.16 day
10 mm/h	5	1.8 M	100	4.16 day

The sample rates in the table above are the data acquisition rate to the internal memory when the acquisition mode is set to normal.

If the acquisition mode is set to envelope, the data is acquired at the maximum sampling rate of each input module. Then, the maximum and minimum values are determined over each interval defined by the sample rate in the table above and stored in the internal memory.

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