DL1540C/1540CL

Digital Oscilloscope

USER'S MANUAL

YOKOGAWA
Yokogawa Electric Corporation

IM 701530-01E
2nd Edition

Introduction

Thank you for purchasing the YOKOGAWA DL1540C/DL1540CL Digital Oscilloscope.
This User's Manual contains useful information about the functions and operating procedures of the instrument, mainly DL1540C. It also contains precautions that should be observed during use. Main differences in the specifications between DL1540C and DL1540CL is that DL1540CL allows record length of up to 2M words. Due to these differences, functions and operations differ slightly among these models. For a detailed description, refer to the relevant sections of this manual. To ensure correct use of the instrument, please read this manual thoroughly before operating it.
Keep the manual in a safe place for quick reference whenever a question arises. Two manuals are provided with the instrument in addition to this manual.

Manual Name	Manual No.	Description
DL1540C/1540CL Operation Guide	IM701530-02E	Describes basic operations only.
DL1540C/1540CL Communication Interface User's Manual	IM701530-11E	Describes the communications functions for the GP-IB/RS-232-C interface.

Notes

- The contents of this manual are subject to change without prior notice as a result of improvements in the instrument's performance and functions. Display contents illustrated in this manual may differ slightly from what actually appears on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA representative as listed on the back cover of this manual.
- Copying or reproduction of all or any part of the contents of this manual without YOKOGAWA's permission is strictly prohibited.

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Revisions

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2nd Edition: May 2000

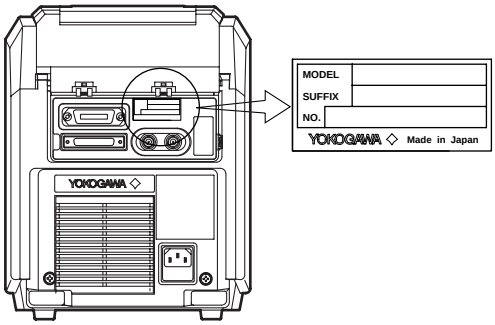
Disk No. DL26
2nd Edition: May 2000 (YK)

Checking the Contents of the Package

Unpack the box and check the contents before operating the instrument. If the wrong instrument or accessories have been delivered, if some accessories are missing or if they appear abnormal, contact the dealer from which you purchased them.

Main Body

Check that the model name and suffix code given on the name plate of the rear panel match those on your order.



MODEL (Type Name)
701530 : DL1540C, 701540 : DL1540CL

SUFFIX (Suffix Code)

Suffix Code		Specifications
Power voltage		100-120 VAC/200-240 VAC
Power cord	-D	UL/CSA Standards Power Cord (Part No.: A1006WD) [Maximum Rated Voltage: 125 V, Maximum Rated Current: 7 A]
	-F	VDE Standard Power Cord (Part No.: A1009WD) [Maximum Rated Voltage: 250 V, Maximum Rated Current: 10 A]
	-Q	BS Standard Power Cord (Part No.: A1054WD) [Maximum Rated Voltage: 250 V, Maximum Rated Current: 10 A]
	-R	SAA Standard Power Cord (Part No.: A1024WD) [Maximum Rated Voltage: 240 V, Maximum Rated Current: 10 A]
Options	/B5	Built-in printer (real-time printing function)
	/E1	With two additional 150 MHz probes (700998)
	/F1	Additional trigger (OR, Pattern, Width)
	/F5*1	I^2C-bus analysis function
	/C8*2	2.1-GB internal HDD
	/V1*2	VGA output

*1 /F5 includes the enhanced trigger function for the DL1540CL.
*2 /V1 and /C8 cannot be specified simultaneously.
Example : DL1540C, UL/CSA standard power cord and full options → 701530-D/B5/E1/F1/V1

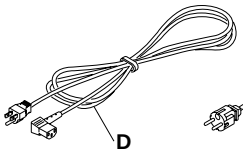
NO. (Instrument No.)
When contacting the dealer from which you purchased your instrument, please quote the instrument No.

Standard Accessories

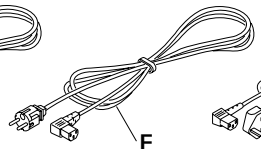
The following standard accessories are supplied with the instrument. Make sure that all items are present and undamaged.

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

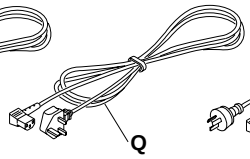
UL/CSA standard
A1006WD



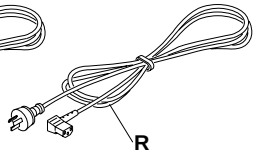
VDE standard
A1009WD



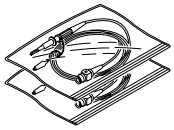
BS standard
A1054WD



SAA standard
A1024WD



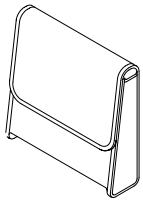
150MHz probe
(10:1, 1:1 selectable)(x2)[*1]
700998



Printer roll chart[*2]
B9850NX

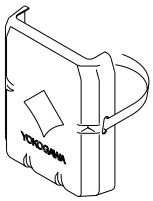
Rubber feet(x4)
A9088ZMx2

Soft case
B9918EZ

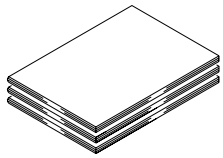


Power supply fuse
(in fuse holder)
A1351EF

Front cover
B9957DG



User's manual (this manual) (x1)
Communication interface manual (x1)
Operation guide (x1)



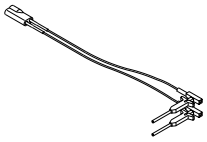
*1 For DL1540C/DL1540CL, a total of four passive probes are supplied (if the two optional probes are included).

*2 A roll chart will be supplied only when the instrument is equipped with a built-in printer.

Optional Accessories

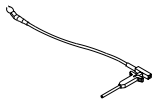
The following optional accessories are available. On receiving these optional accessories, make sure that all the items that you ordered have been supplied and that they are undamaged.
If you have any questions regarding optional accessories, or if you wish to place an order, contact the dealer from whom you purchased the instrument.

Mini-clip convertor B9852CR



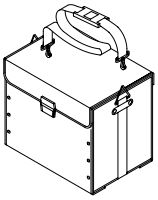
BNC adapter B9852CS

Ground lead B9852CT

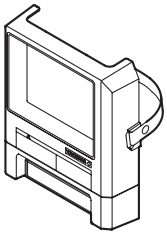


50 Ω Through terminator 700976

Carrying case 700915



Front cover (clear type) 700917



Optional Spare Parts

The following optional spare parts are available. On receiving these optional spare parts, make sure that all the items that you ordered have been supplied and that they are undamaged.
If you have any questions regarding optional spare parts, or if you wish to place an order, contact the dealer from whom you purchased the instrument.

Part Name	Part No.	Minimum Q'ty	Remarks
150 MHz probe (10:1, 1:1 selectable)	700998	1	Input impedance: 10 MΩ, Length: 1.5 m
Roll chart	B9850NX	5	Thermo-sensible paper, Total length: 30 m
Power supply fuse	A1351EF	2	Time lag, 3.15 A, 250 V

Note

It is recommended that the packing box be kept in a safe place. The box can be used when you need to transport the instrument somewhere.

Safety Precautions

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

The following symbols are used on this instrument.


To avoid injury, death of personnel or damage to the instrument, the operator must refer to an explanation in the User's Manual or Service manual.


Function Grounding Terminal (This terminals shold not be used as a "Protective grounding terminal".)


Alternating current

ON(power)


OFF(power)


In-position of a bistable push control


Out-position of a bistable push control

WARNING

Power Supply
Ensure the source voltage matches the voltage of the power supply before turning on the power.

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

Protective Grounding
Make sure to connect the protective grounding to prevent an electric shock before turning on the power.

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

Defect of Protective Grounding and Fuse
Do not operate the instrument when protective grounding or fuse might be defective.

Fuse
To prevent a fire, make sure to use fuses with specified standard (current, voltage, type). Before replacing the fuses, turn off the power and disconnect the power source. Do not use a different fuse or short-circuit the fuse holder.

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

Do not Remove any Covers
There are some areas with high voltage. Do not remove any cover if the power supply is connected. The cover should be removed by qualified personnel only.

External Connection
To ground securely, connect the protective grounding before connecting to measurement or control unit.

How to Use this Manual

Structure of the Manual

This User's Manual consists of 16 chapters, an Appendix and an Index as described below.

Chapter	Title	Description
1	**Functions**	Describes measurement principles and functions. Although this section does not give a description of the operating methods, it will help you to understand the basic operations.
2	**Name and Use of Each Part**	Gives the name of each part and describes how to use it. The corresponding reference pages for panel keys and the rotary knobs are also given.
3	**Before Starting Observation and Measurement of Waveforms**	Describes points to watch during use and describes how to install the instrument, connect the power cord, turn the power switch ON/OFF and connect probes as well as how to set the date and time.
4	**Common Operations**	Describes the operations used to make settings, such as start/stop acquisition, auto set-up and initialization of each setting as well as operations, such as snapshot, clear trace and calibration, that are used frequently during operation.
5	**Setting the Vertical and Horizontal Axes**	Describes how to turn channels ON/OFF, how to make settings, such as input coupling, probe attenuation and vertical sensitivity, that are related to the vertical axis (voltage axis), as well as how to make settings related to the horizontal axis (time axis).
6	**Activating a Trigger**	Describes trigger setting operations, such as those for setting trigger mode, trigger type, trigger source and trigger level, that enable you to determine acquisition timing.
7	**Changing Acquisition and Display Conditions**	Describes how to make acquisition condition settings, such as acquisition mode, sampling mode, input filter and hysteresis, as well as how to make display condition settings, such as waveform expansion, interpolation, accumulation, X-Y display and graticule.
8	**Analyzing Waveforms**	Describes how to measure waveforms using cursors, performautomatic measurement of waveform parameters and waveform math, and how to display the power spectrum obtained by FFT computation.
9	**Performing a GO/NO-GO Action**	Describes how to perform a GO/NO-GO action by setting the waveform zone or setting limits for waveform parameters, then detecting whether the input signal waveform is within the specified range (zone or limits).
10	**Outputting Displayed Waveforms and Setting Parameters to the Printer/Plotter**	Describes how to output displayed waveforms (screen hardcopy) and set-up information to the built-in printer or plotter connected to the GP-IB interface.
11	**Storing and Recalling Data from the Internal Memory**	Describes how to store displayed waveforms or settings in the internal memory, how to recall stored waveform data and display the waveforms, and how to recall settings and change them.
12	**Saving and Loading Data from a Floppy Disk**	Describes how to save waveform data or set-up data to a floppy disk, how to load saved data, how to initialize a floppy disk and how to delete data.
13	**Saving and Loading Data from a SCSI Device or the Internal Hard Disk**	Describes how to save the waveform data or set-up data to the SCSI device or the internal hard disk. Describes how to load the saved data, initialize the disk, delete the data, and other operations.
14	**Other Operations**	Describes operations such as those required for trigger output.
15	**Troubleshooting, Maintenance and Inspection**	Describes how to diagnose the cause of trouble and how to correct it, as well as describing each message that may appear on the screen and how to perform a self test.
16	**Specifications**	Describes the specifications.
	Appendix	Shows a menu map, describes the relationship between the time axis, sample rate and record length, and describes the data format which must be specified when waveform data is saved.
	Index	Important terms used in this manual with corresponding reference page numbers are given.

Conventions Used in this Manual

Unit

k ..... Denotes “1000”. Example: 100kS/s

K ..... Denotes “1024” or “1002”.

- Example of when K indicates “1024” : 640 KB (storage capacity of a floppy disk)
- Example of when K indicates “1002” : 100 KW (record length for acquisition memory)

Used Characters

Alphanumerics enclosed in double quotation marks usually refer to characters and set values that appear on the screen and panel.
The SHIFT + xxx key refers to first pressing the SHIFT key (the indicator above the SHIFT key lights), and then pressing the xxx key to obtain another, specified, function.

Symbols Used

The following symbol marks are used in this User's Manual.

To avoid injury or death of personnel, or damage to the instrument, the operator must refer to the User's Manual. In the User's Manual, these symbols appear on the pages to which the operator must refer.

WARNING Describes precautions that should be observed to prevent the danger of serious injury or death to the user.

CAUTION Describes precautions that should be observed to prevent the danger of minor or moderate injury to the user, or the damage to the property.

Note Provides information that is important for proper operation of the instrument.

Symbol Marks Used for Descriptions of Operations

The following symbol marks are used in Chapters 3 to 14 to distinguish certain feg|ures in descriptions.

Relevant Keys Indicates the relevant panel key which are necessary to carry out the operation.

Operating Procedure Carry out steps in the order shown. The operating procedures are given with the assumption that you are not familiar with the operation. Thus, it may not be necessary to carry out all the steps when changing settings.

Keys and Procedure Shows the above mentioned relevant keys and the operating procedure in one block.

Explanation Describes settings and restrictions relating to the operation. A detailed description of the function is not provided. For a detailed description of the function, refer to Chapter 1.

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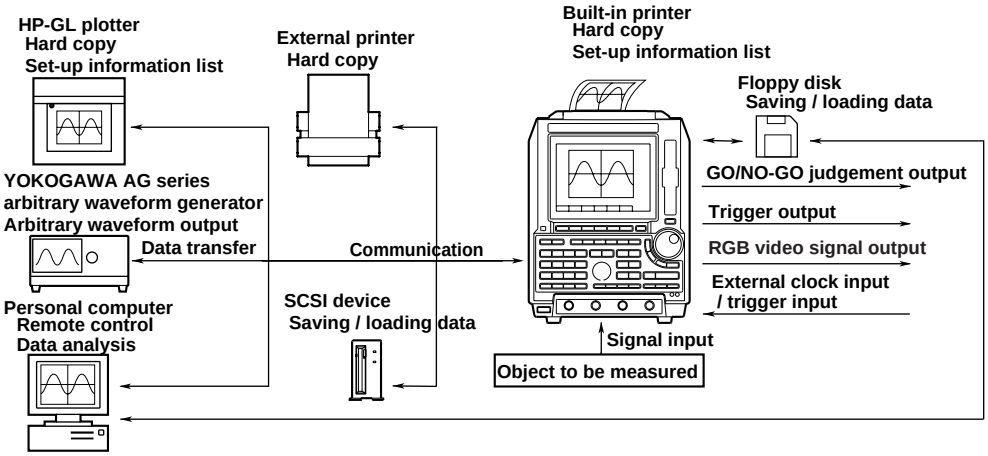
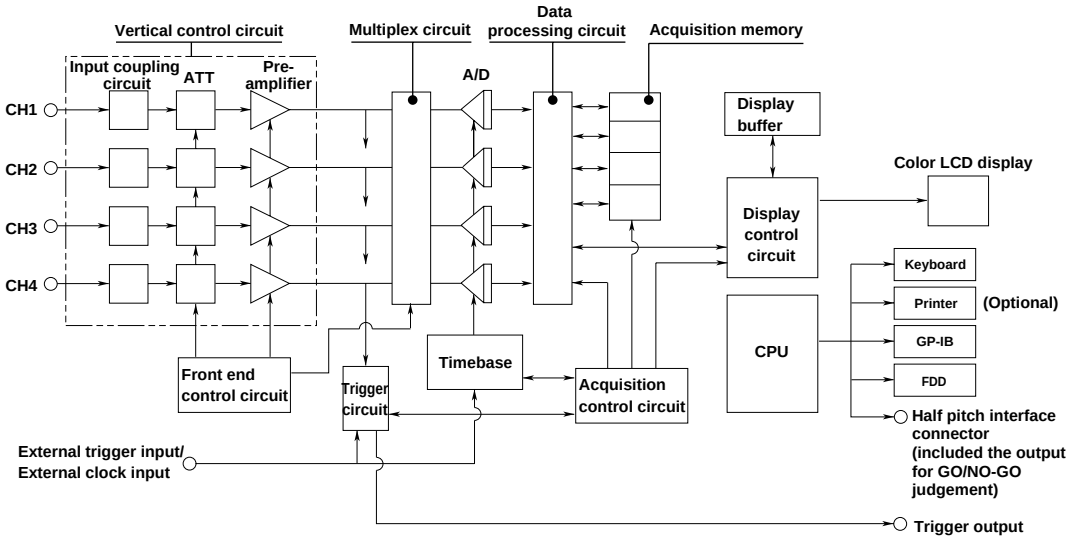
1.1 System Configuration and Block Diagram

System Configuration



Block Diagram



Signal Flow

A signal input via the input terminal is sent to the vertical control circuit. The vertical control circuit consists of an input coupling circuit, attenuator (ATT) and pre-amplifier, and it adjusts the voltage and amplitude of the signal according to the input coupling, probe attenuation, vertical sensitivity and offset voltage settings, before sending the signal to the multiplex circuit. The signal will then be sent to the A/D converter matching settings such as time axis and so on. The A/D converter samples the signal at a sample rate of 100 MS/s to convert it to digital data. The digital data is then stored in the acquisition memory by the data processing circuit at a sample rate which matches the time axis setting.

The data sent out from the acquisition memory by the data processing circuit is then processed according to the invert waveform and averaging settings, then subjected to interpolation and P-P compression (to obtain the maximum/minimum values within each specified intervals), then converted into display data by the display control circuit and finally memorized in the waveform display buffer.

The data read from the waveform display buffer and non-waveform display data read from the graphic display buffer are combined, and the combined image is displayed on the color LCD display.

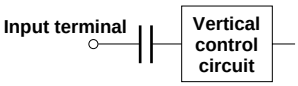
1.2 Setting the Vertical and Horizontal Axes

Input coupling ≡ page 5-2. ≡

When you only want to observe the amplitude of an alternating current signal, or when you just want to observe the signal relative to a given reference voltage, eliminating the direct current components from the input signal makes observation easier. You may also want to check the ground level or observe the input signal waveform with the offset voltage removed. In this case, you can change the input coupling setting. This will switch the coupling method, which determines how the input signal is input to the vertical control circuit (voltage axis).
The input coupling method can be chosen from the following.

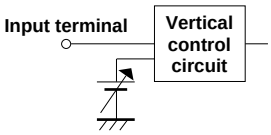
AC

The input signal is sent through a capacitor to the attenuator in the vertical control circuit. This method can be used when you just want to observe the amplitude of the alternating current signal, eliminating the DC components from the input signal, or when you want to observe the signal relative to a given reference voltage.



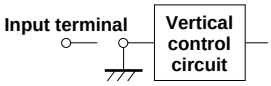
DC

The input signal is sent directly to the attenuator in the vertical control circuit.
This method can be used when you want to observe both the DC and AC components of the vertical input signal. This method also enables observation of the input signal with the offset voltage (DC voltage) eliminated. This function is useful when you want to observe ripples in a DC output signal.



GND

The ground signal, not the input signal, is connected to the attenuator in the vertical control circuit. This method enables observation of the ground level on the screen.



Probe Attenuation ≡ page 5-4. ≡

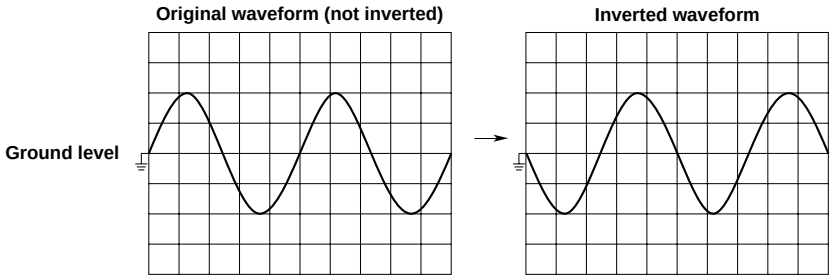
A probe is usually used to connect the circuit to be measured to an input terminal. Use of a probe provides the following advantages.

- the voltage and current of the circuit to be measured are not disturbed;
- a signal can be input without distortion;
- the measurement voltage range of the oscilloscope can be widened.

A 150 MHz passive probe is supplied with the instrument. The probe attenuates the input signal by 1/10. When a probe is used, the probe attenuation must match the instrument's attenuation setting so that the input voltage can be measured directly. Set the instrument's attenuation to 10:1 if the supplied probe is to be used.
In addition to 10:1, attenuations of 1:1, 100:1 and 1000:1 are provided. When you use a probe other than the one supplied with the instrument, set the instrument's attenuation so that it matches the probe's attenuation.

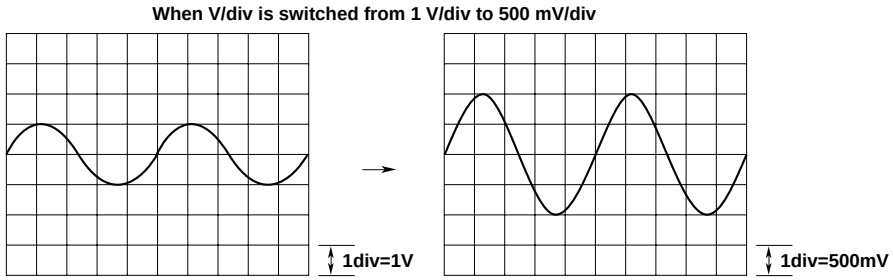
Inverted Waveform Display ≡ page 5-5. ≡

The voltage axis is inverted about the ground as shown below, and the waveform is displayed. In other words, + voltage is converted to – voltage and – voltage to + voltage.



Vertical sensitivity ≡ page 5-6. ≡

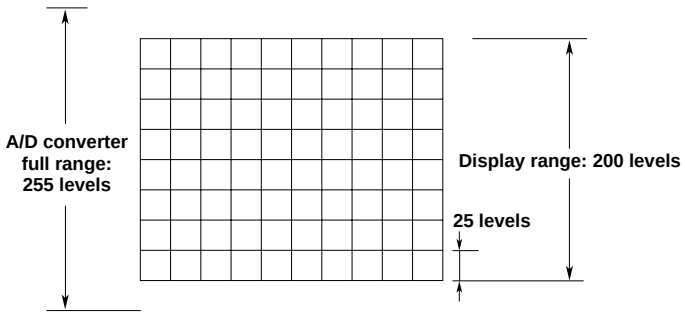
The V/div (vertical sensitivity) setting is used to adjust the amplitude of the displayed waveform so that the waveform can be observed easily.
The V/div setting is made by setting the voltage value per division on the screen grid. The set-up value for the vertical sensitivity is displayed according to the probe's attenuation setting.
The V/div setting can be either "VAR" or "CAL". In case of the "CAL" setting, attenuators with different attenuation rates are used to change the vertical sensitivity, which then changes in steps of 1 V/div → 2 V/div → 5 V/div.
In case of the "VAR" setting, fine adjustment of the sensitivity set under the "CAL" setting can be performed. The setting range is approximately 0.4 to 2.5 times the value of the "CAL" setting. Digital data are taken from the "CAL" setting and after calculating they will be displayed at the "VAR" setting. The measurement accuracy of the voltage axis using the "VAR" setting however, is the same as the measurement accuracy set at the "CAL" setting.



Note

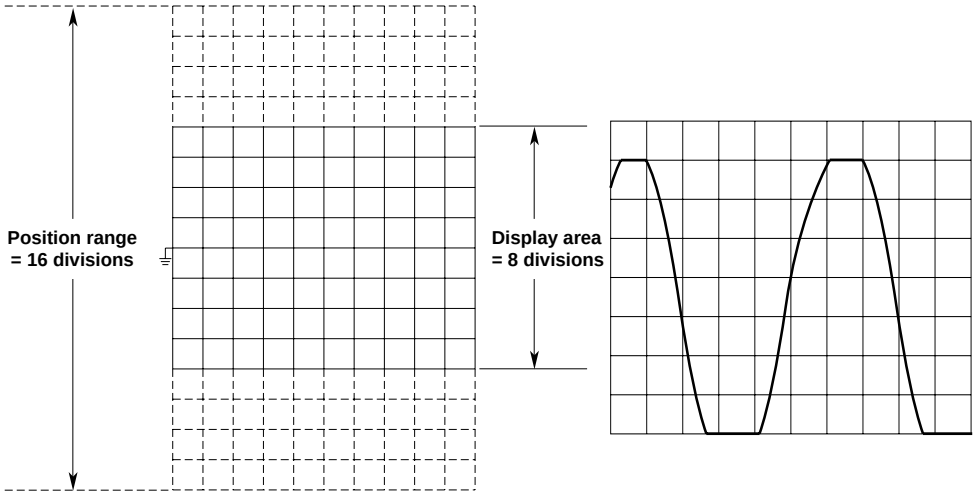
Vertical sensitivity setting and measurement resolution

For accurate voltage measurement, set the V/div so that the maximum amplitude of the displayed waveform is displayed using the full height of the screen (8 divisions).
The instrument uses an 8-bit A/D converter to sample the input signal with a resolution of 255 levels. When displaying a waveform, 25 levels are used for each division of the grid. Thus, in normal display mode (not expansion display mode), the full range (255 levels) of the A/D converter is equivalent to 10.24 div.
From this, it can be understood that increasing the V/div setting decreases the voltage per div (25 levels), thereby increasing the display (measurement) resolution.



Vertical Position of the Waveform ≡ page 5-7. ≡

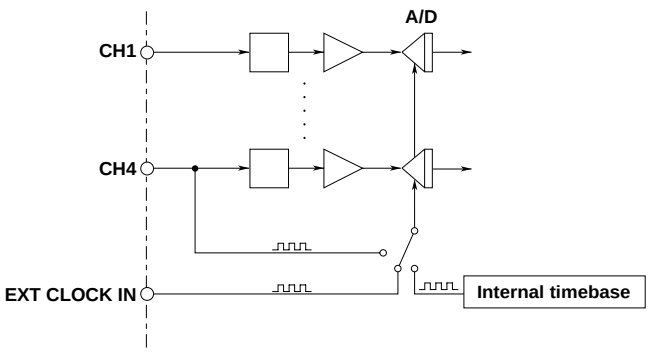
Since a total of four input waveforms can be displayed, they may overlap each other, making observation difficult. In this case, the waveforms can be moved in the vertical direction so that they can be observed more easily.
Furthermore, full scale in the vertical direction is eight divisions of the grid as mentioned earlier, and the voltage display range is eight times the vertical sensitivity setting (voltage value per division). Thus, increasing the vertical sensitivity results in a narrower voltage display range. However, this function allows the ground level (0 V level) to be shifted up and down up to four divisions from the center of the waveform frame, so that observation of waveforms is possible over the entire voltage display range (V/div value x 16 divisions). This is because the input voltage range of the A/D converter shifts due to the change in the frame position. However, when acquisition is stopped and displayed waveforms are not updated, the input voltage range does not shift even if the frame position is moved. As a result, acquisition within a voltage display range exceeding 10.24 divisions (that is, equivalent to the full range of the A/D converter) becomes impossible, thereby resulting in a discontinuous waveform
as shown on the right.



Time Axis ≡ pages 5-8 and 5-10. ≡

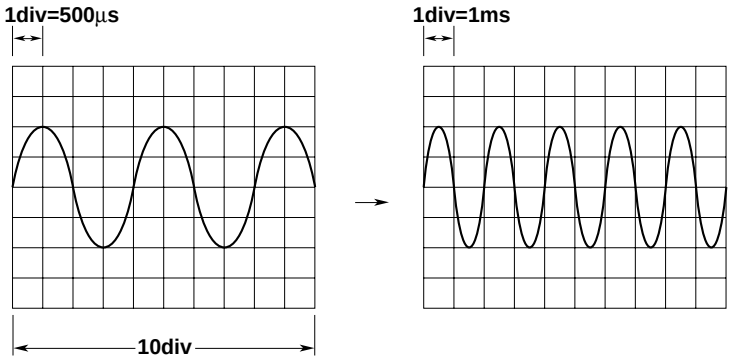
Selection of the timebase

With the default settings, sampling timing is controlled by the clock signal output from the timebase circuit of the instrument (refer to the Block Diagram, page 1-1). The sampling timing can be controlled by an external clock signal instead of the clock signal from the timebase circuit.
For DL1540C/DL1540CL, an external clock signal can be input to the CLOCK IN terminal on the rear panel or to the CH4 input terminal. When an external clock is input to the CLOCK IN terminal, the clock must be of TTL level, however up to four waveforms can be observed at the same time. On the other hand, if an external clock is input to the input terminal, the clock can be of the same signal level normal input signals. This also allows you to check the clock signal waveform before observing the desired waveform.
This external clock function is useful when you are observing a signal whose period varies or when you are observing a waveform by synchronizing it with the clock signal to be measured.



Setting the time axis

When using the internal clock, set the time axis scale as a time duration per division of the grid (T/div). The setting range is 2 ns/div to 50 s/div. The time range in which waveform is displayed is “time axis setting x 10”, as the display range along the horizontal axis is 10 divisions.



Note

Display of time axis direction

The sampled data is read into the acquisition memory, and a waveform is displayed based on this data. The number of data stored into the acquisition memory differs depending on settings such as time axis settings, trigger mode, and acquisition mode.

The number of display points in the time axis direction on a 10-div screen is 501 points (i.e. 50 points per division). Thus, the number of displayed points and record length might slightly differ and this will be treated as follows (for more details on the relation between time axis, trigger mode, acquisition mode, record length of acquisition memory and displayed record length, refer to Appendix 2).

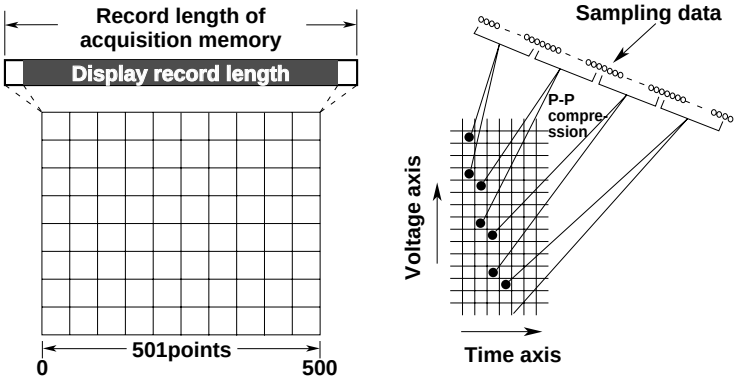
• When the record length is too long

The data is displayed in the time axis direction after first being compressed per one division. Depending on the time axis settings, there will be times when all data of full record length of the acquisition memory can be displayed, and times when the data can only be displayed partially. The part which does not appear on your screen, can be viewed by moving the horizontal position of the waveform (refer to page 1-7).

• When the record length is too short

The missing data will be interpolated (refer to page 1-15).

* Record length is expressed in units of words. One word refers to one point of sampled data. For example, 10 KW means 10020 points. (K represents 1002.)



Relationship between the time axis setting, sample rate and record length

If you change the time axis setting, the sample rate and the record length of the acquisition memory changes too. This is because a linear relation exists between “record length of the acquisition memory” and “time required for acquisition of all data x sample rate”. For more detailed information, refer to Appendix 2/Appendix 3.

Relationship between time axis setting and sampling mode

The sampling method (sampling mode) for an input signal changes according to the time axis setting as described hereafter.

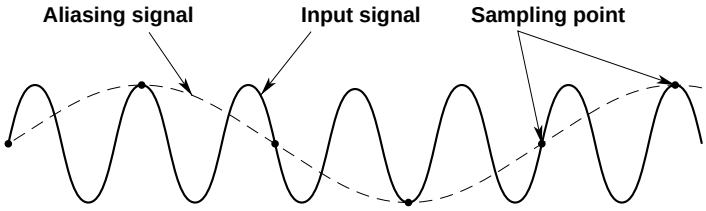
For T/div settings in the range between 5 μs/div and 100 ns/div, it is possible to switch real-time sampling area to repetitive sampling area. But, for DL1540CL, note that the time axis range over which this feature is actually available will vary according to the maximum displayable record length, as shown in Appendix 3.

• **"50s/div to 100 ns/div"** → Real-time sampling mode

When changing the time axis settings, the sample rate will change and sampling can be performed at a sample rate of maximum 200 MS/s (or 100 MS/s when ch. 3 and 4 are also used). The input signal is sampled sequentially, and data is stored in the acquisition memory.

In this mode, the waveform can only be displayed correctly at frequencies up to half the sample rate, due to Nyquist's theorem*. Sample rate is expressed in S/s (number of samples per second). Thus, this mode is suitable for observation of a waveform which fluctuates more slowly than the sample rate.

* If the sample rate is later than the frequency of the input signal, high frequency components will be lost. In this case, a phenomenon in which high frequency components change to lower frequency components occurs, due to Nyquist's theorem. This phenomenon is called aliasing.



• **50 ns/div to 5 ns/div → Repetitive sampling mode**

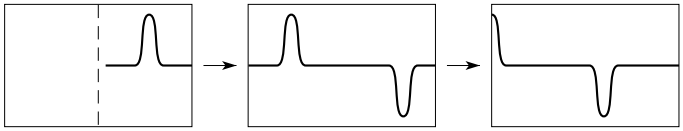
If T/div is set so that the sample rate exceeds 200 MS/s (or 100 MS/s), the sampling mode is switched to the repetitive sampling mode automatically. In this mode, sampling is performed only once for each cycle of a repetitive signal and several cycles are needed to form a waveform. It appears as if the signal is sampled at a sample rate higher than the actual rate. An apparent sample rate of up to 20 GS/s can be used. However, the maximum observable frequency is 150 MHz due to the instrument's frequency characteristics. With DL1540CL, it is not possible to set T/div if the maximum display record length is 400 KW or more.

There are two repetitive sampling methods: sequential sampling, in which a signal is sampled sequentially at a fixed interval, and random sampling, in which a signal is sampled at random to produce a waveform. This instrument uses a random sampling method which also enables observation of the waveform up to the trigger point.

Time axis setting and roll mode display

If trigger mode (described on page 1-10) is set to auto-mode or auto-level mode, and T/div is set between 50 ms/div and 50 s/div, the display will not be updated by trigger anymore (update mode), but the mode will switch to roll mode when new data is acquired. In roll mode, the oldest data is deleted, and the waveform shifts from right to left on the screen. A waveform can be observed in the same way as it is recorded on a pen recorder. This mode is useful when you are observing a signal which repeats or which fluctuates slowly. This mode is also useful when you want to detect glitches (fast spikes on a waveform) which occur intermittently. With DL1540CL, the time axis range for roll mode varies depending on the maximum display record length. Refer to Appendix 3.

* Roll mode is also turned on when trigger mode is switched to single (short/long) mode, but the displayed waveform stops when a trigger is activated since trigger setting is effective in single (short/ long) mode.



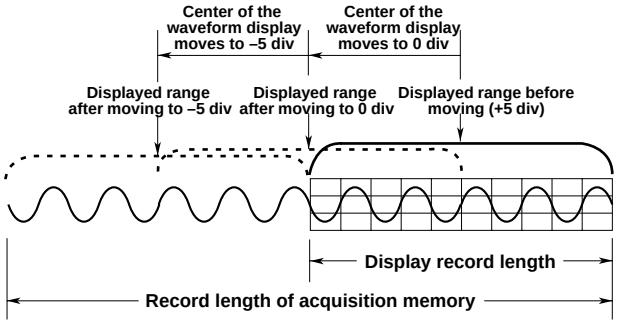
Horizontal Position of the Waveform ≡ page 5-12 ≡

In case you acquired more data than can be displayed on one (10 div) screen (i.e. the record length* of the acquisition memory is longer than the record length of one screen), then you can view the data by moving the display position in the time axis direction. This might be the case when using the roll mode display or when the trigger mode is set to single long mode (for DL1540C). The displayed waveform can be moved over a span of +/- 5 div from the center of the screen.

* For more details on the relation between record length of acquisition memory and displayed record length, refer to page 1-5, Appendix 2 and Appendix 3.

Moving the horizontal position

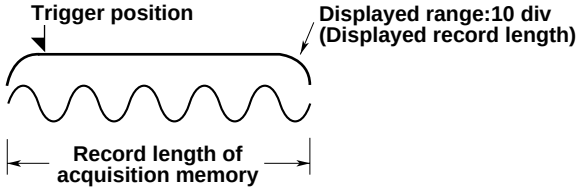
In roll mode, the display position can be moved after data acquisition is stopped. If the instrument is in a mode other than roll mode, the display position can be moved even during data acquisition. The following example shows how the display position is moved in roll mode.



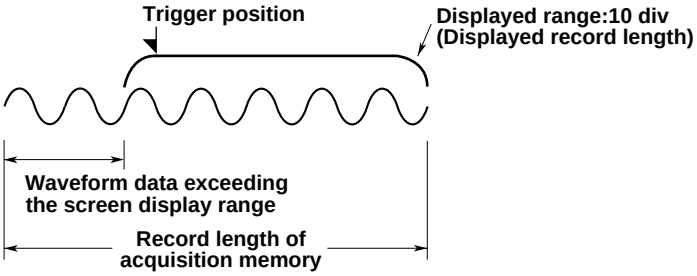
Note

Relationship between the display range on the screen and the display record length, acquisition memory's record length and trigger position (see page 1-11) is given below.

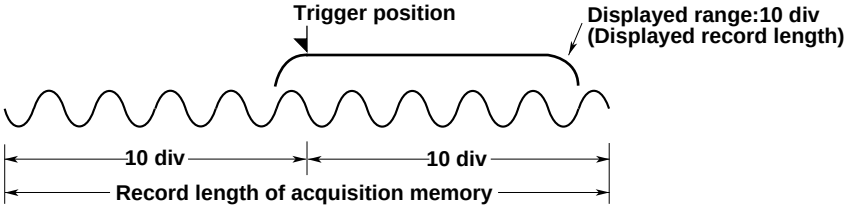
- **Display range on the screen = Acquisition memory's record length**
  The entire waveform data saved in the acquisition memory can be displayed without the need for moving the horizontal position of the waveform.



- **Display range on the screen x 2 > Acquisition memory's record length > Display range on the screen**
  Waveform datas which are out of the display range on the screen are acquired in the acquisition memory (up to 10 div) located before (on the left of) the trigger position. The part which is out of the display range on the screen can be displayed by adjusting the horizontal position of the waveform as described earlier.



- **Display range on the screen x 2 = Acquisition memory's record length > Display range on the screen**
  When the length of the waveform data acquired in the acquisition memory located before (on the left of) the trigger position exceeds 10 div, waveform data will be acquired in the acquisition memory located after (on the right of) the trigger position. Waveform data of up to 20 div is acquired. The part which is out of the display range on the screen can be displayed by adjusting the horizontal position of the waveform as described earlier.



1.3 Setting a Trigger

Trigger Type / Trigger Source / Trigger Level ≡ pages 6-1 to 6-11. ≡

Trigger type : Selects the type of trigger. The following types are available as described below: Edge trigger, TV trigger and window trigger. Furthermore, the OR trigger, pattern trigger and width trigger are available as an option.

Trigger source : Selects the signal for the selected trigger type.

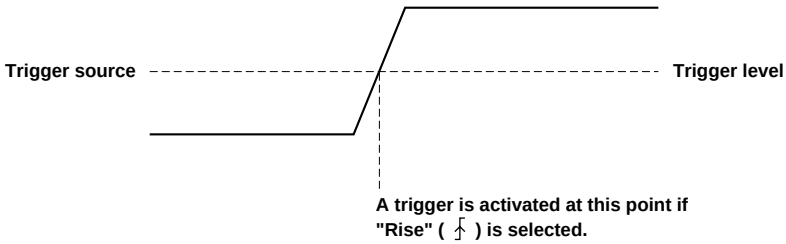
Trigger level : Sets the voltage level used to judge trigger conditions such as trigger slope (rise/fall of a signal) and trigger state (high/low level).

Edge trigger → page 6-2.

The edge trigger is the simplest type of trigger and uses a single trigger source to activate a trigger. A trigger is activated when the trigger source exceeds (rises above) or drops (falls) below the preset trigger level*.

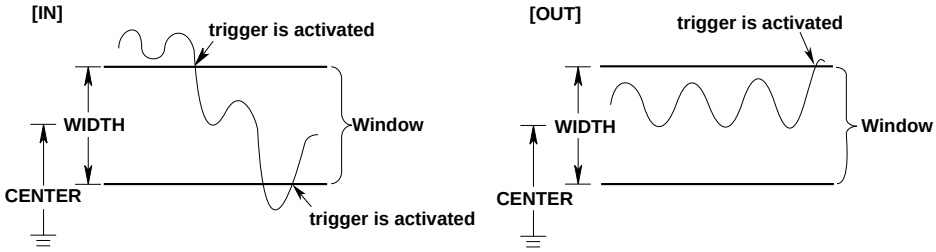
In addition to input signals (CH1 to CH4), the external trigger input signal and the commercial power supply signal can be used as a trigger source.

* "A trigger is activated" refers to the condition in which trigger conditions are satisfied and a waveform is displayed.



Window Trigger → page 6-4.

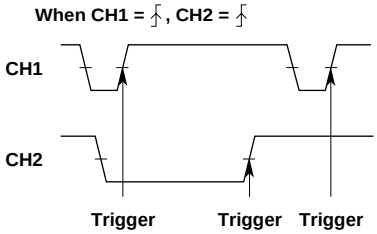
A certain voltage range (window) is set and a trigger is activated when the trigger source level enters this voltage range (IN) or exits from this voltage range (OUT).



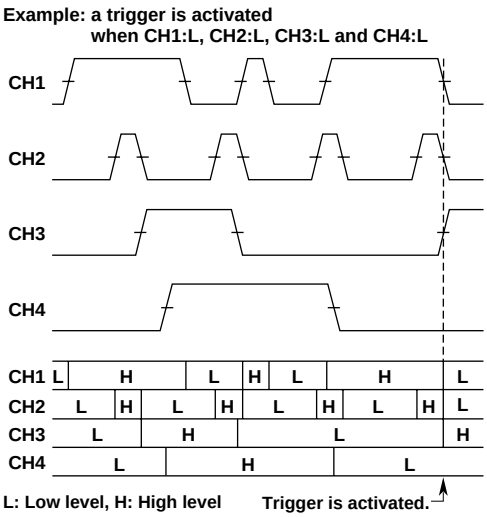
TV Trigger → page 6-5.

The TV trigger is used when you are observing a video signal, and is compatible with NTSC, PAL and HDTV broadcasting systems.

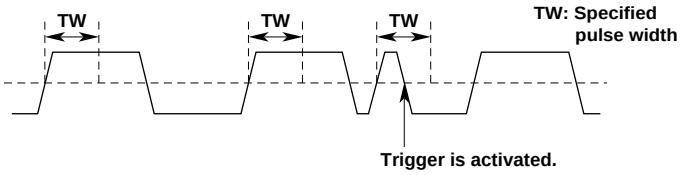
OR Trigger (option) → page 6-8.
Multiple trigger sources are selected, and a trigger is activated when one of the trigger conditions set for each trigger source becomes true. Trigger conditions are established by setting the trigger slope.



Pattern trigger (option) → page 6-9.
Multiple trigger sources are selected, and a trigger is activated when all of the trigger conditions set for each trigger source become true or false. Trigger conditions are established by setting combinations of the state (High or Low) of each trigger source.
Furthermore, one of the trigger sources can be used as the clock signal, and triggering is synchronized with this clock signal.



Width trigger (option) → page 6-11.
If the pulse width of a trigger source is narrower or wider than some specified time, then a trigger is activated accordingly.
A trigger can also be activated by a single trigger source.

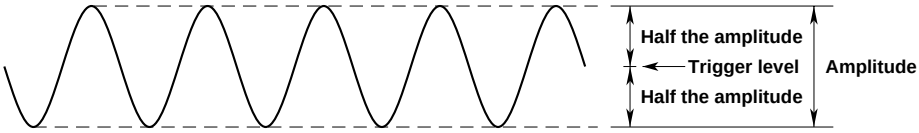


Trigger Mode ≡ page 6-13. ≡

Conditions for updating displayed waveforms are set. The following six types of trigger mode are available.

Auto-mode
Displayed waveforms are updated each time a trigger is activated within a specified time (approximately 100 ms, referred to as the time-out period) and are updated automatically after each time-out period.

Auto-level mode
Waveforms are displayed in the same way as in Auto-mode if a trigger is activated within the time-out period. If no trigger is activated, the center value of the amplitude of the trigger source (page 1-7) is detected and the trigger level is changed automatically to this center value, then a (edge) trigger is activated to update the displayed waveforms.

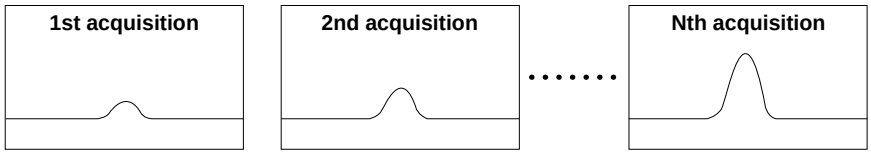


Normal mode
Displayed waveforms are updated only when a trigger is activated. Displayed waveforms will not be updated if no trigger is activated.

Single (short) mode
When a trigger is activated, displayed waveforms are updated only once, then acquisition stops. This mode is useful when you are observing a single-shot signal. (Called single-shot mode for DL1540C, and single mode for DL1540CL)

Single long mode
As with the single (short) mode, when a trigger is activated, displayed waveforms are updated only once, then acquisition stops. However, the length of acquired data is longer in this mode (up to 120 K words). This mode is available only with DL1540C.

Single (N) mode
This mode is useful when using the sequential store function (refer to page 1-14). Waveforms are acquired and stored in different memory areas each time a trigger is activated, then acquisition stops, and the waveforms are displayed. Acquisition is performed the specified number of times. Acquired waveforms can be displayed together, or they can be displayed individually. This mode is useful when you want to detect a sudden abnormality in a waveform.



Action-On Trigger ≡ page 6-15. ≡

The displayed waveform can be output to the optional built-in printer or saved to a floppy disk each time a trigger is activated.

Trigger Coupling ≡ page 6-17. ≡

Input coupling can also be switched for trigger sources as it is for input signals. Select the type of input coupling which is most suitable for the trigger source signal. The following two types of input coupling are available for trigger source signals.

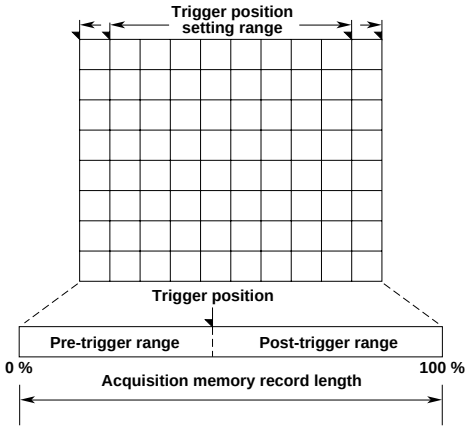
- DC : The trigger source signal is used as the trigger source without any process.
- AC : The trigger source signal is used as the trigger source after DC the content has been removed from it. A trigger can always be activated if the trigger level is set to 0 V as long as the signal's amplitude is one division or more.

HF Rejection ≡ page 6-17. ≡

Set HF rejection to ON when you want to remove high frequencies exceeding 15 kHz from the trigger source. This prevents a trigger from being activated unexpectedly due to high frequency noise.

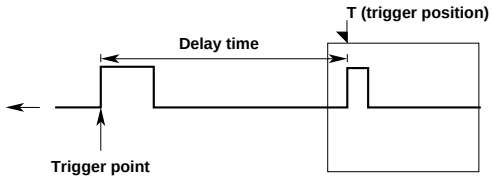
Trigger Position ≡ page 6-18. ≡

The trigger position indicates which position of the waveform in the acquisition memory will actually be displayed on the screen. The trigger position can be moved on the display from the center (0 div) to +/-4 div, which enables observation of the waveform up to the trigger point (the pre-trigger section). You can also set the trigger position in the range of +/-5div in steps of 1/50 div. The trigger point refers to the point at which a trigger is activated. In case the trigger delay (to be explained here after) is set to 0s, the trigger point and the trigger position refer to the same location.
Observation of the waveform up to the trigger position is made possible by constantly storing sampled data in the acquisition memory (i.e. removing the oldest data each time new data is acquired), retaining data in the memory and displaying it on the screen each time a trigger is activated.



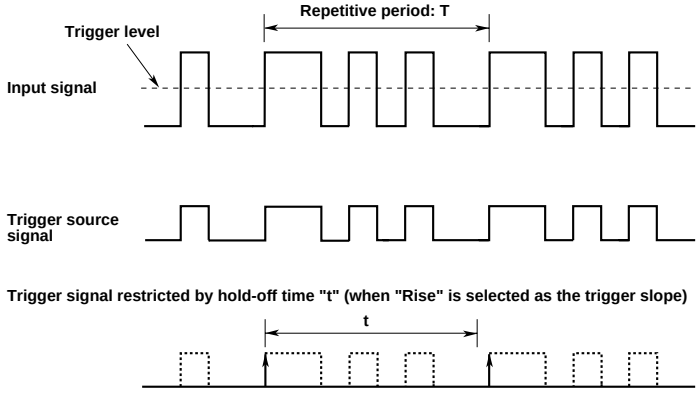
Trigger Delay ≡ page 6-19. ≡

Normally, the waveform around the trigger point is displayed. However the trigger delay function enables display of a waveform which has been acquired after a specified time (called the delay time) has elapsed following activation of a trigger.



Trigger Hold-off ≡ page 6-20. ≡

The trigger hold-off function temporarily stops detection of the next trigger once a trigger has been activated. For example, when observing a pulse train signal, such as a PCM code, display of the waveform can be synchronized with repetitive cycles; or when using the history memory function, you may want to change the repetitive period, as shown below.



1.4 Setting the Acquisition and Display Conditions

Acquisition Modes ≡ page 7-1. ≡

When storing sampled data in the acquisition memory, it is possible to perform processing on specified data and display the resultant waveform. The following data processing methods are available.

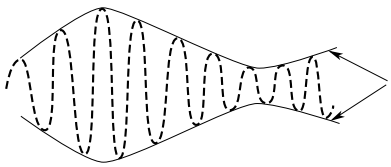
Normal mode

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

Envelope mode

In normal mode and averaging mode, the sample rate (the number of times data is acquired per second in the acquisition memory) drops if T/div is increased (refer to Appendix 2/Appendix 3). In envelope mode, the maximum and minimum values are obtained at each acquisition of the data (sampled at 100 MS/s), then the maximum and minimum values are stored as a pair in the acquisition memory (one pair takes up 2 words of memory).

Envelope mode is useful when you want to avoid aliasing (page 1-6), since the sample rate is kept high irrespective of the time axis setting (T/div). Furthermore, envelope mode is also useful when you want to detect glitches (pulsing signals which rise very fast) or display an envelope of a modulating signal.



Averaging mode

Averaging is a process in which waveforms are acquired repeatedly to obtain the average of waveform data of the same timing (the same time in relation to the trigger point).

When the trigger mode is not single mode, exponential averaging is performed on the waveform data using the following equation, then the resultant waveform is stored in the acquisition memory and displayed on screen. The attenuation constant can be set between 2 and 256 (in steps of 2^n).

Exponential averaging

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

An : Value obtained after nth averaging
Xn : nth measured value
N : Attenuation constant

This averaging process is useful when you want to eliminate random noise.

Sampling Mode ≡ page 7-1. ≡

As explained earlier in “Relationship between the time axis setting and sampling mode” (page 1-6), data sampling can be performed either in real-time or in repetitive sampling mode depending on the T/div setting (for DL1540CL, the T/div and maximum displayable record length). If T/div is set between 50 ns/div and 5 ns/div, data sampling will be performed in the repetitive sampling mode. (But, for DL1540CL, note that these T/div settings are not available if maximum displayable record length is set to a high value.) And, if T/div is set between 5 μs/div and 100 ns/div, data sampling can be performed both in real-time or repetitive sampling mode and schould be selected beforehand. But, for DL1540CL, the range over which this feature is actually available will again vary according to the maximum displayable record length. For details, refer to Appendix 2/Appendix 3.

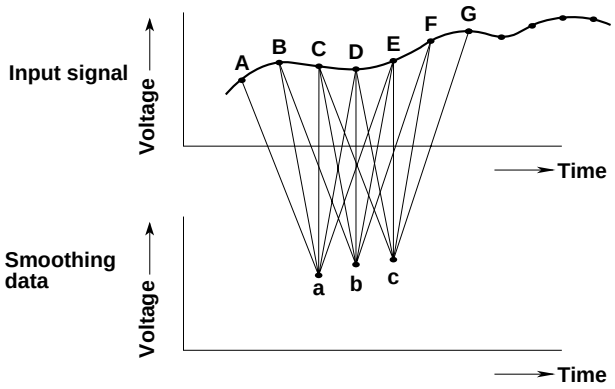
Record Length (Maximum Displayable Record Length) ≡ page 7-1. ≡ , (for DL1540CL)

The term “record length” refers to the number of data points (per channel) read into acquisition memory. “Displayed record length” refers to the number of these data points that actually appear on the screen. (Note that sampling rate and record length will vary according to the T/div setting; see page 1-5). The term “maximum displayable record length” refers to the maximum number of points that can be displayed on the screen. This value can be selected by the user: the available selections are 1 KW, 10 KW, 100 KW, 400 KW, 1 MW, and 2 MW.
In general, the acquisition-memory record length and the displayed record length are equivalent. But if the maximum displayable record length is set to 1 KW, 10 KW, or 100 KW and operation is in roll mode, then the acquisition acquisition -memory record length will be double the maximum displayable record length. As an example: if maximum displayable record length is set to 100 KW and the T/div is 50 ms/div, then the record length within acquisition memory will be 200 KW (200, 400 points). Only 100 KW of this length can appear on the screen at any given time. But the waveform’s horizontal position can be shifted as necessary to enable viewing over the entire 200 KW record (see page 1-7). High record-length settings are useful for monitoring repetitive long-period signals and rapid sustained single-pulse signals. But note that the three highest settings (400 KW, 1 MW, and 2 MW) involve various operational restrictions. For details about these restrictions, refer to Section 7.1.
For details of the record length, refer to Appendix 2/Appendix 3.

Input Filter ≡ page 7-3. ≡

Smoothing

The smoothing function enables the instrument to ignore small fluctuations in rapidly changing waveform data so that the overall characteristic of the data can be understood. The function acts as a low-pass filter. A weighted moving average value is obtained for each set of five points of sampled data, then the result is displayed as a waveform. This process is useful when you want to eliminate low levels of noise on input signals. Furthermore, smoothing is performed on the data stored in the acquisition memory, thus it can still be performed after acquisition has stopped, allowing the elimination of noise on single-shot signals.



Bandwidth limit

High frequency noise of 20 MHz or higher can be eliminated from the input signal.

Expanded Waveform ≡ page 7-4. ≡

Waveforms can be expanded in the time axis direction. This function is useful when you want to change the T/div setting after the waveform has been displayed in single mode or when you want to extend the acquisition time to observe a particular part of the waveform thoroughly.
As explained in “Display of the time axis direction” on page 1-5, the number of data points stored in the acquisition memory in normal display mode is greater than the number of display points (501 points) stored in the time axis direction. Hence, the displayed waveform is P-P compressed in the time axis direction. In other words, more than one waveform data value is displayed at same individual points.

The zoom function described here reduces the compression ratio so as to enable observation of individual data points from acquisition memory. The maximum selectable magnification rate depends on the displayed record length: 10x zoom at 1 KW length; 100x at 10 KW; 1000x at 100 KW, 5000x at 400 KW; 10,000x at 1 MW; and 25,000x at 2 MW. Specifically, the waveform can be zoomed until the number of displayed samples per division falls to 10 (until the displayed record length for the full screen falls to 100 points). If you zoom in such that the number of points per division is less than 50, an interpolation function will automatically supply interpolation over the time axis direction, as described on the next page. Zoom position is specified in units of grid division.

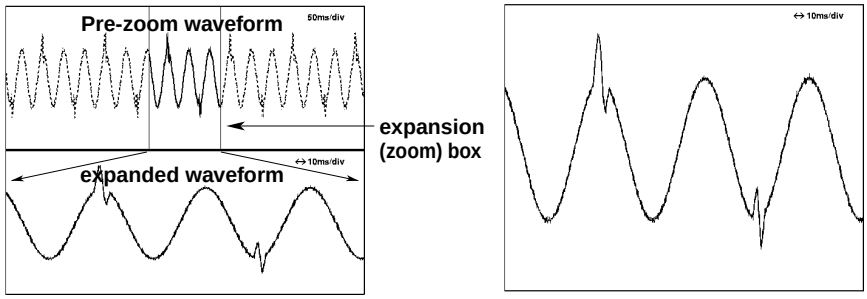
* Display record length of 400 KW, 1 MW and 2 MW is available on DL1540CL.

Display in zooming mode

As shown below, it is possible to select to display a pre-zoom waveform (MAIN) and its expanded waveform (ZOOM) simultaneously, or to display the expanded waveform only.

In the MainZoom display, a box is displayed in the display frame for the pre-zoom waveform to indicate the position of the expanded waveform.

MainZoom display **ZOOM display**



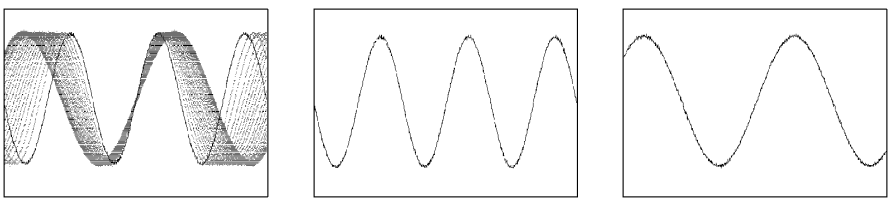
Sequential Store ≡ page 7-7. ≡

In the real-time sampling mode, waveform data will be stored to the acquisition memory only a set number of times, and all waveforms can be displayed. This stops automatically after acquisition. This function is operable when the trigger mode is set to single(N) mode. The maximum number of waveforms that can be stored into acqsuisition memory under this mode varies according to model and the maximum displayable record length in the range from 5 to 100 waveforms. The acquisition-memory record length (the number of data points per waveform for a given channel) is equivalent to the maximum displayable record length. Sequential-store operation is not available at maximum displayable record lengths of 400KW or above.

Once the specified number of waveforms have been stored, you can display any of the waveforms individually or all of them together, so that it is possible to derive a time series of the waveform variation. The drawings below illustrate how stored data can be displayed (assuming sequential storage of 100 waveforms).

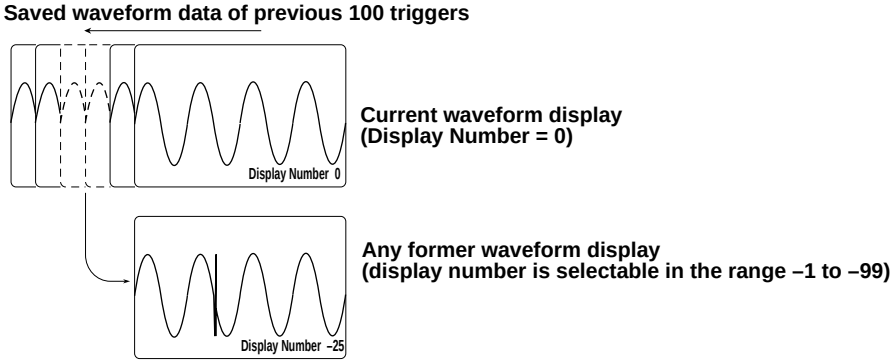
Display example in case N=100 times

Displaying all waveforms (ALL) **Displaying newest waveform (Display Number=0)** **Displaying oldest waveform (Display Number=–99)**



History Memory ≡ page 7-9. ≡

The oscilloscope automatically retains the last N waveforms recorded by real-time sampling, where N is equivalent to the maximum number of waveforms that can be stored by sequential-store. (The record-length for history storage is the same as that for sequential-store.) The oscilloscope retains all waveforms for the first N triggers; then, for each subsequent trigger, the oscilloscope deletes the oldest stored waveform. You are free to switch the display from the current (newest) waveform to any of other N-1 waveforms in the history. The illustration below shows how data can be displayed, assuming N=100.



Wide Screen ≡ page 7-11. ≡

The area for displaying the waveform can be switched from normal mode at 501 dots (horizontal) X 401 dots (vertical) to wide mode at 601 dots (horizontal) X 401 dots (vertical).

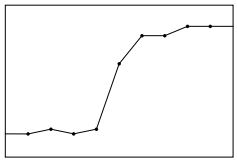
Display Interpolation ≡ page 7-12. ≡

This instrument displays waveforms at 50 dots* per division in both the vertical and horizontal axis directions, as shown below. However, if the dots corresponding to the sampled data are not contiguous, the instrument will interpolate between them. The interpolation method can be selected from the following.

* Dots are also called pixels, and are the smallest units used to construct waveforms and characters on the screen.

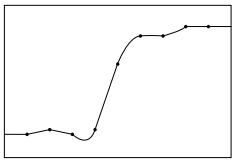
Line interpolation

Interpolates between two dots using a straight line.



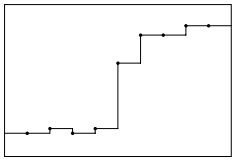
Sine interpolation

Generates interpolation data using the function sin(X)/X then interpolates between two dots using resulting sine curve. Sine interpolation is suitable for observation of sine waves.



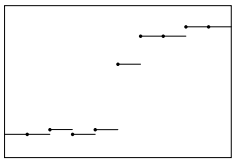
Pulse interpolation

Draws a horizontal line to the time axis position of the next data point, then interpolates between the two dots by drawing a vertical line from the next data point.



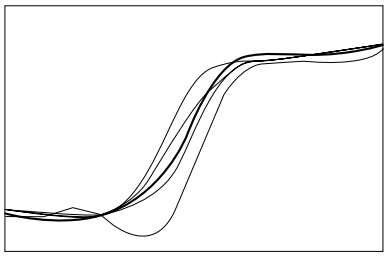
No interpolation

Draws only a horizontal line to the time axis position of the next dat point.



Accumulated Waveform Display ≡ page 7-13. ≡

The time that old waveforms remain on the screen is made longer than the waveform update interval so that new waveforms can be accumulated on top of old waveforms. In addition, waveforms can be displayed in different colors depending on the frequency of occurrence of the waveforms.
This function is useful when you want to observe jitters and temporary turbulence in waveforms.



X-Y Waveform Display ≡ page 7-15. ≡

The horizontal axis (X-axis) is used as the voltage axis for the input signal to CH1 and the vertical axis (Y-axis) is used as the voltage axis for the input signal to CH2 for observing the relationship between the voltages between the two signals. The X-Y waveforms for CH1 and CH2 can be displayed simultaneously. In addition, they can also be displayed simultaneously with a normal V-T waveform (a waveform displayed using voltage and time axes).
Use of this X-Y waveform display function enables measurement of the phase angle between two sine wave signals. For example, two X-Y sine waveforms are displayed to obtain an X-Y waveform (called a Lissajous waveform), from which the phase angle can be obtained.

Lissajous waveform

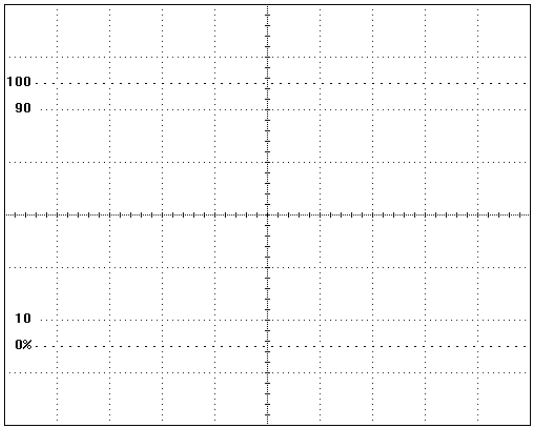
Phase angle 0°			
Phase angle 45°			
Phase angle 90°			
Frequency ratio (X:Y)	**1:1**	**1:2**	**1:3**

Other Display Modes Settings ≡ pages 7-16 to 7-18. ≡

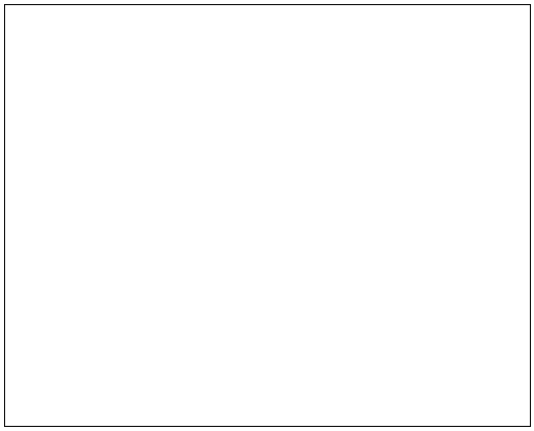
Graticule/scale/% marker

Under the default settings, the graticule (including the grid and frame), scale or % marker is displayed on the display, as shown below, enabling the easy observation of waveforms. The type of graticule can be changed and scale display and % marker can be turned ON/OFF.

Graticule: Grid, Scale: ON, % Marker: ON



Graticule: Frame, Scale: OFF, % Marker: OFF



Intensity

The intensity for items displayed on the LCD display such as characters, graticule and so on can be adjusted. Adjust the intensity according to your needs.

1.5 Analyzing the Waveform

Cursor Measurements ≡ pages 8-1, 8-5 and 8-19. ≡

The vertical dotted lines shown in the figure below are called cursors. Moving the cursors enables measurement of the voltage at various points on the waveform, the voltage difference between two points, the time interval from the trigger point (or delay point), and the time difference between two displayed points. They also enable the frequency to be calculated. The measured values are displayed in the waveform display frame, as shown below.

The following types of cursor are available.

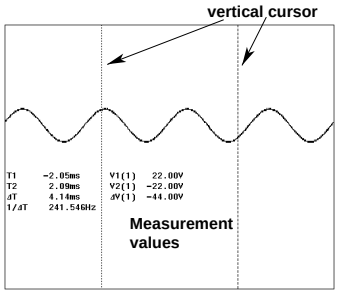
In case of V-T display : Vertical and horizontal cursors

When using the V-T waveform display, use the V-T cursor, to measure thedata on screen. Using the V-T ACQ cursor, it is possible to make measurements with the actual data acquired in the acquisition memory.

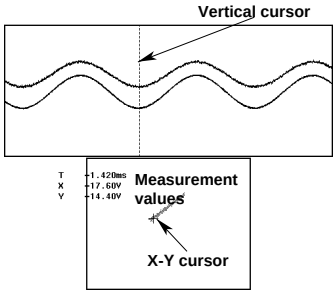
In case of X-Y display : Vertical, horizontal and X-Y cursors are available

In case of FFT (power spectrum) display : Vertical cursors

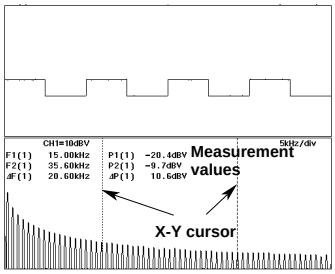
V-T waveform display



X-Y waveform display



FFTdisplay



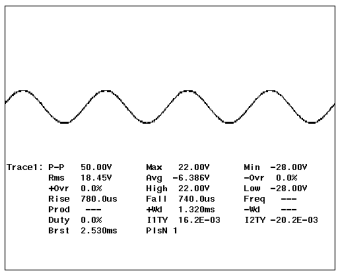
Automated Measurements ≡ page 8-7. ≡

This instrument can automatically measure 22 items of a displayed waveform, such as rise time and pulse width. Also the delay between channels can be measured. Any of the parameters can be selected for any displayed waveform.

Maximum 24 measurement values can be displayed. However, if measurement values are displayed simultaneously with the corresponding waveforms, the number of measurement values which can be displayed for one channel depends on the number of to be measured waveforms. For example, in case there are four waveforms to be measured, only six measurement values can be displayed for each waveform.

Under normal settings, the oscilloscope calculates measurement values based on the displayed data(P-P-compressed data or interpolated data). But you can also opt to perform calculations directly on the data values within the acquisition memory.

Furthermore, use of the MISC Information menu or communications function enables output of all the selected measured values, though the measured values cannot be updated by the Information menu.



Measurement values

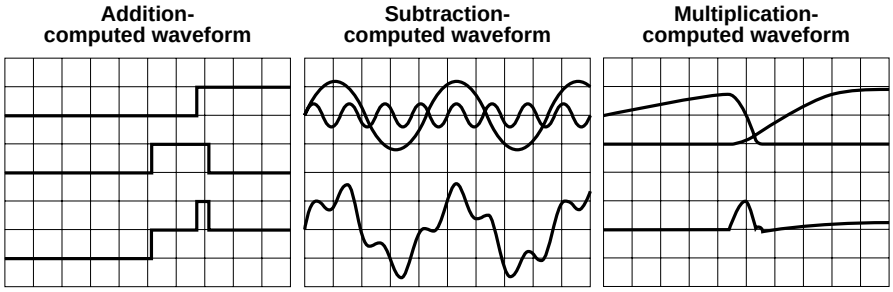
Linear Scaling ≡ page 8-14. ≡

It is possible to append a scaling constant A, an offset value B and a unit to the measurement value X of cursor or automated measurements. Linear scaling is useful for example, when applying a voltage divider ratio to the measurement values, or in case of automatically calculating the current value from the voltage measurement results.

Y(UNIT) = AX + B Y = result of linear scaling

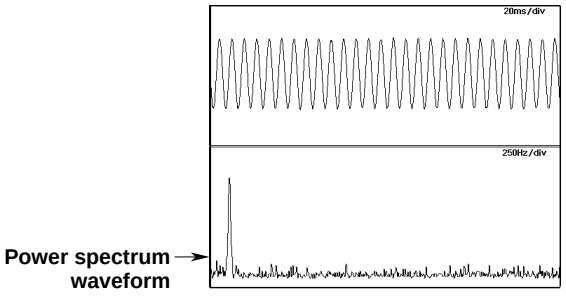
Waveform Math ≡ page 8-16. ≡

Waveforms obtained by adding the waveform data of CH1 and CH2 (addition), waveforms obtained by subtracting waveform data CH2 from CH1 (subtraction), and waveforms obtained by multiplying waveform data CH1 by CH2 (*f*•ltiplication) can be displayed on CH3. Waveform math can be performed while the phase of CH2 is shifted. Addition and subtraction computations are useful when you want to compare data with a reference signal, to check the logic of a signal and to make a phase comparison. Multiplication computation is useful when you want to input a voltage signal and a current signal to check the power waveform.



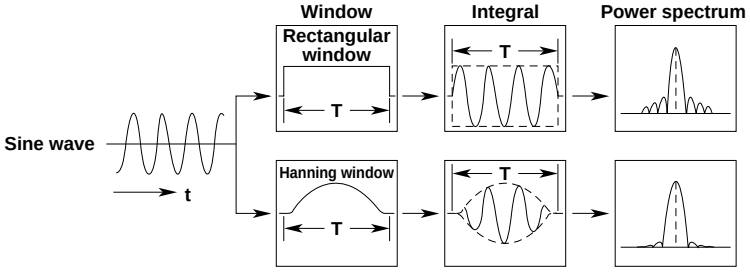
Power Spectrum Display ≡ page 8-18. ≡

FFT (Fast Fourier Transform) computation can be performed on the input signal to display its power spectrum. This is useful when you want to check the frequency distribution of the input signal.



Two time windows are available: a rectangular window and a Hanning window. The rectangular window is effective for transient signals, such as an impulse wave, which attenuate completely within the time window. The Hanning window allows 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 effective for continuous signals.

FFT computation generates 1000 measurement data points, but only 500 points are displayed on the screen.



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

Hanning window : W(t) = (0.5 - 0.5 cos2π $\frac{t}{T}$)

[FFT function]

When the complex result of FFT computation is G = R + jI, the power spectrum can be expressed as follows.

$$\text{Power spectrum} = 10 \log \left(\frac{R^2 + I^2}{2}\right)$$

R : Real Part, I : Imaginary Part

Reference value (0 dB) of log mag: 1 Vrms

1.6 Other Useful Functions

Auto Set-up ≡ page 4-2. ≡

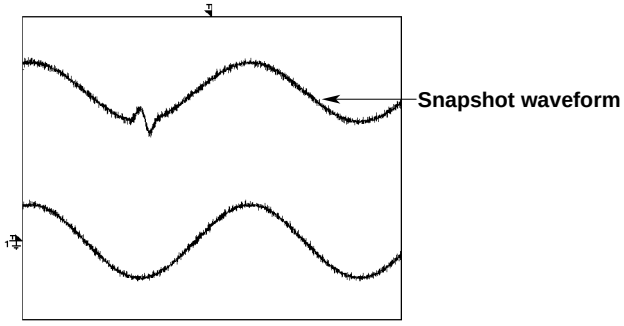
This function makes settings automatically such as vertical sensitivity, time axis and trigger settings, to suit the signal to be measured. This is useful when the signal to be measured is unknown. However, there might be particular signals for which the auto set-up function may not work properly.

Initialization ≡ page 4-4. ≡

This function resets the key settings to the factory settings (default settings), and is useful when complex settings have been made and you want to cancel all of them at once.

Snapshot ≡ page 4-5. ≡

If single mode is not selected as the trigger mode, a waveform is updated at the specified intervals or is displayed in roll mode. Thus, to retain the currently displayed waveform, acquisition must be stopped. Use of the snapshot function allows the currently displayed waveforms to remain temporarily on the screen without acquisition being stopped. To activate this function, just press the SNAP SHOT key without stopping acquisition. The currently displayed waveform will be retained. This waveform is called a snapshot waveform. The snapshot waveform is displayed with a different intensity from that used for the updated waveform, making comparison between the two easier.
Snapshot waveforms are screen image waveforms, so they cannot be used for cursor measurement, automated measurement or be stored.

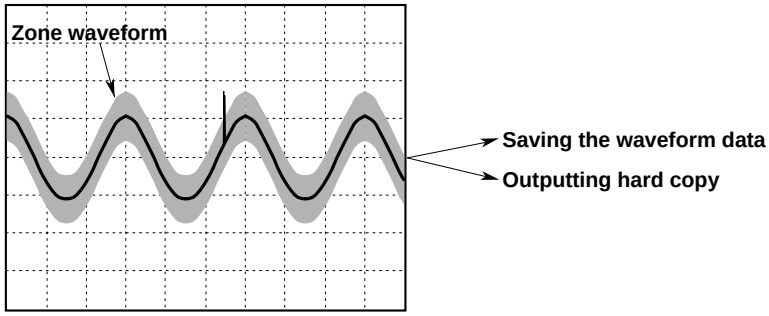


Clear Trace ≡ page 4-5. ≡

This function enables you to clear snapshot waveforms and accumulated waveforms, and restart the averaging process or repetitive sampling in a single operation.

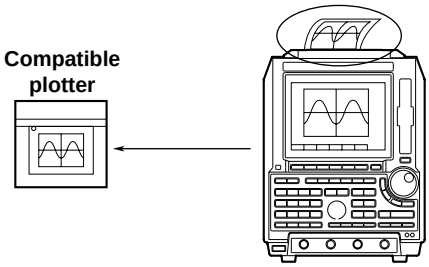
GO/NO-GO Determination ≡ Chapter 9. ≡

The GO/NO-GO function is useful when you want to inspect signals and track down abnormal symptoms on a production line making electronic equipment. It performs pass/fail determinations on whether waveforms are within a specified range or not, and takes preset actions in the case of failure (NO-GO). There are two determination methods. In the first one a waveform zone is specified on the screen, and in the second a range for each waveform parameter is specified.
Determination can be performed on up to four input signals using “AND” or “OR” logic. In the case of NO-GO, various actions can be performed, for example, waveform data can be saved and screen hardcopy can be output to the built-in printer (optional). In addition, the determination results can be output by an external signal.



Making Hardcopy Print-outs of the Screen and Printing Set-up Information ≡ Chapter 10. ≡

Screen hardcopy and setting parameters (measurement conditions) can be printed on the built-in printer (optional), on an external HP-GL plotter or an external color printer.



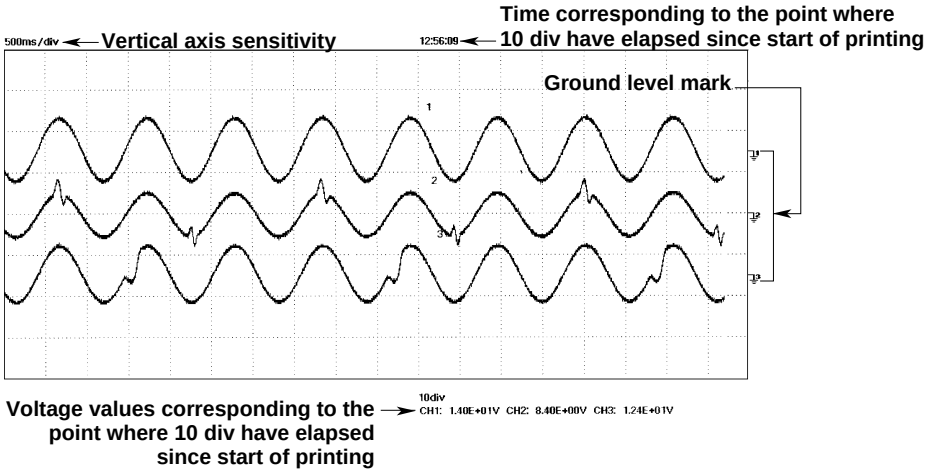
Note

- **Entering a comment**
  The instrument provides a function which enables you to use the keyboard displayed on the screen to enter and display a comment. If you enter a comment which indicates the contents of the displayed waveforms before printing a hard-copy, it will help you to distinguish between different print-outs.
- The GP-IB/Centronics adapter is necessary, when printing to an external color printer.

Real-time Printing ≡ page 10-6. ≡

It is possible to print waveforms continuously as a recorder using the built-in printer. Real-time printing can be done when the setting range of the time axis lies within 500 ms/div to 50 s/div. The chart speed is fixed at 16.7 mm/s.

Print Example (DL1540C)

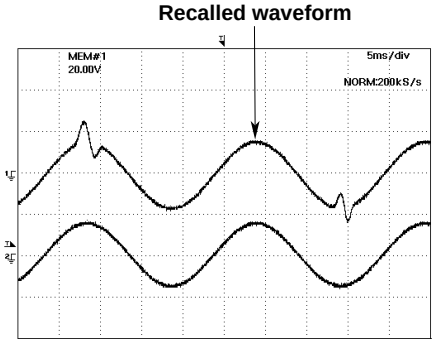


Storing/Recalling Displayed Waveforms and Setting Parameters ≡ page 11-1, 11-3. ≡

Displayed waveforms (P-P compressed data, not acquisition data) and setting parameters can be stored in the internal memories.

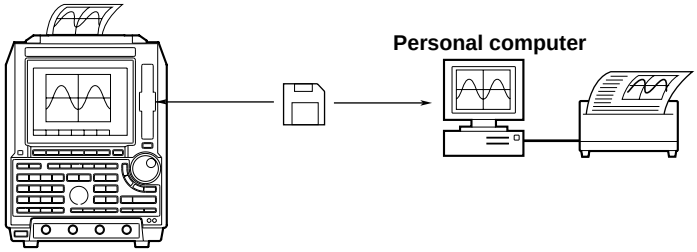
It is also possible to recall and display stored waveforms, and to recall and modify stored set-up data.

This function is useful when you want to compare the previously acquired waveform with a newly acquired waveform.



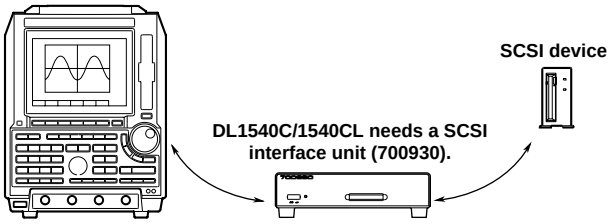
Saving/Loading Data from a Floppy Disk ≡ Chapter 12. ≡

The instrument is equipped with a floppy disk drive as standard. This enables you to save setting parameters on a floppy disk, and load it when you need it. Furthermore, it is also possible to save screen image data in HP-GL, PostScript, TIFF or BMP format and import these into documents created by DTP application software.



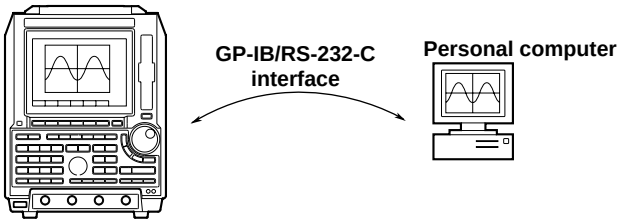
Saving/Loading Data from the SCSI Device ≡ Chapter 13. ≡

DL1540C/DL1540CL can save/load data from the SCSI device through the separately sold SCSI interface unit in the same way as saving /loading from the floppy disk as described above.



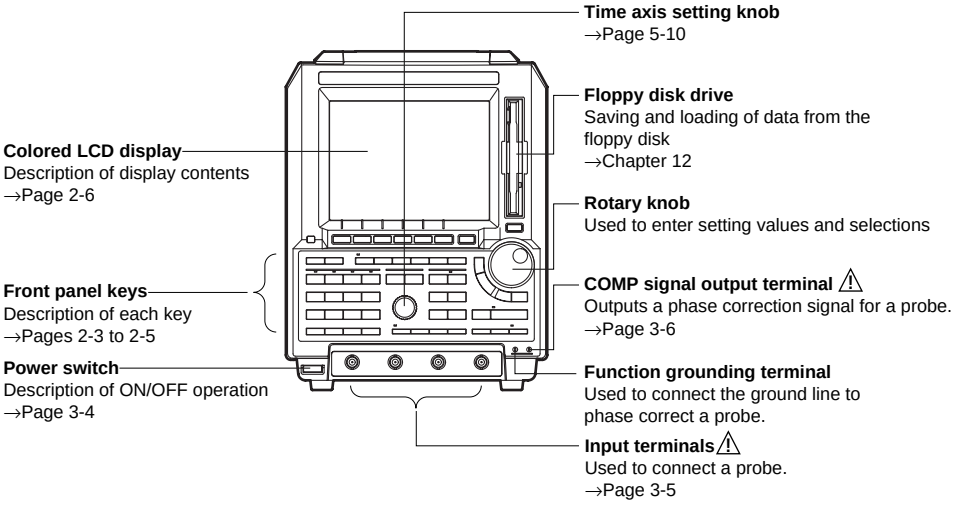
GP-IB/RS-232-C ≡ Communications Interface User's Manual (IM 701530-11E). ≡

The instrument is equipped with a GP-IB interface as standard, whereas a RS-232-C interface unit is optional. Either interface enables you to send waveform data to a personal computer for analysis, as well as to perform waveform measurement while controlling the instrument using an external controller.

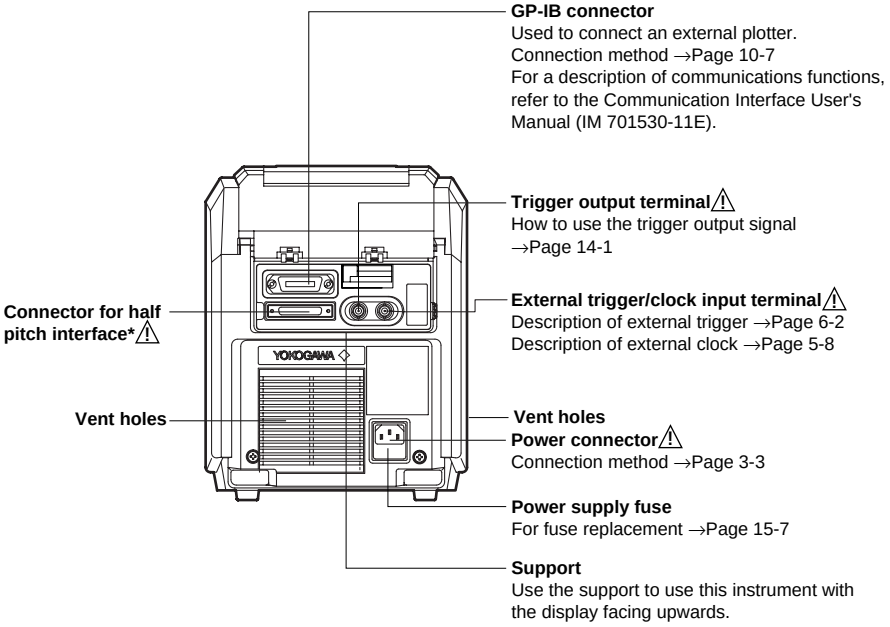


2.1 Front Panel / Rear Panel / Top View

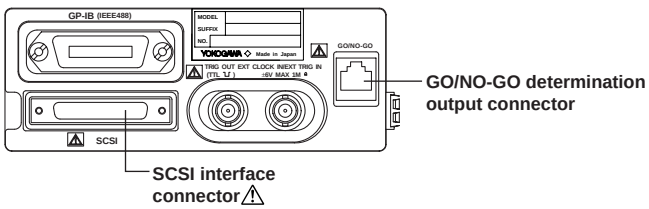
Front Panel



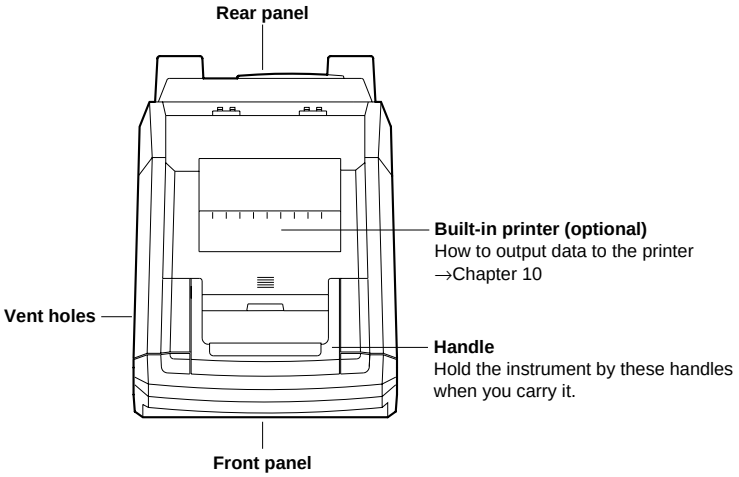
Rear Panel



* The following sections of the rear panel on DL1540CL models with the /C8 option differ from those of the standard model.

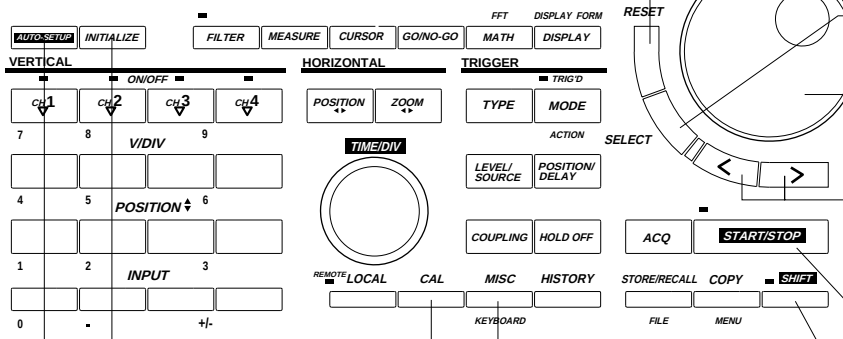


Top View


Rear panel
Built-in printer (optional)
How to output data to the printer
→Chapter 10
Vent holes
Handle
Hold the instrument by these handles
when you carry it.
Front panel

2.2 Operation Keys / Rotary Knob

Keys and Rotary Knob used for Various Functions



CLEAR TRACE key (Page 4-5)
Deletes the snapshot waveform or accumulated waveform. Also used to re-start averaging and repetitive time sampling.

Soft keys
Used to make settings corresponding to the soft key menu displayed above the keys.

ESC key
Deletes the currently displayed menu.

RESET key
Resets the settings made using the rotary knob to their default settings.

SNAP SHOT key (Page 4-5)
Retains the waveform which is displayed when this key is pressed, even if updating is performed.

SELECT key
Confirms the items and characters selected.

Rotary knob
Used to set values, move the cursor, and select the desired items.

<> key
Used to shift from one digit to the next of the value you are setting using the rotary knob.

START/STOP key (Page 4-1)
Starts or stops acquisition.
The indicator on this key is lit during acquisition.

SHIFT key
Used to operate functions written in blue over/under the operation keys.

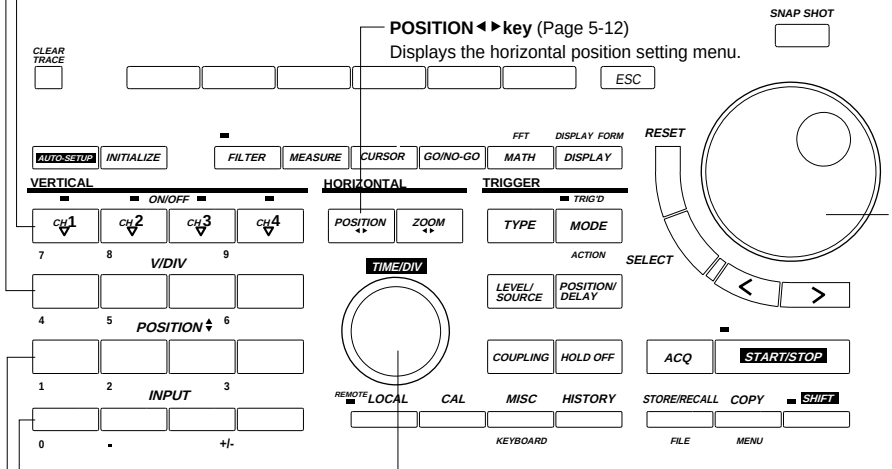
INITIALIZE key (Page 4-4)
Displays the initialization menu which can be used to reset the settings to their default values.

SHIFT+MISC (KEYBOARD key) (Page 4-7)
Displays a keyboard which enables you to enter values directly.

AUTO-SETUP key (Page 4-2)
Displays the auto setup menu which can be used to execute auto setup.

CAL key (Page 4-6)
Displays the calibration execution menu.

Keys and Rotary Knob used for Setting the Vertical/Horizontal Axis



V/DIV key (Page 5-6)
Displays the voltage axis sensitivity setting menu for each channel.

CH key (Page 5-1)
Turns ON/OFF display of the waveform for each channel.
The indicator above the key is lit when the display is ON.

POSITION ◄► key (Page 5-12)
Displays the horizontal position setting menu.

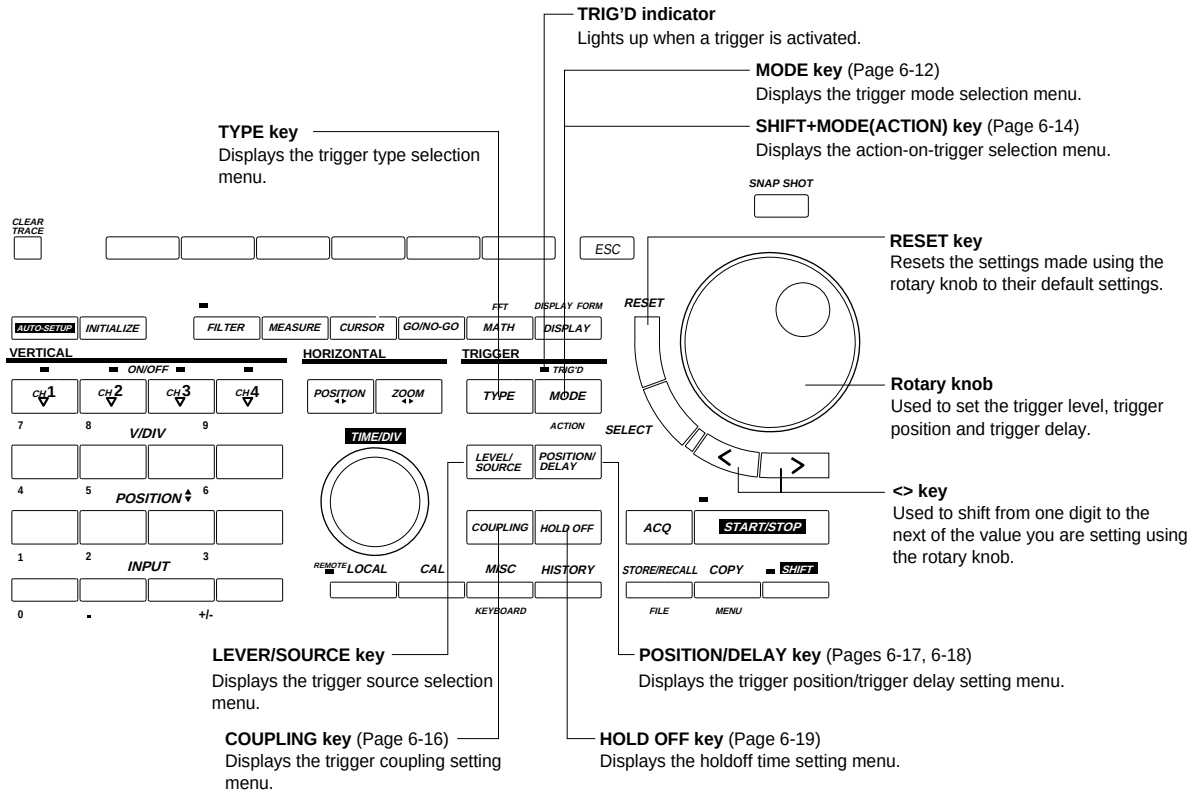
Rotary knob
Used to make vertical axis sensitivity (V/div), waveform vertical/horizontal position and offset voltage settings.

Time axis setting knob (TIME/DIV) (Page 5-10)
Used to change the time axis scale.

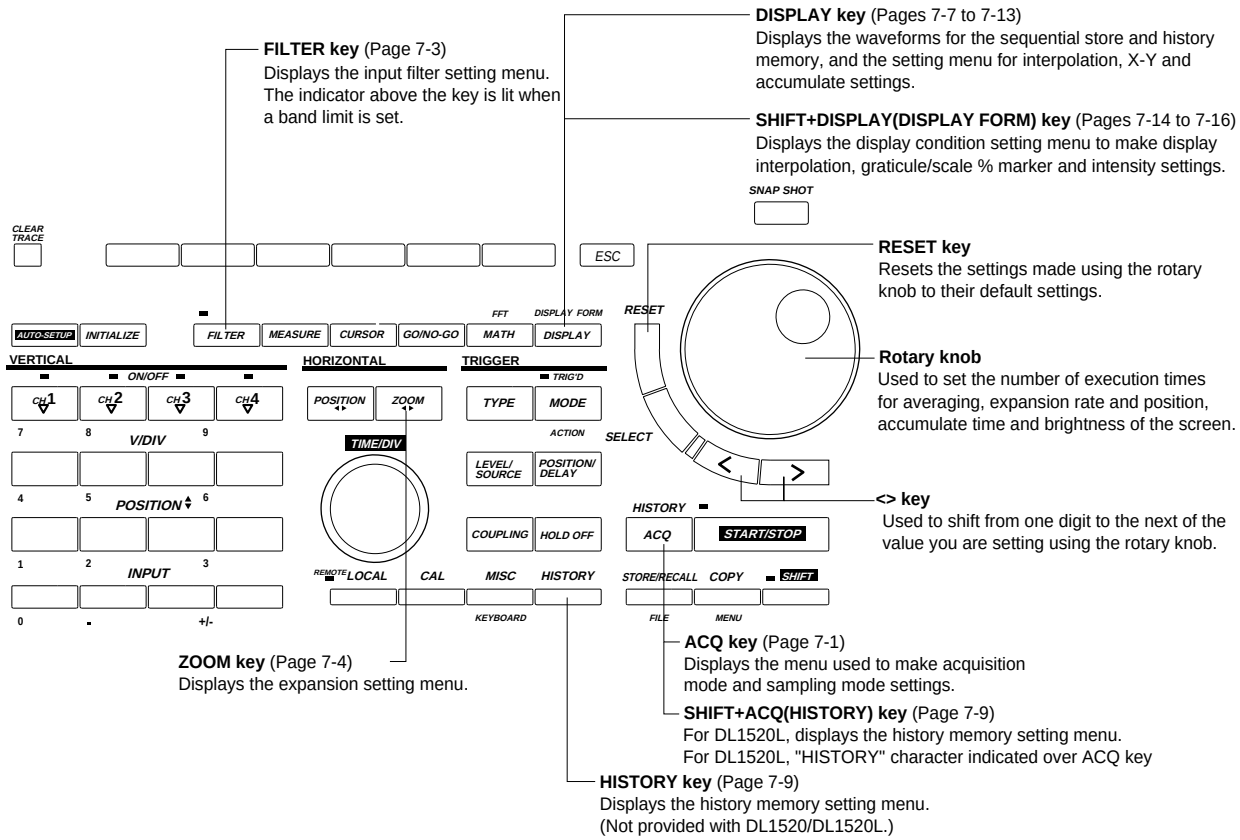
INPUT key (Pages 5-2 to 5-5)
Sets the input coupling, probe attenuation, inverted display, and acquisition hold.

POSITION ▲▼ key (Page 5-7)
Displays the vertical position setting menu for each displayed waveform.

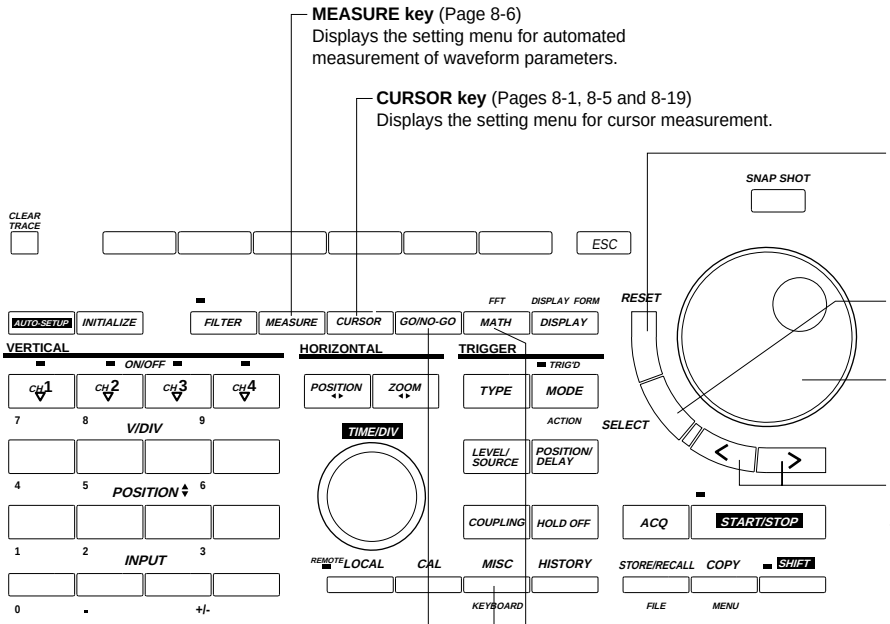
Keys and Rotary Knob used for Making Trigger Settings



Keys and Rotary Knob used for Setting Acquisition and Display Conditions



Keys and Rotary Knob used for Analysis of Waveforms



MEASURE key (Page 8-6)
Displays the setting menu for automated measurement of waveform parameters.

CURSOR key (Pages 8-1, 8-5 and 8-19)
Displays the setting menu for cursor measurement.

RESET key
Resets the settings made using the rotary knob to their default values.

SELECT key
Confirms the items and characters selected.

Rotary knob
Used to select cursor position, waveform parameters, linear scaling, phase shift, FFT computation, etc.

<> key
Used to shift from one digit to the next of the value you are setting using the rotary knob.

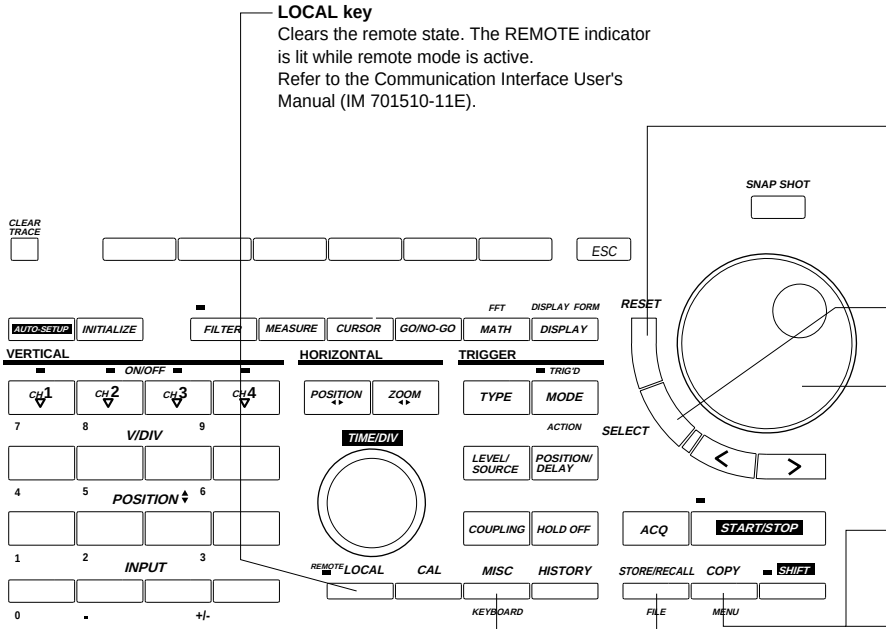
GO/NO-GO key (Pages 9-1 and 9-8)
Displays the GO/NO-GO setting menu.

MATH key (Page 8-16)
Displays the waveform computation menu.

SHIFT + MATH(FFT) key (Page 8-18)
Displays the FFT computation menu.

MISC key (Page 8-14)
Used to set the linear scaling function.

Keys and Rotary Knob used for Other Operations



LOCAL key
Clears the remote state. The REMOTE indicator is lit while remote mode is active.
Refer to the Communication Interface User's Manual (IM 701510-11E).

RESET key
Resets the settings made using the rotary knob to their default values.

SELECT key
Used to input the file name, for selection and confirmation.

Rotary knob
Used to select the desired setting items or values.

COPY key (Chapter 10, Page 12-11)
Used for outputting to internal printer, external plotter, hard copy of screen image data, etc.

SHIFT + COPY(MENU)
(Chapter 10, Page 12-11)
Displays the setting menu for outputting to the internal printer, external plotter, and for hard copy of screen image data, etc.

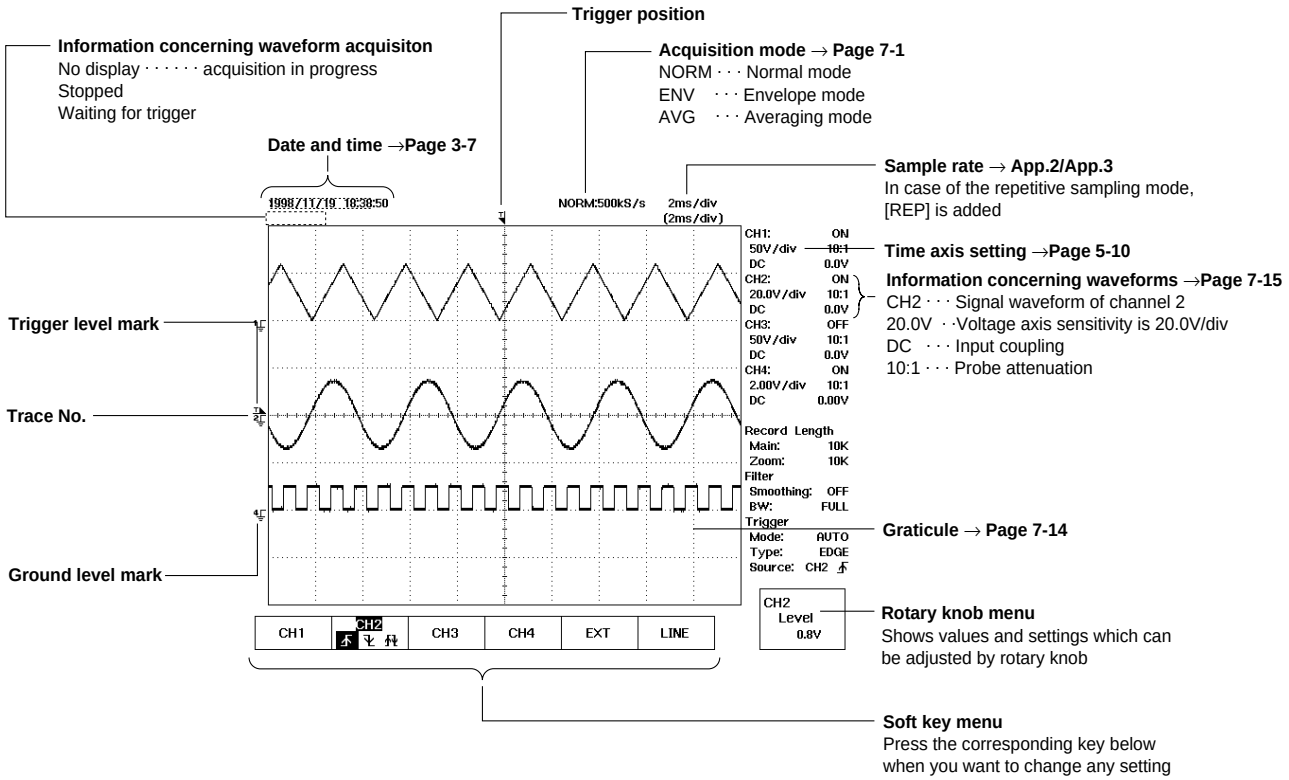
MISC key (Pages 14-2 to 14-4, 15-7)
Displays the MISC menu used to make communications, date and time settings, confirm system condition, perform a self test, LCD brightness and make system configuration setting.

STORE/RECALL key (Chapter 11)
Displays the store/recall menu used to store or recall displayed waveforms and setting parameters from the internal memory.

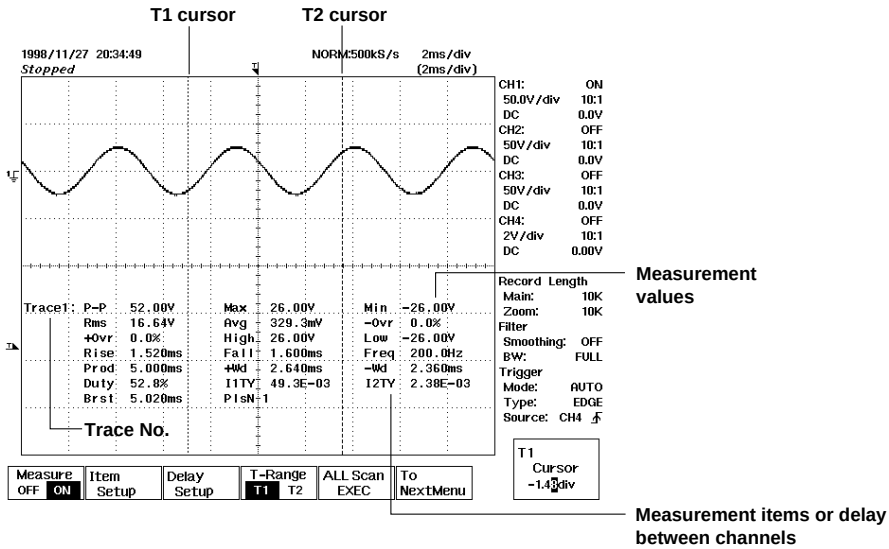
SHIFT + STORE/RECALL(FILE) key (Chapter 12 and 13)
Displays the setting menu used to save/load data to/from the floppy disk or the SCSI device.

2.3 Display

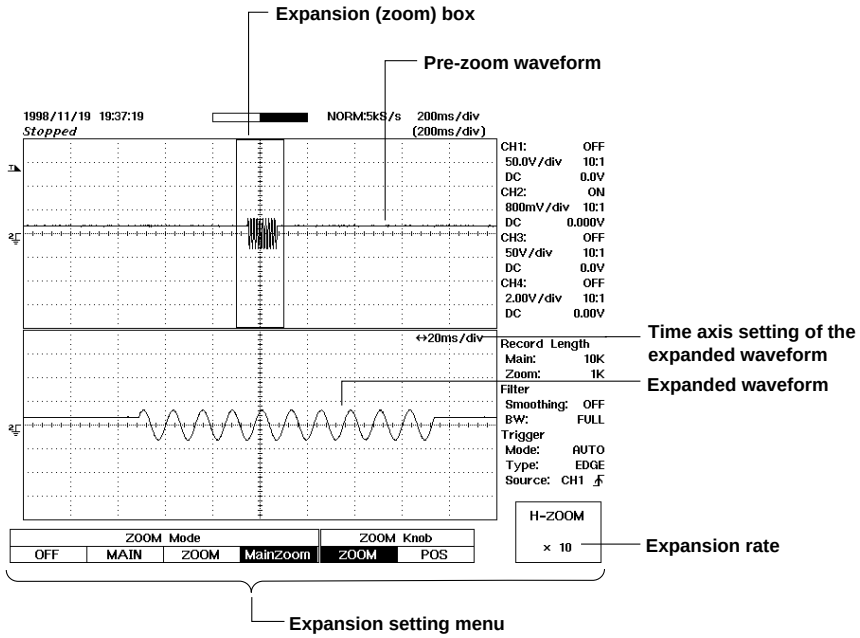
Normal Waveform Display



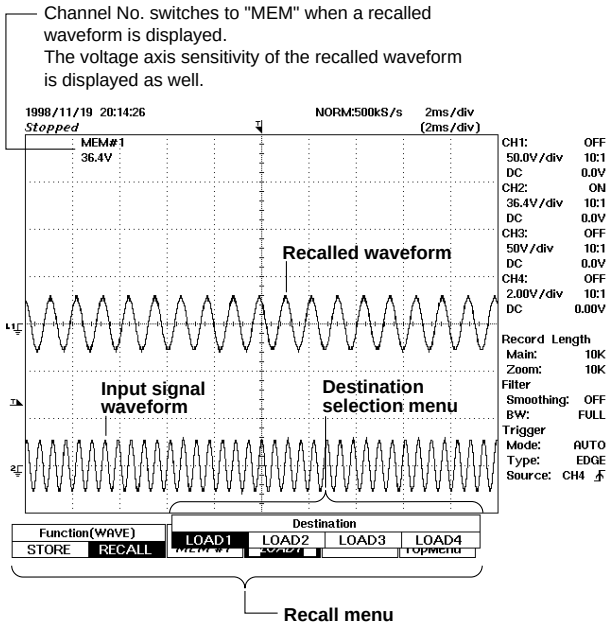
Automated Measurements → Refer to page 8-7.



Expanded Display → Refer to page 7-4.



Recalled Waveform → Refer to page 11-1.



3.1 Precautions During Use

Safety Precautions

When using this instrument, thoroughly read the “Safety Precautions” given on page 5 and 6. In addition, pay attention to the following points:

Do not remove the cover from the instrument
Some parts of the instrument use high voltages, which are extremely dangerous. When the instrument needs internal inspection or adjustment, contact your dealer or nearest YOKOGAWA representative as listed on the back cover of this manual.

Unusual occurrences
If you notice smoke or unusual odors coming from the instrument, turn OFF the power and unplug the power cord immediately. Contact your dealer or the nearest YOKOGAWA representative as listed on the back cover of this manual.

Power cord
Nothing should be placed on the power cord; also, it should be kept away from any heat sources. When unplugging the power cord from the AC outlet, never pull the cord itself. Always hold the plug and pull it. If the power cord is damaged, contact your dealer. Refer to page 3 for the part number to quote when placing an order.

General Handling Precautions

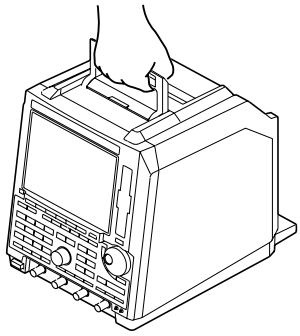
Never place anything on top of the instrument
Never place another instrument or any objects containing water on top of the instrument, otherwise a breakdown may occur.

Do not subject the input terminals or connecting cables to shock
Shock to the input terminals or connecting cables may turn into electrical noise and enter the instrument via the signal lines.

When the instrument is not going to be used for a long period
Unplug the power cord from the AC outlet.

Do not scratch the LCD
The LCD is very susceptible to scratches. Make sure not to scratch the surface with pointed objects. In addition, never apply vibration or shock to the LCD.

When moving the instrument
Disconnect the power cord and connecting cables. Always carry the instrument by the handles or carry it with both hands as shown on the right.
Note that the chart paper might show some discoloration due to friction after the instrument is moved with the roll paper installed. In such a case, we recommend to remove and re-install the chart paper again. For details on the procedure, refer to page 10-1.

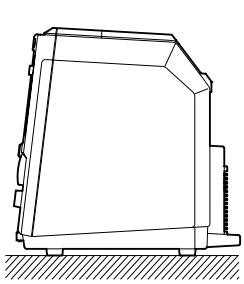


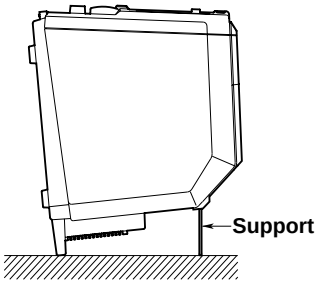
Cleaning
For cleaning the case and the operation panel, unplug the power cord first, then gently wipe with a dry, soft and clean cloth. Do not use chemicals such as benzene or thinner, since these may cause discoloration or damage.

3.2 Installing the Main Unit

Installation Position

Place the instrument in a flat, horizontal position as shown in the figure below. To tilt the screen slightly forwards, use the support, as shown below also.
When using the support, pull it forwards until it is at right angles to the bottom of the instrument, and lock it. If you are installing the instrument in a slippery place, attach the rubber stoppers to all feet to prevent the instrument from sliding.





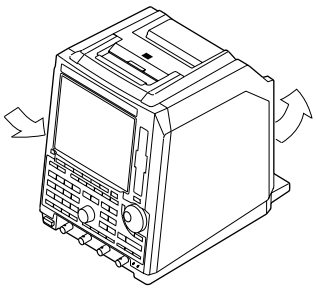
Installation Conditions

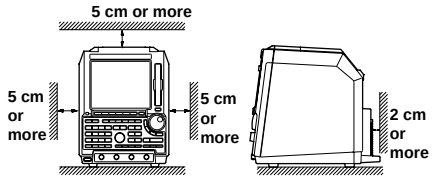
The instrument must be installed in a place where the following conditions are met.

Ambient temperature and humidity
Ambient temperature: 5 to 40 °C
To ensure high measurement accuracy, ambient temperature should be 23 ±2 °C.
Ambient humidity: 20 to 80% RH
No condensation should be present. To ensure high measurement accuracy, ambient humidity should be 55 ±10% RH.

Flat, horizontal locations
Place the instrument in a stable location, which is horizontal in each direction. Operating the instrument in an unstable location may hinder recording of the printer and accurate measurement.

Well-ventilated location
Vent holes are situated on the left side of the instrument. In addition, vent holes for the cooling fan are also situated in the rear panel. To prevent a rise in the internal temperature, the vent holes should not be blocked and sufficient clearance should be maintained around them.





If the instrument is equipped with a built-in printer or when the GP-IB cable is connected, make sure to allow sufficient space for operations in addition to the space for the vent holes.

Never install the instrument in any of the following places.
- In direct sunlight or near heat sources
- Where an excessive amount of soot, steam, dust or corrosive gases are present.
- Near strong magnetic field sources
- Near high voltage equipment or power lines
- Where the level of mechanical vibration is high
- In an unstable place

Note

Internal condensation may occur if the instrument is moved to another place where both the ambient temperature and humidity are higher, or if the temperature changes rapidly. In such cases allow the instrument to acclimatize to its new environment for at least one hour before starting operation.

3.3 Connecting the Power Cord

Before Connecting the Power

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

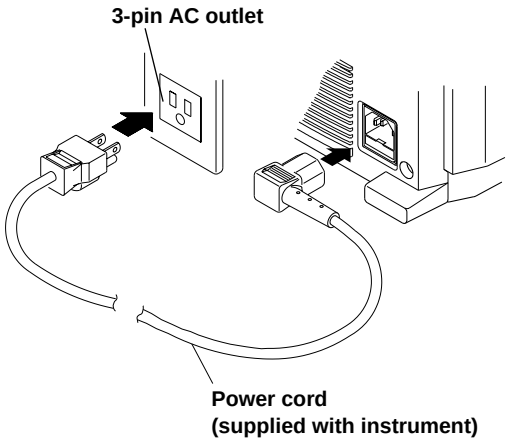
WARNING

- **Connect the power cord after confirming that the voltage of the power supply complies to the rated electric power voltage for this instrument.**
- **Connect the power cord after confirming that the power switch is OFF.**
- **Always use protective ground to prevent electric shock. Connect the accessory power cord to a power outlet with grounding terminal.**
- **Do not use non-grounding extension cords or other measures that defect the protective grounding.**
- **Never use an extension cord that does not have protective grounding, otherwise the protection feature will be negated.**

Connecting the Power Cord

1. Make sure that the main power switch is OFF.
2. Plug the power cord into the power connector socket on the rear panel of the instrument.
3. Plug the other end of the power cord into an AC outlet that meets the following specifications. The AC outlet must be of 3-pin type with a protective grounding terminal.

Rated supply voltage	100 to 120 VAC/220 to 240 VAC
Permitted supply voltage range	90 to 132 VAC/180 to 264 VAC
Rated supply voltage frequency	50/60 Hz
Permitted supply voltage frequency range	48 to 63 Hz
Maximum power consumption (when the built-in printer is used)	240 VA/300 VA
Typical power consumption (when the built-in printer is not used)	150 VA (at 100 VAC) /190 VA (at 200 VAC)



3.4 Turning the Power Switch ON/OFF

Points to be Checked before Turning ON the Power

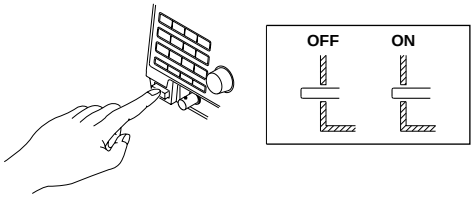
Check that the instrument is correctly installed as described in Section 3.2 “Installing the Main Unit” (page 3-2).
Check that the power cord is correctly connected as shown in Section 3.3 “Connecting the Power Cord” (page 3-3).

Location of the Power Switch

The power switch is located on the front panel in the lower left corner.

Turning the Power Switch ON/OFF

The power switch is a push-button type switch, and the power is turned ON and OFF alternately as the switch is pressed.



The Order in Turning the Power Switches ON/OFF

When peripheral devices are connected to the half pitch interface connector of the this instrument, turn ON the power switches on all peripheral devices first, then turn ON the power switch of this instrument. When turning OFF the power, reverse the order.

Action When Power is Switched ON

Calibration (correction of the ground level and gain etc.) starts automatically when the power switch is turned ON. Front panel keys are not operative during calibration (which lasts approximately seven seconds). When calibration has been completed, the normal waveform display screen will appear.

Note

If calibration does not start when the power switch is turned ON, or if the normal waveform display screen does not appear, check the following points.

- Check that the power cord is plugged in properly.
- Check that the correct voltage is being supplied from the AC outlet. (Refer to page 3-3.)
- Check that the fuse is not blown. (Refer to page 15-7.)
- If the power switch is turned ON while the INITIALIZE key is pressed, all settings will be reset to the factory settings. For details, refer to Section 4.3 “Initializing Settings” (page 4-4).

If there is still no power even after the above points have been checked, contact your nearest YOKOGAWA representative as listed on the back cover of this manual.

For Accurate Observation and Measurement

Turn the power switches ON and allow the unit to warm up for approximately 30 minutes.
Just before starting observation/measurement, perform calibration. The ground level and gain etc. will be corrected. For a description of the calibration method, refer to Section 4.5 “Performing Calibration” (page 4-6).

Action When Power is Switched OFF

Settings made prior to turning OFF the power switch are retained. This allows display of waveforms using these saved settings the next time the power switch is turned ON.

Note

The settings are backed up by a lithium battery. The battery lasts for approximately five years if it is used at an ambient temperature of 23 °C. When the battery runs out, an icon Li appears in the top left of the screen. In this case, the battery needs to be replaced immediately. The battery cannot be replaced by the user. Contact your nearest YOKOGAWA representative as listed on the back cover of this manual.

3.5 Connecting a Probe

Input Terminals

A probe (or an input cable such as a BNC cable) must be connected to one of the input terminals (CH1 to CH4) located on the lower section of the front panel.
The input impedance is 1 MΩ ±1.5% and approximately 25 pF.

CAUTION

The maximum input voltage is 250 V (DC + ACpeak) or 177 Vrms when the frequency is 1 kHz or less. Never input a voltage exceeding this level, as it could damage the input section of the instrument. If the frequency exceeds 1 kHz, the input section may be damaged even when the voltage is below 250 V.

Points to Note when Connecting a Probe

- When connecting a probe to the instrument for the first time, perform phase correction of the probe as described in the next section on page 3-7. Failure to do so may result in unstable gain across different frequencies, thereby preventing correct measurement. Calibration must be performed for each channel.
- If the object to be measured is connected to the instrument directly, without using a probe, correct measurement cannot be performed due to the load effect.

Probe

Specifications for the probe (700998) supplied with the instrument (after calibration)

Item	Specifications Setting 10:1	Setting 1:1	Conditions
Input impedance/capacitance	10 MΩ ±2%/approx. 14 pF	1 MΩ ±1.5%/approx. 100 pF	When used with this instrument
Attenuation ratio	10:1 ±2.5%	—	When used with this instrument
Frequency band	DC to 150 MHz	DC to 6 MHz	When used with this instrument
Rise time	2.4 ns or less	58 ns or less	When used with this instrument
Maximum input voltage	600 V (DC + ACpeak) or 424 Vrms, Frequency is 100 kHz or lower	*1	—
Connector type	BNC	BNC	—
Total length	1.5 m	1.5 m	—

*1 When the probe's attenuation ratio is “1:1,” never input voltage exceeding the maximum input voltage of this instrument.

When using a probe other than the one supplied with the instrument
To measure a signal which contains harmonics of approximately 150 MHz, use a probe with a frequency band of 150 MHz or higher.
Correct measured values cannot be displayed if the probe’s attenuation ratio is not “1:1”, “10:1”, “100:1” or “1000:1”.
When a probe other than 1 MΩ probe (for example a 50 Ω probe) is to be used, connect a through-type 50 Ω terminator*2 for impedance matching.

*2 When placing an order for the 50 Ω terminator as the one supplied with the instrument, quote the number “700976”.

Setting the probe attenuation
Follow the operating procedure given in Section 5.3 “Setting the Probe Attenuation” (page 5-4) so that the probe’s attenuation matches the one displayed below “Probe” in the soft key menu which appears when the INPUT key is pressed. If they do not match, measured values cannot be read correctly.

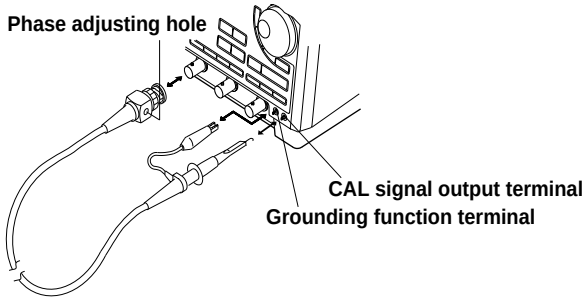
3.6 Compensating the Probe (Phase Correction)

CAUTION

Never apply an external voltage to the COMP terminal, as damage to the instrument may result.

Operating Procedure

1. Turn ON the power switch.
2. Connect the probe to the input terminal to which the signal is to be applied.
3. Touch the probe's tip against the CAL output terminal and connect the grounding wire to the grounding function terminal.
4. Press the **AUTO-SETUP key**.
5. Press the "**AUTOSET EXEC**" soft key. The phase correction signal is displayed on the screen.
6. Insert a screwdriver into the trimmer adjusting hole in the probe and turn the trimmer so that the displayed waveform becomes square.



Explanation

Reason for probe compensation

If the probe's input capacitance is outside the specified range, the gain will not be constant across different frequencies, preventing display of the correct waveforms. The input capacitance varies depending on the probe used, so the variable capacitor (trimmer) provided on the probe must be adjusted.

Probe compensation must be performed when the probe is to be used for the first time.

Moreover, the appropriate input capacitance varies according to which channel is used, so probe compensation is required when the probe is switched from one channel to another.

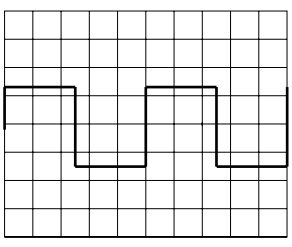
Phase correction signal

A phase correction signal (square waveform) of the following characteristics is output from the COMP terminal on the front panel.

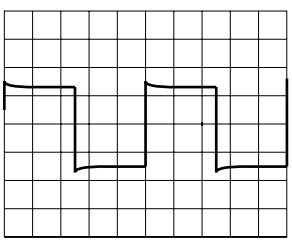
Frequency : Approx. 1 kHz
Amplitude : Approx. 1 V

Waveform differences

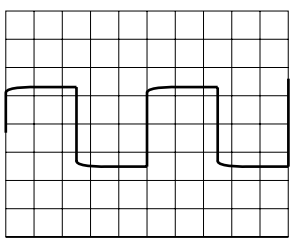
Correct waveform



Over-compensated (gain is too high at high frequency)

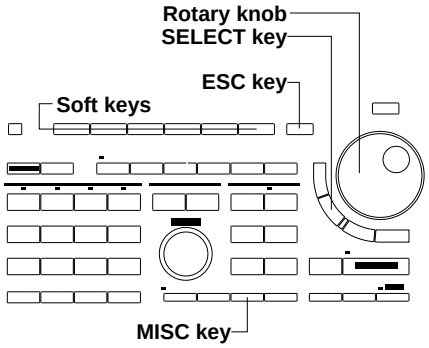


Under-compensated (gain is too low at high frequency)

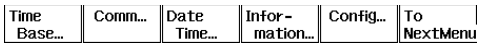


3.7 Setting the Date and Time

Keys and Procedure



1. Press the **MISC key** to display the MISC menu.
2. Press the "**Date/Time**" soft key to display the DATE/TIME setting menu.

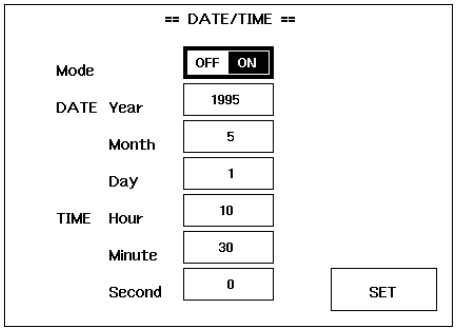


Turning the Date/Time ON/OFF

3. Turn the rotary knob to select "**Mode**", and select "ON" or "OFF" using the **SELECT key**.

Setting the Date/Time

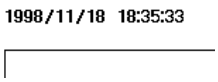
4. Turn the rotary knob to select "**Year**", "**Month**", "**Day**", "**Hour**", "**Minute**" or "**Second**". Press the **SELECT key** to display the setting screen.
5. Set the required value using the rotary knob.
6. Press the **SELECT key** or the **ESC key** to close the setting screen.
7. Repeat steps 4 to 6 until all necessary items are set.
8. Turn the rotary knob to select "**SET**" and press the **SELECT key** to confirm the settings.
9. Press the **ESC key** to close the menu.



Explanation

Setting the Date/Time ON or OFF

When you set the mode to ON, the date and time will appear in the upper left corner of the screen. And when making a hard copy of the screen (to the built-in printer or external plotter) the date and time will be printed together with the waveform.



The current date and time are saved together with the waveform data or set-up data when the data is saved to a floppy disk.

Setting values of Date/Time

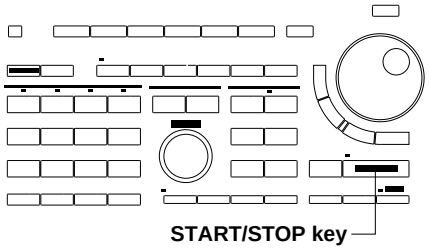
DATE		TIME	
Year	: 1980 to 2079	Hour	: 00 to 23
Month	: 1 to 12	Minute	: 00 to 59
Day	: 1 to 31	Second	: 00 to 59

Note

- The date and time are backed up by the built-in lithium battery.
- Leap years are provided. Turn the rotary knob to select "SET" and press the SELECT key to judge.

4.1 Starting and Stopping Acquisition

Keys and Procedure



1. Press the **START/STOP key** to start/stop waveform acquisitioning.
2. In case the indicator located at the upper left of the **START/STOP key** is lit, waveform acquisition is in progress.
3. In case the indicator located at the upper left of the **START/STOP key** is not lit, waveform acquisition is not in progress. In the upper left corner of the screen, “Stopped” appears.

Explanation

Operation when averaging mode is selected as the acquisition mode
Averaging stops when acquisition is stopped, and resumes when acquisition is restarted.

Operation during display of accumulated waveforms
Accumulated display stops temporarily when acquisition is stopped. When measurement is restarted, the accumulated display is reset and accumulation starts.

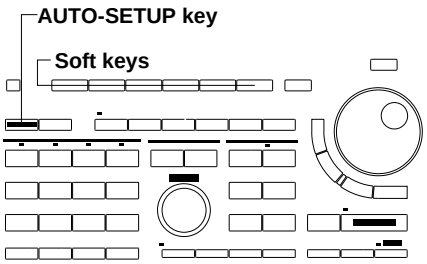
The START/STOP key is not operative in the following cases
- When remote state is active (i.e. the REMOTE indicator is lit);
- When a short or long copy is being output to the built-in printer;
- When the floppy disk is being accessed (e.g. when data is being saved to it). (If acquisition is in progress, access to the floppy disk starts after acquisition is stopped.);
- When calibration, auto set-up or initialization is in progress.

Operation in combination with external clock
When the external clock is being used and you start acquisition, the error messages “Ext clock too slow” or “Ext clock too fast” might appear.

Note
- If the START/STOP key is pressed to start acquisition while acquisition data (ACQ data) loaded from a floppy are being displayed, the acquisition data will disappear from the screen. It is possible to retain the waveform on screen by stopping acquisition only for the channel corresponding to the trace No. of the waveform. For a description of this operation, refer to page 12-6.
- For details regarding the external clock settings, refer to page 5-8.

4.2 Displaying Waveforms using the Auto Set-up Function

Keys and Procedure



1. Press the **AUTO-SETUP key** to display the auto set-up execution menu.

Executing auto set-up

2. Press the "**AUTOSET EXEC**" soft key to perform auto set-up. Channels will be turned ON/OFF automatically depending on whether input is applied or not.

Canceling auto set-up

3. Press the "**UNDO**" soft key to restore the previous settings which were in effect before the auto set-up. Note however that, if you have performed any other settings, it might be necessary to press the **AUTO-SETUP key** once again.

AUTOSET EXEC UNDO

Explanation

Waveforms for which auto set-up is effective

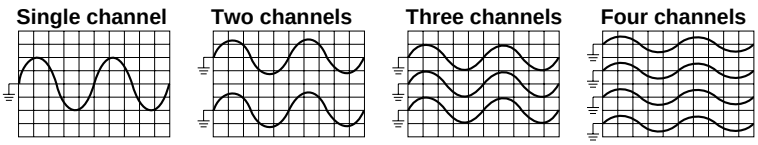
Frequency : Approx. 40 Hz to 150 MHz
Amplitude : Approx. 50 mV or higher (when probe attenuation is 1:1)
Type : Repetitive (but not complex) waveform

Auto set-up settings related to the vertical axis

CH1 to 4 Depending on whether input is applied or not, the channels are automatically turned ON or OFF. (In case of an amplitude of at least approx. 50 mV (and probe attenuation is 1:1), the channel will be turned ON).

V/DIV
- when one waveform is displayed : Set to a value so that the peak voltage is between 1.6 div p-p and 4 div p-p.
- when two waveforms are displayed : Set to a value so that the peak voltage is between 0.8 div p-p and 2 div p-p.
- when three waveforms are displayed : Set to a value so that the peak voltage is between 0.4 div p-p and 1 div p-p.
- when four waveforms are displayed : Set to a value so that the peak voltage is between 0.4 div p-p and 1 div p-p.

POSITION Set as follows depending on the number of channels which are ON.



INPUT
- Input coupling: DC; Offset: 0V
- Inversion: Unchanged
- Probe attenuation : Unchanged
  Probe attenuation must be set before starting auto set-up.
- Acquisition hold : Unchanged

Auto set-up settings related to the horizontal axis

TIME/DIV Time axis is set so that the waveform with the longest cycle shows 2 to 4 cycles on the screen.
If this is not possible for any of the channel input signals, set to 1ms/div.

TIMEBASE Set to “INT”.

Auto set-up settings related to triggers

MODE Set to “AUTO”.

TYPE Set to “EDGE”.

LEVEL/SOURCE The trigger level is set to half the amplitude of the trigger source. The Channel having the waveform with the longest cycle is selected as the trigger source. The slope setting is set to “⎍”.

COUPLING Set to “DC”, HF rejection remains unchanged.

POSITION Set to 0div.

DELAY Set to “0s”.

HOLD OFF Set to “OFF”.

Auto set-up settings related to acquisition/display conditions

START/STOP Acquisition is started.

ACQUISITION Set to “NORMAL”.

LENGTH (for DL1540CL)
Unchanged.

FILTER Smoothing is set to “OFF”, Band to “FULL”.

ZOOM Mode is set to “OFF”, and other settings remain unchanged.

DISPLAY Settings related to interpolation, the X-Y display, and accumulate display remain unchanged.

DISPLAY FORM Settings related to graticule, scale, %marker and Waveform information remain unchanged.

Auto set-up settings related to waveform analysis

MEASURE Settings related to automated measurements remain unchanged.

CURSOR Settings related to cursor measurements remain unchanged.

MATH Waveform computation and phase shift are set to “OFF”.

Other Auto set-up related settings

STORE/RECALL Display of recalled waveforms is set to “OFF”.

SAVE/LOAD Display of loaded waveforms is set to “OFF”.

UNDO : Cancellation of auto set-up

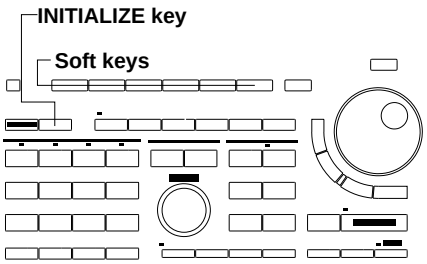
After auto set-up has been completed, this function allows you to restore the settings which were in effect before the auto set-up was performed.
However, if the power is turned OFF, the settings which were in effect before the auto set-up will be lost. Thus, it is not possible to perform an UNDO before an auto set-up.

Note

- It is not possible to perform auto set-up while GO/NO-GO determination is in progress.
- The snapshot waveform will be deleted if auto set-up is performed.
- The auto set-up function may not operate correctly in certain cases such as when the waveform contains DC components or high frequency components.

4.3 Initializing Settings

Keys and Procedure



1. Press the **INITIALIZE key** to display the initialization execution menu.
2. Press the "**INITIAL EXEC**" soft key to execute initialization.

INITIAL EXEC

Explanation

Default settings related to the vertical and horizontal axes

CH1 to CH4	All channels ON
V/DIV	50 V/div
POSITION	The horizontal position is set to 0div. For the vertical position, refer to the figures (Two channels, Four channels) given under title "POSITION" in section 4.2.
INPUT	Input coupling: DC, Probe attenuation: 10:1, Inversion: OFF
TIME/DIV	1 ms/div
TIMEBASE	INT

Default settings related to trigger

MODE	AUTO
FUNCTION	EDGE
LEVEL/SOURCE	Trigger source: CH1, Trigger slope: "$\int$",Trigger level: 0 V
COUPLING	Trigger coupling: AC, HF rejection: OFF
POSITION	Center of the waveform display frame
DELAY	Delay time: 0 s
HOLD OFF	Mode: OFF, Hold-off time: MIN (0.2µs)

Default settings related to other settings

ACQUISITION	Mode: NORMAL
LENGTH (for DL1540CL)	Record length: 10K
FILTER	Smoothing: OFF, Band limit: FULL
DISPLAY	Interpolation: SINE, X-Y display: OFF, Accumulate: OFF, Wide screen:OFF
DISPLAY FORM	Graticule: GRID, Scale: ON, % Marker: OFF, Waveform information: ON, Intensity: TEXT (9)
SHIFT	OFF (LED is not lit)

Settings which cannot be initialized

In the following cases, the settings which were in effect before initialization will be retained even if initialization is performed.

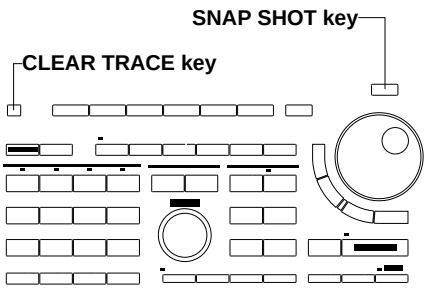
- Date and time
- Displayed waveforms/setting parameters stored in the internal memory
- GO/NO-GO zone waveforms
- Communications addresses

Points to note when initializing

- Snapshot waveforms will be deleted when initialization is performed.
- Operations such as measurements, computations, etc. will be halted.
- Initialization cannot be performed during GO/NO-GO.

4.4 Halting a Waveform and Erasing the Halted Waveform (Snapshot and Clear Trace)

Keys and Procedure



1. Press the **SNAP SHOT key** to halt the waveform.
2. Press the **CLEAR TRACE key** to erase the halting waveform.

Explanation

Snap Shot Function

A snapshot waveform is displayed each time the SNAP SHOT key is pressed and will be deleted when you switch between MAIN/ZOOM or MainZoom display, or when initialization of settings is performed.

A snapshot cannot be performed during X-Y waveform display.

In order to view snapshot waveforms only, you can either turn off the input signal (by pressing the CH key), or move the vertical position of the displayed channel.

Snapshot waveforms will remain on the screen even if calibration is performed.

The following operations are not possible on snapshot waveforms.

- Position movement
- Cursor measurement
- Automated measurement
- Expansion
- Waveform computation
- Storage in the internal memory
- Outputting to an external plotter
- Saving on a floppy disk in case of the HP-GL and PS format

Functions of the CLEAR TRACE key

Deletes the following waveforms.

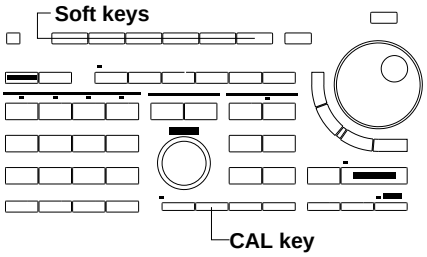
- Snapshot waveform
- Accumulated waveform (refer to page 7-13)

Restarts the following operations.

- Averaging (refer to page 7-1)
- Equivalent time sampling

4.5 Performing Calibration

Keys and Procedure



1. Press the **CAL key** to display the calibration execution menu.

Executing manual calibration

2. Press the "**EXEC**" soft key to execute calibration.

Turning automatic calibration ON

3. Press the "**Auto CAL**" soft key to select "**ON**".

Explanation

About the calibration function

The following parameters are calibrated.

- Ground level offset
- A/D converter gain
- Trigger threshold level
- Time axis for equivalent time sampling

Calibration takes approximately five seconds. No keys are operative during calibration.

Automatic calibration function

When the automatic calibration function is ON, calibration is performed automatically after the following time periods has elapsed in case T/div has been changed.

After the power is turned ON

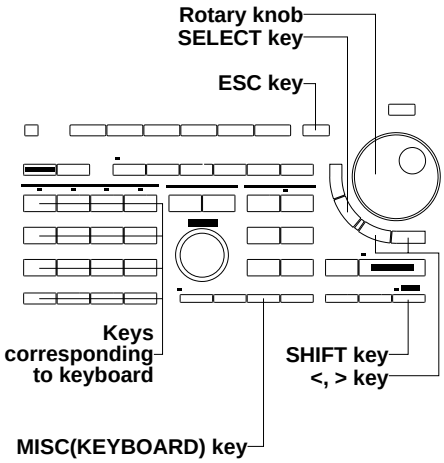
3 minutes;

10 minutes;

30 minutes, then every half hour.

4.6 Setting Values

Keys and Procedure



Entry using the keyboard

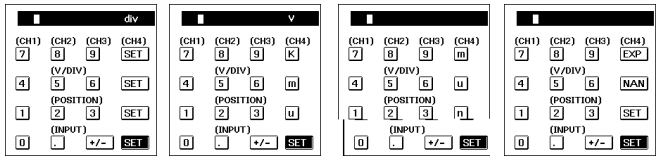
1. Press the **SHIFT + MISC(KEYBOARD) key** to display the keyboard.

Setting by rotary knob and SELECT key

2. Use the rotary knob to select the desired value and press the **SELECT key**. This allows setting one by one.
3. Select the "**SET**" **key** and press the **SELECT key**. The keyboard screen will be closed.

Setting by corresponding panel keys

2. After having performed step 1, press the corresponding panel keys directly.
3. After having entered the new value, select the "**SET**" **key** and press the **SELECT key**. The keyboard screen will be closed.



Entry by rotary knob

1. Change the value (displayed in the lower right side of the screen) by turning the rotary knob.
2. When the new value has been selected using the rotary knob, use the **<**, **>** keys to move to the next position to be changed.

Ex.

CH Position To				
-3div	-1div	0div	+1div	+3div

CH1
Position
100div

Explanation

Entry using the keyboard

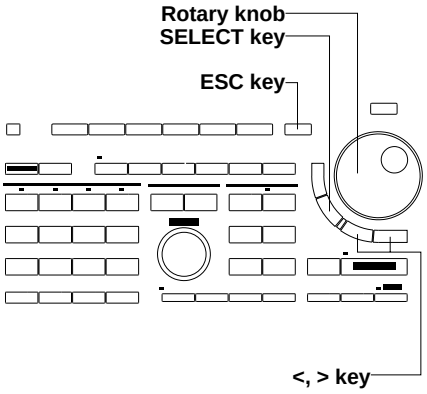
The operation described in step 1 will only result in displaying the corresponding keyboard when the setting allows numerical input.
Depending on the setting, there are cases when units such as k, m, u (symbolizing μ), EXP and NAN (Ignore) appear. To change such a setting, select the correct one using the rotary knob, and press the SELECT key.
Pressing the RESET key will clear the keyboard display.
Decimal enterings will be rounded as necessary to comply with the step size.

Entry using the rotary knob

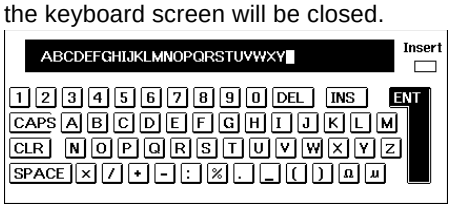
Pressing the RESET key will reset the value displayed in the rotary knob menu to the default value (factory setting).

4.7 Entering Characters using the Keyboard

Keys and Procedure



1. Display the keyboard used for entering a file name or comment (displayed when your are prompted a character input).
2. Use the rotary knob to select the desired character or symbol and press the **SELECT key**. The entered character will appear on the displayed keyboard.
3. Repeat step 2 until all characters and symbols are entered.
4. Move the rotary knob to the "**ENT**" setting and press the **SELECT key**. The file name, comment and such will be set and the keyboard screen will be closed.



Explanation

Displaying the keyboard to enter characters/symbols

For entry of a file name, refer to

6.9 Setting the Action-On Trigger (page 6-15)
9.1 Judging using a Waveform Zone (page 9-1)
9.2 Judging using Measured Values of Waveform Parameters (page 9-8)
12.3 Saving and Loading Waveform Data (page 12-4)
13.5 Saving and Loading Waveform Data (page 13-6)

For entry of a comment, refer to

10.6 Entering a Comment (page 10-10)

Function keys on the soft keyboard

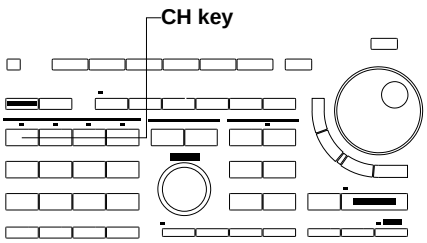
DEL ..... Deletes the character or symbol left of the cursor in the character string.
INS ..... Switches between insert and overwrite modes.
CAPS ..... Switches between upper and lower case letters.
CLR ..... Deletes all entered characters and symbols. Has thus the same function as the RESET key on the front panel.
SPACE ... Enters one space.
ENT ..... Confirms the entered characters and symbols.
* Pressing the < or > key shifts the entry position (cursor) to the left or right.
ESC key. Aborts entering file name or comments during setting. The keyboard screen will be closed and setting will be ignored.

Points to note

- The following number of characters can be entered.
  File name : 1 to 8
  Comment : 0 to 25
- The following character types are available.
  File name : Digits, letters (not case sensitive), _(underline), – (minus), %, (,)
  Comment : All characters and symbols on the keyboard (case sensitive), and space
- The following five file names are not available due to MS-DOS restrictions.
  AUX, CON, PRN, NUL, CLOCK

5.1 Turning Display of Input Signal Waveforms ON/OFF

Keys and Procedure



1. The waveform will appear on the display after you have pressed the **CH key**. The indicator above the **CH key** will light up.
2. If you want to display all waveforms, press all the **CH keys**, and verify that all the indicators light up.
3. In order to turn the display of a waveform off, press the corresponding **CH key** once more.

Explanation

Maximum display record length and limits on waveform acquisition (when 2 MW for DL1540CL is selected)

The channels which acquire/display the waveform are limited to channel 1 and 2 on DL1540CL. Channel 3 and 4 on DL1540CL do not acquire/display the waveform. When the time axis setting is set to 50 ns to 5 ns range; when the trigger mode is not single mode; or when one of the two, channel 2 or one of the two, channel 3 or 4 in the case of DL1540CL is ON, maximum display record length of 2 MW for DL1540CL can not be selected.

For information about selection of maximum displayable record length, refer to Section 7.1 (page 7-1).

CH key operation during waveform math

The math waveform will be displayed at trace 3 (location where the input signal of channel 3 is usually displayed). Even if you press the CH3 key, and the indicator is lit, the math waveform will be displayed.

The math waveform consists of data of channel 1 and channel 2. Even when you turn off the display of channel 1 or 2, the math waveform will remain.

To display the input signal waveform of channel 3, you have to turn OFF waveform math. Refer to page 8-18.

CH key operation during display of a recalled waveform

When you recall waveform data from the internal memory, that waveform will appear on the screen.

To turn the display of the recalled waveform off, press the CH key corresponding to the number of the recalled waveform (displayed as “MEM”), and select OFF at the appeared menu. Refer to page 11-2, step 13 and 14.

CH key operation during display of a loaded waveform

When you load P-P waveform data or acquisition waveform data from a floppy disk, that waveform will appear on the screen.

To turn the display of the P-P waveform off, press the CH key corresponding to the number of the P-P waveform (displayed as “MEM”), and select OFF at the appeared menu. Refer to page 12-5, step 19 and 20.

To turn the display of the acquisition waveform off, press the CH key corresponding to the number of the acquisition waveform.

CH key operation during display of a GO/NO-GO zone waveform

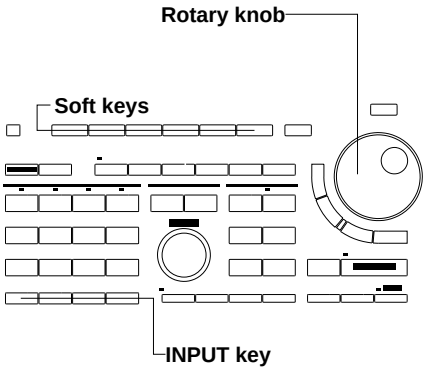
Pressing a CH key turns display of both the corresponding input signal waveform and the zone waveform ON/OFF.

Note

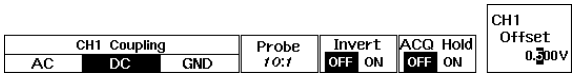
- If the START/STOP key is pressed to start acquisition while loaded waveforms are displayed, the displayed waveforms will be cleared from the screen. It is possible to retain a desired waveform on screen by stopping acquisition of the corresponding channel. For a description of this operation, refer to page 12-6.
- For DL1540CL, if you have saved ACQ data to multiple floppy disks, you can opt to load all of this data or only part of it (for example, data from one disk only). If you do a partial load, the waveform display will not appear over the entire time axis, but only over a portion of it. Refer to the procedures for saving and loading of ACQ waveform data, beginning on page 12-5.
- Pressing the SNAP SHOT key also keeps the waveform on the screen. To clear the snapshot waveform, press the CLEAR TRACE key.
- In the following cases erroneous waveforms might appear on channel 3 or 4. Acquiring the waveform once again will result in a correct display.
  - For DL1540C, when the record length is 120KW, the trigger mode is SGL (L) and waveform acquisitioning has ended and you turn CH3 or CH4 ON, while they had been OFF until then.
  - After acquiring waveforms at 200 MS/s and you stop acquisition, and then you switch CH3 or CH4 ON.

5.2 Setting the Input Coupling

Keys and Procedure



1. Press the **INPUT key** corresponding to the channel for which input coupling is to be selected. The input setting menu will be displayed.
2. Press the soft key corresponding to the desired coupling type.
3. When DC is selected, turn the rotary knob to set the desired offset voltage.



Explanation

Input coupling

The following three types of input coupling are available. The default is “DC”.

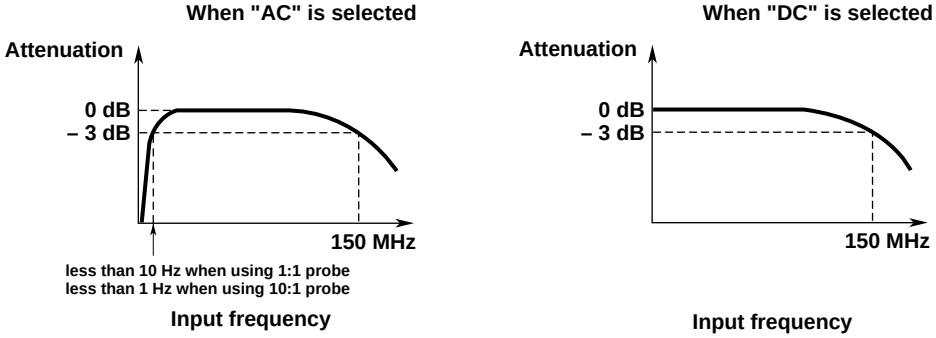
AC Displays only the AC content of the input signal.

DC Displays both the DC and AC content of the input signal. Only in this case an offset value can be set. This setting can also be done pressing the KEYBOARD key (refer to page 4-7).

GND Used to check the ground level.

Input coupling and frequency characteristic

The frequency characteristic when “AC” or “DC” is selected is shown below.
Note that low-frequency signals and low-frequency contents are not acquired if “AC” is selected.



Offset voltage and vertical sensitivity

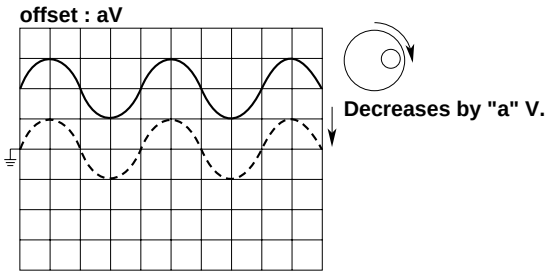
If “DC” is selected, it is possible to cancel the offset voltage for the input signal.
The allowable setting range varies depending on the vertical sensitivity as shown in the table below.

Vertical sensitivity*	Allowable setting range*	Setting step
10 mV to 500 mV/div	–10 V to ±10 V	500 µV
1 V to 5 V/div	–100 V to ±100 V	5 mV
10 V to 50 V/div	–1000 V to ±1000 V	50 mV

* The above values are given for a probe attenuation of 10:1. They will be 1/10 the value shown when the attenuation is 1:1, 10 times the value shown when it is 100:1, and 100 times the value shown when it is 1000:1.

Offset voltage and displayed value (measured value)

The offset function eliminates unnecessary DC voltage from an input signal voltage. If the offset voltage is set to a positive value, the input signal is displayed with the offset voltage subtracted from it, as shown below. The offset voltage is also subtracted from the measured voltages obtained during automated measurements.



Points to note when setting the offset voltage

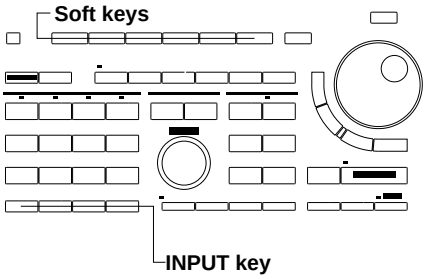
- Once the offset voltage has been set, it will not change unless initialization is performed. For instance, if the input coupling is set to “AC” after the offset voltage has been set, the offset voltage will remain unchanged even if the input coupling is later switched to “DC”.
- When the probe attenuation is changed, the offset voltage also changes accordingly.
- The offset voltage remains unchanged irrespective of the vertical sensitivity. However, if the offset voltage exceeds the allowable setting range, it will be set to the maximum or minimum vertical sensitivity value.
- When the offset voltage is set, it will also be subtracted from the acquired waveform data in acquisition memory. Thus, care must be taken when saving acquisition data.

CAUTION

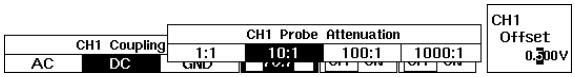
When using AC coupling with a 10 MΩ, 10:1 probe, keep in mind that the voltage at the input connector will not be attenuated to 1/10 at the probe tip for input signal components below 1 Hz. Be careful not to let the input voltage at the probe tip exceed 250 V (DC+ACpeak) or 177 Vrms for signal components below 1 Hz.

5.3 Setting the Probe Attenuation

Keys and Procedure



1. Press the **INPUT key** corresponding to the channel for which the probe attenuation is to be selected. The input setting menu will be displayed.
2. Press the "**Probe**" soft key to display the probe selection menu.
3. Press the soft key corresponding to the desired attenuation.



Explanation

Probe attenuation

Probe attenuation can be selected from "1:1", "10:1", "100:1" and "1000:1". The default is "10:1".

Set to "10:1" when using the probe supplied with the instrument.

Set to "1:1" when using a BNC cable.

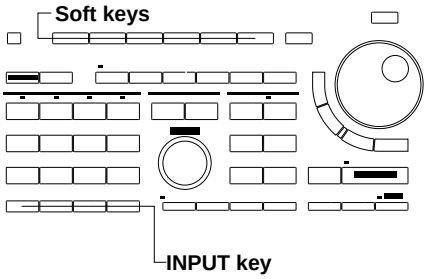
Note

The selected probe attenuation will remain unchanged even if auto set-up is performed.

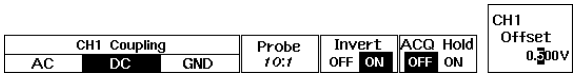
When the probe attenuation is changed, the offset voltage also changes accordingly.

5.4 Inverting a Waveform

Keys and Procedure



1. Press the **INPUT key** corresponding to the channel whose waveform is to be inverted. The input setting menu will be displayed.
2. Press the "**Invert**" soft key to select "**ON**".



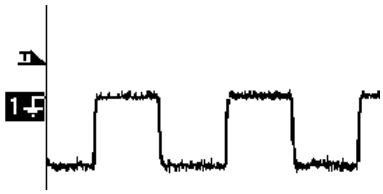
Explanation

Relevant channels

The input signals for channels CH1 to CH4 can be inverted independently of one another. Each time the soft key is pressed, "ON" or "OFF" are displayed alternately, and the waveform will be inverted accordingly.

Indication of an inverted signal

When a waveform is inverted, the corresponding trace number is highlighted as shown below.

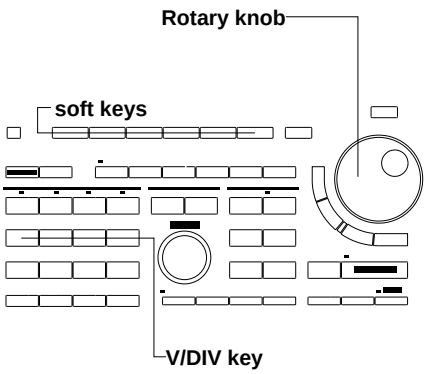


Points to note

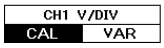
- Cursor measurement, automated measurement, waveform math and GO/NO-GO determination are performed on the inverted waveforms, not on the original ones.
- The waveform data that will be saved in the acquisition memory will not be inverted, so care must be taken when saving the acquisition data.

5.5 Setting the Vertical Sensitivity

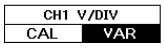
Keys and Procedure



1. Press the **V/DIV key** of the desired channel to display the vertical sensitivity setting menu. Verify that the "**CAL**" setting is highlighted.
2. Turn the rotary knob to set the desired sensitivity (V/div).



3. In case you want to adjust the setting in smaller steps, press the "**Variable**" soft key.
4. Turn the rotary knob to set the desired sensitivity.



Explanation

Setting the range and probe attenuation

The V/div setting range varies depending on the attenuation of the probe used, as shown below.

Probe attenuation	Setting range*
1:1	1 mV to 5 V/div
10:1	10 mV to 50 V/div
100:1	100 mV to 500 V/div
1000:1	1 V to 5000 V/div

* V/div can be set in multiples of 1, 2 and 5, e.g. 1 V/div → 2 V/div → 5 V/div.

Variable mode

When "Variable" is highlighted, V/div can be set in fine steps as shown below.

CAL Setting value	Variable Setting range*	Setting step*
10 mV	5.0 mV to 20.0 mV	0.1 mV
20 mV	10.0 mV to 50.0 mV	0.1 mV
50 mV	20.0 mV to 100.0 mV	0.1 mV
100 mV	50 mV to 200 mV	1 mV
200 mV	100 mV to 500 mV	1 mV
500 mV	200 mV to 1000 mV	1 mV
1 V	0.5 V to 2.00 V	0.01 V
2 V	1.00 V to 5.00 V	0.01 V
5 V	2.00 V to 10.00 V	0.01 V
10 V	5.0 V to 20.0 V	0.1 V
20 V	10.0 V to 50.0 V	0.1 V
50 V	20.0 V to 100.0 V	0.1 V

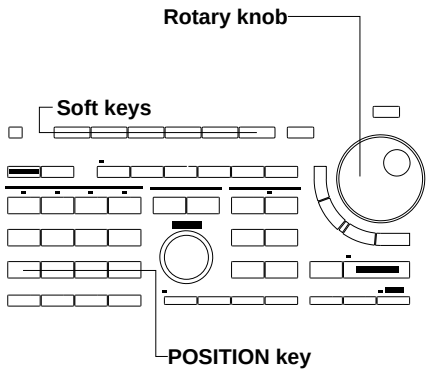
* The above values are given for a probe attenuation of 10:1. They will be 1/10 of the value shown when the attenuation is 1:1, 10 times the value shown when it is 100:1, and 100 times the value shown when it is 1000:1.

Note

- If the RESET key is pressed to reset V/div setting, V/div will be set to the maximum possible level.
- For a description of how to set the probe attenuation, refer to page 5-4.

5.6 Changing the Waveform's Vertical Position

Keys and Procedure



1. Press the **POSITION key** of the channel whose waveform you want to move.
2. Select the position of the screen where you want the waveform to be displayed by pressing the corresponding soft key.
3. Turn the rotary knob to fine adjust the position.

CH Position To				
-3div	-1div	0div	+1div	+3div

CH1
Position
0.00div

Explanation

Moving range

The ground level can be moved up to ±4.000 div from the center of the waveform display frame. This range can be travelled using the rotary knob. The soft keys allow you to move the waveform quickly to either of the positions "**–3div/–1div/0div/+1div/+3div**".

Setting resolution

The ground level can be moved in steps of 0.02 divisions irrespective of the vertical sensitivity.

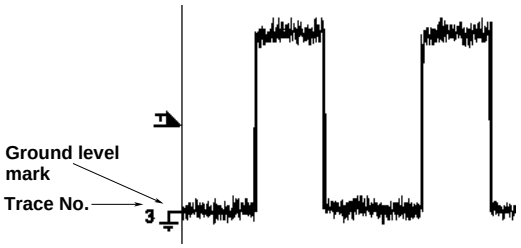
Waveforms which cannot be moved

Snapshot waveforms

Indication of the vertical position

For an input signal waveform or computed waveform, the corresponding trace No. and ground level mark are displayed on the left edge of the waveform display frame. The trace No. and ground level mark also move with the waveform when the waveform is moved.

For a recalled or loaded waveform, the trace No. (preceded by "**L**") also moves with the waveform when the waveform is moved.

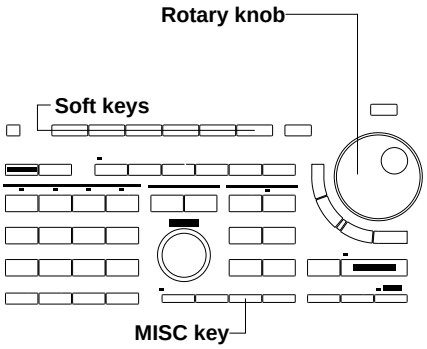


Note

- Waveforms can still be moved vertically if acquisition is in progress. However, if some parts of the waveform exceed 10.24 divisions before acquisition is stopped, those parts will remain at the end of the display frame even if the waveform is moved.
- If a waveform is moved vertically out of the waveform display frame, measured values obtained during automated measurement or cursor measurement may not be accurate.

5.7 Selecting the Timebase

Keys and Procedure



1. Press the **MISC key** to display the MISC menu.
2. Press the "**Time Base...**" soft key to display the timebase setting menu.

Time Base...	Comm...	Date Time...	Infor-mation...	Config...	To NextMenu

3. Select the required timebase by pressing the corresponding soft key.

Time Base		
INT	EXT IN	EXT CH4

To TopMenu

4. In case you selected "**EXT IN**" or "**EXT CH4**", use the rotary knob to set the required threshold level.

Time Base		
INT	EXT IN	EXT CH4

To TopMenu

EXT Level 1.5 V

Explanation

Selectable Timebases

Timebase can be selected from the following three types.

INT Internal clock signal
EXT IN Clock signal input to the EXT TRIG IN/EXT CLOCK IN terminal
EXT CH4 Clock signal input to the CH4 input terminal

When "EXT IN" is selected

Input a clock signal to the EXT TRIG IN/EXT CLOCK IN terminal on the rear panel, EXT TRIG terminal on the front panel). The clock signal must conform to the specifications given below.

Input terminal Example (DL1540/DL1540L)

Item	Specifications
Connector type	BNC
Maximum input voltage	±6 V
Frequency range	40 Hz to 15 MHz
Input level	TTL/CMOS level recommended 0.3 Vp-p or greater when measured at the end of the connector ±0.15 V or greater relative to the threshold level
Input impedance	Approx. 1 MΩ
Threshold level	1.5 V or 0.15 V
Minimum pulse width	25 ns or more for both High and Low levels

CAUTION

If a clock signal exceeding the maximum input voltage is input to the each terminal, damage to the internal circuits of the instrument may result.

When "EXT CH4" is selected

Input a clock signal to the CH4 input terminal on the front panel. The clock signal must conform to the specifications given below.

Item	Specifications
Frequency range	40 Hz to 80 MHz
Input level	2 div p-p or higher
Input impedance	1 MΩ
Minimum pulse width	5 ns or more for both High and Low levels

Threshold level setting range for detection of edge : Voltage equivalent to ±5 div

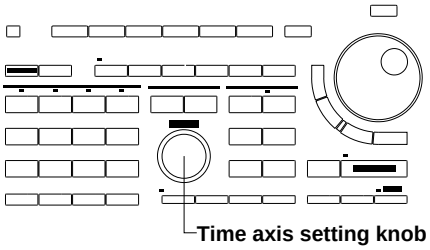
Points to note when sampling using an external clock

- The clock signal must be continuous. No burst signal is allowed.
- If the frequency of the clock signal is out of specification, a warning message “External Clock too slow” or “External Clock too fast” will be displayed at the top of the screen. When the internal clock is switched to the external clock, no waveforms will be displayed until the clock conforms to the specifications.
- Only real-time sampling mode is available.
- Envelope mode cannot be set.
- Display of waveforms is not possible in roll mode.
- No function to divide the clock signal is available.
- Since the time axis setting cannot be changed, expand the time axis if you want to change the display range. For a description of expanding waveforms, refer to page 7-4.
- Trigger delay setting is invalidated.
- The time measured by the cursor measurement or automated measurement function is expressed in the number of pulses of the clock signal. No unit is displayed.

5.8 Setting the Time Axis

Keys and Procedure

Turn the time axis setting knob to adjust the time axis setting. The time axis setting value, displayed in the lower right corner of the screen, will change accordingly.



Explanation

Time axis setting range

T/div can be set within the range of 5 ns/div to 50 s/div (in multiples of 1, 2 and 5)

The relationship between sampling mode and display mode

Sampling mode and display mode change as follows according to the T/div setting. For a detailed description of sampling mode and display mode, refer to page 1-5 and 1-6.

- If maximum displayable record length is set to 1 K (DL1540CL)

Time-axis setting	Sampling mode	Display mode *1
50 s to 50 ms/div	Real-time	Roll mode
20 ms to 1 μ s/div	Real-time	Update mode
500 ns to 100 ns/div	Real-time/repetitive *2	Update mode
50 ns to 5 ns/div	Repetitive	Update mode

- If maximum displayable record length is set to 10 K or 100 K (DL1540CL), or when DL1540C is used

Time-axis setting	Sampling mode	Display mode *1
50 s to 50 ms/div	Real-time	Roll mode
20 ms to 10 μ s/div	Real-time	Update mode
5 μ s to 100 ns/div	Real-time/repetitive *2	Update mode
50 ns to 5 ns/div	Repetitive	Update mode

- If maximum displayable record length is set to 400 K (available only if trigger mode is “single”, DL1540CL)

Time-axis setting	Sampling mode	Display mode *1
50 s to 200 ms/div	Real-time	Roll mode
100 ms to 100 ns/div	Real-time	Update mode

- If maximum displayable record length is set to 1 M (available only if trigger mode is “single”, DL1540CL)

Time-axis setting	Sampling mode	Display mode *1
50 s to 500 ms/div	Real-time	Roll mode
200 ms to 100 ns/div	Real-time	Update mode

- If maximum displayable record length is set to 2 M (available if trigger mode is “single” and display channel is 1 or 2, DL1540CL)

Time-axis setting	Sampling mode	Display mode *1
50 s to 1 s/div	Real-time	Roll mode
500 ms to 100 ns/div	Real-time	Update mode

*1 Indicates the display mode which is in effect when the trigger mode is auto mode or auto level mode and hysterisis is set off. For a description of how to set the trigger mode, refer to 6.8 “Setting the Trigger Mode” (page 6-13).

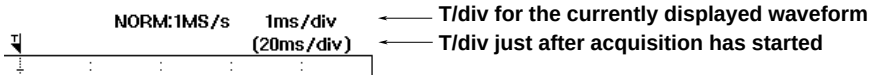
*2 Either real-time or repetitive mode is possible. For a description of how to switch modes, refer to 7.1 “Selecting Acquisition Mode, Sampling Mode and Record Length” (page 7-1).

Relationship between sampling rate and record length

Reducing the time-per-division setting (“T/div” time axis setting) increases the sampling rate. If T/div is set below some specific level, the displayed record length will be shorter than the maximum displayable record length. For details, refer to Appendix 2/Appendix 3.

Changing T/div while acquisition is in progress

T/div can still be changed when acquisition has been stopped with the START/STOP key. The newly set T/div will come into effect when acquisition is restarted. When T/div is changed while acquisition is in progress, the new T/div value will be displayed below the T/div for the displayed waveform, as shown below.

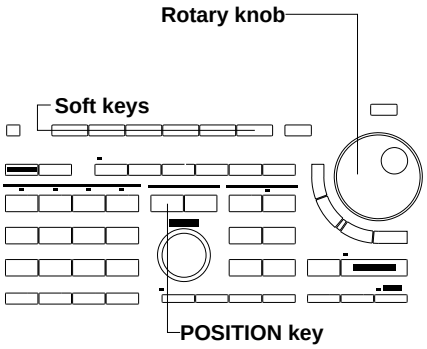


Points to note

- T/div can be changed irrespective of the displayed menu, since a T/div setting knob is available. But, for DL1540CL, note that it is not possible to select a short time axis (50ns/div or less) if maximum displayable record length has been set to 400 KW, 1 MW, or 2 MW (for DL1540CL only). (See page 7-1.)
- The T/div setting has no effect if the external clock signal is selected as the timebase.
- During expansion mode, the T/div obtained by dividing the normal display T/div by the expansion ratio is displayed.
- If T/div is set so that roll mode is activated, averaging will not be performed on the waveform data, even if the acquisition mode has been set to averaging mode (“NORM” will be displayed instead of “AVG”).
- Even if the trigger mode is single mode, if T/div is set to a value within a certain range, roll mode will still be activated. However, when a trigger is activated and acquisition of data of the specified record length ends, waveform display will be stopped.
- Pressing the CLEAR TRACE key while waveforms are displayed in repetitive sampling mode will restart sampling.

5.9 Changing the Waveform's Horizontal Position

Keys and Procedure



1. Press the **POSITION key** to display the menu for horizontal positioning.
2. Select the position to where you want to move the viewing frame by pressing the corresponding soft key.
3. Turn the rotary knob to fine adjust the position.

Position To		
-4div	0div	+4div

Position
-0.80div

Explanation

Moving range

The viewing frame can be moved up to ±5.00 div from the center of the waveform display frame. This range can be travelled using the rotary knob. The soft keys allow you to move the viewing frame quickly to either of the positions "**–4div/0div/ +4div**".

Setting resolution

The frame can be moved in steps of 0.02 divisions irrespective of the horizontal sensitivity.

Waveforms which cannot be moved

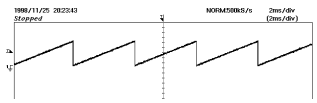
The viewing frame cannot be moved when snapshot waveforms are displayed.

Indication of the horizontal position

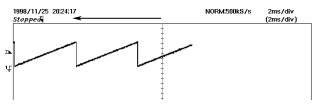
The trigger position marker will show the new position. In roll mode, a bargraph will appear in the upper side of the screen and will show which part of the waveform is shown on the screen.

Other modes than roll mode

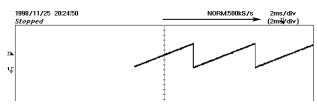
Horizontal position is 0 div



Horizontal position is moved to +4 div



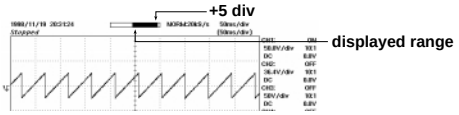
Horizontal position is moved to –4 div



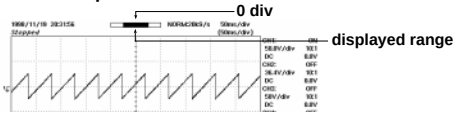
Roll mode

When the display is in roll mode and data acquisition has been started, the horizontal position will automatically be moved to +5 div.

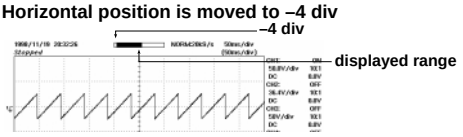
Horizontal position is +5 div



Horizontal position is moved to 0 div



Horizontal position is moved to –4 div



Points to note

- The horizontal position cannot be changed while acquisition is in progress in the roll mode. In order to move the horizontal position, first stop the acquisition.
- In all modes except the roll mode, changing the horizontal position might result in cases where the displayed range exceeds the record length of the acquisition memory. No waveform will be shown at that part of the displayed range.
- Even when the horizontal position has been changed, the zoom box will not change its position on the display. Refer to page 7-4.

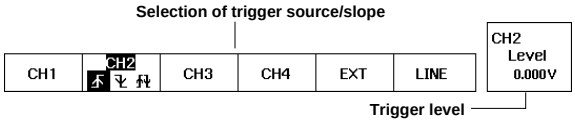
6.1 Relationship between Trigger Type and Trigger Source/Slope/Level

Settings which can be made with the **LEVEL/SOURCE** soft key or rotary knob menu vary as shown below according to the selected trigger type. The setting procedure for each trigger type is described on the page indicated below.

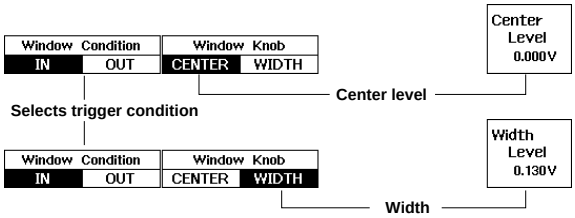
TYPE Selects the trigger type

LEVEL/SOURCE Sets the trigger source/slope (state)/level

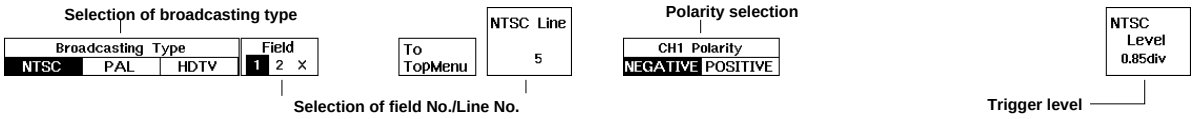
EDGE → page 6-2



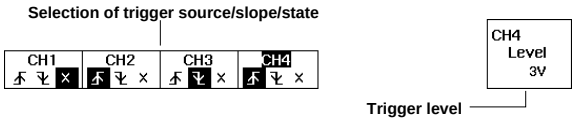
WINDOW → page 6-4



TV... → page 6-5

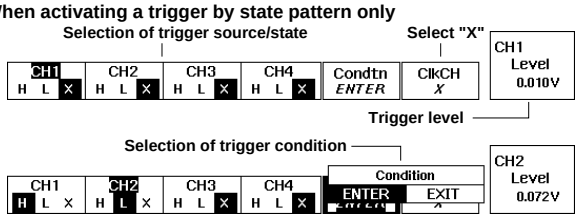


OR → page 6-7

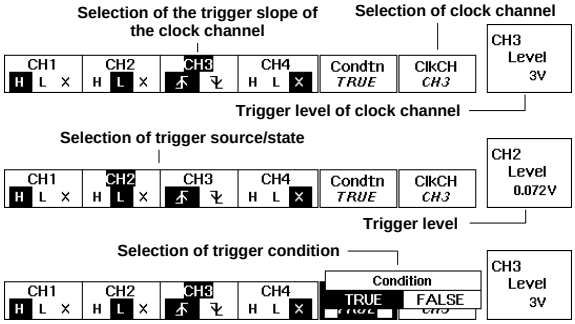


PATTERN → page 6-8

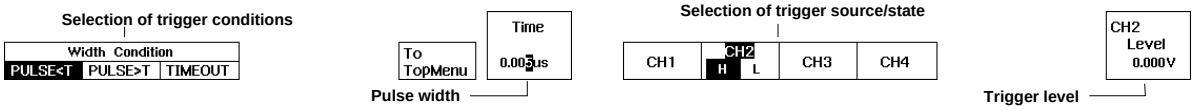
When activating a trigger by state pattern only



When activating a trigger in synchronization with the clock signal

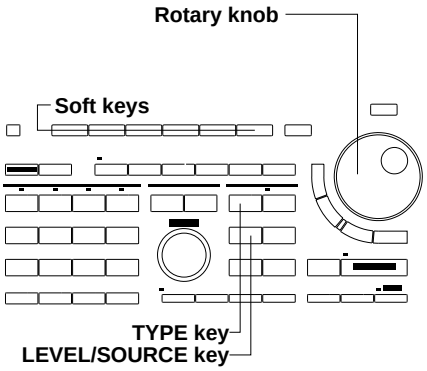


WIDTH... → page 6-10

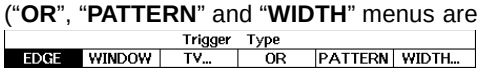


6.2 Setting the Edge Trigger

Keys and Procedure

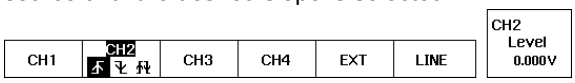


1. Press the **TYPE key** to display the trigger type selection menu.
2. Press the "**EDGE**" soft key.
   ("**OR**", "**PATTERN**" and "**WIDTH**" menus are optional.)

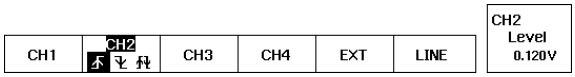


Selecting the trigger source and slope and setting the trigger level

3. Press the **LEVEL/SOURCE key** to display the trigger source selection menu.
4. Press the soft key corresponding to the desired trigger source. The trigger slope selection menu appears. When "LINE" is selected, this menu will not be displayed and thus steps 5 to 11 are not necessary.
5. Keep pressing the soft key corresponding to the selected trigger source until the desired slope is selected.



6. Turn the rotary knob to set the desired trigger level.



Types of Trigger sources and setting the trigger slope/level
CH1/CH2/CH3/CH4

Select one of these to select one of the input signals CH1 to CH4 as the trigger source.

The trigger slope can be selected from the following three slope types.

- ⎍ Activates a trigger when the trigger source changes from a level below the trigger level to one above the trigger level.
- ⎎ Activates a trigger when the trigger source changes from the level above the trigger level to the one below the trigger level.
- ⎍⎎ Activates a trigger in either of the above cases.

The setting range for the trigger level is within ±10 div of the vertical sensitivity, but is however limited by the waveform display frame. For example, when the voltage sensitivity is set to 50 mV/div, the trigger level to +300 mV and the ground level of the trigger source is positioned at 0div, the trigger level becomes +250 mV. In case the ground level of the trigger source is positioned at –3 div, the trigger level becomes +300 mV. The setting step for the trigger level is 1/50 of the vertical sensitivity.

EXT (external Trigger)

Select this when connecting the trigger signal source to the "EXT TRIG IN/EXT CLOCK IN" terminal on the rear panel (also used as the terminal for an external clock) and selecting the signal as the trigger source.

For the specifications of the terminal, refer to "When "EXT IN" is selected" in section 5.7

If a clock signal exceeding the above permissible maximum input voltage is input to the each terminal, damage to the internal circuits of the instrument may result.

The trigger slope must be selected from "⎍", "⎎" and "⎍⎎" in the same way when one of the channels CH1 to CH4 is selected. The trigger level must be either "0.15 V" or "1.5 V".

- EXT range is ±1 V: –1 V to +1 V in steps of 4 mV
- EXT range is ±10 V: –10 V to +10 V in steps of 40 mV

LINE (Line trigger)

Select this when the signal to be displayed is synchronized with the frequency of the commercial power source (50 Hz /60 Hz) and you want to select the commercial power source voltage signal as the trigger source signal.

Points to note when setting the edge trigger

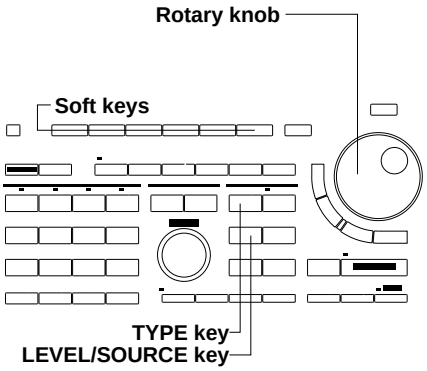
- If the trigger type setting is changed, the edge trigger setting will be invalidated. However, selecting the edge trigger will restore the previous edge trigger setting.
- If the trigger mode is not auto-level mode, the trigger level will not change once it has been set. Thus, changing the amplitude of the trigger signal or changing the offset may invalidate the trigger level, thereby hindering activation of a trigger. Conversely, if the trigger mode is auto-level mode, the median of the amplitude of the trigger signal is detected and the trigger level is set to the median value automatically if the trigger level is invalidated. For a detailed description, refer to 6.8 “Setting the Trigger Mode” (page 6-13).

Note

If the trigger slope is set to “up/down”, no trigger can be activated either at “rise” or “fall”. In this case, try to set an appropriate hold-off time. This may cause a trigger to be activated. For a description of how to set the hold-off time, refer to page 6-20.

6.3 Setting the Window Trigger

Keys and Procedure



1. Press the **TYPE key** to display the trigger type selection menu.
2. Press the "**WINDOW**" soft key.
   ("**OR**", "**PATTERN**" and "**WIDTH**" menus are optional .)

Trigger Type					
EDGE	WINDOW	TV...	OR	PATTERN	WIDTH...

Selecting the trigger condition and setting the window

3. Press the **LEVEL/SOURCE key** to display the trigger condition selection menu.
4. Press either soft key "**IN**" or "**OUT**".

Window Condition		Window Knob	
IN	OUT	CENTER	WIDTH

Center
Level
0.000V

5. Press the "**CENTER**" soft key and set the center level of the window using the rotary knob.

Window Condition		Window Knob	
IN	OUT	CENTER	WIDTH

Center
Level
0.010V

6. Press the "**WIDTH**" soft key and set the width of the window using the rotary knob.

Window Condition		Window Knob	
IN	OUT	CENTER	WIDTH

Width
Level
0.130V

Explanation

Selecting the trigger condition and setting the window

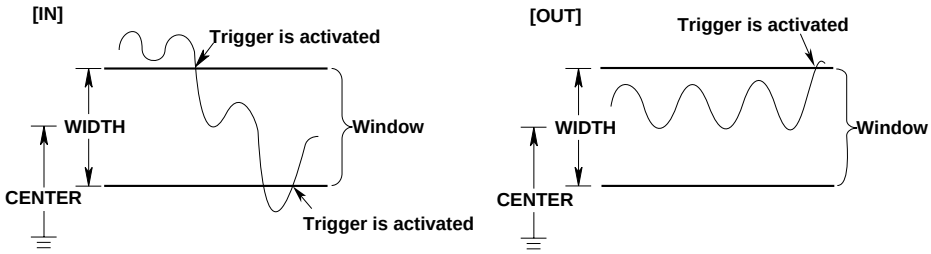
The window trigger will only be applied to the input signal of channel 1.

Trigger conditions can be selected from the following types.

IN Trigger will be activated when the trigger source level enters a preset voltage range.

OUT Trigger will be activated when the trigger source level exits from a preset voltage range.

The center level of the window and the corresponding width can be set. The setting limit and resolution for the trigger level is the same as for the edge trigger. Refer to page 6-2. The smallest width of the window is the CAL setting of the vertical sensitivity.

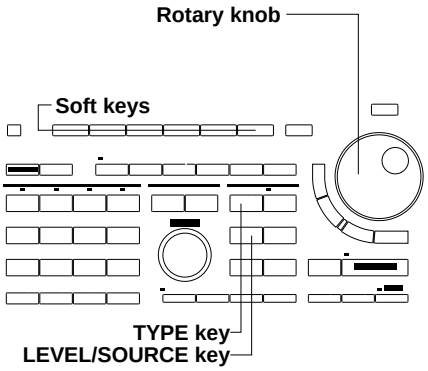


Points to note when setting the window trigger

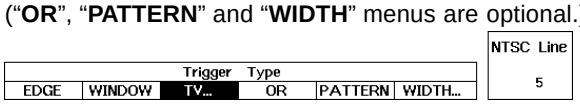
- If the trigger type setting is changed, the window trigger setting will be invalidated. However, selecting the window trigger again will restore the previous settings.
- Auto-mode operations are carried out even if the trigger mode is set to auto-level mode.

6.4 Setting the TV Trigger

Keys and Procedure

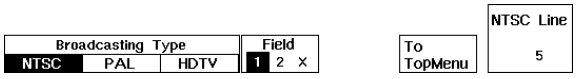


1. Connect the video signal to the CH1 terminal.
2. Press the **TYPE key** to display the trigger type selection menu.
3. Press the "**TV**" soft key.
   ("**OR**", "**PATTERN**" and "**WIDTH**" menus are optional.)



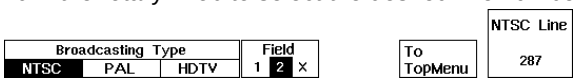
Selecting the broadcasting system for the video signal
If OR, PATTERN and WIDTH menus are not provided, the select menu will be displayed next to the trigger type selection menu.

4. Press any of the "**NTSC**", "**PAL**" or "**HDTV**" soft key to select the desired broadcasting system.



Selecting the field and line number
If OR, PATTERN and WIDTH menus are not provided, the select menu will be displayed next to the trigger type selection menu.

5. Press the "**Field**" soft key to select the desired field number.
6. Turn the rotary knob to select the desired line number.

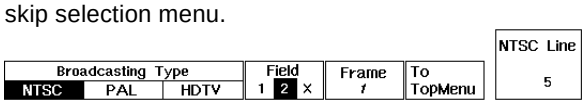


Selecting the polarity and setting the trigger level

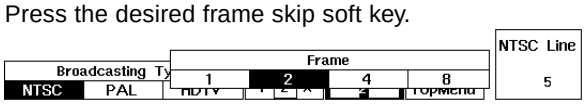
7. Press the **LEVEL/SOURCE key** to display the polarity/trigger level setting menu.
8. Press the soft key corresponding to the desired polarity.
9. Turn the rotary knob to set the desired trigger level.

Selecting the polarity and setting the frame skip

7. After step 6, press the "**Frame**" soft key to display the frame skip selection menu.



8. Press the desired frame skip soft key.



Explanation

Broadcasting systems with which the TV trigger can be used
NTSC, PAL, HDTV

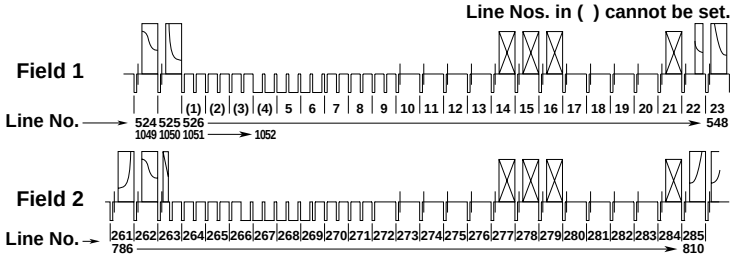
Selecting the field No. : Field

1 Detects a field in which the vertical synchronizing pulse and the line start at the same time.
2 Detects a field in which the vertical synchronizing pulse starts 1/2H (H: horizontal scan time) after the line starts.
X Detects both of the above types of field.

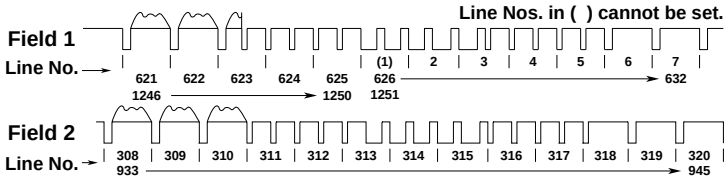
Selecting the line No. : Line

A trigger is activated at the beginning of the selected line.

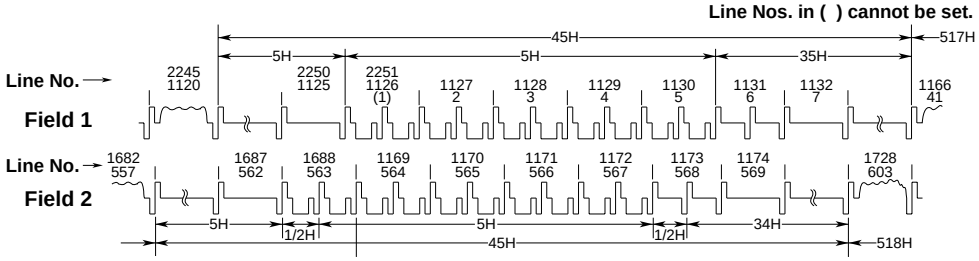
- **NTSC : 5 to 1054**
  Field 1 starts at line No. “5”. (Field 2 starts at line No. “268”.)



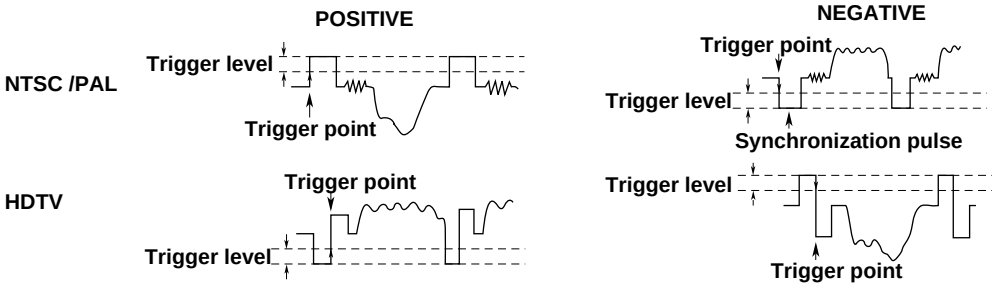
- **PAL : 2 to 1251**
  Field 1 starts at line No. “2”. Field 2 starts at line No. “315”.



- **HDTV : 2 to 2251 (available on DL1540C/DL1540CL)**
  Field 1 starts at line No. “2”. Field 2 starts at line No. “565”.



Selecting the polarity: Polarity



Setting the trigger level : Level

Set the difference between the beginning of the synchronization pulse and the level at which the trigger level is judged.

The setting range is from 0.10 div to 2.00 div. The setting resolution is 0.05 div.

The default settings are given below.

NTSC/PAL 0.50 div

HDTV 1.00 div

Setting frame skip: Frame

This is a function for skipping frames when the color burst is inverted on every frame. You can select how many frames to skip from the following choices.

Frame1 : Trigger every frame at the specified field.
Frame2 : Trigger every two frames at the specified field.
Frame4 : Trigger every four frames at the specified field.
Frame8 : Trigger every eight frames at the specified field.

However, the frame skip function can be used only for the following cases. For all other frame periods, set “HoldOff.”

- NTSC with 60-Hz frame period
- PAL with 50-Hz frame period
- HDTV with 60-Hz frame period

Note

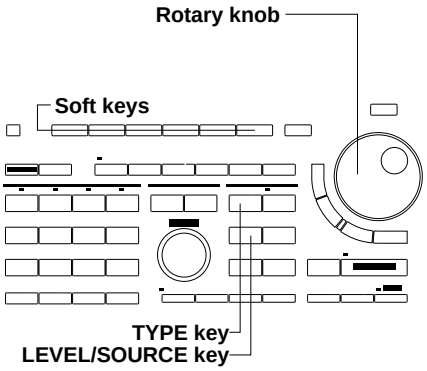
- Frames will not be skipped, if you change the “HoldOff” setting after setting the frame skip function. If you wish to trigger using the frame skip function, make the Frame selection again.
- If you select Frame4 or Frame8, the trigger mode is automatically changed to normal mode. However, if the “ACQ Hold” of the INPUT key is ON, the trigger mode is not changed automatically. In this case, change the trigger mode to normal mode before using the frame skip function.

Points to note when activating a TV trigger

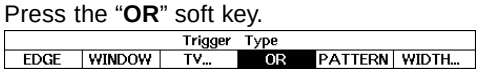
- If the trigger type setting is changed, the TV trigger setting will be invalidated. However, selecting the TV trigger again will restore the previous settings.
- Only channel 1 can be used for the video signal. Other channels cannot be used.
- For a TV trigger, the trigger coupling, HF rejection and trigger hysteresis settings are ignored.

6.5 Setting the OR Trigger (Optional)

Keys and Procedure



1. Press the **TYPE key** to display the trigger type selection menu.
2. Press the "**OR**" soft key.



Selecting the trigger source, trigger slope and state and setting the trigger level

3. Press the **LEVEL/SOURCE key** to display the trigger source selection menu.
4. Press the soft key corresponding to the desired signal source, and press the corresponding soft key to select the desired trigger slope/state selection.
5. In case you selected "↑" or "↓", use the rotary knob to set the desired trigger level.
   Repeat steps 4 and 5 to set the trigger slope, state and level for each trigger source.

Explanation

Types of trigger sources and setting the trigger slope, state and level
CH1/CH2/CH3/CH4

Selects which of the input signals CH1 to CH4 will be used as the trigger source. Select the trigger slope/state from the following.

↑ Activates a trigger when the trigger source changes from a level below the trigger level to one above the trigger level.

↓ Activates a trigger when the trigger source changes from the level above the trigger level to the one below the trigger level.

X This channel will be skipped as a trigger source.

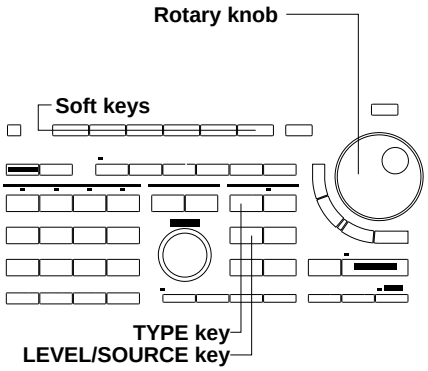
The setting limit and resolution for the trigger level is the same as for the edge trigger. Refer to page 6-2.

Points to note when setting the OR trigger

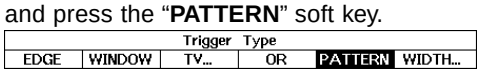
- If the trigger type setting is changed, the OR trigger setting will be invalidated. However, selecting the OR trigger again will restore the previous settings.
- Auto-mode operations are carried out even if the trigger mode is set auto-level mode.

6.6 Setting the Pattern Trigger (Optional)

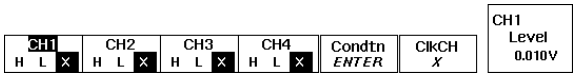
Keys and Procedure



1. Press the **TYPE key** to display the trigger type selection menu and press the "**PATTERN**" soft key.

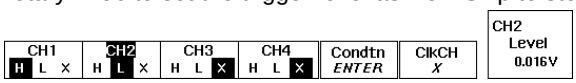


2. Press the **LEVEL/SOURCE key** to display the trigger source/ state selection menu.
3. Press the "**ClkCH**" soft key to display the clock channel selection menu. The default value is "**X**".



Activating a trigger by state pattern only

4. Press the "**X**" soft key.
5. Press the trigger source soft key and select the state. Do this for all trigger sources. In case "**H**" or "**L**" has been selected, use the rotary knob to set the trigger level as well. Skip to step 7.



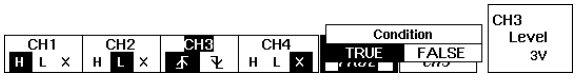
Activating a trigger in synchronization with the clock signal

4. Continuing from step 3, select the desired clock channel and press the corresponding soft key.
5. Select the trigger slope of the clock channel using the soft keys, and then use the rotary knob to set the trigger level.

6. Press the trigger source soft key for the channels which are not clock channel, and select the trigger state. In case "**H**" or "**L**" has been selected, use the rotary knob to set the trigger level as well.

7. Press the "**Condtn**" soft key and select the desired conditions using the corresponding soft keys.
   - menu in case of activating a trigger by state pattern only

   - menu in case of activating a trigger in synchronization with the clock signal



Explanation

Setting the trigger source and trigger state/level

The trigger state can be selected from the following.

L The trigger source level is above the preset trigger level.
H The trigger source level is below the preset trigger level.
X Not used as the trigger source.

The setting limit and resolution for the trigger level is the same as for the edge trigger. Refer to page 6-2.

Selecting the clock channel (ClkCH)

Set the clock channel to "**X**" when no trigger in synchronization with the signal is activated, and select from "**CH1 - CH4**" when a trigger in synchronization with the signal is activated.

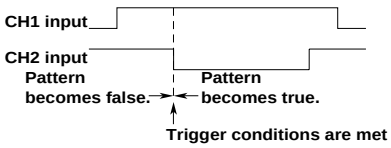
The following trigger slopes can be selected.

- Slope rising edge (changes from a level below the trigger level to one above the trigger level)
- Slope falling edge (changes from a level above the trigger level to one below the trigger level)

Selecting the trigger condition: Condtn

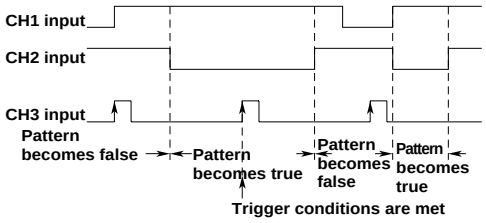
- **Activating a trigger using only the state pattern**
  Select the trigger condition from the following.
  ENTER Activates a trigger when the combination (pattern) becomes true.
  EXIT Activates a trigger when the pattern becomes false.

  [Setting example]
  CH1 : H
  CH2 : L
  CH3 : X
  CH4 : X
  Condition: ENTER



- **Activating a trigger in synchronization with the clock signal**
  Select the trigger condition from the following.
  TRUE Activates a trigger on the slope edge (riseor fall) of the clock channel when the state pattern becomes true.
  FALSE Activates a trigger on the slope edge of the clock channel when the state pattern becomes false.

  [Setting example]
  CH1 : H
  CH2 : L
  CH4 : X
  Clock CH: CH3
  Condition: TRUE

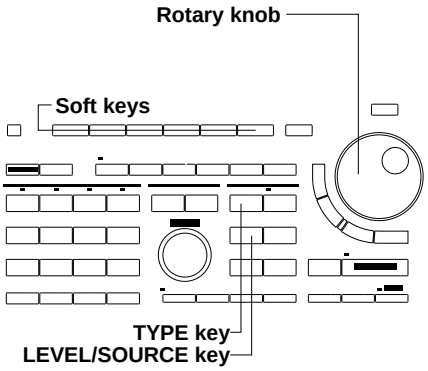


Points to note when setting the pattern trigger

- If the trigger type setting is changed, the pattern trigger setting will be invalidated. However, selecting the pattern trigger again will restore the previous settings.
- Auto-mode operations are carried out even if the trigger mode is set to auto-level mode.
- Select the trigger states for all trigger sources. Make sure to select the trigger slope for the selected clock channel.
- If you want to activate a trigger in synchronization with the clock signal, make sure that the pattern set-up time is 2 ns or more relative to the clock and that the hold-time is 0 ns or less.

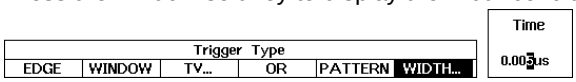
6.7 Setting the Width Trigger (Optional)

Keys and Procedure



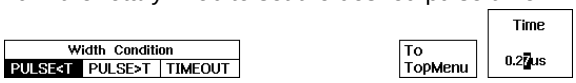
Selecting the width trigger

1. Press the **TYPE key** to display the trigger type selection menu.
2. Press the "**Width**" soft key to display the width condition menu.



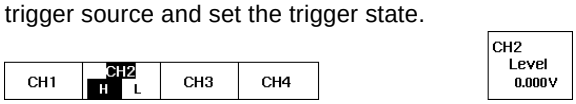
3. Select the width condition by pressing any of the "**PULSE<T**", "**PULSE>T**" or "**TIMEOUT**" soft keys.

4. Turn the rotary knob to set the desired pulse time.

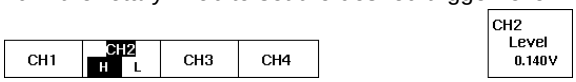


Selecting the trigger source/state and setting the trigger level

5. Press the **LEVEL/SOURCE key** to display the trigger source selection menu.
6. Press the soft key corresponding to the channel to be used as a trigger source and set the trigger state.



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



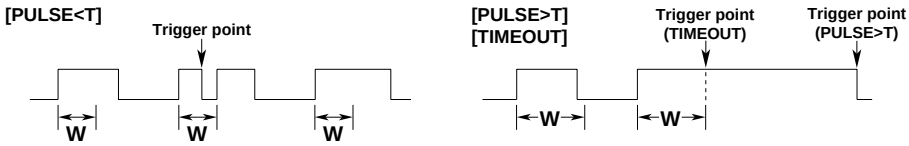
Explanation

Selecting the width condition

PULSE<T Trigger will be activated when the pulse width of the trigger source becomes narrower than the preset pulse width.

PULSE>T Trigger will be activated when the pulse width of the trigger source is wider than the preset pulse width and the state changes.

TIMEOUT Trigger will be activated when the pulse width of the trigger source becomes wider than the preset pulse width.



Width setting range and setting steps

Width setting range and setting steps are given below. The setting accuracy of the width is within ± (2 ns + set value x 0.01), approximately.

Setting range	Setting steps
5 ns to 9.99 µs *1, 2	10 ns
10 µs to 99.9 µs	100 ns
1 ms to 9.999 ms	1 µs
10 ms to 99.99 ms	10 µs
100 ms to 999.9 ms	100 µs
1 s to 9.999 s	1 ms

*1 The next pulse width after 5 ns is 10 ns.

*2 When the width condition is set to PULSE<T, the smallest setting range is 5 ns; when the width condition is set to PULSE>T or TIMEOUT, the smallest setting range is 30 ns.

Selecting the trigger source/state and setting the trigger level

The trigger source should be selected from CH1 to CH4

Select the trigger state from the following.

H The trigger source level is above the preset trigger level.

L The trigger source level is below the preset trigger level.

The setting limit and resolution for the trigger level is the same as for the edge trigger. Refer to page 6-2.

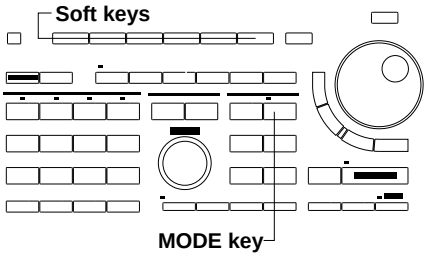
Points to note when setting the width trigger

- A malfunction may occur if pulse intervals are less than 20 ns or more.

- If the trigger type setting is changed, the width trigger setting will be invalidated. However, selecting the width trigger again will restore the previous settings.
- Auto-mode operations are carried out even if the trigger mode is set to auto-level mode.

6.8 Setting the Trigger Mode

Keys and Procedure



1. Press the **MODE key** to display the trigger mode selection menu.
2. Press the soft key corresponding to the desired trigger mode.
   - **Menu (DL1540C)**

Trigger Mode					
AUTO	AT-LVL	NORMAL	SGL(S)	SGL(L)	N-SGL

   - **Menu (DL1540CL)**

Trigger Mode				
AUTO	AT-LVL	NORMAL	SINGLE	N-SGL

Explanation

Selecting the trigger mode
The following six trigger modes are available. The default is “AUTO”.

AUTO (Auto-mode)
Updates the displayed waveform each time a trigger is activated if the trigger condition has become true within the time-out period of approximately 100 ms. Updates the displayed waveform automatically if the trigger condition becomes false within the time-out period.
The roll mode will be activated irrespective of the trigger condition if T/div is set to a value greater than 50 ms. However, the roll mode will not be displayed when the history memory function is “ON”.

AT-LVL (Auto-level mode)
Updates the displayed waveform in the same way as auto-mode if the trigger condition has become true within the time-out period. If the trigger condition becomes false, the trigger level is automatically set to the median of the amplitude of the trigger source, and then the waveform is displayed.
Auto-level mode is only valid, however, if the edge trigger has been selected as the trigger type. Auto-mode operations are carried out even if auto-level mode has been selected for a trigger other than an edge trigger. Furthermore, roll mode will be activated irrespective of the trigger type if T/div is set to a value greater than 50 ms. However, the roll mode will not be displayed when the history memory function is “ON”.

NORMAL (normal transmission mode)
Updates the displayed waveform only when the trigger condition becomes true. The displayed waveform will not be updated if the trigger condition does not become true.
In this mode, it is not possible to judge whether the signal is input or the trigger level is correct unless a trigger is activated. Furthermore, the ground level is not displayed even if the input coupling is set to “GND”.
Furthermore, in this mode, roll mode display is never activated, whatever the T/div setting, and waveforms are displayed only when a trigger is activated.

SGL(S) (Single short mode) : for DL1540C, SINGLE (Single mode) : for DL1540CL
When the START/STOP key is pressed and the trigger condition becomes true, the waveform is updated once only and acquisition stops.
If the time-axis setting corresponds to roll mode, the oscilloscope generates a roll-mode display. When the trigger occurs, the oscilloscope obtains data for the set record length and then stops the displayed waveform.
For details about record length, refer to Appendix 2/Appendix 3.

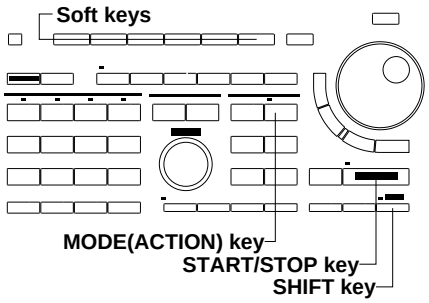
SGL(L) (Single long mode) : for DL1540C
This mode is the same as the aboved mentioned SGL(S) mode, except that the record length here is longer. The maximum record length is 120 K words.
For more details about the relation between time axis setting, sample rate and record length, refer to Appendix 2.

N-SGL (Single (N) mode)
Each time the trigger condition becomes true after the START/STOP key has been pressed, acquisition is performed the specified number of times. The waveforms will be displayed after acquisition stops.
If the START/STOP key is pressed again before acquisition has been completed the specified number of times, acquisition stops immediately. In this case, all the waveform data which has been acquired thus far is valid and can be displayed.
This trigger mode can only be used in real time sampling mode.
For setting the number of repetitions, refer to page 7-7.

Points to note when setting the trigger mode
- If single short mode or single mode is selected with a T/div setting which enables repetitive time sampling mode, acquisition will stop after it has been repeated the specified number times.
- If trigger mode is changed while acquisition is stopped (i.e. while the START indicator is not lit), acquisition starts automatically.
- If acquisition is interrupted in single (N) mode, only the waveforms which have been acquired completely are displayed.
- If the history memory function is set ON or if the acquisition mode is set to averaging, all single mode triggering cannot be done.
- If single long mode or single (N) mode is selected, repetitive sampling cannot be done.
- When the record length (maximum displayable record length) is 400 K/1 MW/2 MW for DL1540CL, single mode is the only mode available.

6.9 Setting the Action-On Trigger

Keys and Procedure



1. Press the **SHIFT + MODE (ACTION) key** to display the trigger on action selection menu.
2. Press the soft key corresponding to the desired action. Data acquisition will stop.
3. In case you selected "**FD(P-P)**" or "**FD(ACQ)**", pressing the "**FileName**" soft key will display the keyboard. In case you selected "**PRINTER**", skip step 4.

Action On Trigger				FileName	EXEC
PRINTER	FD(P-P)	FD(ACQ)	FD(IMG)		

4. Use the keyboard to enter the filename. For details on entering characters using the keyboard, refer to page 4-8.

Starting the action on trigger

5. Press the "**EXEC**" soft key to restart acquisition. The selected action will be validated when a trigger is activated.

Action On Trigger				EXEC
PRINTER	FD(P-P)	FD(ACQ)	FD(IMG)	

or

Action On Trigger				FileName	EXEC
PRINTER	FD(P-P)	FD(ACQ)	FD(IMG)		

Stopping the action on trigger

6. Press the "**ABORT**" soft key to stop acquisition.

Action On Trigger				EXEC
PRINTER	FD(P-P)	FD(ACQ)	FD(IMG)	

or

Action On Trigger				FileName	EXEC
PRINTER	FD(P-P)	FD(ACQ)	FD(IMG)		

Explanation

Selecting the action-on trigger

The action can be selected from the following.

PRINTER Outputs hardcopy to the built-in printer.

FD(P-P) Saves all the displayed waveforms (as P-P compressed data) on a floppy disk when a trigger is activated.

FD(ACQ) Saves all the displayed acquisition data (binary data) on a floppy disk when a trigger is activated.

FD(IMG) Saves the current screen image data to the floppy disk.

SCSI(IMG)*1 Saves the current screen image data to the SCSI device.

SCSI(P-P)*1 Saves the entire displayed waveform (P-P compressed data) to the SCSI device.

SCSI(ACQ)*1 Saves the acquisition data (binary data) of the entire displayed waveform to the SCSI device.

HD(IMG)*2 Saves the current screen image data to the internal hard disk.

HD(P-P)*2 Saves all the displayed waveforms (as P-P compressed data) to the internal hard disk.

HD(ACQ)*2 Saves all the displayed acquisition data (binary data) to the internal hard disk.

*1 You need to be using a model with the internal hard disk (DL1540CL /C8 option) or the SCSI interface unit 700930 (sold separately).

*2 Selectable only on models with the internal hard disk (DL1540CL /C8 option).

When the action on trigger starts, the trigger mode will change automatically to the single short mode or single mode.

Specifying a file name when "FD(P-P)", "FD(ACQ)", "FD(IMG)", "SCSI(P-P)", "SCSI(ACQ)", "SCSI(IMG)", "HD(P-P)," "HD(ACQ)," or "HD(IMG)" has been selected as the trigger action

A file No. (starting from "0001") is assigned to each waveform data automatically when the data is saved on a floppy disk, a SCSI device, or the internal hard disk. When saving the screen image data, set the image data format. You can set the format at the hard copy selection menu that appears by pressing the SHIFT+COPY(MENU) key (see page 12-11).

It is possible to insert a common file name (character string consisting of up to four characters) before the assigned file No. (for instance, "TRGO0001").

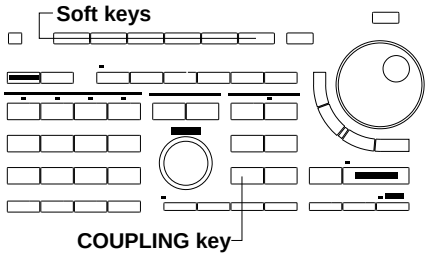
The entered file name is reset when "ABORT" is selected.

Points to note when using the action on trigger

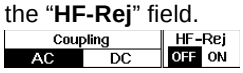
- When you change the trigger mode to any other than the single short mode or single mode, the trigger on action will be aborted.
- It is not possible to perform auto set-up or GO/NO-GO determination while the action on trigger is in progress.
- When the action on trigger starts, the trigger mode will change automatically to the single short mode or single mode. Even after canceling the action on trigger, the previous trigger mode will not be restored.
- When the action on trigger is restarted ("EXEC") after first being aborted ("ABORT"), the automatically assigned file No. will start from 0001. Previous saved data will therefore be overwritten.
- For DL1540CL, note that under "FD(ACQ)" action, ACQ-data record length may in some cases be too long to be saved onto a single floppy disk. In this case the screen will display an error message after saving data to the initial floppy disk.

6.10 Setting the Trigger Coupling and HF Rejection

Keys and Procedure



1. Press the **COUPLING key** to display the trigger coupling selection menu.
2. Press the soft key corresponding to the desired trigger coupling.
3. In case you want to set HF rejection, press the "**ON**" soft key at the "**HF-Rej**" field.



Explanation

Selecting the Trigger coupling

The following types are available.

AC The trigger source signal is used as the trigger source after the DC content has been removed. The trigger level becomes 0 V.

DC The trigger source signal is used as the trigger source without any processing. The trigger level becomes the center of the amplitude of the trigger source.

The default value is "AC".

The trigger coupling setting applies to all channels simultaneously.

Turning HF rejection ON/OFF

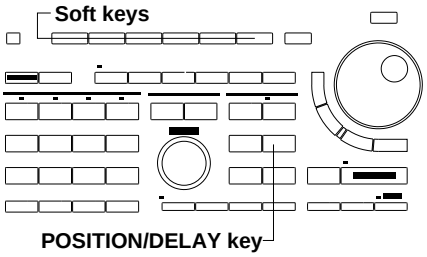
Set to "ON" if you want to use the trigger source signal as the trigger source after the high frequency content (frequency contents exceeding approximately 15 kHz) has been removed.

Points to note when setting the trigger coupling and HF rejection

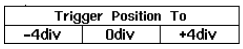
These settings will be ignored if "EXT" or "LINE" is selected as the trigger source or "TV" is selected as the trigger type.

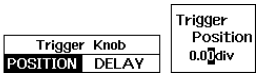
6.11 Changing the Trigger Position

Keys and Procedure



1. Press the **POSITION/DELAY key** to display the trigger position/ delay setting menu.
2. Press the soft key to set the desired trigger position. The trigger position can also be set using the rotary knob.

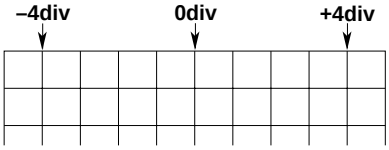




Explanation

Selecting the trigger position

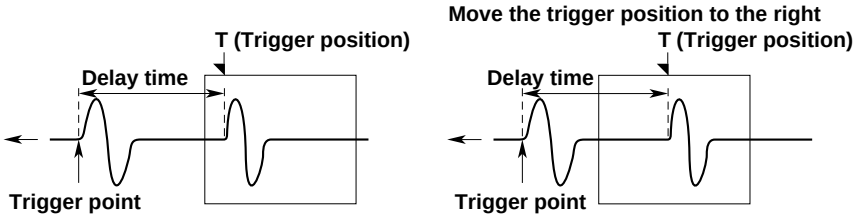
- The trigger position can be selected from the following.
  +4div +4 divisions from the center of the waveform display frame
  0div the center of the waveform display frame
  –4div –4 divisions from the center of the waveform display frame



- The trigger position can be set with in steps of 1/50 div using the rotary knob.

Setting the trigger delay and trigger position

The trigger position indicates which position of the waveform in the acquisition memory will actually be displayed on the screen. The trigger point refers to the point at which a trigger is activated. If no delay time has been set (i.e. delay time: 0 s), the trigger position and the trigger point refer to the same location.
However, if a delay time is set using the trigger delay, the trigger position must be moved using the above operations, since the delay point will not match the trigger point.
For more details on delays, refer to the next page.

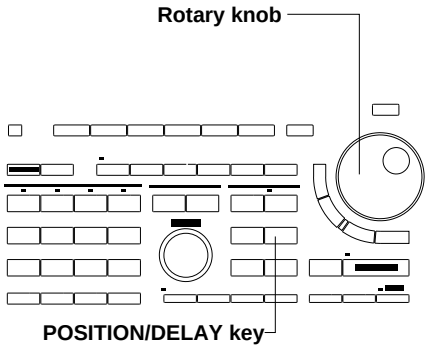


Points to note when setting the trigger position

- If the trigger position is changed while acquisition is not in progress (i.e. while the START indicator is not lit), the setting will not be valid until acquisition starts and the waveforms are updated.
- The time measured by cursor measurement will change if the trigger position is changed, because the trigger position is used as the reference position (except when the roll mode is being displayed).

6.12 Setting the Trigger Delay

Keys and Procedure

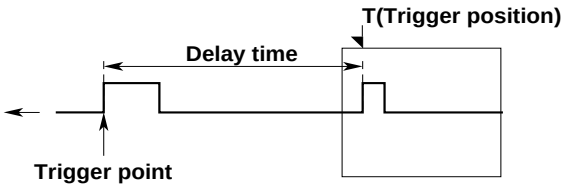


1. Press the **POSITION/DELAY key** to display the delay time setting menu.
2. Turn the rotary knob to set the desired delay time. You can also use the **<** or **>** keys.

Explanation

Setting the delay time

The trigger delay time is the duration between the point at which a trigger is activated, and the point at which data acquisition starts.



The setting range is 0 to 9.999 s. The setting step is as follows.

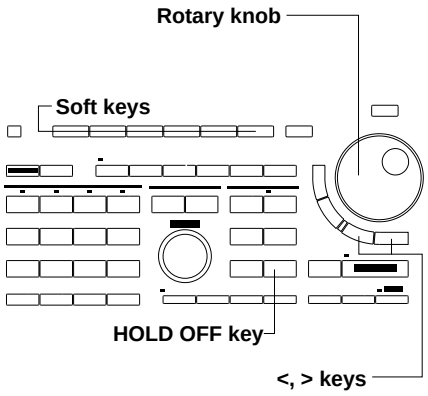
Setting time	Setting step
0 to 999.9 ns	0.1 ns
1 µs to 9.999 µs	1 ns
10 µs to 99.99 µs	10 ns
100 µs to 999.9 µs	100 ns
1 ms to 9.999 ms	1 µs
10 ms to 99.99 ms	10 µs
100 ms to 999.9 ms	100 µs
1 s to 9.999 s	1 ms

Points to note when setting the delay time

A delay time cannot be set if the external clock has been selected as the timebase. The setting will be invalid if sampling is performed using the external clock.

6.13 Setting the Hold-off Time

Keys and Procedure



1. Press the **HOLD OFF key** to display the hold-off time setting menu.
2. Turn the rotary knob to set the desired hold-off time. You can also use the **<** or **>** keys. Turning the rotary knob switches the "**Mode**" ON automatically.

3. To deactivate the hold-off function, press the "**Mode**" soft key and select "**OFF**".

Explanation

Hold-off time setting

The hold-off time setting range is 0.2 μs to 9.999 s.
The hold-off time will be 0.2 μs (minimum) if initialization is performed or if hold-off mode has been turned "OFF".

Turning the hold-off function ON/OFF

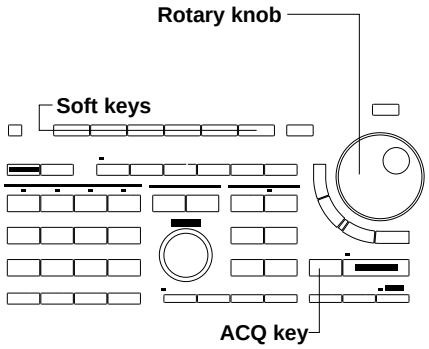
The hold-off time which has been set will be retained even if the hold-off function is set to OFF. If the hold-off function is switched ON again, the hold-off time which was in effect before the hold-off function was switched OFF will be restored.

Points to note when setting the hold-off time

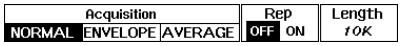
- If the hold-off time has been set to 100 ms or more, do not switch the trigger mode to auto-mode or auto-level mode. No trigger can be activated properly, as this conflicts with the time-out period (100 ms).
- The waveform updating interval may get longer depending on the hold-off time. In this case, switch the hold-off function OFF or change the hold-off time.

7.1 Selecting Acquisition Mode, Sampling Mode, and Record Length for DL1540CL

Keys and Procedure



1. Press the **ACQ key** to display the acquisition mode/sampling mode setting menu. “**Length**” menu is provided with DL1540CL.
2. Press the soft key corresponding to the desired acquisition mode.



When averaging mode is selected

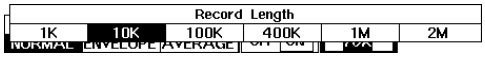
3. Turn the rotary knob to set the desired averaging count (attenuation constant).

Selecting sampling mode

2. After step 1 has been completed, press the “**Rep**” soft key and select “**ON**” for real-time sampling mode or “**OFF**” for repetitive sampling mode.

Selecting the record length (maximum displayable record length), (for DL1540CL)

2. After step 1 has been completed, press the “**Length**” soft key. The screen returns the length selection menu.
3. Press the soft key corresponding to the maximum displayable record length that you want to use.



Explanation

Selecting acquisition mode

Acquisition mode can be selected from the following modes. The default setting is “NORMAL”.

- **NORMAL (Normal mode)**
  Sampled data is stored in the acquisition memory without specific data processing.
- **ENVELOPE (Envelope mode)**
  The data is sampled at 100 MS/s. Each time data is stored in the acquisition memory, the maximum and minimum values are extracted. These are then stored in the acquisition memory and used to display the envelope waveform.
- **AVERAGE (Averaging mode)**
  The averaging count can be set to values between “1” and “256” in steps of 2^n.

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

An : Value obtained after nth averaging
Xn : nth measured value
N : Attenuation constant

Selecting sampling mode: Repetitive

A sampling mode can be selected provided that the selected T/div setting allows sampling both in real-time and repetitive modes.

However, the repetitive sampling mode is not effective when the trigger mode is set to single long mode. Furhermore, the repetitive sampling mode cannot be set in case of the single (N) trigger mode, when the history memory function is used, or in case FFT is used.

T/div settings which enable the selection of the sampling mode are from 5 μs to 100 ns/div.

Selecting the (maximum displayable) record length, for DL1540CL

You can set the maximum displayable record length to 1 KW, 10 KW, 100 KW, 400 KW, 1 MW, or 2 MW. The default selection is 10 KW. The following restrictions apply.

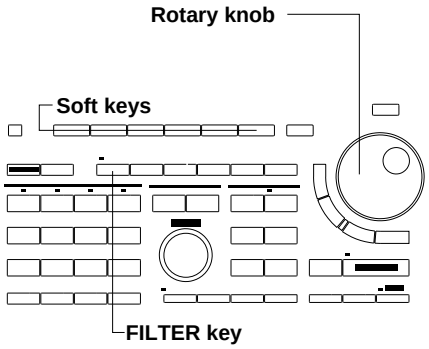
- Time-axis settings from 50 ns to 5 ns cannot be used in combination with 400 KW, 1 MW, and 2 MW record lengths. If the time-axis value is already set within this range, the 400 KW, 1 MW, and 2 MW selections will not be available.
- If the selected record length is 400 KW or 2 MW, certain time-axis settings will produce waveform display over eight divisions only, with no waveform appearing over the two rightmost time-axis divisions.
- Selection of 400 KW, 1 MW, and 2 MW record lengths is available only if trigger mode is “single.”
- It is not possible to switch on Channel 3 or Channel 4 while record length is set to 2 MW. It is not possible to select 2 MW as the record length while Channel 3 or Channel 4 is on.
- Refer to Appendix 3 for information about the relationship between time axes, sampling rates, and record lengths.

Points to note when making acquisition mode and sampling mode settings

- Normal mode operations are carried out, even if envelope mode has been selected.
- It is not possible to select envelope mode if waveforms are sampled by the external clock.
- If each single mode has been selected as the trigger mode or if the history memory function has been set to ON, averaging mode cannot be selected.
- If auto-mode or auto-level mode has been selected as the trigger mode and T/div has been set such that the display is in roll mode, averaging will not be performed, even if averaging mode is selected. In this case, waveforms are displayed in roll mode.
- It is not possible to select envelope mode if input smoothing or FFT has been set to ON.

7.2 Setting the Input Filter

Keys and Procedure



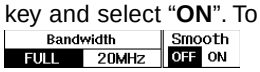
1. Press the **FILTER key** to display the input filter setting menu.

Applying the bandwidth limit

2. Press the "**20 MHz**" soft key to apply the bandwidth limit. To cancel the bandwidth limit, select "**FULL**".

Applying the smoothing function

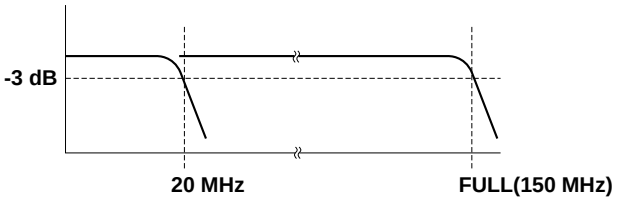
2. After step 1 has been completed, press the "**Smoothing**" soft key and select "**ON**". To stop smoothing, select "**OFF**".



Explanation

Bandwidth limit

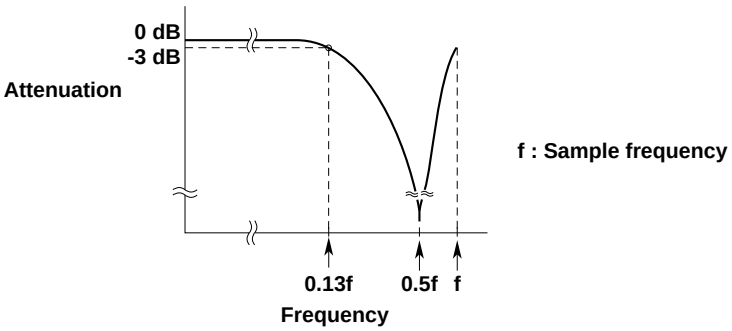
The bandwidth frequency limit can be "20MHz". The frequency characteristic when the bandwidth limit is applied is shown below. When "FULL" is selected, the frequency bandwidth is 150 MHz.



Smoothing process

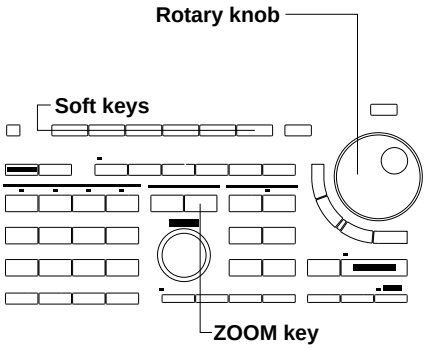
A moving average value is obtained for each five points of sampling data and the data obtained is used when displaying the waveform. This process is performed on the data in the acquisition memory, so it can still continue even if acquisition is stopped.

The following frequency characteristic of the smoothing process is dependent on the sample rate. The attenuation rate will be –3 dB when the frequency is approximately 13% of the sample rate. When the acquisition mode is envelope mode, this process cannot be carried out.



7.3 Zooming the Waveform

Keys and Procedure



1. Press the **ZOOM key** to display the zoom setting menu.

Displaying the pre-zoom and expanded waveform

2. Press the "**MainZoom**" soft key of the "**ZOOM Mode**" setting. The expansion rate and position selection menu appears.

ZOOM Mode			
OFF	MAIN	ZOOM	MainZoom

Setting the expansion rate and position

3. After having pressed the "**ZOOM**" soft key of the "**ZOOM Knob**" setting, use the rotary knob to adjust the expansion rate.

ZOOM Mode				ZOOM Knob	
OFF	MAIN	ZOOM	MainZoom	ZOOM	POS

H-ZOOM
× 5

4. After having pressed the "**POS**" soft key of the "**ZOOM Knob**" setting, use the rotary knob to adjust the position.

ZOOM Mode				ZOOM Knob	
OFF	MAIN	ZOOM	MainZoom	ZOOM	POS

Position
1.0div

Displaying the expanded waveform only

2. After step 1 has been completed, press the "**ZOOM**" soft key of the "**ZOOM Mode**" setting. The expansion rate and position are as described in step 3 and 4.

ZOOM Mode				ZOOM Knob	
OFF	MAIN	ZOOM	MainZoom	ZOOM	POS

H-ZOOM
× 5

Displaying the pre-zoom waveform only

2. After step 1 has been completed, press the "**MAIN**" soft key of the "**ZOOM Mode**" setting. The expansion rate and position are as described in step 3 and 4.

ZOOM Mode				ZOOM Knob	
OFF	MAIN	ZOOM	MainZoom	ZOOM	POS

H-ZOOM
× 5

Explanation

Expansion Rate

- **Expansion rate limits**

  The expansion rate which can be set varies according to the specified record length of the pre-zoom waveform. The specified record length depends on the model, time axis setting, sampling mode and trigger mode. For more details, refer to Appendix 2/Appendix 3.

  The following table shows the maximum expansion rates for some record lengths.

Displayed record length	**2M(8div)**	**2M**	**1M**	**800K(8div)**	**500K**	**400K(8div)**
Maximum expansion rate	25000	20000	10000	10000	5000	5000
Setting position step (div)	0.00002	0.00001	0.00001	0.00001	0.00002	0.00002

Displayed record length	**400K**	**200K**	**160K(8div)**	**100K**	**50K**	**40K**
Maximum expansion rate	4000	2000	2000	1000	500	400
Setting position step (div)	0.00005	0.00005	0.00005	0.0001	0.0002	0.0005

Displayed record length	**20K**	**10K**	**5K**	**4K**	**2K**	**1K**
Maximum expansion rate	200	100	50	40	20	10
Setting position step (div)	0.0005	0.001	0.002	0.005	0.005	0.01

Displayed record length	**500**	**400**	**200**	**100**
Maximum expansion rate	5	4	2	1
Setting position step (div)	0.02	0.05	0.05	0.1

- **Expansion rate steps**
  Depending on the T/div value, the expansion rate steps are as follows.
  In case of 50 s, 5 s, 500 ms, 50 ms, 5 ms, 500 µs, 50 µs and 5 µs/div
  x1, x2.5, x5, x10, x25, x50, x100, x250, x500, x1000, x2500, x5000, x10000, x25000
  In case of 20 s, 2 s, 200 ms, 20 ms, 2 ms, 200 µs and 20 µs/div
  x1, x2, x4, x10, x20, x40, x100, x200, x400, x1000, x2000, x4000, x10000, x20000
  In case of 10 s, 1 s, 100 ms, 10 ms, 1 ms, 100 µs and 10 µs/div
  x1, x2, x5, x10, x20, x50, x100, x200, x500, x1000, x2000, x5000, x10000, x20000

- **Zooming range position**
  The center of the zooming position box can be set within ±5 div of the waveform display frame. The setting step depends on the displayed record length.

Selecting the display type when displaying an expanded waveform

The type of display can be selected from the following.

OFF Only the original display will be displayed;
MAIN The pre-zoom waveform together with the zoom box will be displayed;
ZOOM Only the expanded waveform will be displayed. The part of the pre-zoom waveform selected in the zoom box will be expanded.
MainZoom Both the original and the expanded waveform will be displayed on the screen, which is divided in two.

Selecting the display type when displaying an X-Y waveform

The type of display depends on the settings in the expansion menu. For X-Y mode, refer to page 7-15.

ZOOM mode	X-Y Mode		
	OFF	**X-Y**	**T-Y & X-Y**
OFF	V-T pre-zoom waveform	X-Y pre-zoom waveform	V-T pre-zoom waveform (upper) X-Y pre-zoom waveform (lower)
MAIN	V-T pre-zoom waveform + zoom box	X-Y pre-zoom waveform	V-T pre-zoom waveform + zoom box (upper) X-Y pre-zoom waveform (lower)
ZOOM	V-T expanded waveform	X-Y expanded waveform	V-T expanded waveform (upper) X-Y expanded waveform (lower)
MainZoom	V-T pre-zoom waveform + zoom box (upper) V-T expanded waveform (lower)	X-Y expanded waveform	V-T pre-zoom waveform + zoom box (upper) X-Y expanded waveform (lower)

Selecting the display type in case of FFT mode (power spectrum)

The type of display depends on the settings in the expansion menu. For more details on the power spectrum, refer to page 8-20.

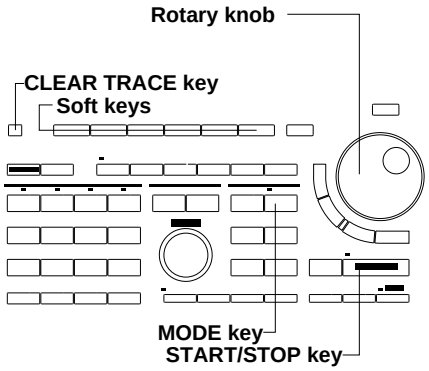
ZOOM mode	FFT Mode		
	FFT OFF	**FFT**	**VT & FFT**
OFF	V-T pre-zoom waveform	FFT pre-zoom waveform	V-T pre-zoom waveform (upper) FFT pre-zoom waveform (lower)
MAIN	V-T pre-zoom waveform + zoom box	FFT pre-zoom waveform	V-T pre-zoom waveform + zoom box (upper) FFT pre-zoom waveform (lower)
ZOOM	V-T expanded waveform	FFT expanded waveform	V-T expanded waveform (upper) FFT expanded waveform (lower)
MainZoom	V-T pre-zoom waveform + zoom box (upper) V-T expanded waveform (lower)	FFT expanded waveform	V-T pre-zoom waveform + zoom box (upper) FFT expanded waveform (lower)

Points to note when displaying an expanded waveform

- The waveform zone cannot be edited during GO/NO-GO if both pre-zoom waveform and its expanded waveform are displayed at the same time.
- If you press the ZOOM Mode soft key while accumulated waveform display is in progress, accumulated waveform display will be reset.
- If you press the ZOOM Mode soft key while a snapshot waveform display is being displayed, the snapshot waveform will disappear.

7.4 Acquiring Waveforms using the Sequential Store Function

Keys and Procedure



Acquiring the waveform data only a specified number of times

1. Press the **MODE key** to display the trigger mode setting menu.
2. Press the "**N-SGL**" soft key. When a trigger is activated at the time the "**N-SGL**" soft key is pressed, waveform acquisition starts.
   For DL1540CL, "**SINGLE**" menu will be displayed instead of "**SGL(S)**" and "**SGL(L)**" menus.

Trigger Mode						Acquisition Count(N)
AUTO	AT-LVL	NORMAL	SGL(S)	SGL(L)	N-SGL	100

3. Turn the rotary knob to set the number of acquisitions at "**Acquisition Count (N)**". When waveform acquisition is already in progress and you change the number of acquisitions, make sure to restart to get the specified number of acquisitions.

Trigger Mode						Acquisition Count(N)
AUTO	AT-LVL	NORMAL	SGL(S)	SGL(L)	N-SGL	90

4. If no trigger has been activated already, press the **START/STOP key** or once more the "**N-SGL**" soft key to start data acquisition.

Displaying a specific acquired data by selecting its number

5. Press the **CLEAR TRACE key** to clear the displayed waveforms.
6. Press the **DISPLAY key** to display the display selection menu.
7. Use the rotary knob to set the number of the data you want to see. The corresponding waveform will appear at the same time.

Intrpl	X-Y	Accumu	Time	All Disp	Wide Scrn	Display Number
SINE	OFF	OFF	Stamp	EXEC	OFF ON	0

Displaying a specific acquired data by selecting its time of acquisition

8. Continuing from step 6, press the "**Time Stamp**" soft key to display the list of acquired data with their acquisition times.

Intrpl	X-Y	Accumu	Time	All Disp	Wide Scrn	Display Number
SINE	OFF	OFF	Stamp	EXEC	OFF ON	0

9. Use the rotary knob to highlight the data you want to see.

Stopped Count= 90

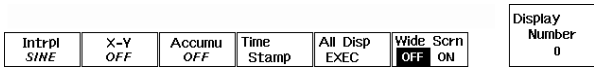
== Time Stamp ==

#000	06:58:54	#020	06:58:56	#040	06:58:58	#060	06:59:00	#080	06:59:02
#001	06:58:54	#021	06:58:56	#041	06:58:58	#061	06:59:00	#081	06:59:02
#002	06:58:54	#022	06:58:56	#042	06:58:58	#062	06:59:00	#082	06:59:02
#003	06:58:54	#023	06:58:56	#043	06:58:58	#063	06:59:00	#083	06:59:02
#004	06:58:54	#024	06:58:56	#044	06:58:58	#064	06:59:00	#084	06:59:02
#005	06:58:54	#025	06:58:56	#045	06:58:58	#065	06:59:00	#085	06:59:02
#006	06:58:54	#026	06:58:56	#046	06:58:58	#066	06:59:01	#086	06:59:03
#007	06:58:54	#027	06:58:57	#047	06:58:59	#067	06:59:01	#087	06:59:03
#008	06:58:55	#028	06:58:57	#048	06:58:59	#068	06:59:01	#088	06:59:03
#009	06:58:55	#029	06:58:57	#049	06:58:59	#069	06:59:01	#089	06:59:03
#010	06:58:55	#030	06:58:57	#050	06:58:59	#070	06:59:01	#090	---
#011	06:58:55	#031	06:58:57	#051	06:58:59	#071	06:59:01	#091	---
#012	06:58:55	#032	06:58:57	#052	06:58:59	#072	06:59:01	#092	---
#013	06:58:55	#033	06:58:57	#053	06:58:59	#073	06:59:01	#093	---
#014	06:58:55	#034	06:58:57	#054	06:58:59	#074	06:59:01	#094	---
#015	06:58:55	#035	06:58:57	#055	06:58:59	#075	06:59:01	#095	---
#016	06:58:55	#036	06:58:57	#056	06:59:00	#076	06:59:02	#096	---
#017	06:58:56	#037	06:58:58	#057	06:59:00	#077	06:59:02	#097	---
#018	06:58:56	#038	06:58:58	#058	06:59:00	#078	06:59:02	#098	---
#019	06:58:56	#039	06:58:58	#059	06:59:00	#079	06:59:02	#099	---

10. Press the **SELECT key**. The list will disappear and the selected waveform will appear on the screen.

Displaying all waveforms

11. Continuing from step 6, 7 or 10, press the "**ALL disp EXEC**" soft key to display all waveforms.



Explanation

Number of acquisitions: Acquisition Count (N)

- For DL1540C, this setting specifies the number of times that data acquisitions will be stored in memory, and ranges from 1 to 100. 100 is default setting.
- For DL1540CL, the record length per iteration (for a given channel) and the number of allowable iterations are determined by the selected maximum displayable record length (see page 7-2), as indicated below. Under default settings the record length is 10 KW, and 100 iterations are stored.

Maximum Displayable Record Length	Supported Iteration Settings DL1540CL	Record Length per Waveform Iteration (per channel)
1 KW	1 to 100	Same as "displayed record length" in App. 3 (page App-5)
10 KW	1 to 100	Same as "displayed record length" in App. 3 (page App-6)
100 KW	1 to 10	Same as "displayed record length" in App. 3 (page App-7)

- For DL1540CL, 400 KW or above: Function is not supported.
- The number of acquired data can be viewed in the upper side of the screen, where the indication such as "**Count=9**" appears.

Displaying acquired data: Display Trace

The way of displaying the acquired data can be selected from the following.

- **Displaying the selected waveform only**
  Selecting the waveform can be done by setting the Display Number or by highlighting data from the Time Stamp list.
- **Displaying all waveforms**
  When all waveforms are displayed, you can easily spot the waveform which is selected by the Display Number since it is displayed more brightly.

Selecting the waveform to be displayed: Display Number

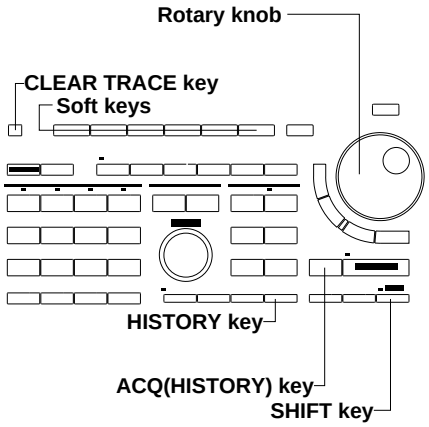
The setting ranges from 0 to –(the acquisition count number –1). The maximum value is 0. The latest data being 0, previous data are labeled –1, –2, –3, etc..

Points to note when using the sequential store function

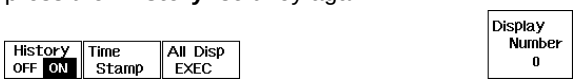
- For more details on trigger modes, refer to page 6-13.
- After the data is acquired the specified number of times, all the waveforms will appear on the screen at once.
- Data will not be acquired in case of the repetitive sampling mode.
- If data acquisition is aborted while in progress, only the waveforms which have been acquired so far will appear on the display. Only the acquired waveforms can be selected at the Display Number setting.
- The all single modes will be deacivated when the history memory function is turned ON.
- Trigger mode cannot be set to "single (N) mode" if the selected record length is 400 KW, 1 MW, or 2 MW (for DL1540CL only).

7.5 Using the History Memory Function

Keys and Procedure



1. Press the **HISTORY key** to display the history memory ON/OFF setting menu.
2. Press the "**History**" soft key and select "**ON**". To select "**OFF**", press the "**History**" soft key again.



Displaying a waveform from the memory

3. Stop data acquisition by pressing the **START/STOP key**.

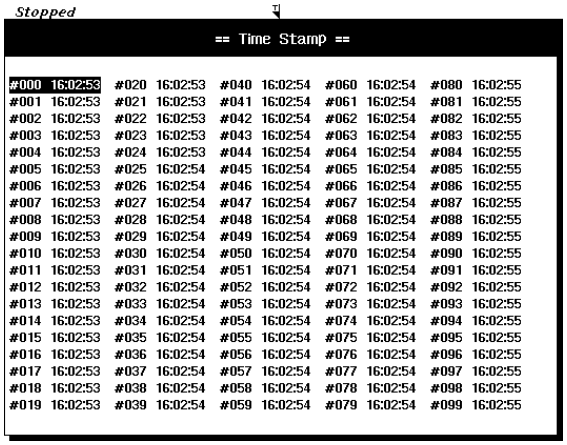
Displaying a specific data by selecting its number

4. Use the rotary knob to set the number of the data you want to see (display number). The corresponding waveform will appear on the screen.

Displaying a specific acquired data by selecting its time of acquisition

5. Continuing from step 3, press the "**Time Stamp**" soft key to display the list of acquired data with their acquisition times.

6. Use the rotary knob to highlight the data you want to see.



7. Press the **SELECT key**. The list will disappear and the selected waveform will appear on the screen.

Displaying all waveforms

8. Continuing from step 3, 4 or 7, press the "**ALL Disp EXEC**" soft key.

Explanation

Number of waveforms in the history memory

- Acquisition memory retains waveforms for the last N triggers, where N is equivalent to the maximum number of iterations that can be stored under sequential-store operation.The record length per waveform (on a given channel) is the same as that for sequential-store mode. For details, refer to page 7-8.
- Once the history has become full (the number of triggers has exceeded N), each new waveform acquisition deletes the oldest waveform in the history.

Displaying acquired data

Refer to page 7-8.

Selecting the waveform to be displayed: Display Number

The setting ranges from 0 to 99. The latest data being 0, previous data are being labeled –1, –2, –3, etc..

Acquisition period

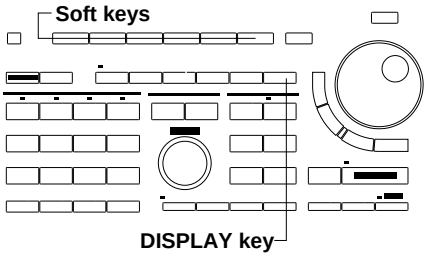
You can extend the acquisition period by setting the hold-off time, which temporarily halts the trigger detection. This feature makes it possible to obtain a history of a periodically occurring waveform.

Points to note when using the history memory function

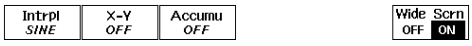
- Data will not be acquired in case of the repetitive sampling mode.
- If data acquisition is aborted while in progress, only the waveforms which have been acquired so far will appear on the display. Only the acquired waveforms can be selected at the Display Number setting.
- The history memory function cannot be turned ON when the acquisition mode is set to average, or when the trigger mode is set to SINGLE, SGL(S), SGL(L), or N-SGL.
- When the history memory function is set to ON, the display cannot be in the roll mode.
- The previously acquired waveforms will not appear on the screen while acquisition is in progress.
- Waveforms will be acquired in the memory even if the display of the input signals has been turned OFF. To display the acquired waveforms however, the display of the input signals should be set to ON. Refer to page 5-1.
- When the conditions of waveform acquisition are changed, the history memory function will be reset and previous waveform data will be lost.
- The history-memory function cannot be switched on if the selected record length is 400 KW, 1 MW, or 2 MW (for DL1540CL only).

7.6 Changing the area for displaying the waveform

Keys and Procedure



1. Press the **DISPLAY key** to display the setting menu.
2. Press the "**Wide Scrn**" soft key and select either "ON" or "OFF"



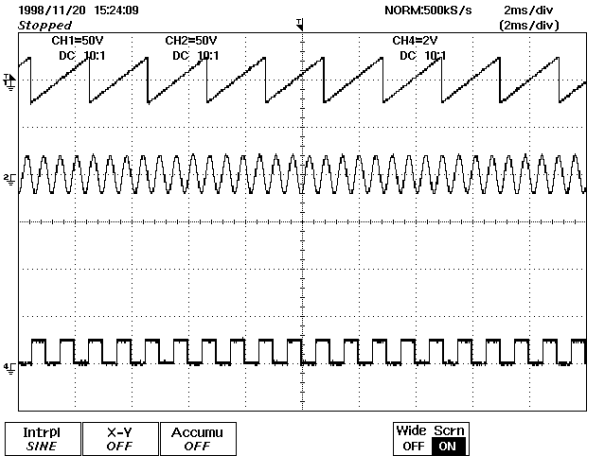
Explanation

The information display can be selected "ON" or "OFF". The default is "OFF".

OFF The area for displaying the waveform becomes normal mode at 501 dots (horizontal) X 401 dots (vertical).

ON The area for displaying the waveform becomes wide mode at 601 dots (horizontal) X 401 dots (vertical).

Display, when the "Wide screen mode" is set to ON



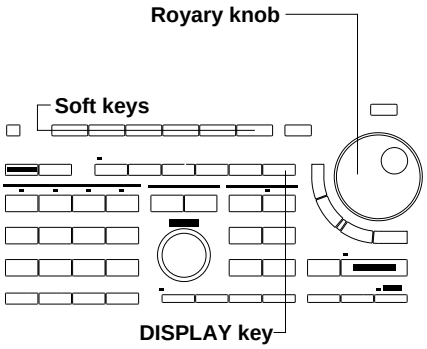
Note

When the wide screen mode is turned ON, the area for displaying the waveform changes from the normal size of 501 dots (horizontal) X 401 dots (vertical) to 601 dots (horizontal) X 401 dots (vertical).

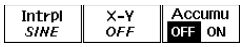
In the wide screen mode, one point out of every six points in the horizontal direction is displayed using interpolation. As a result, the interpolated points may look discontinuous or distorted depending on the waveform being observed. In such case, check the waveform in the normal screen mode.

7.7 Changing the Interpolation Settings

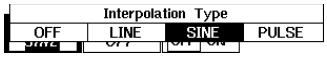
Keys and Procedure



1. Press the **DISPLAY key** to display the setting menu.
2. Press the "**Intrpl**" soft key to display the interpolation selection menu.



3. Press the soft key corresponding to the desired interpolation type.



Explanation

Selecting the interpolation type

The following four interpolation types are available. The default is "SINE".

OFF No interpolation; Displays the sampling data as a horizontal line.

LINE Interpolates between two dots with a straight line.

SINE Generates interpolation data using the sin(X)/X function and interpolates between two dots using a sine curve.

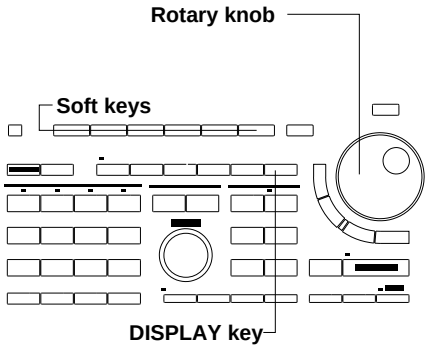
PULSE Draws a horizontal line to a point directly above or below the next data point and then interpolates using two dots so that the end of the horizontal line is connected to the next data point by a vertical line.

Note

LINE, SINE and PULSE can only be selected if the number of display points per division is 50 or less. OFF can always be selected.

7.8 Displaying an Accumulated Waveform

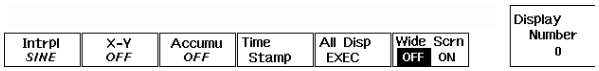
Keys and Procedure



1. Press the **DISPLAY key** to display the setting menu.
2. Press the "**Accumu**" soft key to display the accumulated waveform selection menu.

Accumulation

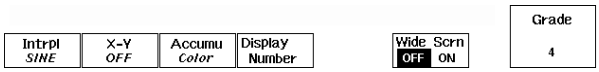
3. After step 2 has been completed, press the "**Persist**" soft key.
4. Turn the rotary knob to set the desired accumulation time.



Accumulation with colored waveform

3. After step 2 has been completed, press the "**Color**" soft key.

4. Turn the rotary knob to set the desired grade width.



Cancel the accumulation

5. Press the "**Accumu**" soft key and select "**OFF**".

Explanation

Accumulation modes

Persist mode : Allows overlapping display of waveforms in a single color. The most recent waveform is bright and old waveforms (accumulated waveforms) are dark.

Color grade mode : Allows overlapping display of waveforms in eight colors according to the frequency of occurrence of th edata values.

Accumulation time (for the persist mode)

When "Persisit" has been selected at the accumulation mode, the following can be selected. The default settings is "100ms".

100ms, 200ms, 300ms, 400ms, 500ms, 600ms, 700ms, 800ms, 900ms, 1s, 2s, 3s, 4s, 5s, 6s, 7s, 8s, 9s, 10s, 20s, 30s, 40s, 50s, 60s, INFINITE

Grade width (for color grade mode)

When "Color" has been selected at the accumulation mode, select the color grade width. The frequency of data value occurrence is indicated in eight colors as illustrated below. The grade width can be set within the range given below. The default setting is 8. Overlapping display is performed indefinitely in color grade mode.

Higher frequency

When grade width = 4		When grade width = 32	
red	24 to	red	192 to
magenta	20 to 23	magenta	160 to 191
yellow	16 to 19	yellow	128 to 159
white	12 to 15	white	96 to 127
cyan	8 to 11	cyan	64 to 95
green	4 to 7	green	32 to 63
blue	1 to 3	blue	1 to 31
black	0	black	0

For example, a dot which has appeared on the screen 100 times is display in red if the grade width is 4, or in white if the grade width is 32.

Clearing the accumulated waveform

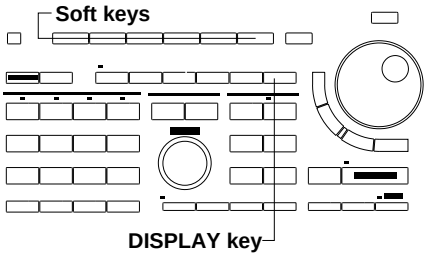
Pressing the CLEAR TRACE key clears all accumulated waveforms except the most recent one.

Points to note

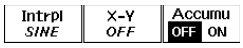
- The following operations apply only to the latest waveform's data if they are performed using accumulated waveform display.
  - Cursor measurements and automated measurements
  - Saving the waveform data
- If you want to stop accumulation, press the START/STOP key to stop measurement. Pressing the START/STOP key again to restart measurement will clear the previously displayed waveforms and the accumulation time will be reset.
- Waveforms which can be accumulated are Pre-zoom waveforms, expanded waveforms and X-Y waveforms.
- The currently accumulated waveforms will be cleared and accumulation will restart, if the following operations are carried out.
  When the display type (ZOOM Mode setting) is changed during zoom or X-Y display.
  When the area for displaying the waveform (Wide Screen setting) is changed.

7.9 Displaying an X-Y Waveform

Keys and Procedure



1. Press the **DISPLAY key** to display the setting menu.
2. Press the "**X-Y**" soft key to display the X-Y selection menu.



When displaying both the X-Y waveform and the T-Y waveform

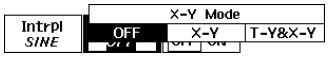
3. Press the "**T-Y & X-Y**" soft key.

When displaying the X-Y waveform only

3. After step 2 has been completed, press the "**X-Y**" soft key.

When displaying the T-Y waveform only

3. After step 2 has been completed, press the "**OFF**" soft key.



Explanation

Assigning channels to the X axis (horizontal axis) and Y axis (vertical axis)

The assignment has been pre-determined as follows. The CH1 input voltage is assigned to the X axis and the CH2 input voltage to the Y axis.
An X-Y waveform can also be displayed for acquisition data loaded from a floppy disk. In this case, the trace No. will simply be replaced by the channel No.

Selecting the display type

The display type can be selected from the following three types.

OFF Displays only the V-T waveform.

X-Y Displays only the X-Y waveform. In case the zoom setting has been set to ZOOM, the display will show the expanded waveform as specified in the zoom box.

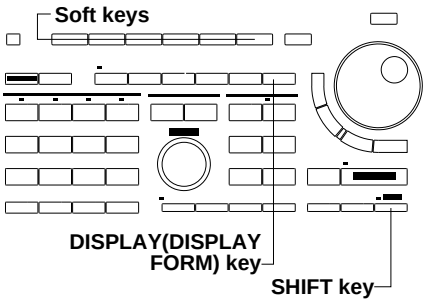
T-Y & X-Y Displays both the V-T waveform and the X-Y waveform. The display depends on the zoom settings. Refer to X.X for more details.

Points to note when displaying an X-Y waveform

- When displaying X-Y waveforms, only measurement of "Integ1XY" and "Integ2XY" is possible during automated measurement. For a description of measurement operations and the measured parameters, refer to 8.3.
- When you want to display a sequentially stored waveform or one stored in history memory as an X-Y waveform, you turn the rotary knob to select a [display number].
  However, all the selected waveforms will appear on the screen. In order to display one selected waveform only, press the CLEAR TRACE key after selection.
- When displaying both the X-Y and V-T waveforms, V-T waveforms are also displayed accumulated (accumulated display).
- The display area for X-Y waveforms is constant regardless of the ON/OFF state of the wide screen mode.

7.10 Changing the Graticule, Scale and % Marker Settings

Keys and Procedure



1. Press the **SHIFT + DISPLAY (DISPLAY FORM) key** to display the display condition setting menu.

Changing the graticule type

2. Select by pressing the "**FRAME**" or the "**GRID**" soft key.

Turning the scale ON/OFF

2. After step 1 has been completed, press the "**Scale**" soft key and select "**ON**" or "**OFF**".

Turning the % Marker ON/OFF

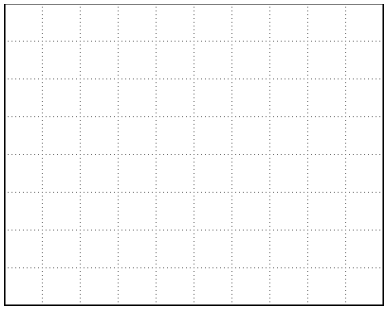
2. After step 1 has been completed, press the "**% Marker**" soft key and select "**ON**" or "**OFF**".

Explanation

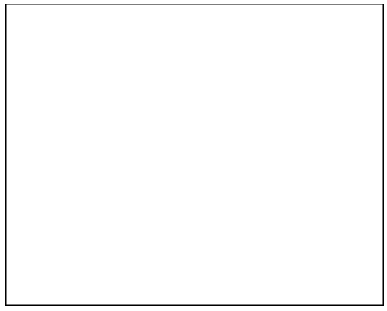
Graticule

The graticule type can be selected from the following two types. The default is "GRID".

FRAME



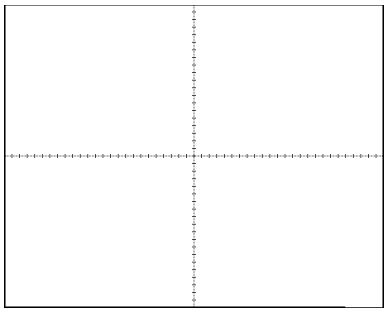
GRID



Scale

The cross type scale, shown below, can be turned ON or OFF. The default is "ON".

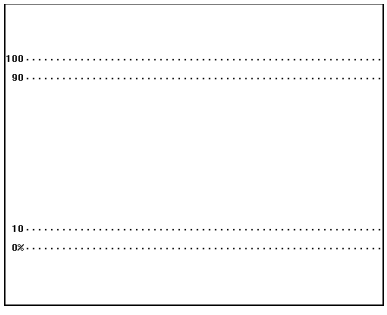
Scale ON



Scale OFF

% Marker

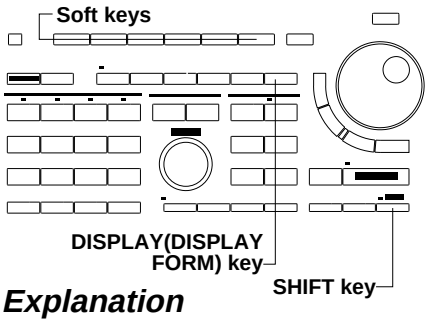
The % marker, shown below, can be turned ON or OFF. The default is "OFF".



7.11 Turning the Waveform Information Display ON/ OFF

Keys and Procedure

1. Press the **SHIFT + DISPLAY (DISPLAY FORM) key** to display the display condition setting menu.
2. Press the "**Wave Info**" soft key and select either "**ON**" or "**OFF**".



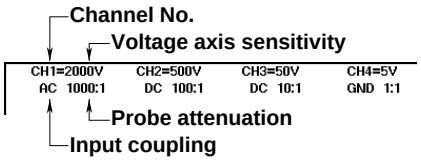
Explanation

Selecting the waveform information display ON/OFF

The information display can be selected "ON" or "OFF". The default is "ON".

OFF Displays only the time axis setting, acquisition mode, and sample rate. This is useful if the displayed waveform information prevents observation of other waveforms.

ON Displays the channel No./ voltage axis sensitivity settings/ input coupling/ probe attenuation as shown below in addition to the "OFF" display.



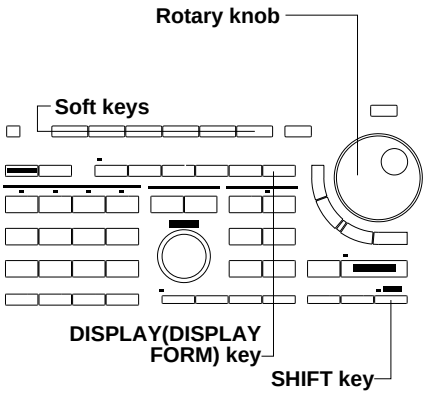
When the wide screen mode is OFF, the waveform information is displayed on the outside the waveform display area on the right.

Points to note concerning the waveform information display

- Turning ON/OFF the waveform information display in the normal screen mode does not affect the information that is displayed on the outside of the waveform display area on the right.
- If a recalled waveform is displayed, the memory number and the voltage axis sensitivity are displayed inside the waveform display area.
- If P-P waveform data loaded from a floppy disk is displayed, the file name and the voltage axis sensitivity will be displayed. Up to 8 characters of the file name will be displayed, but overlap may occur with other displayed file names (depending on the size of the used characters).
- If ACQ waveform data loaded from a floppy disk is displayed, the channel No., voltage axis sensitivity, input coupling and probe attenuation will all be displayed at the site of the waveform. The channel No. of the channel for which acquisition has been halted (i.e. for which "ACQ Hold" is set to "ON") will be highlighted.

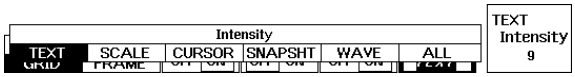
7.12 Changing the Screen Intensity

Keys and Procedure

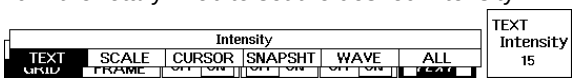


1. Press the **SHIFT + DISPLAY (DISPLAY FORM) key** to display the display condition setting menu.
2. Press the "**Inten**" soft key to display intensity selection menu.

3. Press the soft key corresponding to the item for which the intensity is to be changed.



4. Turn the rotary knob to set the desired intensity.



5. Repeat step 3 and 4 to adjust the intensity of other items.

Explanation

Intensity

Intensity can be set to one of 15 levels, with the darkest intensity "1" and the brightest intensity "15".

Items for which the intensity can be adjusted

Intensity can be adjusted independently for the following items. The value in ( ) indicates the default setting.

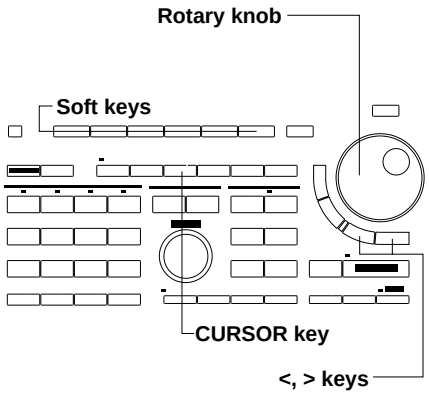
TEXT (12) : Characters, value
SCALE (8) : Graticule, scale, % marker
CURSOR (11) : Cursor
SNAPSHOT (11) : Snapshot waveform
WAVE (12) : All waveform except snapshot

Note

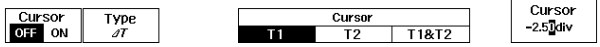
You can change the brightness of the back light of the LCD. Refer to Section 14.6 "Setting the Brightness of the LCD."

8.1 Measuring a V-T Waveform using Cursors

Keys and Procedure

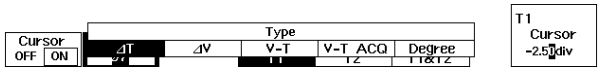


1. Press the **CURSOR key** to display the cursor measurement setting menu.
2. Press the "**Cursor**" soft key and select "**ON**".
3. Press the "**Type**" soft key to display the measurement type selection menu.

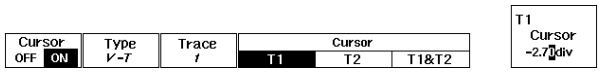


Measuring time difference/ frequency/ voltage/ voltage difference using the vertical cursors

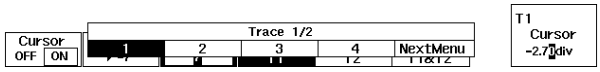
4. Press the "**V-T**" soft key to display the cursor selection menu. Two vertical cursors will appear on the screen.



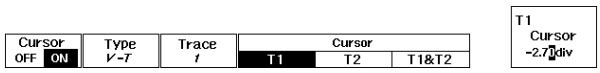
5. Press the "**Trace**" soft key to display the trace selection menu.



6. Press the soft key corresponding to the trace you want to measure.

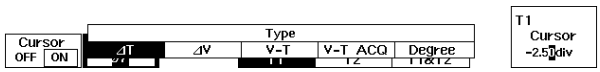


7. After having pressed any of the "**T1**", "**T2**" or "**T1&T2**" soft keys, use the rotary knob to adjust the position of the cursor.

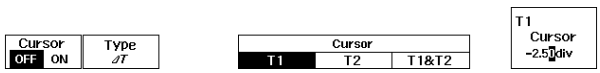


Measuring only the time difference using the vertical cursors

4. After step 3 has been completed, press the "**ΔT**" soft key to display the cursor selection menu. Two vertical cursors will appear on the screen.

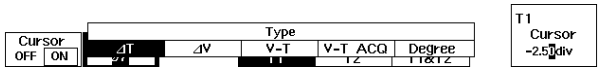


5. After having pressed any of the "**T1**", "**T2**" or "**T1&T2**" soft keys, use the rotary knob to adjust the position of the cursor.

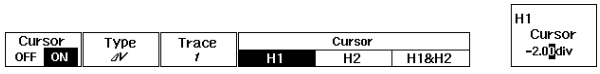


Measuring only the voltage difference using the horizontal cursors

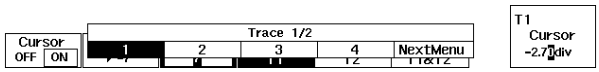
4. After step 3 has been completed, press the "**ΔV**" soft key to display the cursor selection menu. Two horizontal cursors will appear on the screen.



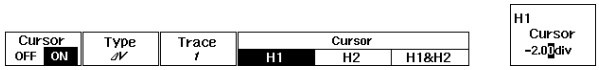
5. Press the "**Trace**" soft key to display the trace selection menu.



6. Press the soft key corresponding to the trace you want to measure.

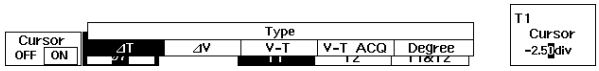


7. After having pressed any of the "**H1**", "**H2**" or "**H1&H2**" soft keys, use the rotary knob to adjust the position of the cursor.

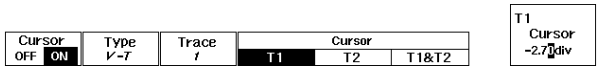


Measuring time difference/voltage/voltage difference of the acquisition data using the vertical cursors

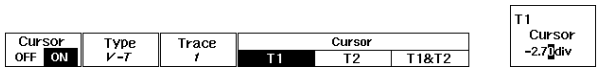
4. After step 3, press the "**V-T ACQ**" soft key to display the vertical cursor position selection menu. The vertical cursors appear on the screen.



5. Press the "Trace" soft key to display the trace selection menu, and select the desired trace with the soft key.

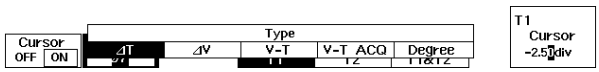


6. After pressing any of the "**T1**," "**T2**," or "**T1&T2**" soft keys, use the rotary knob to adjust the position of the cursor. You can use the <,> key to move between digits.

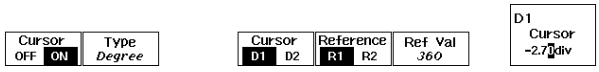


Measuring phase difference using the vertical cursors (Phase Cursor)

4. After step 3, press the "**Degree**" soft key to display the vertical cursor position selection menu. The vertical cursors appear on the screen.

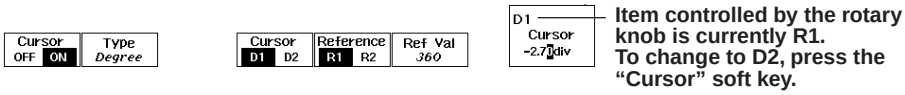


5. Press the "**Ref Val**" soft key to display the reference phase selection menu, and press the soft key corresponding to the desired phase.



6. Press the "**Reference**" soft key to select either "**R1**" or "**R2**." Then, use the rotary knob to adjust the position of the cursor (reference phase selection cursor). Pressing the "**Reference**" soft key each time toggles through the items controlled by the rotary knob as follows: "**R1**" -> "**R2**" -> "**R1&R2**" -> "**R1**."

7. Press the "**Cursor**" soft key to select either "**D1**" or "**D2**." Then, use the rotary knob to adjust the position of the cursor. Pressing the "**Cursor**" soft key each time toggles through the items controlled by the rotary knob as follows: "**D1**" -> "**D2**" -> "**D1&D2**" -> "**D1**."



Explanation

Waveforms which cannot be measured using cursors

The following waveforms are excluded from measurements using cursors.

- Snapshot waveform;
- Accumulated waveforms other than the most recent one;
- Waveforms other than those which are specified (by Display Number) and displayed (by Display Trace) using the sequential store or history memory function.

Selecting the measurement waveform: Trace

When “V-T” or “ΔV” has been selected at the type selection menu, the following can be selected at the trace menu. The menu is divided into two menus, which can be reached using the “PrevMenu” and “NextMenu” soft keys.

1-4 Measurements will only be performed on the selected trace;

LOAD1-4 Measurements will only be performed on the selected loaded waveform;

ALL (in case of “V-T” only) Measurements will be performed on all traces and loaded waveforms.

Measurement items

The following items can be measured.

- **Using vertical cursors to measure time difference/ frequency/ voltage/ voltage difference : V-T**

  In all cases excluding “ALL”

  T1 Time difference between position of cursor T1 and trigger position

  T2 Time difference between position of cursor T2 and trigger position

  ΔT Time difference between positions of cursors T1 and T2

  1/DT Reciprocal of DT (frequency)

  V1(X) Voltage at the position where the waveform intersects cursor T1

  V2(X) Voltage at the position where the waveform intersects cursor T2

  ΔV(X) V2-V1

  (X) indicates the waveform of measurement, e.g. LOAD1 is shown as (L1)

  In the case of “ALL”

  T1 Time difference between position of cursor T1 and trigger position*

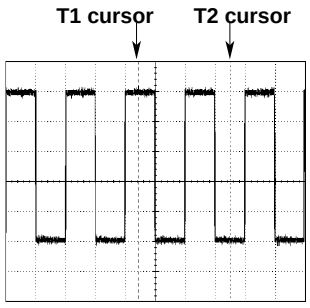
  T2 Time difference between position of cursor T2 and trigger position*

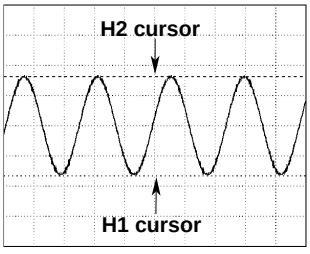
  ΔT Time difference between positions of cursors T1 and T2

  1/DT Reciprocal of DT (frequency)

  V1(X) Voltage at the position where all waveforms intersect cursor T1. The waveform of measurement is indicated between brackets.

  * In case of roll mode, this is not the trigger position, but the center of the acquisition memory record length. This position is shown at the 0div in the figure on page 1-7.





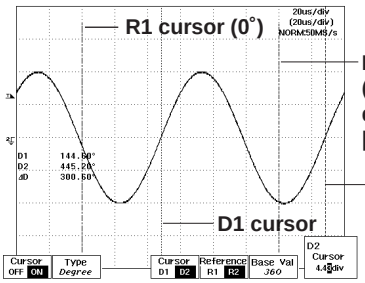
- **Using vertical cursors to only measure time difference : ΔT**

  ΔT Time difference between positions of cursors T1 and T2

- **Using horizontal cursors to only measure voltage difference : ΔV**

  ΔV(X) V2-V1; where V2 is the position where the waveform intersects cursor H2, and V1 is the position where the waveform intersects cursor H1.

- **Using vertical cursors to measure time difference/voltage/voltage difference of the acquisition data : V-T ACQ**
  In contrast to V-T cursor which measures the data on the screen, V-T ACQ cursor makes measurements on the actual data acquired in the acquisition memory. Furthermore, since the vertical cursor is on the actual data, moving the horizontal position moves the cursor along with the waveform.
  Specified resolution = sample rate.
  T1 Time difference between the position of cursor T1 and the trigger position*.
  T2 Time difference between the position of cursor T2 and the trigger position*.
  ΔT Time difference between the positions of cursors T1 and T2.
  1/ΔT Reciprocal of DT (frequency).
  V1(X) Voltage at the position where the waveform intersects cursor T1.
  V2(X) Voltage at the position where the waveform intersects cursor T2.
  ΔV(X) V2 - V1.
  (X) indicates the waveform under measurement. For example, trace 1 is shown as (1). Loaded waveforms cannot be measured using V-T ACQ measurement.
- **Using vertical cursors (phase cursor) to measure the phase difference: Degree**



  D1 Phase angle of cursor D1 with respect to cursor R1.
  D2 Phase angle of cursor D2 with respect to cursor R1.
  ΔD Phase difference between the positions of cursors D1 and D2.
  R1 Cursor indicating phase angle of 0˚.
  R2 Cursor position indicating the phase angle defined with Base Val*.
  * You can select from 180˚, 360˚, 540˚, or 720˚.

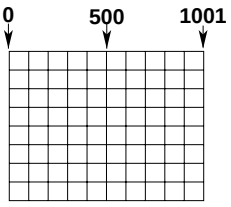
Cursor movement method

The cursors can be selected as follows.

- **Time measurement cursor (vertical)**
  T1 Moves cursor T1 only.
  T2 Moves cursor T2 only.
  T1&T2 Moves both cursors T1 and T2 simultaneously without changing the distance between them.
- **Voltage measurement cursor (horizontal)**
  H1 Moves cursor H1 only.
  H2 Moves cursor H2 only.
  H1&H2 Move both cursors H1 and H2 simultaneously without changing the distance between them.
- **Vertical (phase measurement) cursor**
  D1 Move cursor D1 only.
  D2 Move cursor D2 only.
  D1&D2 Move cursors D1 and D2 simultaneously without changing the distance between them.
- **Vertical (Reference phase selection) cursor**
  R1 Move cursor R1 only.
  R2 Move cursor R2 only.
  R1&R2 Move cursors R1 and R2 simultaneously without changing the distance between them.

Cursor movement range

- **Vertical cursor**
  Movement range : Each vertical cursor can be moved to 1002 different positions from the left edge (–5.00 div) to the right edge (5.00 div) of the waveform display frame. One time position is used for the P-P value of the displayed waveform, and two points (maximum and minimum) are measured at this position.

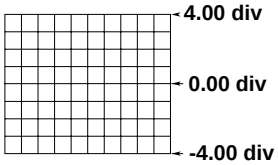


  The default setting : –2.50 div for T1, 2.50 div for T2

- **Horizontal cursor**

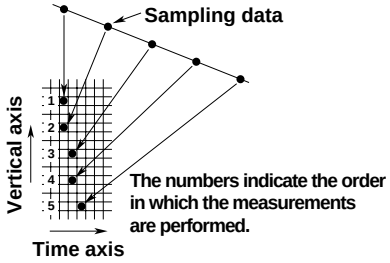
  Movement range : Each horizontal cursor can be moved to 401 different positions from the top (4.00 div) to the bottom (–4.00 div) of the waveform display frame.

  The default setting : –2.00 div for H1, 2.00 div for H2



Voltage measurement using vertical cursors

When two voltage data (maximum and minimum) are displayed at the same time axis position, moving a vertical cursor from left to right measures each datum in the order in which it was sampled.

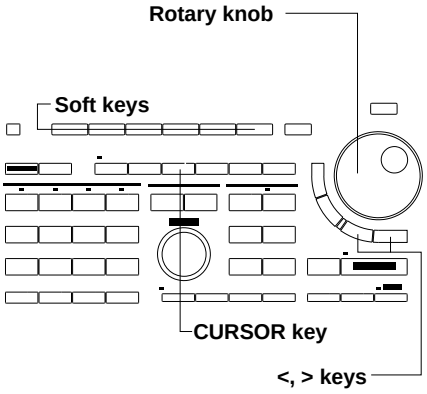


Points to note when performing cursor measurements

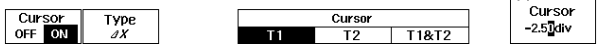
- The cursors and measured values will still be displayed even if a different menu is selected. However, the cursors cannot then be moved.
- Cursor-measured values will be cleared if the automated measurement function is turned ON. However, pressing the CURSOR key (when “Cursor” is set to “ON”) will display the cursor-measured values.
- If the GO/NO-GO “Mode” has been set to “ON” and the “GO/NOGO EXEC” soft key has been pressed, the cursor measurement function will not operate even if the CURSOR key is pressed. To operate the cursor measurement function, the GO/NO-GO “Mode” must be set to “OFF”.
- In case the type selection menu is set to “V-T”, and a measured voltage value is interpolation data, a “*” will be displayed with the measurement item.
- If measurement is not possible, “- - -” will be displayed.
- When the type selection menu is set to “V-T ACQ,” measurements can be made only when the waveform acquisition is stopped.
- Cursor measurement is also possible on expanded waveforms. Even if the display is switched to show the expanded waveform, the position of the cursor on the screen does not change.
  If the type selection menu is set to “V-T” and both the pre-zoom and the expanded waveform are displayed, cursor measurement will be performed on the expanded waveform.
  If the type selection menu is set to “V-T ACQ” and both the pre-zoom and the expanded waveform are displayed, cursors are displayed on both waveforms. Therefore, cursor measurements on waveforms outside the zoom box can be performed.
- When the type selection menu is set to “V-T ACQ,” cursor measurements on interpolation data cannot be performed.
- When the type selection menu is set to “V-T ACQ,” the measurement range is 10 div within the screen when the horizontal position is +0 div (+5 div during roll mode display).
  V-T ACQ cursor measurements cannot be performed on data outside the measurement range, even if the waveform display range is changed by moving the horizontal position such as during the roll mode display.
- V-T ACQ cursor measurements cannot be performed on loaded waveforms.
- There might be cases where the displayed waveform is not in synchronization with the measurement values. To synchronize, stop data acquistion.
- When using waveform computations, the displayed unit will become “div” for waveforms obtained by addition/subtraction, and “V2” for waveforms obtained by multiplication.
- In case engineering units have been set by the linear scaling function, the first three characters of the unit setting will appear on the screen.
- Time is measured based on the T/div value set for the input signal waveform. Thus, be careful if the T/div set for a loaded or recalled waveform does not match the T/div for the input signal waveform.

8.2 Measuring an X-Y Waveform using Cursors

Keys and Procedure

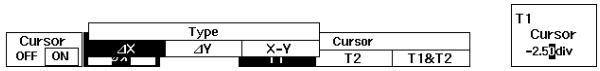


1. Display both the T-Y and the X-Y waveform in the same display.
2. Press the **CURSOR key** to display the cursor measurement setting menu.
3. Press the "**Cursor**" soft key and select "**ON**".
4. Press the "**Type**" soft key to display the measurement type selection menu.



Measuring time difference/ voltage using the X-Y cursors

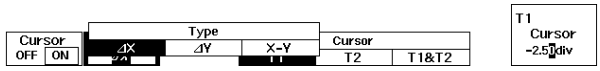
5. Press the "**X-Y**" soft key. The X-Y cursors will appear on the screen.



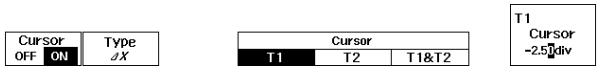
6. Use the rotary knob to adjust the position of the X-Y cursor.

Measuring only voltage difference on the X axis using the vertical cursors

5. After step 4 has been completed, press the "**ΔX**" soft key to display the cursor setting menu. The vertical cursors will appear on the screen.

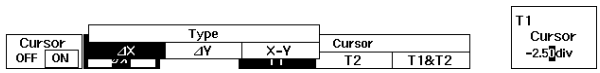


6. After having pressed any of the "**T1**", "**T2**" or "**T1&T2**" soft keys, use the rotary knob to adjust the position of the cursor.

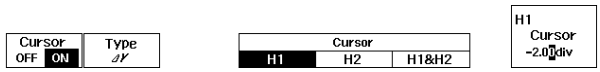


Measuring only voltage difference on the Y axis using the horizontal cursors

5. After step 4 has been completed, press the "**ΔY**" soft key to display the cursor setting menu. The horizontal cursors will appear on the screen.



6. After having pressed any of the "**H1**", "**H2**" or "**H1&H2**" soft keys, use the rotary knob to adjust the position of the cursor.



Explanation

Channel assignment for the X-Y axis

X-axis Input voltage of CH1

Y-axis Input voltage of CH2

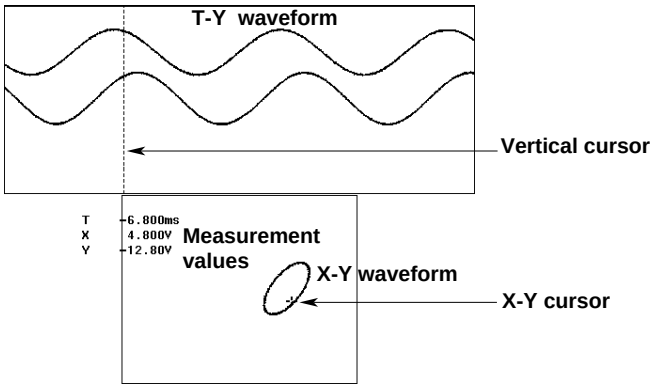
Waveforms which cannot be measured

For waveforms which cannot be measured, refer to page 8-3.

Measurement items

The following items can be measured.

- **Using X-Y cursors to measure time difference/ voltage : X-Y**
  - **T** Time difference between position of vertical cursor and trigger position (the vertical cursor is also displayed on the T-Y waveform in case the T-Y and X-Y waveform are being displayed on the same screen)
  - **X** X-axis voltage at the position of the X-Y cursor (Voltage at the position where waveform CH1 intersects the vertical cursor of the T-Y waveform)
  - **Y** Y-axis voltage at the position of the X-Y cursor (Voltage at the position where waveform CH2 intersects the vertical cursor of the T-Y waveform)



- **Using vertical cursors to measure only voltage difference of the X-axis : dX**
  - **ΔX** V2-V1; where V1 is the voltage at the X-axis where cursor T1 intersects, and V2 is the voltage at the X-axis where cursor T2 intersects.
- **Using horizontal cursors to measure only voltage difference of the Y-axis : dY**
  - **ΔY** V2-V1; where V1 is the voltage at the Y-axis where cursor H1 intersects, and V2 is the voltage at the Y-axis where cursor H2 intersects.

Cursor movement method

The cursors can be selected as follows.

- **X-Y cursor**
  The X-Y cursor is indicated by a “+” symbol and moves over the X-Y waveform. In case the display shows both the X-Y and the T-Y waveform, there will be only one vertical cursor displayed, on the T-Y waveform. This cursor, related to the X-Y cursor, moves over the time-axis.
- **Vertical cursor**
  - **T1** Moves cursor T1 only.
  - **T2** Moves cursor T2 only.
  - **T1&T2** Moves both cursors T1 and T2 simultaneously without changing the distance between them.
- **Horizontal cursor**
  - **H1** Moves cursor H1 only.
  - **H2** Moves cursor H2 only.
  - **H1&H2** Moves both cursors H1 and H2 simultaneously without changing the distance between them.

Cursor movement range

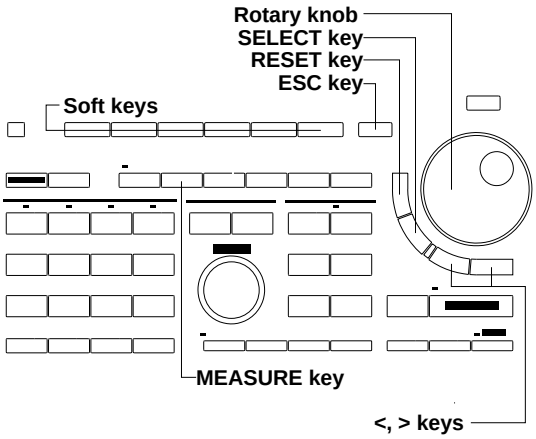
The X-Y cursor can only be moved over the X-Y waveform. For details regarding the horizontal/vertical cursors, refer to page 8-4.

Points to note when performing cursor measurements

For more details regarding the points to note when performing cursor measurements, refer to page 8-4.

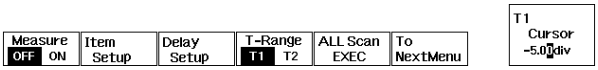
8.3 Measuring Waveform Parameters Automatically

Relevant Keys



Operating Procedure

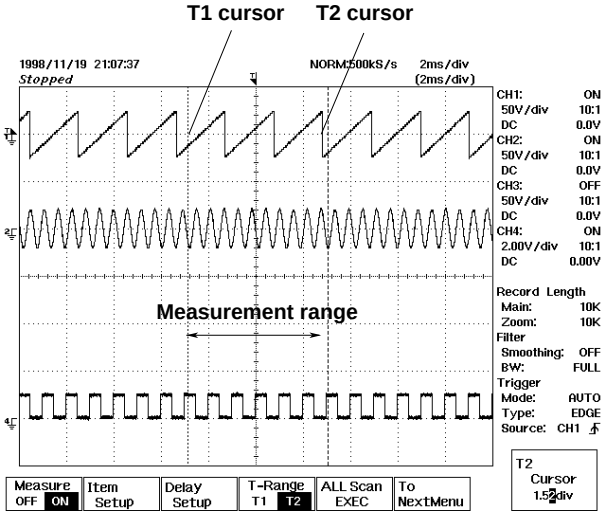
1. Press the **MEASURE key** to display the automated measurement setting menu.
2. Press the "**Measure**" soft key and select "**ON**".



You can perform measurement both on displayed waveform data and on the corresponding waveform values within acquisition memory. You first set the various conditions (measurement range, measurement items, distal/proximal values, and channel delay). You can then start measurement of the displayed waveform data by pressing the **"Measure"** soft key so that it comes **ON**.
You must first stop waveform acquisition, then you can execute the measurement by pressing the **"ALL Scan EXEC"** soft key. Each press of the key takes a single measurement of the various waveform parameters, using the memory-resident values corresponding to the displayed waveform data. The measurement conditions (range, items, distal/proximal values, and channel delay) are the same as those for the displayed data.

Setting the measurement range
The measurement range is determined by the two vertical cursors T1 and T2. The position of cursor T1 indicates the starting point of measurement, and the position of cursor T2 indicates the end point.

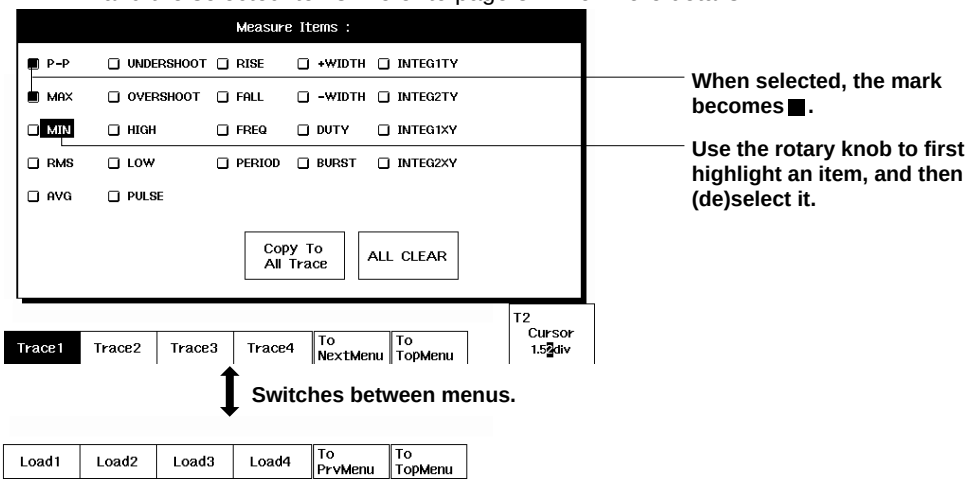
3. After having pressed either the "**T1**", or "**T2**" soft keys, use the rotary knob to adjust the position of the cursor. You can also use the **<** or **>** keys.



Selecting the measurement items

The measurement items can be selected from 22 different ones. For the meaning of each item, refer to the description on page 8-12.

4. Press the "**Measure**" soft key at the automated measurement setting menu to display the item selection menu.
5. Press the soft key corresponding to the desired trace or loaded waveform number.
6. Use the rotary knob to highlight the desired measurement item.
7. Press the **SELECT key** to select an item. The selection mark in front of the item will be highlighted to indicate it has been selected. Press the **SELECT key** again to undo this, or to reset all selection at once, press the "**ALL CLEAR**" soft key.
8. Repeat step 6 and 7 to select all the desired measurement items. The display of the measurement items depends on the number of waveforms to be measured and the selected items. Refer to page 8-14 for more details.



9. Repeat steps 5 to 12 in case you want to select measurement items for another trace or loaded waveform. In case you want to select the same measurement items for all traces and loaded waveforms, select "**Copy To All Trace**" using the rotary knob and press the **SELECT key**.

Returning to the top menu

10. Press the "**To Topmenu**" soft key to return to the automated measurement setting menu.

Setting the distal/mesial/proximal values

The two levels which are used as the reference for the measurement of rise and fall times can be set. For more details, refer to the description on page 8-12.

11. Press the "**Trace**" soft key to select measurement items for trace or loaded waveform.
12. Press the "**Dpr Mode**" soft key to select "**%**" or "**Unit**" .
13. Use the rotary knob to select the "**Proximal**" , "**Mesial**" or "**Distal**" setting and press the **SELECT key** to display the value setting box.
14. Use the rotary knob to set the desired value. Press the **RESET key** to restore the new value to the default value.
15. Repeat steps 12 to 14 In case you want to select the same measurement items for all the "**Proximal**" , "**Mesial**" or "**Distal**" settings. Repeat steps 11 to 14 in case you want to select measurement items for another trace or loaded waveform.

Returning to the top menu

16. Press the "**To Topmenu**" soft key or the **ESC key** to return to the automated measurement setting menu.

Setting delay measurement between channels

The delay between channels is the time difference of the rising or falling edge between traces or loaded waveforms. For each trace and loaded waveform, the waveform to be used as a reference and the measurement waveform need to be specified.

Setting the measurement waveform

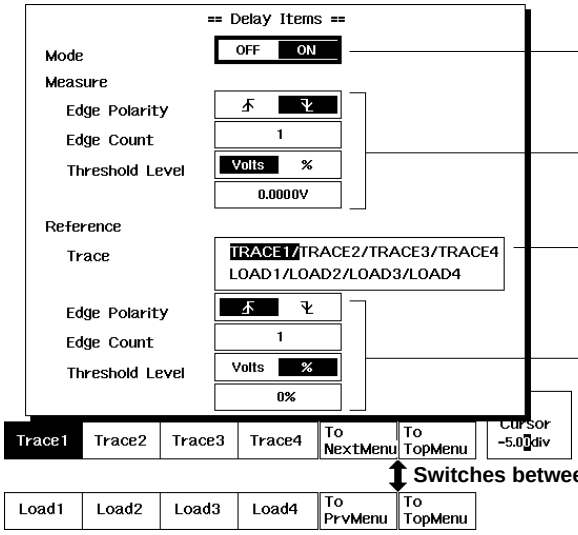
17. Press the "**Delay Setup**" soft key at the automated measurement setting menu to display the delay selection menu.
18. Press the soft key corresponding to the desired trace or loaded waveform number which will be subjected to measurement.
19. After having selected "**Mode**" using the rotary knob, press the **SELECT key** to select "**ON**". Pressing the **SELECT key** once more will result in selecting "**OFF**".
20. After having selected "**Edge Polarity**" of the "**Measure**" setting using the rotary knob, press the **SELECT key** to select rising edge or falling edge.
21. After having selected "**Edge Count**" of the "**Measure**" setting using the rotary knob, press the **SELECT key** to display the count setting box.
22. Use the rotary knob to set the desired count number. Press the **RESET key** to restore the new value to the default value.
23. Press the **SELECT key** or the **ESC key** to close the count setting box.
24. After having selected "**Threshold**" of the "**Measure**" setting using the rotary knob, press the **SELECT key** to set the delay detection level to "**Volts**" or "**%**".
25. Use the rotary knob to select the screen below and press the **SELECT key** to display the value setting box.
26. Use the rotary knob to set the desired value. Press the **RESET key** to restore the new value to the default value.
27. Press the **SELECT key** or the **ESC key** to close the value setting box.

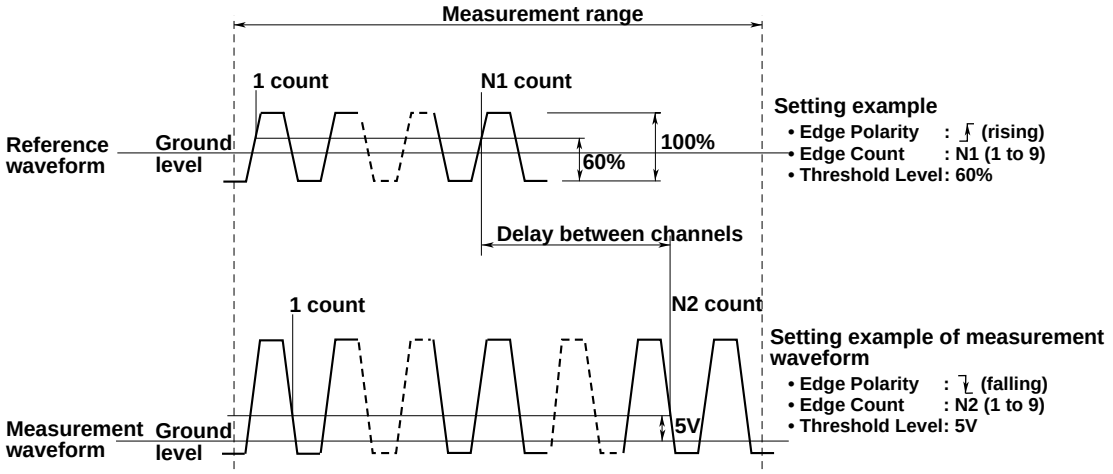
Setting the reference waveform

28. After steps 17 to 25 have been completed, and after having selected "**Trace**" of the "**Reference**" setting using the rotary knob, press the **SELECT key** to select the trace or loaded waveform to be used as reference.
29. After having selected "**Edge Polarity**" of the "**Reference**" setting using the rotary knob, press the **SELECT key** to select rising edge or falling edge.
30. After having selected "**Edge Count**" of the "**Reference**" setting using the rotary knob, press the **SELECT key** to display the count setting box.
31. Use the rotary knob to set the desired count number. Press the **RESET key** to restore the new value to the default value.
32. Press the **SELECT key** or the **ESC key** to close the count setting box.
33. After having selected "**Threshold**" of the "**Reference**" setting using the rotary knob, press the **SELECT key** to set the delay detection level to "**Volts**" or "**%**".
34. Use the rotary knob to select the screen below and press the **SELECT key** to display the value setting box.
35. Use the rotary knob to set the desired value. Press the **RESET key** to restore the new value to the default value.
36. Press the **SELECT key** or the **ESC key** to close the value setting box.
37. Repeat steps 16 to 34 in case you want to set delay measurement for other trace or loaded waveforms.

Returning to the top menu

38. Press the "**To Topmenu**" soft key or the **ESC key** to return to the automated measurement setting menu.



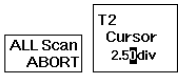


Measuring data in acquisition memory

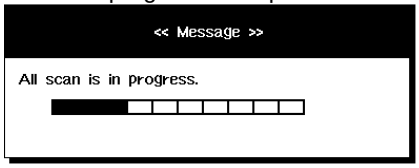
1. Set the measurement range, measurement items, distal/proximal values, and channel delay to appropriate values. Then confirm that the "**Measure**" soft key in the automated measurement setting menu (top menu) is set to "**ON**".

- **To execute measurement of memory data**

2. Press the **START/STOP key** to halt waveform acquisition.
3. Press the "**ALL Scan EXEC**" soft key. The key name immediately changes to "**ALL Scan ABORT**" and the oscilloscope begins executing a single measurement of the relevant data in memory, while displaying progress on the screen. When measurement is finished the key name changes back to "**ALL Scan EXEC**".



Indicates progress of acquisition-memory data measurement.



- **To abort measurement of memory data**

4. The "**ALL Scan ABORT**" soft key remains on the screen while measurement is being carried out. You can abort the measurement at any time by pressing this key. (The key name will immediately change back to "**ALL Scan EXEC**").

Explanation

Waveforms which cannot be measured

For waveforms which cannot be measured, refer to page 8-2.

Setting the measurement range : Time range

The measurement range is determined at the displayed time axis by the two vertical cursors T1 and T2. The position of cursor T1 indicates the starting point of measurement, and the position of cursor T2 indicates the end point. Automatic measurements will be carried on data within this range.
The default measurement range is 10div (time axis).

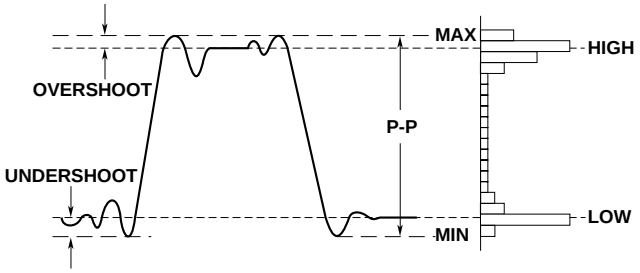
Measurement items : Item Setup

Measurement items can be selected from 22 different types. Items can be selected separately for each related waveform. The default is no items selected.
A maximum of 24 items can be displayed at once on the waveform display. This also includes the values of delay measurement.
The method of displaying the measurement values depends on the number of selected traces or loaded waveforms. Refer to page 8-14 for more details.
The items which can be selected are as follows.

- **Measurement items related to the voltage axis**
  When measuring items such as rise time and fall time, “High” represents the voltage for the most frequently occurring high amplitude (at 100% level), while “Low” represents the voltage for the most frequently occurring low amplitude (at 0% level). They are therefore different from “Max” and “Min”, which just represent the maximum and minimum voltage respectively.

P-P (P-P)* : Peak to peak value (MAX - MIN) [V]
MAX (Max)* : Maximum voltage [V]
MIN (Min)* : Minimum voltage [V]
RMS (Rms)* : Root mean square value $(1/\sqrt{n})(\Sigma(xi)^2)^{1/2}$ [V]
AVG (Avg)* : Average voltage (1/n)Σxi [V]

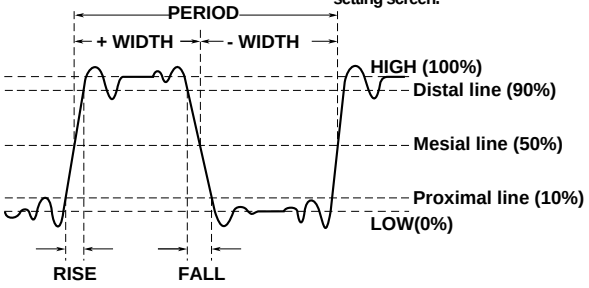
UNDERSHOOT (- Ovr)* : Undershoot value (LOW - MIN)/(HIGH - LOW) x 100 [%]
OVERSHOOT (+ Ovr)* : Overshoot value (MAX - HIGH)/(HIGH - LOW) x 100[%]
HIGH (High)* : High level voltage [V]
LOW (Low)* : Low level voltage [V]
*( ) shows the corresponding name at the measurement item setting screen.

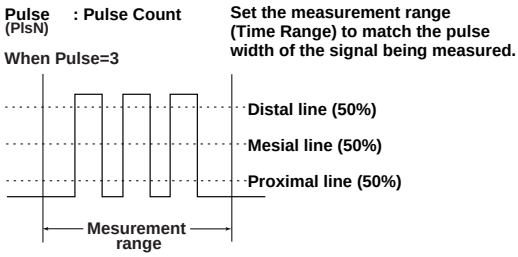


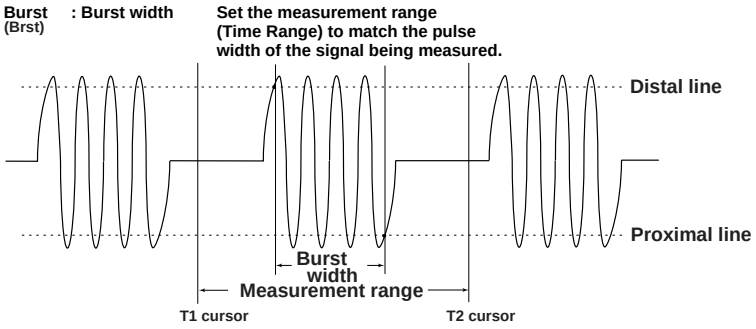
- **Measurement items related to the time axis**

RISE (Rise)* : Rise time [s]
FALL (Fall)* : Fall time [s]
FREQ (Freq)* : Frequency [Hz],1/PERIOD
PERIOD (Prod)* : Period [s]

+ WIDTH (+ Wd)* : Width (s) greater than the mesial value
- WIDTH (- Wd)* : Width (s) smaller than the mesial value
DUTY (Duty)* : Duty ratio + WITHDTH/PERIOD x 100[%]
*( ) shows the corresponding neme at the measurement item setting screen.







- **Other Measurement items**

  INTEG1TY(I1TY) Area of positive amplitude
  INTEG2TY(I2TY) Area of positive amplitude - Area of negative amplitude
  INTEG1XY(I1XY) Total sum of the triangular areas of the X-Y waveform
  INTEG2XY(I2XY) Total sum of the trapezoid areas of the X-Y waveform

Note

For a detailed description of the area calculation method, refer to Appendix 4.

Proximal, Mesial, Distal settings : Dpr Mode

The “Proximal” setting ranges from 0 to 49, in 1 % steps or the voltage value corresponding to ± 8 div, in 1 V step.
The “Mesial” setting ranges from 10 to 89, in 1 % steps or the voltage value corresponding to ± 8 div, in 1 V step.
The “Distal” setting ranges from 50 to 100, in 1 % steps or the voltage value corresponding to ± 8 div, in 1 V step.

Delay between channels : Delay Setup

The delay between channels is the time difference of the rising or falling edge between traces or loaded waveforms. For the relation between the channel of measurement and the reference channel, refer to page 8-11.
Measurement starts when the “Mode” setting is set “ON”. The default setting is “OFF”.
The trigger slope can be either “⌐” or “¬” and is selected at the “Edge Polarity” setting. The default setting is “⌐”. The number of times the trigger is activated is set at the “Edge Count” setting, and can be set from 1 to 9. The default setting is “1”. The voltage level at which triggering occurs is set at the “Threshold Level” setting, and can be selected from “Volts” or “%”. The default setting is “0.0000 V”. This volts setting range is the voltage value corresponding to ± 8 div. The setting step is 0.04 div. % can be set to a percentage of 0 to 100 %, where 100 % corresponds to the amplitude of “HIGH - LOW”. The setting step is 1 %. The measurement values will be displayed as “Dly”.

Points to note relating to automated measurement

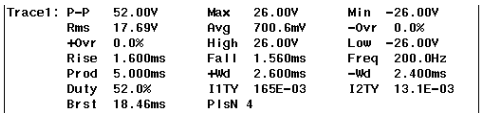
- The cursors and measured values will still be displayed even if a different menu is selected. However, the cursors cannot then be moved.
- Values gathered by the automated measurement function will be cleared if the cursor measurement function is turned ON. However, pressing the MEASURE key (when “Measure” is set to “ON”) will display the automatically measured values.
- If the GO/NO-GO “Mode” has been set to “ON” and the “GO/NOGO EXEC” soft key has been pressed, the automated measurement function will not operate even if the MEASURE key is pressed. To operate the automated measurement function, the GO/NO-GO “Mode” must be set to “OFF”.

- If measurement is not possible, “- - -” will be displayed.
- If two or more periods of the waveform lie within the measuring range, the first period will be measured.
- Automated measurement is also possible for expanded waveforms. When switching the display to show the expanded waveform, the position of the cursor on the screen does not change. When both the pre-zoom and the expanded waveform are displayed, automated measurement will be performed on the expanded waveform.
- Automated measurement is not synchronized with the update of the displayed waveform. Hence, the displayed waveform may not match the measured values. To make the displayed waveform match the automatic measurements, stop acquisition.
- When using waveform computations, the displayed unit will become “div” for waveforms obtained by addition/subtraction, and “V2” for waveforms obtained by multiplication.
- Time is measured based on the T/div value set for the input signal waveform. Thus, be careful if the T/div set for a loaded or recalled waveform does not match the T/div for the input signal waveform.
- Only the measurement items INTEG1XY and INTEG2XY can be displayed in case of the X-Y display and T-Y & X-Y display.

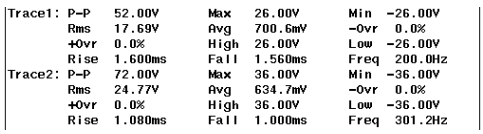
Display Example of measurement values

The number and type of measurement items which can be displayed at a screen together with the waveform(s) depend on the number of waveforms under measurement. Furthermore, if the number of measurement items exceeds the maximum which can be displayed, the type of measurement items which will appear on the display is designated. The following shows an example where the type of displayed measurement values is designated.

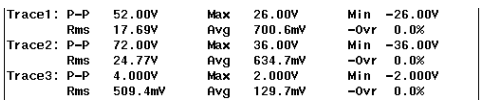
- **In case of one waveform under measurement**
  Measurement values of selected measurement items and delay between channels will all be displayed.

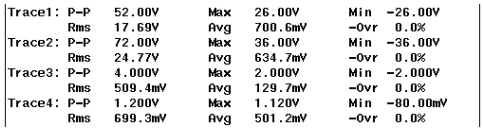


- **In case of two waveforms under measurement**
  Up to 12 measurement values of selected measurement items of one waveform will be displayed. In case delay measurement is set “ON”, the maximum number of displayed measurement items becomes 11.



- **In case of three or four waveforms under measurement**
  Up to 6 measurement values of selected measurement items of one waveform will be displayed. In case delay measurement is set “ON”, the maximum number of displayed measurement items becomes 5.





- **In case of more than five waveforms under measurement**
  Up to 3 measurement values of selected measurement items of one waveform will be displayed. In case delay measurement is set “ON”, the maximum number of displayed measurement items becomes 2.

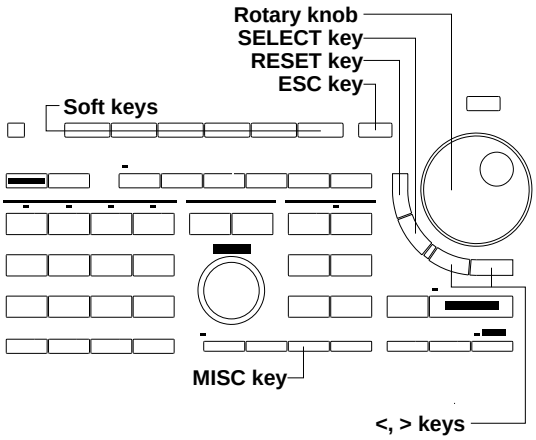
```
Trace1: P-P   52.00V      Max   26.00V      Min  -26.00V
Trace2: P-P   72.00V      Max   36.00V      Min  -36.00V
Trace3: P-P   4.000V      Max   2.000V      Min  -2.000V
Trace4: P-P   1.200V      Max   1.120V      Min  -80.00mV
Load1:  P-P   51.20V      Max   25.60V      Min  -25.60V
```

```
Trace1: P-P   52.00V      Max   26.00V      Min  -26.00V
Trace2: P-P   72.00V      Max   36.00V      Min  -36.00V
Trace3: P-P   4.000V      Max   2.000V      Min  -2.000V
Trace4: P-P   1.200V      Max   1.120V      Min  -80.00mV
Load1:  P-P   51.20V      Max   25.60V      Min  -25.60V
Load2:  P-P   72.00V      Max   36.00V      Min  -36.00V
Load3:  P-P   72.00V      Max   36.00V      Min  -36.00V
Load4:  P-P   72.00V      Max   36.00V      Min  -36.00V
```

* MISC: Use of the Information menu or communications function enables output of all the selected measured values, though the measured values cannot be updated by the Information menu. When saving screen image data on a floppy disk in HP-GL or PostScript format, all the selected items can be saved.

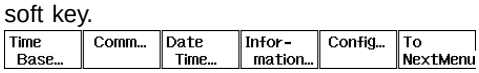
8.4 Using the Linear Scaling Function

Relevant Keys

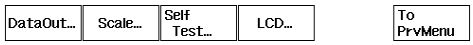


Operating Procedure

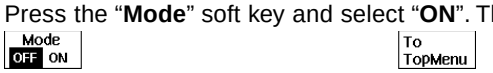
1. Press the **MISC key** to display the setting menu and press the "**To NextMenu**" soft key.



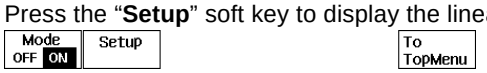
2. Press the "**Scale**" soft key.



3. Press the "**Mode**" soft key and select "**ON**". The "**Setup**" soft key will appear.



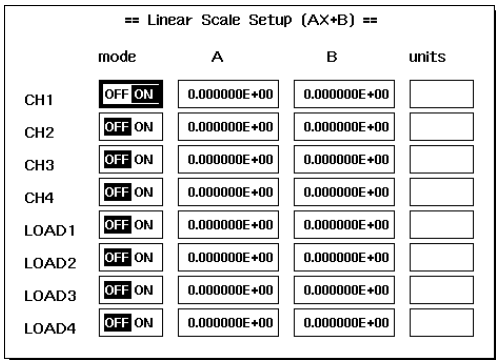
4. Press the "**Setup**" soft key to display the linear scaling setting menu.



In order to use the linear scaling function, it is necessary to select the waveform of measurement, to set the coefficient A and the offset value B, and to apply a unit.

Selecting the waveform of measurement

5. Use the rotary knob to select the desired waveform of measurement.
6. Press the **SELECT key** to turn the "**Mode**" setting "**ON**". Pressing the **SELECT key** once more will result in selecting "**OFF**".

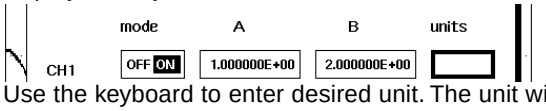


Setting the scaling coefficient A and the offset value B

7. Use the rotary knob to select the coefficient A of the measurement waveform and press the **SHIFT + MISC (KEYBOARD) key** to display the keyboard.
8. Use the keyboard to enter the desired value. For details concerning operation of the keyboard, refer to page 4-8.
9. Use the rotary knob to select the coefficient B of the measurement waveform and press the **SHIFT + MISC (KEYBOARD) key** to display the keyboard.
10. Use the keyboard to enter the desired value. For details concerning operation of the keyboard, refer to page 4-8.

Applying a unit

11. Use the rotary knob to select the "**UNIT**" setting and press the **SELECT key** to display the keyboard.



12. Use the keyboard to enter desired unit. The unit will appear at the "units" setting on the screen. For details regarding the usage of the keyboard, refer to page 4-8.
13. Repeat steps 5 to 12 in case you want to set the linear scaling function for other waveforms.

Returning to the top menu

14. Press the **ESC key** to close the linear scaling setting menu.
15. Press the "**To Topmenu**" soft key to return to the **MISC** menu.

Explanation

Waveforms which cannot be measured

For waveforms which cannot be measured, refer to page 8-2.

Setting the coefficient A and offset value B

If the setting range of A, B is within –3.4E38≤AX + B≤3.4E38*, the results will be displayed. If the setting exceed this range, the display will show "- - -". For an example, refer to the next page.

The default setting is 0.000000E+00*.

* 1E38 represents 1x1038.

Setting the unit

This setting is useful to enter any unit. Up to eight characters can be input. Note however, that only the first three characters will appear on the display.

Display Example of linear scaling results

The results of linear scaling will not appear on the display until data acquisition has been started.

The scaling coefficient A, offset B, and new defined unit will be applied to measurement values of cursor measurements and automated measurements. The following is a display example of the results of automated measurement.

- **When linear scaling is ON**

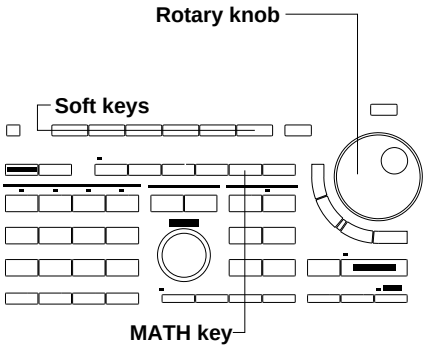
```
Trace1: P-P   50.00V      Max   22.00V      Min  -28.00V
        Rms   18.56V      Avg  -6.842V      -Ovr  0.0%
        +Ovr  0.0%        High  22.00V      Low  -28.00V
        Rise  760.0us     Fall  780.0us     Freq   ---
        Prod   ---        +Wd   1.300ms     -Wd    ---
        Duty  0.0%        I1TY  15.8E-03    I2TY -21.2E-03
        Brst  2.530ms     PlsN 1
```

- **When linear scaling is OFF**

```
Trace1: P-P   50.0E+00V   Max   24.0E+00V   Min  -26.0E+00V
        Rms   17.9E+00V   Avg  -4.84E+00V   -Ovr  0.0%
        +Ovr  0.0%        High  24.0E+00V   Low  -26.0E+00V
        Rise  760.0us     Fall  780.0us     Freq   ---
        Prod   ---        +Wd   1.300ms     -Wd    ---
        Duty  0.0%        I1TY  18.2E-03V   I2TY -14.9E-03V
        Brst  2.530ms     PlsN 1
```

8.5 Performing Waveform Math (Addition, Subtraction and Multiplication)

Keys and Procedure



1. Press the **MATH key** to display the waveform math setting menu.

Selecting the type of computation

2. Press the soft key corresponding to the math to be carried out.

Math Operation			
OFF	1+2->3	1-2->3	1×2->3

Phase
Shift
0.001div

Performing a phase shift

3. In case of computation of multiplication, press the "**Phase**" soft key.
4. Turn the rotary knob to shift the phase. Step 3 is not required if a MATH function other than multiplication is selected.

Math Operation				Math Knob	
OFF	1+2->3	1-2->3	1×2->3	PHASE	SENS

Phase
Shift
0.200div

Changing the display sensitivity of the computation result of multiplication

3. After step 2 has been completed, press the "**SENS**" soft key.
4. Turn the rotary knob to adjust the sensitivity.

Math Operation				Math Knob	
OFF	1+2->3	1-2->3	1×2->3	PHASE	SENS

Sensi-
tivity
2.01div

Explanation

Types of computation

The following types can be selected. The default value is "OFF".

OFF computation will not be carried out;

1+2(→3) The result of adding waveform data of CH1 and CH2 will be displayed as trace 3.

1–2(→3) The result of subtracting waveform data of CH1 and CH2 will be displayed as trace 3.

1x2(→3) The result of multiplying waveform data of CH1 and CH2 will be displayed as trace 3.

Phase shift

Math can be performed with the phase of CH2 shifted. The setting range and steps are as follows.

Setting range : ±5div

Setting steps: depending on the display record length. Refer to page 7-4 for more details.

Changing the display sensitivity of the computation result of multiplication

In order to observe the computation result better, the waveform size from the ground level (display sensitivity) can be changed. The display sensitivity of the computation result of multiplication is specified as follows.

Waveform size (from the ground level) of the computation result: Z=(SENS/2) x (XxY/2)

SENS set value using rotary knob (div)

X waveform size of channel 1 (compared to ground level)

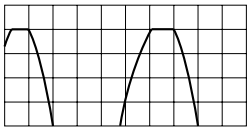
Y waveform size of channel 2 (compared to ground level)

Setting ranges from 0.50 to 4.00 div.

Setting step is 0.01 div.

Points to note relating to waveform computation

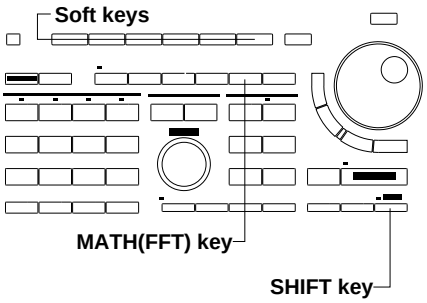
- Computation cannot be carried out on snapshot waveforms or recalled waveforms.
- Computation between channels is carried out using the original acquisition data which are then displayed using P-P compression. In case the input coupling is AC and an offset voltage is applied, the offset part will not be included in computation.
- Addition and subtraction computation is carried out regardless of the V/DIV setting of the channels. Therefore, in case of cursor measurement or automated measurement of trace 3, the displayed unit will become “div”.
- The voltage axis sensitivity of channel 1 and 2 being V1 and V2 respectively, the voltage axis sensitivity of the computation result becomes (4/SENS) x V1 x V2/div. Therefore, in case of cursor measurement or automated measurement of trace 3, the displayed unit will become “V^2”.
- The computed waveform displayed on trace 3 is P-P compressed data. When this data is stored or saved on the internal memory/floppy disk/SCSI device, information indicating that this is a computed waveform and the voltage axis information after the computation are not stored or saved. Therefore, if this data is recalled or loaded and then a measurement is made using the cursors or automated measurement of waveform parameters, correct values will not be displayed. To display the correct values, save the waveform data on CH1 and CH2 from the acquisition memory to the floppy disk/SCSI device as binary data. Then, load the data and redo the waveform computation. Waveform data in the acquisition memory cannot be stored in the internal memory.
- If the computed result due to adding or subtracting is larger than 10.24 div or the result due to multiplying is larger than 13 div, a chopped waveform will be displayed as in the following diagram. This is due to the fact that the computed result exceeds the display range.



- Even if "OFF" is selected at the waveform math setting menu, the phase shift function is still effective. To disable the phase shift function, set the phase shift to 0 div.

8.6 Displaying the Power Spectrum (Performing FFT Computation)

Keys and Procedure



1. Press the **SHIFT + MATH (FFT) key** to display the FFT computation setting menu.
2. Press the "**FFT**" soft key and select "**ON**".

FFT	Trace	Window		Display	
OFF ON	1	RECT	HANNING	VT&FFT	FFT

Selecting the waveform of measurement

3. Press the "**Trace**" soft key to display the trace selection menu.
4. Press the soft key corresponding to the trace you want to measure.

FFT	Trace				
OFF ON	1	2	3	4	FFT

Selecting the time window

3. After step 2 has been completed, press the "**RECT**" or the "**HANNING**" soft key to select the time window.

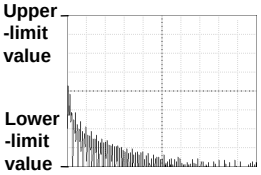
Selecting the display format

3. After step 2 has been completed, press the "**VT&FFT**" or the "**FFT**" soft key to select the display format.

FFT	Trace	Window		Display	
OFF ON	1	RECT	HANNING	VT&FFT	FFT

Explanation

The upper and lower limits of the power spectrum display take on fixed values depending on the vertical sensitivity (V/div) as shown in the figure below. They are not displayed on the screen.



V/div	Upper -limit value (dBV)	Lower -limit value (dBV)
5000 V	100	20
2000 V	90	10
1000 V	80	0
500 V	80	0
200 V	70	–10
100 V	60	–20
50 V	60	–20
20 V	50	–30
10 V	40	–40
5 V	40	–40
2 V	30	–50
1 V	20	–60
500 mV	20	–60
200 mV	10	–70
100 mV	0	–80
50 mV	0	–80
20 mV	–10	–90
10 mV	–20	–100
5 mV	–20	–100
2 mV	–30	–110
1 mV	–40	–120

Waveforms on which FFT computation can be performed

FFT computation can be performed on any one trace selectable from trace 1 to trace 4.

Selecting the time window

The time window can be selected from the following window types.

RECT (rectangular window)
Useful for transient signals which attenuate completely within the time window

HANNING Useful for signals which are continuous and not periodical

FFT frequency band

Maximum 50 MHz

Display format

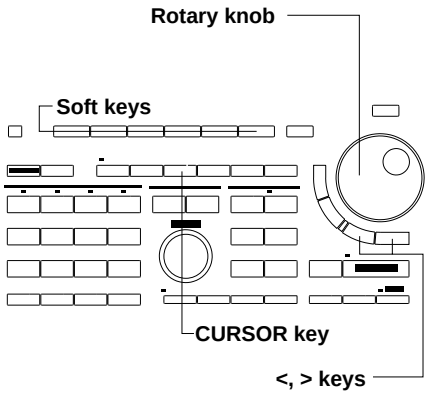
The display format depends on the expansion settings. Refer to page 7-5 for more details.

Points to note relating to displaying the power spectrum

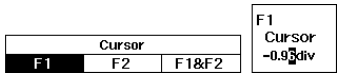
- FFT computation is not possible in repetitive sampling mode or when the acquisition mode is envelope mode.
- FFT computation is not possible when the Waveform's Horizontal Position set except to 0div.
- The unit of the voltage axis is [dBV].
- In case the waveform is expanded, FFT computation will be carried out on the expanded range.
- FFT computation is not possible when the wide screen mode is turned ON. Turning ON the FFT while the wide screen mode is ON automatically turns OFF the wide screen mode.

8.7 Measuring the Power Spectrum using Cursors

Keys and Procedure



1. Display the power spectrum. For details, refer to the previous page.
2. Press the **CURSOR key** to display the cursor measurement setting menu.
3. Press the "**Cursor**" soft key and select "**ON**".
4. After having pressed any of the "**F1**", "**F2**" or "**F1&F2**" soft keys, use the rotary knob to adjust the position of the vertical cursor. You may also use the **<** or **>** key.



Explanation

Waveforms which can be measured

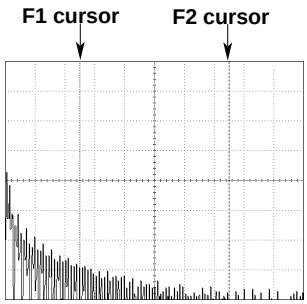
Waveforms which can be measured are the same on which FFT computation can be performed. Refer to the previous page for more details.

Measurement items

The following items can be measured.

- **F1(X)** Frequency at the position of cursor F1.
- **F2(X)** Frequency at the position of cursor F2.
- **DF(X)** F2–F1
- **P1(X)** Frequency level at the position of cursor F1.
- **P2(X)** Frequency level at the position of cursor F2.
- **DP(X)** P2–P1

(X) indicates the waveform of measurement.



Cursor movement method

The cursors can be selected as follows.

- **F1** Moves cursor F1 only.
- **F2** Moves cursor F2 only.
- **F1&F2** Moves both cursors F1 and F2 simultaneously without changing the distance between them.

Cursor movement range

Each vertical cursor can be moved to 501 different positions from the left edge (–5.00 div) to the right edge (5.00 div) of the waveform display frame. However, there is no data at the 501 position of the rigth edge. Thus, when you move the cursor to this position, the display will show "- - -"

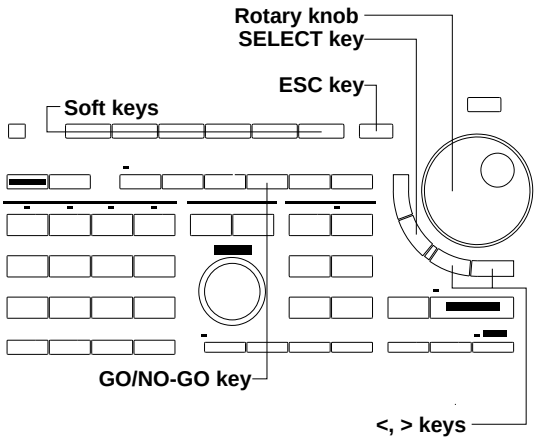
The default setting is –2.50 div for T1 and 2.50 div for T2.

Points to note when performing cursor measurements

- The cursors and measured values will still be displayed even if a different menu is selected. However, the cursors cannot then be moved.
- Cursor-measured values will be cleared if the automated measurement function is turned ON. However, pressing the CURSOR key (when "Cursor" is set to "ON") will display the cursor-measured values.
- If the GO/NO-GO "Mode" has been set to "ON" and the "GO/NOGO EXEC" soft key has been pressed, the cursor measurement function will not operate even if the CURSOR key is pressed. To operate the cursor measurement function, the GO/NO-GO "Mode" must be set to "OFF".
- If measurement is not possible, "- - -" will be displayed.
- Cursor measurement is also possible for expanded waveforms. When switching the display to show the expanded waveform, the position of the cursor on the screen does not change. When both the pre-zoom and the expanded waveform are displayed, cursor measurement will be performed on the expanded waveform.
- There might be cases where the displayed waveform is not in synchronization with the measurement values. To synchronize, stop data acquistion.

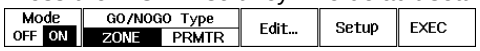
9.1 Judging using a Waveform Zone

Relevant Keys



Operating Procedure

1. Press the **GO/NO-GO key** to display the GO/NO-GO setting menu.
2. Press the "**Mode**" soft key and select "**ON**". The GO/NO-GO top menu appears.
3. Press the "**ZONE**" soft key. The default setting is "**ZONE**".



When using the GO/NO-GO determination funtion, the following settings/selections can be specified.

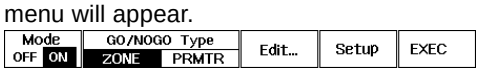
- Creating the determination zone (refer to page 9-1, 9-2);
- Saving the determination zone (refer to page 9-3);
- Redrawing/editing the saved determination zone (refer to page 9-3);
- Setting up the determination conditions (refer to page 9-4, 9-5);
  trace conditions, determination logic, determination sequence, action after determination
- Executing and aborting the determination function (refer to page 9-5).

Note

- The determination waveforms are saved in the internal memory. Old determination waveforms which are already present in the internal memory, will be overwritten when new ones will be saved. An error message will not appear. Therefore, verify before saving whether or not determination waveforms already exist in the internal memory. Refer to steps 18 to 20.
- Only below buttons can be operated, when a zone waveform is being created:
  Soft keys, SELECT key, RESET key, <, > keys, Rotary knob
  If any other button is being pushed the following message will appear:
  "This key cannot be operated when the zone wave edit mode is in progress."

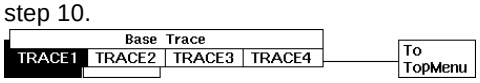
Creating the Waveform

4. Press the "**Edit...**" soft key of the GO/NO-GO top menu. The zone creation menu will appear.



5. Press the "**NEW...**" soft key and the base trace menu will appear.

6. Press the soft key corresponding to the desired base trace. To edit the entire waveform, continue with step 7; to edit a part of the waveform, continue with step 10.

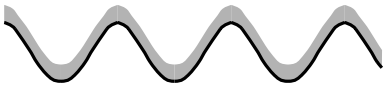


Editing the whole waveform

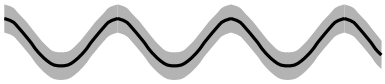
7. Press the “**WHOLE**” soft key to display the editing menu. The default setting is “**WHOLE**”.

8. After having pressed the “**Move**” soft key to select the editing direction, use the rotary knob to edit the zone. You may also use the **<** or **>** keys.

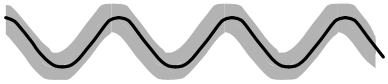
Example in case “⇧” is set at the “MOVE” setting.



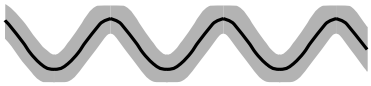
Example in case “⇩” is set at the “MOVE” setting, following the previous example.



Example in case “⇦” is set at the “MOVE” setting, following the previous example.



Example in case “⇨” is set at the “MOVE” setting, following the previous example.



9. Repeat step 8 until editing the waveform has been completed. To edit a part of the waveform, continue with step 10; if editing has been completed, continue with step 14.

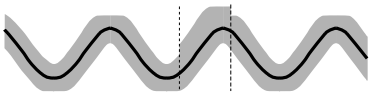
Editing a part of the waveform

10. After having completed step 6 or step 9, press the “**PART**” soft key to display the editing menu.

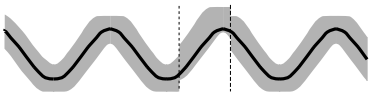
11. After having pressed the “**T-Range**” soft key, select either “**T1**” or “**T2**” to set either boudary of the setting range. Then use the rotary knob to edit the boundary position. You may also use the **<** or **>** keys. Do this for both the left (T1) and right side boundary (T2).

12. After having pressed the “**Zone**” soft key to select the editing direction, use the rotary knob to edit the zone. You may also use the **<** or **>** keys.

Example in case “⇧” is set at the “**ZONE**” setting, following the previous zone editing example.



Example in case “⇩” is set at the “**ZONE**” setting, following the previous example.



13. Repeat steps 11 and 12 until partial editing of the waveform has been completed.

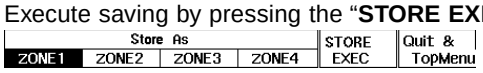
Completing editing the waveform

14. After having completed editing the waveform, press the “**DONE**” soft key to display the saving menu.

Saving the determination zone

15. Select the field where the determination zone will be saved by pressing any of the "**ZONE1 - ZONE4**" soft keys. The determination waveforms which have been saved in ZONE1, ZONE2, ZONE3 and ZONE4 can only be applied to trace1, 2, 3, and 4 respectively.

16. Execute saving by pressing the "**STORE EXEC**" soft key.



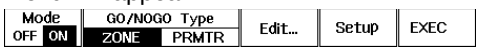
Note

The determination waveforms are saved in the internal memory. Old determination waveforms which are already present in the internal memory, will be overwritten when new ones will be saved. An error message will not appear. Therefore, verify before saving whether or not determination waveforms already exist in the internal memory. Refer to steps 18 to 20.

17. Return to the GO/NO-GO top menu by pressing the "**Quit & TopMenu**" soft key.

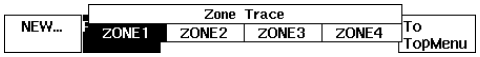
Redrawing/editing the saved determination zone

18. Press the "**Edit...**" soft key of the GO/NO-GO top menu. The zone creation menu will appear.



19. Press the "**REDRAW...**" soft key and the zone trace menu will appear.

20. Press the soft key corresponding to the desired zone you want to redraw. The saved determination zone will appear.



21. To edit the redrawn zone, repeat steps 7 to 14 on the previous page.

22. To save the edited redrawn zone, repeat steps 15 to 17.

Setting up the determination conditions

23. Press the "**Setup**" soft key of the GO/NO-GO top menu. The condition setup menu will appear.

24. After having selected the "**Mode**" setting of the trace to be measured using the rotary knob, press the **SELECT key** to select "**ON**". Pressing the key once again results in selecting "**OFF**", and no waveform determination will occur.

25. After having selected the "**Condition**" setting of the same trace using the rotary knob, press the **SELECT key** to select the desired condition. When the condition is met, "NO-GO" will result.
"OUT" : The waveform under measurement protrudes from the determination zone;
"IN" : The waveform under measurement enters the determination zone.

26. Repeat steps 24 and 25 for other traces if necessary.

Selecting AND or OR determination : Logic

27. After having selected the "**Logic**" setting on the condition setup menu, press the **SELECT key** to select the desired condition. When the condition is met, "NO-GO" will result.
"AND" : All determinations are "NO-GO"
"IN" : Any of the determination is "NO-GO"

Sequence determination

28. After having selected the "**Sequence**" setting on the condition setup menu, press the **SELECT key** to select the desired sequence. The following types can be selected.
"SINGLE" : Stops determination when a "NO-GO" determination is made
"CONTINUE" : Carries out determination repeatedly until the "**ABORT**" soft key is pressed

Setting action after determination

29. After having selected the "**Action**" setting on the condition setup menu, press the **SELECT key** to select the desired action. After a "NO-GO" determination, the data can be recorded in the following manners.
"NONE" : No action;
"PRINT" : A hardcopy of the screen will be printed out on the built-in printer;
"FD(P-P)" : All waveforms displayed on the screen will be saved to the floppy disk as P-P compressed data;
"FD(ACQ)" : Acquisition data of all waveforms displayed on the screen will be saved to the floppy disk as binary data.
"Buzzer" : Sounds the buzzer.
"FD(IMAGE)" : Saves the current screen image data to the floppy disk.
"SCSI(IMAGE)"*1 : Saves the current screen image data to the SCSI device.
"SCSI(P-P)"*1 : Saves the entire displayed waveform (P-P compressed data) to the SCSI device.
"SCSI(ACQ)"*1 : Saves the acquisition data (binary data) of the entire displayed waveform to the SCSI device.
"HD(IMAGE)"*2 : Saves the current screen image data to the internal hard disk.
"HD(P-P)"*2 : Saves all the displayed waveforms (as P-P compressed data) to the internal hard disk.
"HD(ACQ)"*2 : Saves all the displayed acquisition data (binary data) to the internal hard disk.

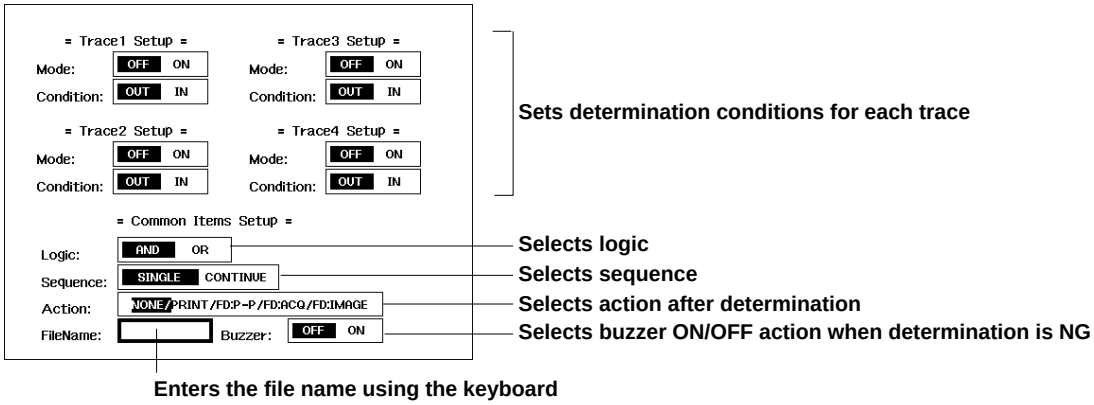
*1 You need to be using a model with the internal disk (DL1540CL /C8 option) or the SCSI interface unit 700930 (sold separately).
*2 Selectable only on models with the internal hard disk (DL1540CL /C8 option).

30. After having selected either “**FD(P-P)**” or “**FD(ACQ)**”, move to the “**FileName**”setting and press the **SELECT key**. The keyboard will be displayed. After having selected either “**NONE**” or “**PRINT**”, continue with step 32.

31. Use the keyboard to enter the name of the file. The entered filename will be displayed at the “**FileName**”setting. For details how to operate the keyboard, refer to page 4-8.

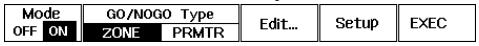
Returning to the top menu

32. Return to the GO/NO-GO top menu by pressing the **ESC key**.

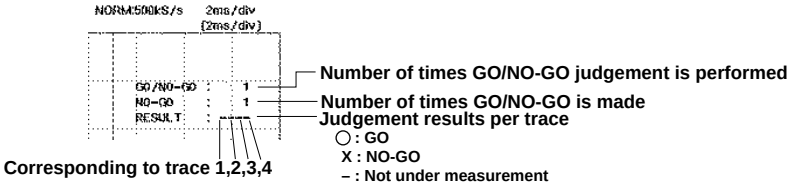


Executing the determination function

33. Press the “**EXEC**” soft key. The name of the soft key will change to “**ABORT**”.

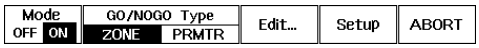


Display while GO/NO-GO judgement is in progress



Aborting the determination function

34. Press the “**ABORT**” soft key. The name of the soft key will change to “**EXEC**”.



Explanation

Selecting the reference waveform: Base Trace

Selects the waveform on which the determination range is to be based. The reference waveform can be selected from the following four types which can be displayed as
TRACE.

- Input signal waveform;
- ACQ waveform data (BIN data) loaded from a floppy disk;
- Computed waveform.

Editing the determination zone

Up to four determination zones can be set. The determination zone can be specified by expanding the reference waveform vertically and horizontally as follows.

- **Setting range in the vertical direction (⇧ , ⇩)**
  ±8div from the reference waveform, setting step is 0.02div.
- **Setting range in the horizontal direction (⇦, ⇨)**
  ±5div from the center of the display, setting step is 0.02div.

Specifying a file name when “FD(P-P),” “FD(ACQ),” “FD(IMAGE),” “SCSI(P-P),” “SCSI(ACQ),” “SCSI(IMAGE),” “HD(P-P),” “HD(ACQ),” or “HD(IMAGE)” has been selected as the trigger action

- **Specifying the file name: File Name**
  A file No. (starting from “0001”) is assigned to each waveform data automatically when the data is saved on a floppy disk, a SCSI device, or the internal hard disk. It is possible to insert a common file name (character string consisting of up to four characters) before the assigned file number (for instance “NOGO0000”).
  The entered file name is will be reset when the action becomes “NONE” or when GO/NOGO determination is set to “OFF”.
  The file name will be reset if the GO/NOGO determination is executed/aborted using EXEC and ABORT soft keys.
  When saving the screen image data, set the image data format. You can set the format at the hard copy selection menu that appears by pressing the SHIFT+COPY(MENU) key (see page 12-11).

Example of data format

After GO/NO-GO determination has been completed, the NO-GO counts, the date, time, and the results for each trace will be saved automatically in the DL-MISC directory at the floppy disc. The extension is “.GNG”. These files cannot be opened using this instrument; use a personal computer for this purpose.

JudgeCnt	NoGoCnt	Date	Time	Trace1	Trace2	Trace3	Trace4
3	1	95/03/03	10:10:10	Go	NoGo	Go	G
5	2	95/03/03	10:10:12	NoGo	Go	NoGo	Go
10	3	95/03/03	10:10:15	Go	NoGo	NoGo	NoGo
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
100	100	95/03/03	10:23:10	Go	NoGo	NoGo	Go

Forcing determination to stop and clearing the zone waveform

To force determination to stop, press the “ABORT” soft key or set “Mode” (at the GO/NO-GO top menu) to “OFF”. To clear the displayed zone waveform, switch “Mode” (at the GO/NO-GO top menu) to “OFF”.

Points to note relating to zone determination

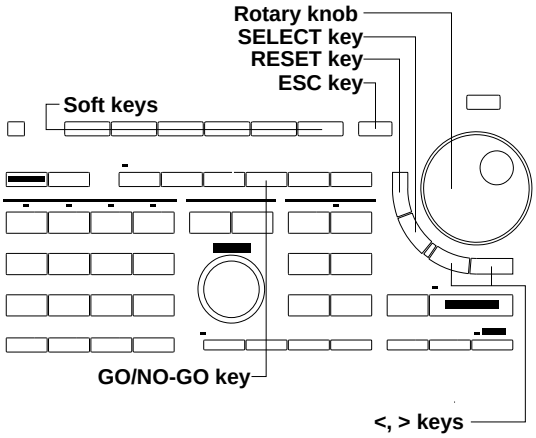
- Trigger mode is automatically switched to single short mode/single mode irrespective of the selected trigger mode during GO/NO-GO determination. However, determination will be repeated if the determination sequence has been set to “CONTINUE”. Even in case the GO/NO-GO mode (at the GO/NO-GO top menu) is changed to OFF again, the setting at the trigger mode selection will not become valid again.
- It is not possible to perform zone determination while both pre-zoom waveform and its expanded waveform are displayed at the same time or while an FFT or X-Y waveform is displayed. Neither is it possible to a display zone waveform. To perform GO/NO-GO determination using a zone waveform, make sure that the expanded waveform alone is displayed before “Mode” is set to “ON” (at the GO/NO-GO top menu).
- The following operations are not possible after having pressed the “EXEC” soft key. In order to perform these operations, it is necessary to set “Mode” (at the GO/NO-GO top menu) to “OFF”, after having pressed the “ABORT” soft key.
  - Initialization of the settings
  - Auto set-up
  - Cursor measurements
  - Action on trigger
  - Automated measurements
  - Changing of expansion settings
  - Display of an X-Y waveform
- A zone waveform is not displayed if the following conditions are not satisfied after the zone waveform has been created.
  - “Mode” at the GO NO-GO top menu : ON
  - “GO/NO-GO Type” : ZONE
  - “Mode” for selected trace : ON
  - Display for selected trace : ON (corresponding LED is lit)
- During the time in which an action is being executed after GO/NO-GO determination, no waveform data will be acquired.

Note

The zone waveform generated can be retained by saving the set-up data on a floppy disk. However, “Mode” (at the GO NO-GO top menu) must be set to “ON” and “GO/NO-GO Type” to “ZONE”. For a description of how to save set-up data on a floppy disk, refer to 12.4 “Saving and Loading Set-up Data” (page 12-7).

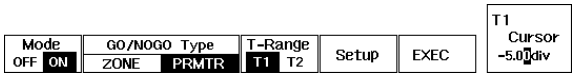
9.2 Judging using Measured Values of Waveform Parameters

Relevant Keys



Operating Procedure

1. Press the **GO/NO-GO key** to display the GO/NO-GO setting menu.
2. Press the "**Mode**" soft key and select "**ON**". The GO/NO-GO top menu appears.
3. Press the "**PRMTR**" soft key. The default setting is "**ZONE**".

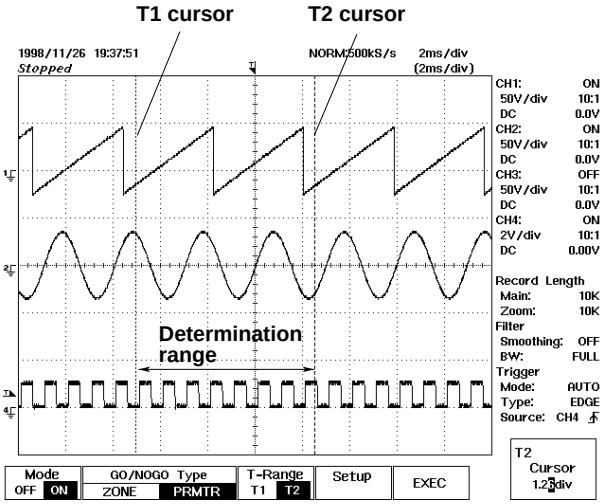


The parameters which can be selected/set at this setting consist of the following.

- Determination range (refer to page 9-8);
- Determination conditions, such as parameter setup, determination logic, sequence determination, and action after determination (refer to page 9-9, 9-10);
- Executing/aborting determination after setting/selecting the parameters. (refer to page 9-10).

Setting the determination range

4. After having pressed the "**T-Range**" soft key, select either "**T1**" or "**T2**" to set either boudary of the determination range. Then use the rotary knob to edit the boundary position. You may also use the **<** or **>** keys. Do this for both the left (T1) and right side boundary (T2).



Setting the determination conditions

Parameter setup

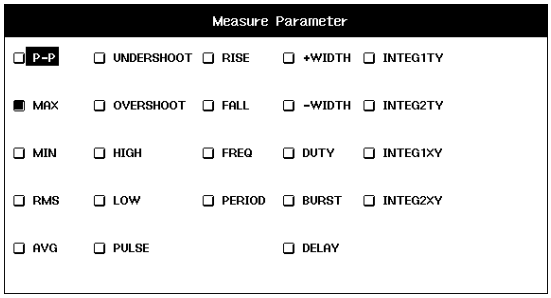
5. Press the "**Setup**" soft key of the GO/NO-GO top menu. The parameter menu will appear.

6. After having selected the "**Mode**" setting using the rotary knob, press the **SELECT key** to select "**ON**". Pressing the key once more results in selecting "**OFF**".

7. After having selected the "**Trace**" setting using the rotary knob, press the **SELECT key** to select the trace used for measurement. Selectable from "**1**" to "**4**".

8. After having selected the "**Item**" setting using the rotary knob, press the **SELECT key** to display the parameter setting screen.

9. Use the rotary knob to select the parameter of measurement. Press the **SELECT key**, the setting screen will disappear, and the setting will be shown at the "**Item**" setting.



10. After having selected the "**Upper**" setting using the rotary knob, press the **SHIFT + MISC (KEYBOARD key** to display the keyboard.

11. Use the keyboard to enter the desired value. For details concerning operation of the keyboard, refer to page 4-7.

12. After having selected the "**Lower**" setting using the rotary knob, press the **SHIFT + MISC (KEYBOARD key** to display the keyboard.

13. Use the keyboard to enter the desired value. For details concerning operation of the keyboard, refer to page 4-7.

14. After having selected the "**Condition**" setting using the rotary knob, press the **SELECT key** to select the condition setting. When the condition is met, "NO-GO" will result.

"OUT" : The value of the measurement parameter lies outside the values determined by the Upper and Lower values.

"IN" : The value of the measurement parameter lies inside the values determined by the Upper and Lower values.

15. Repeat steps 6 to 14 until the parameter setup has been completed.

Determination Logic

16. After having selected the "**Logic**" setting using the rotary knob, press the **SELECT key** to select the desired condition. When the condition is met, "NO-GO" will result.

"AND" : All determinations are "NO-GO";

"IN" : Any of the determination is "NO-GO".

Sequence determination

17. After having selected the "**Sequence**" setting on using the rotary knob, press the **SELECT key** to select the desired sequence. The following types can be selected.

"SINGLE" : Stops determination when a "NO-GO" determination is made;

"CONTINUE" : Carries out determination repeatedly until the "**ABORT**" soft key is pressed.

Setting action after determination

18. After having selected the "**Action**" setting using the rotary knob, press the **SELECT key** to select the desired action. After a "NO-GO" determination, the data can be recorded in the following manners.

"NONE" : No action;
"PRINT" : A hardcopy of the screen will be printed out on the built-in printer;
"FD(P-P)" : All waveforms displayed on the screen will be saved to the floppy disk as P-P compressed data;
"FD(ACQ)" : Acquisition data of all waveforms displayed on the screen will be saved to the floppy disk as binary data.
"Buzzer" : Sounds the buzzer.
"FD(IMAGE)" : Saves the current screen image data to the floppy disk.
"SCSI(IMAGE)"*1 : Saves the current screen image data to the SCSI device.
"SCSI(P-P)"*1 : Saves the entire displayed waveform (P-P compressed data) to the SCSI device.
"SCSI(ACQ)"*1 : Saves the acquisition data (binary data) of the entire displayed waveform to the SCSI device.
"HD(IMAGE)"*2 : Saves the current screen image data to the internal hard disk.
"HD(P-P)"*2 : Saves all the displayed waveforms (as P-P compressed data) to the internal hard disk.
"HD(ACQ)"*2 : Saves all the displayed acquisition data (binary data) to the internal hard disk.

*1 You need to be using a model with the internal hard disk (DL1540CL /C8 option) or the SCSI interface unit 700930 (sold separately).
*2 Selectable only on models with the internal hard disk (DL1540CL /C8 option).

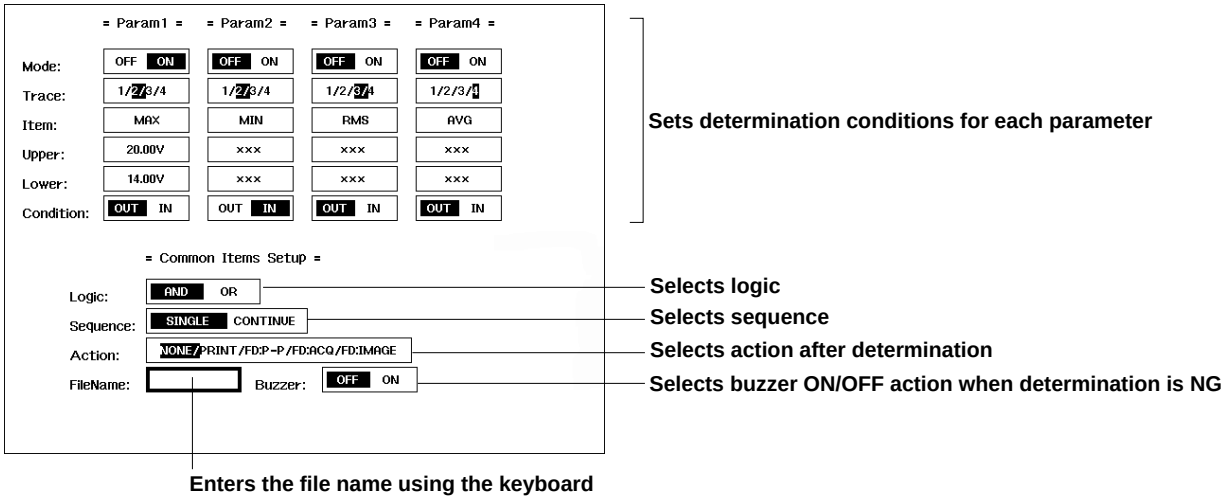
19. After having selected either "**FD(P-P)**" or "**FD(ACQ)**", move to the "**FileName**"setting and press the **SELECT key**. The keyboard will be displayed. After having selected either "**NONE**" or "**PRINT**", continue with step 21.

20. Use the keyboard to enter the name of the file. The entered filename will be displayed at the "**FileName**"setting. For details how to operate the keyboard, refer to page 4-8.

21. After having selected the "**Buzzer**" setting using the rotary knob, press the **SELECT key** to select ON/OFF action. In case of "ON", the buzzer sounds after "NO-GO" determination.

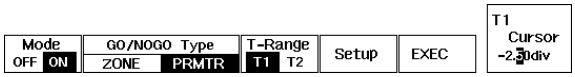
Returning to the top menu

22. Return to the GO/NO-GO top menu by pressing the **ESC key**.



Executing the determination function

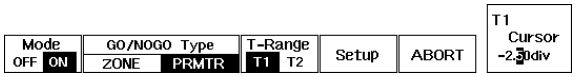
23. Press the "**EXEC**" soft key. The name of the soft key will change to "**ABORT**".



For the display which appears during measurement, refer to page 9-5.

Aborting the determination function

24. Press the "**ABORT**" soft key. The name of the soft key will change to "**EXEC**".



Explanation

Selecting the waveforms to be judged

Input signal waveforms which are displayed as trace Nos. 1 to 4 can be judged. Computed waveforms can also be judged. Acquisition-memory data is not available.

Setting the determination range: T-Range

The range of determination is set by the two cursors T1 and T2. The setting lies within –5.00 div at the left side to +5.00 div at the right side measured from the center of the display.

Note that this range is different from the one used for automated measurements.

Selecting waveform parameters and setting the range: Item, Upper, Lower

Up to four waveform parameters can be selected from the following items. If you do not know the upper-limit or lower-limit, set the +side of the setting range, or (when the keyboard shows this settings) select "**NAN**" (Ignore). In the latter case, the display will show "**XXX**" at the corresponding setting.

For the meaning of each item, refer to page 8-12.

Each parameter can be set within the range given in the table below.

Measurement item	Upper-/lower-limit setting range	Setting step
Max, Min, High, Low P-P, AVG, RMS	± 8 div	0.04 div
+Overshoot, -Overshoot	0 to 200 %	1 %
+Duty, -Duty	0 to 100 %	1 %
Freq *	0.02 to 10 div	–
Period, Rise, Fall +Width, -Width	0 to 10 div	0.01 div
Delay , Delay	–10 to 10 div	0.01 div
INTEG1TY, INTEG2TY INTEG1XY, INTEG2XY	$\pm 3.4 \times 10^{38}$	–

* The setting step is not constant since the frequency is the reciprocal of the period.

Specifying a file name when "FD(P-P)," "FD(ACQ)," "FD(IMAGE)," "SCSI(P-P)," "SCSI(ACQ)," "SCSI(IMAGE)," "HD(P-P)," "HD(ACQ)," or "HD(IMAGE)" has been selected as the trigger action

- **Specifying the file name: File Name**

  A file No. (starting from "0001") is assigned to each waveform data automatically when the data is saved on a floppy disk, a SCSI device, or the internal hard disk. It is possible to insert a common file name (character string consisting of up to four characters) before the assigned file number (for instance "NOGO0001").

  The entered file name will be reset when the action becomes "NONE" or when GO/NOGO determination is set to "OFF".

  The file name will not be reset if the GO/NOGO determination is executed/ aborted using EXEC and ABORT soft keys.

  When saving the screen image data, set the image data format. You can set the format at the hard copy selection menu that appears by pressing the SHIFT+COPY(MENU) key (see page 12-11).

Example of data format

In case of NO-GO determination, the measurement values will appear. For the other contents, refer to page 9-6.

JudgeCnt	NoGoCnt	Date	Time	Param1(T1/P-P)	Param2(T2/Max)	· · ·
3	1	95/03/03	10:10:10	Go	2.000e+02V	· · ·
5	2	95/03/03	10:10:12	1.000e+02V	Go	· · ·
10	3	95/03/03	10:10:15	Go	1.500e+02V	· · ·
•	•	•	•	•	•	· · ·
•	•	•	•	•	•	· · ·
•	•	•	•	•	•	· · ·
•	•	•	•	•	•	· · ·
100	100	95/03/03	10:23:10	Go	1.950e+02V	· · ·

Forcing determination to stop

To force determination to stop, press the “ABORT” soft key or set “Mode” (at the GO/NO-GO top menu) to “OFF”.

Points to note relating to parameter determination

- Trigger mode is automatically switched to single mode irrespective of the selected trigger mode during GO/NO-GO determination. However, determination will be repeated if the determination sequence has been set to “CONTINUE”. Even in case the GO/NO-GO mode (at the GO/NO-GO top menu) is changed to OFF again, the setting at the trigger mode selection will not become valid again.
- While both pre-zoom waveform and its expanded waveform are displayed at the same time, the expanded waveform will become the object of determination.
- The following operations are not possible after having pressed the “EXEC” soft key. In order to perform these operations, it is necessary to set “Mode” (at the GO/NO-GO top menu) to “OFF”, after having pressed the “ABORT” soft key.
  - Initialization of the settings
  - Auto set-up
  - Cursor measurements
  - Action-on trigger
  - Automated measurements
  - Changing of expansion settings
  - Display of an X-Y waveform
- During an action is being executed after GO/NO-GO determination, no waveform data will be acquired.
- In case the linear scaling function has been set to ON, you can enter linear scaled values at the GO/NO-GO parameter setting menu.
- Only waveforms displayed on screen are available for judgment. Acquisition-memory data is not available.

9.3 Using the GO/NO-GO Signal Output Function

Output Signal

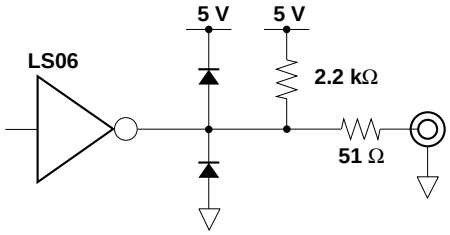
NO-GO OUT signal

The output signal level (TTL level) changes from high to low (L) temporarily when a "NO-GO" determination is made.

GO OUT signal

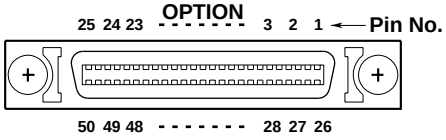
The output signal level (TTL level) changes from high to low (L) temporarily when a "GO" determination is made.

Signal output circuit diagram



Output Connector

Pin configuration



Pin No.	Signal name
1	NO-GO OUT
2	GND
26	GO OUT
27	GND

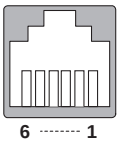
* Only use pin No. 1, 2, 26, and 27. Other pins are used for other communication purposes.

For DL1540CL models with the /C8 option

The output connector on DL1540CL with the /C8 option is as follows:

- **Format**
  The connector uses a modular jack (RJ11). 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.
- **Pin arrangement**

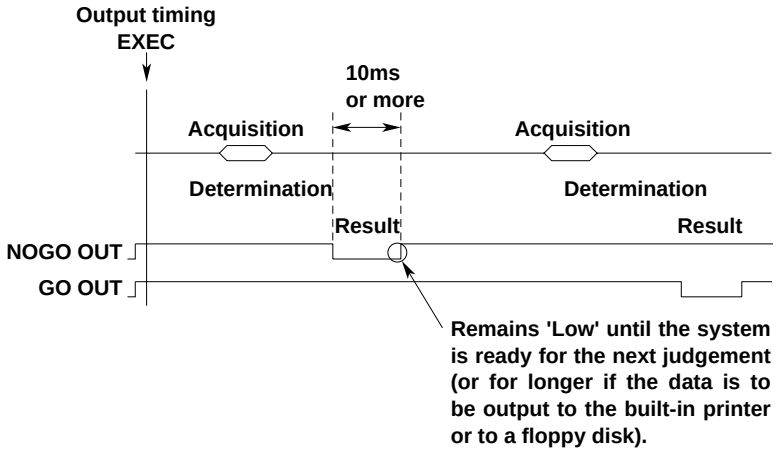
GO/NO-GO



DL side connector

Pin No.	Signal Name	Logic
1	NC (no connection)	
2	NC (no connection)	
3	GO OUT	Negative logic
4	NOGO OUT	Negative logic
5	GND	
6	NC (no connection)	

Output Timing



Connecting to Another Instrument

CAUTION

- **Never apply an external voltage to the NO-GO OUT and GO OUT terminals, otherwise damage to the instrument may result.**
- **When connecting the GO/NO-GO signal output externally, make sure not to connect other signal pins by mistake. Errors in connection may cause damage to this instrument or to the other connected instrument.**

For models other than the DL1540CL with the /C8 option

Use the dedicated half-pitch interface cable (B9920TA) to connect each terminal to the terminals of another instrument.

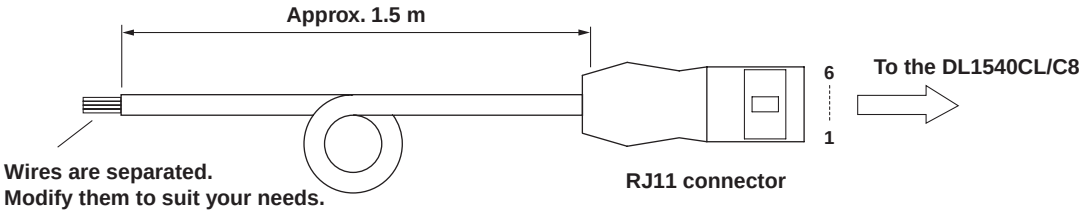
A DC voltage of 5 V is always present on the output terminals. Thus, take care when you connect to another instrument or when you touch the “NO-GO OUT” terminal.

For DL1540CL models with the /C8 option

To connect the DL1540CL to external equipment, use the GO/NOGO cable (366973, sold separately).

Do not use the GO/NOGO cable (366973, sold separately) for any other purpose than for carrying out GO/NO-GO determination on the DL1540CL model with the /C8 option.

- **About the GO/NOGO cable (366973, sold separately)**



Color	Pin No.	Signal Name	Logic
White	3	GO OUT	Negative
Green	4	NOGO OUT	Negative
Blue	5	GND	

10.1 Loading a Chart in the Optional Built-in Printer

Printer Roll Charts

Use only YOKOGAWA's roll charts (the same type as the one supplied with the instrument) with the built-in printer.

When Roll Charts have Run out

When your roll charts have run out, purchase more from your dealer or YOKOGAWA sales representatives as listed on the back cover of this manual. Price information can be obtained from them.

Part No. : B9850NX
Specification : Thermo-sensible, 30 m
Minimum quantity : 5 rolls

Handling the Roll Chart

Thermo-sensible roll charts generate color using a thermal reaction, therefore the following precautions must be taken.

Storage precautions

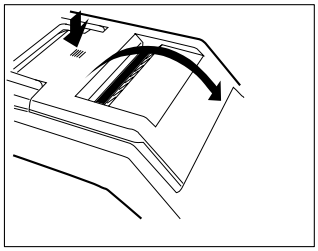
The roll chart begins to develop color at approximately 70 °C. It is very sensitive to heat, damp, light and chemicals both before and after use.

- Keep roll charts in a dry, cool and dark place.
- Once the package is opened, use the roll chart as soon as possible.
- If the roll chart is left in contact with plastic films containing plasticizer (for instance, vinyl chloride film, cellophane tape etc.) for a long period of time, discoloration will occur on the recording area of the chart due to the plasticizer. If you are going to keep the roll chart in a holder, for instance, use a polypropylene holder.
- When you use adhesive on the roll chart, never use adhesive which contains an organic solvent such as alcohol or ether, otherwise color may develop on the chart.
- When you are going to store recorded roll charts for a long period of time, we suggest you make a copy of the charts since discoloration of the originals may occur.

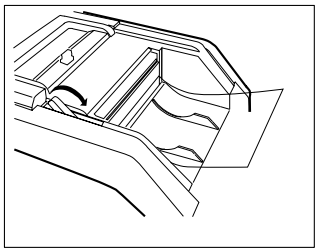
Usage precautions

- Use only YOKOGAWA's genuine roll charts.
- Do not touch the roll chart with sweaty hands.
- Do not rub the surface of the roll chart hard with a solid object: color development may occur due to frictional heat.
- Do not allow chemicals or oil to come into contact with the roll chart, otherwise color development or loss of information may result.
- The chart paper might show some discoloration due to friction after the instrument is moved with the roll paper installed. Therefore it is recommended to remove and re-install the chart paper before moving.

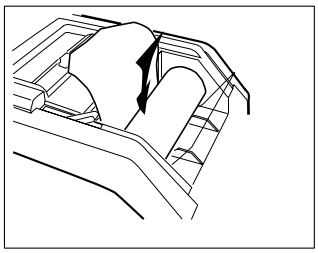
Loading Procedure



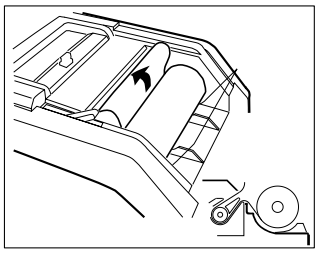
Push the printer cover firmly at the point of the push mark.
The cover springs open, allowing you to open it.



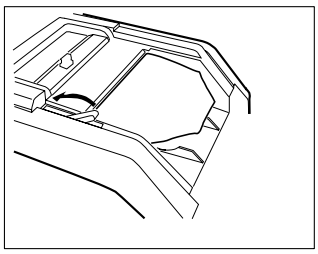
There is a release arm located at the upper right side. Viewing it from the angle as in the figure, move it from left to right.



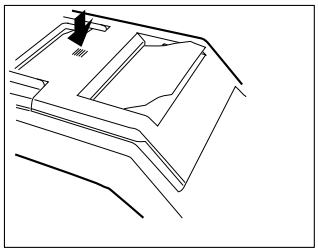
Hold the chart so that the end of the chart faces away from you, and then place the roll in the provided space, as shown in the figure.



Insert the end of the roll into the gap beneath the black guides so that the chart protrudes approximately 10 cm from above the guides. The paper can be inserted easily after cutting off both corners of the end of the paper.



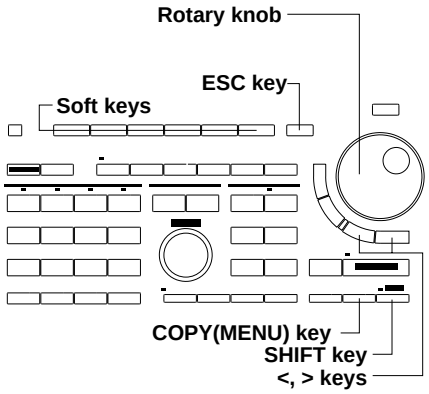
Rotate the chart to make sure that it is properly aligned and stretched out, then secure the chart paper by sliding the release arm back into its old position.
If the release arm is not put back in its old position, an error message will be displayed when printing is performed.



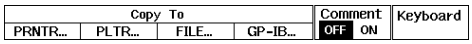
Half close the printer cover, insert the end of the chart through the paper slot in the cover, and then close it.
Push the cover firmly at the point marked until it clicks into place.

10.2 Printing Waveforms and Additional Information using the Optional Built-in Printer

Keys and Procedure



1. Press the **SHIFT + COPY (MENU) key** to display the hardcopy setting menu.
2. Press the "**PRNTER**" soft key to display the printout type selection menu.

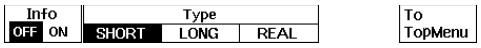


Selecting additional information

3. Press the "**Info**" soft key to select "**OFF**" or "**ON**".

Selecting the type of printout

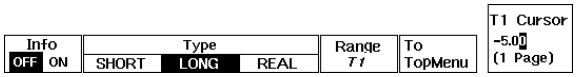
4. Select from "**SHORT**", "**LONG**" or "**REAL**". If "**SHORT**" is selected, read chapter 11; If "REAL" is selected, refer to page 10-6.



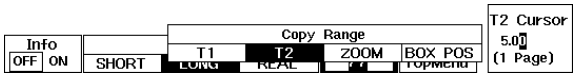
Long copy

Setting the printing range

5. Press the "**LONG**" soft key and the "**Range**" soft key will appear. The display will automatically show the pre-zoom and expanded waveform.

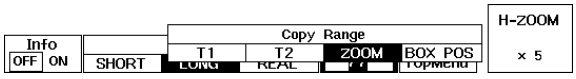


6. Press the "**Range**" soft key to display the printing range setting menu.
7. After having pressed either the "**T1**" or "**T2**" soft keys, use the rotary knob to adjust the position of the cursor. You can also use the **<** or **>** keys. The position of cursor T1 indicates the starting point of printing, and the position point of cursor T2 indicates the end point of printing.



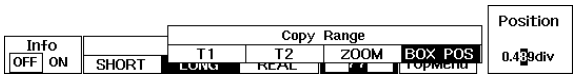
Setting the zoom value

8. After having pressed the "**ZOOM**" soft key, use the rotary knob to adjust the zoom value.



Verifying the waveform to be printed

9. Press the "**BOX POS**" soft key to move the zoom box to the desired printing range. This allows you to verify which part of the waveform will be printed.



10. Press the **ESC key** to close the printing range setting menu.

Outputting to the printer

11. Press the **COPY key** to execute the printing.

Aborting the printing

12. After having performed step 11, press the **COPY key** again to abort the printing.

Explanation

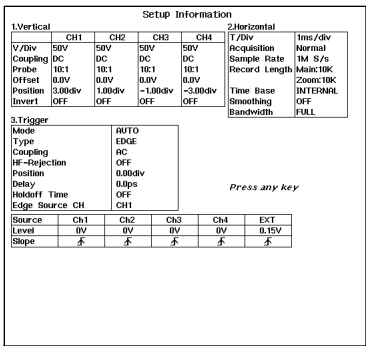
Contents of hardcopy

- Displayed waveforms;
- Ground display (such as graticule, measured values);
- Menu;
- Setting information such as filter, offset, display record length and trigger settings (only in case printing type is set to “SHORT”).

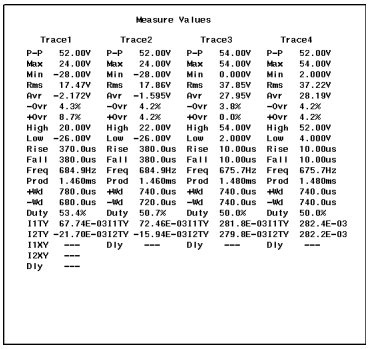
Additional information: Addition Info

The following additional information (setup and waveform parameters) can also be output. To output the hardcopy only, select “OFF”.

Setup Information



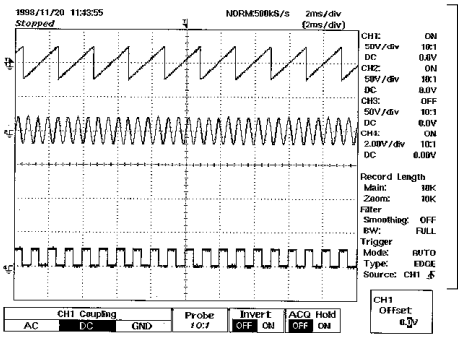
Measurement Values of Waveform Parameters



Setting the printing type

SHORT (short copy)

Select this type of output if you want to printout an exact copy of the screen. It looks as the figure below.

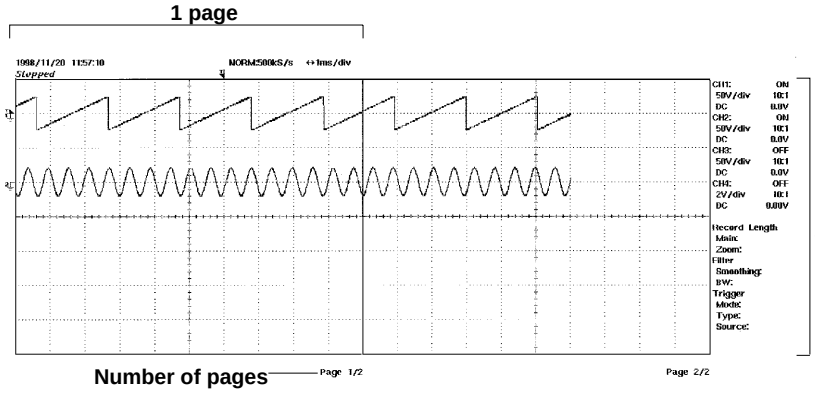


Printout of chanel infomation, record lengths, filter settings and trigger settings

LONG (long copy)

Select this type of output if you want to printout normal waveforms on screen as expanded waveforms. The following settings must be made.

- Setting the printing range; Sets from where to where printing will be done. 10div of the time axis will be printed on one page. A printout page will always be filled up to 10div, and therefore more of the waveform might be printed than specified by the printing range.
- Setting the expansion rate; For setting limits and expansion rate, refer to page x.x This setting is not necessary if expanded waveforms have already been displayed before the hardcopy output setting menu is displayed and you do not want to change the expansion rate.



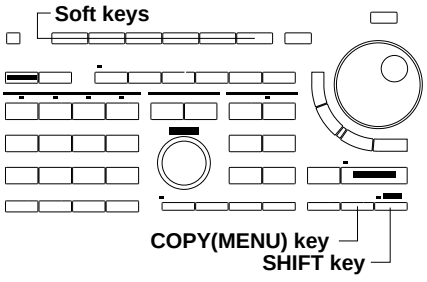
After having selected the long copy and having closed the hard copy setting menu, the display will still be according to the MainZoom display mode. To display normal waveforms only, press the ZOOM key and select OFF or MAIN.

Note

The printer density can be adjusted. For more details, refer to page 14-4.

10.3 Real-time Printing using the Optional Built-in Printer

Keys and Procedure



1. Press the **SHIFT + COPY (MENU) key** to display the hardcopy setting menu.

Copy To				Comment	Keyboard
PRNTR...	PLTR...	FILE...	GP-IB...	OFF ON	

2. Press the "**PRNTR**" soft key to display the printout type selection menu.
3. Press the "**REAL**" soft key.

Info	Type			To
OFF ON	SHORT	LONG	REAL	TopMenu

Outputting to the printer

4. Press the **COPY key** to execute the printing.

Aborting the printing

5. After having performed step 4, press the **COPY key** again to abort the printing.

Explanation

Chart speed

The chart speed depends on the time axis setting as shown in the table below.

Time axis setting	Chart Speed
500 ms/div	16.67 mm/s
1 s/div	8.33 mm/s
2 s/div	4.17 mm/s
5 s/div	1.67 mm/s
10 s/div	0.83 mm/s
20 s/div	0.42 mm/s
50 s/div	0.17 mm/s

Points to note when printing real-time

Before carrying out real-time printing, verify the following settings.

- The trigger mode should be set to Auto mode or Auto Level mode;
- The history memory function should be set to OFF;
- The time base should be selected INT;
- For DL1540L, the record length must be set to 10 K or 100 K.
- The time axis setting should lie within 500 ms/div to 50 s/div;
- Waveform acquisition should be started.

During real-time printing, only the execution/abortion operations are valid.

During real-time printing, the cursor measurements and waveform parameter measurements will be halted.

When you press the START/STOP key during real time printing, data acquisition will stop and therefore real-time printing will also stop. Pressing the START/STOP key again results in resuming data acquisition and therefore real-time printing.

Real-time printing is not possible during ZOOM/MainZoom display, X-Y display or when loaded/recalled waveforms are being displayed.

10.4 Connecting an External Plotter

Compatible Plotters

Any plotter which accepts HP-GL commands can be used.
However, the plotting range varies according to the model, causing loss of output data on some plots.

Communications Settings

This instrument

Initiating output to the plotter will switch this instrument to talk-only mode automatically.

Plotter

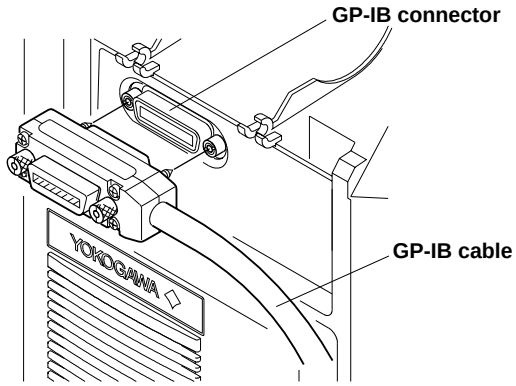
Set the plotter to listen-only mode.

Note

- For a description of the GP-IB interface, refer to the “Communication Interface User’s Manual” (IM 701530-11E).

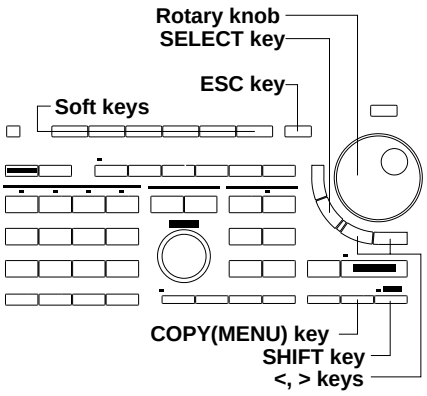
Connecting Procedure

1. Turn OFF the power to both the instrument and the plotter.
2. Connect the plotter to the instrument using the GP-IB cable.
   After the plotter is connected, tighten the screws firmly.

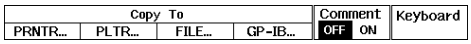


10.5 Printing Displayed Waveforms and Additional Information using an External Plotter

Keys and Procedure



1. Press the **SHIFT + COPY (MENU) key** to display the hardcopy setting menu.
2. Press the "**PLTR...**" soft key.



3. Press the "**Setup**" soft key to display the plotter setup menu.

Selecting the paper size

4. After having selected the "**Paper Size**" setting using the rotary knob, press the the **SELECT key** to select the desired paper size.

Selecting the pen speed

5. After having selected the "**Pen Speed**" setting using the rotary knob, press the the **SELECT key** to select from "**NORMAL**" or "**SLOW**".

Selecting the XY Mode

6. After having selected the "**XY Mode**" setting using the rotary knob, press the the **SELECT key** to select from "**DOT**" or "**LINE**".

Assigning pens

7. After having selected the "**Pen Mode**" setting using the rotary knob, press the the **SELECT key** to select from "**AUTO**" or "**MANUAL**".

In case of AUTO

8. After having selected "**AUTO**", and after having selected the "**Auto Pen**" setting using the rotary knob, press the **SELECT key** to display the setting frame.
9. Use the rotary knob to set the number of pens. Press the **RESET key** to return the default value. Continue with step 10.

In case of MANUAL

8. After having selected "**MANUAL**", use the rotary knob and the **SELECT key** to set the "**Grid Pen**" setting, the "**TRACE1 Pen - TRACE4 Pen**" setting and the "**LOAD1 Pen - LOAD4 Pen**" setting.
9. Use the rotary knob to set the pen numbers. Press the **RESET key** to return the default value.

Closing the plotter setup menu

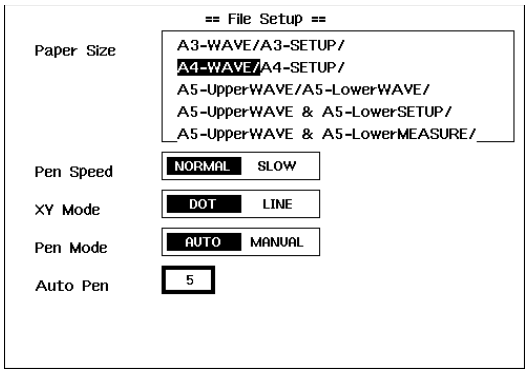
10. Press the **SELECT key** or the **ESC key** to close the setting frame.
11. Press the **ESC key** to close the setting menu.

Outputting to the external plotter

12. Press the **COPY key**.

Aborting the printing

13. After having performed step 12, press the **COPY key** again to abort the printing.



Explanation

Selecting the paper size

The contents of printing, printing size and printing location can be selected from the following eight types. However, only one type of output can be selected at a time. “A5-Upper WAVE” and “A5-Lower WAVE” allow output of two A5-sized screens of information on a sheet of A4 paper.

Setting	Output item	Output size	Output location
A3-WAVE	Screen hardcopy	A3	Middle
A3-SETUP	Set-up parameters	A3	Middle
A4-WAVE	Screen hardcopy	A4	Middle
A4-SETUP	Set-up parameters	A4	Middle
A5-Upper WAVE	Screen hardcopy	A5	Upper half
A5-Lower WAVE	Screen hardcopy	A5	Lower half
A5-Upper WAVE &	Screen hardcopy	A5	Upper half
A5-Lower SETUP	Set-up parameters	A5	Lower half
A5-Upper WAVE &	Screen hardcopy	A5	Upper half
A5-Lower MEASURE	waveform measurement data	A5	Lower half

Selecting the pen speed

The pen speed can be selected from the following two speeds.

NORM Plots at the default speed setting.

SLOW Plots at a speed of 10 cm/s.

Selecting the pen assignment method: Pen Mode

The pens can be assigned according to the following two methods.

AUTO Assigns pens automatically, as shown in the table below, according to the number of pens.

Number of installed pens	GRID	TRACE				LOAD			
		1	2	3	4	1	2	3	4
1	1	1	1	1	1	1	1	1	1
2	1	2	1	1	2	2	1	1	2
3	1	2	3	1	2	2	3	1	2
4	1	2	3	4	1	2	3	4	1
5	1	2	3	4	5	2	3	4	5

MANUAL A particular pen can be assigned to the graticule, to TRACE1 to 4 and to LOAD 1 to 4. The pen numbers that can be assigned are 0 to 12. If “0” is selected, no plotting is performed for the corresponding item.

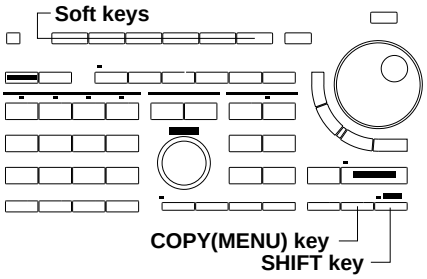
Assignment of pens to the grid, trace and load

The grid, TRACE1 to TRACE4 and LOAD 1 to LOAD4 can have pens assigned to them as follows.

Setting	Assignment for hardcopy
Grid setup	Graticule, all cursors, trigger position mark, date and time, comments, information list, measurement values
TRACE1	Trace1 waveform, ground level, trigger level mark, voltage axis conditions, input coupling, probe attenuation
TRACE2 to 4 LOAD1 to 4	Same as Trace1

10.6 Entering a Comment

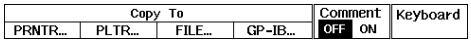
Keys and Procedure



1. Press the **SHIFT + COPY (MENU) key** to display the hardcopy setting menu.

Entering comments

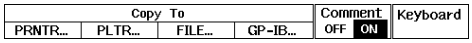
2. Press the "**Keyboard**" soft key to display the keyboard.



3. Use the keyboard to enter the comment. For details regarding the usage of the keyboard, refer to page x.x.

Displaying comments

4. Press the "**Comment**" soft key to select "**ON**". Pressing the soft key once again results in "**OFF**".and therefore comments will not be displayed.



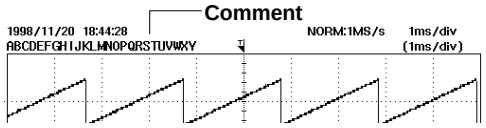
Explanation

Number of characters which can be entered

Up to 25 characters may be entered.

Displaying a comment

The comment will appear above the waveform display frame, as shown in the figure below.



Clearing the comment

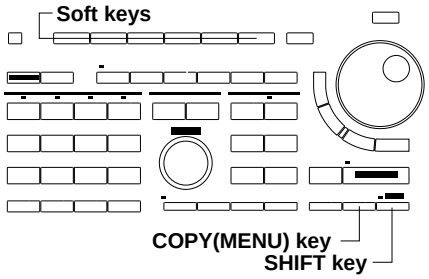
Press the "EXEC" soft key in the hardcopy setting menu or display another menu. The comment will be cleared.

Points to note when entering a comment

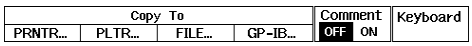
The displayed comment may overlap the messages which occur during waveform acquisition. When you want to display the comment in such a case, turn off data acquisition, and set the "Comment" setting on the hardcopy setting menu to "ON" once again.

10.7 Printing the Screen Image to an External Printer

Keys and Procedure



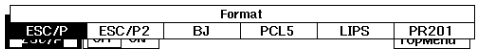
1. Press the **SHIFT + COPY (MENU)** key to display the hardcopy setting menu.
2. Press the "**GP-IB**" soft key to display the external output setting menu.



Selecting the external printer

3. After step 2 has been completed, press the "**Format**" soft key to display the external printer selection menu.

4. Press the soft key corresponding to the external printer to be selected.



Selecting the resolution

5. If you selected "**BJ**" in step 4, press the "**Resolution**" soft key to display the resolution selection menu.
6. Press the "**180dpi**," "**300dpi**," or "**360dpi**" soft key.

Selecting the print type

7. After step 2 has been completed, press the "**Color**" soft key to select "**OFF**" or "**ON**".

Outputting to the external printer

8. Press the **COPY key**.

Aborting the printing

9. After having performed step6, press the **COPY key** again to abort the printing.

Explanation

Centronics interface

Centronics interface is a typical interface used to transfer print data and is employed in many printers. DL1540C/DL1540CL can print screen image to a printer which supports the following print formats. If you need the information of the GP-IB/Centronics converter, contact your nearest YOKOGAWA representative.

External printer type: Format

Select from ESC/P, ESC/P2, BJ, PCL5, LIPS or PR201.

Print type

Select from the following.

ON : Print using the same colors as the screen (except grid, scale, etc. are in black and no background)

OFF : Prints just like the "SHORT (short copy)" printing type described on page 10-4.

Points to note when printing the screen image to an external printer

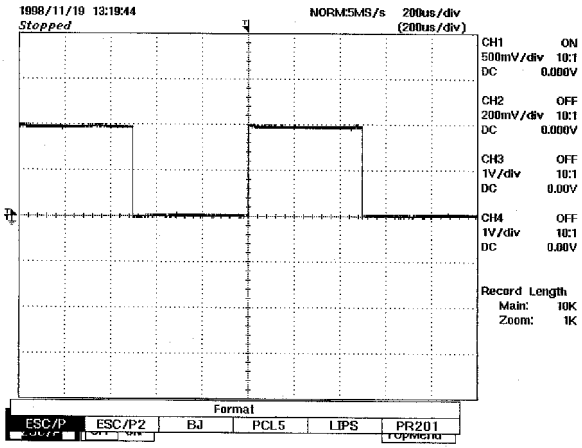
- With some printers, the screen image cannot be printed properly. If this problem continues to occur, even when the printer has been adjusted, contact the printer's manufacturer.
- It is possible to print the screen image to a printer connected to a personal computer. Save the screen image data to a floppy disk as described in Section 12.5, "Saving Screen Image Data", then open the data using the computer and print it.

Note

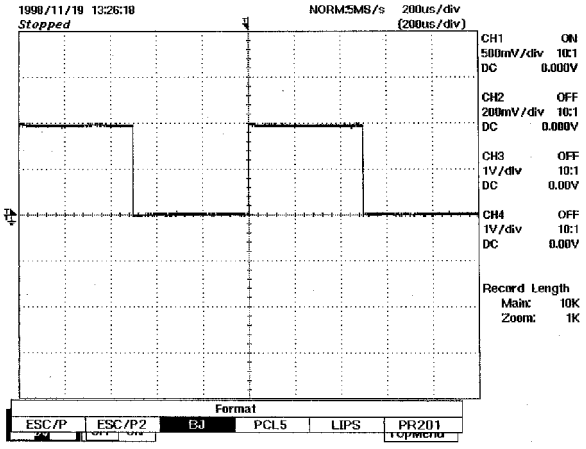
DL1540C/DL1540CL doesn't be recognizable errors (example, the chart end) of external printer. In case of occuring the errors, if DL1540C/DL1540CL is executed to output to the external printer, aborting the printing by pressing the COPY key.

Print example

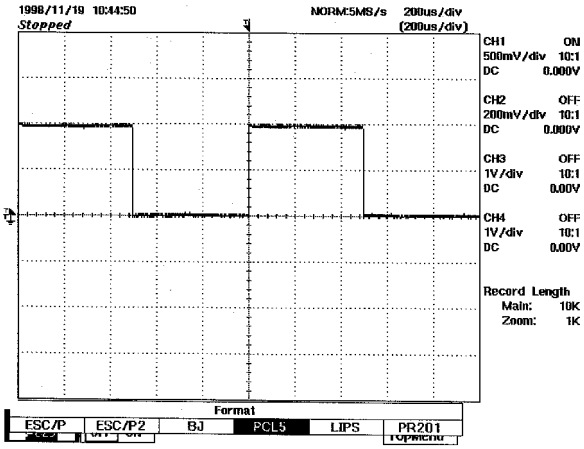
- **ESC/P: Printed by Canon Buble Jet BJC-440J**



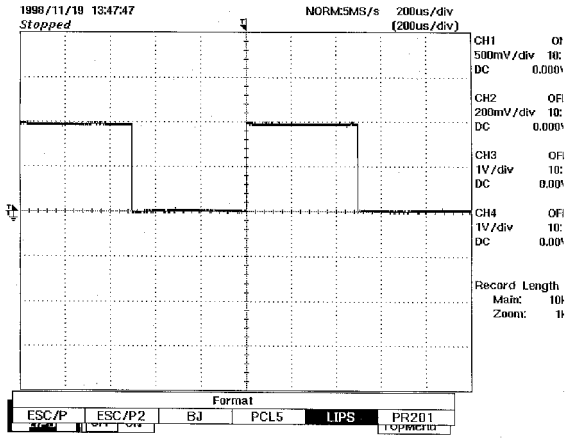
- **BJ: Printed by Canon Bubble Jet BJC-440J**



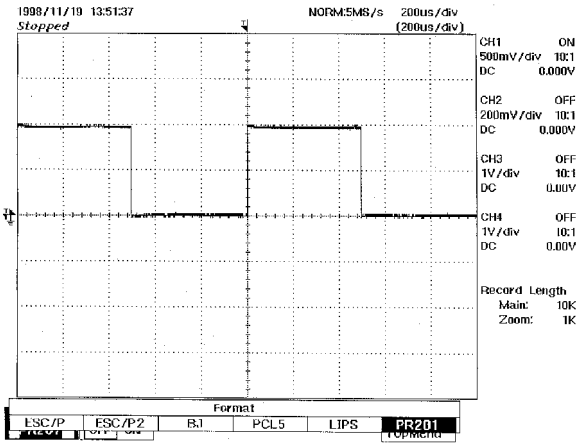
- **PCL5: Printed by HEWLETT PACKARD Desk Jet 880C**



- **LIPS: Printed by Canon Laser Shot A404F**

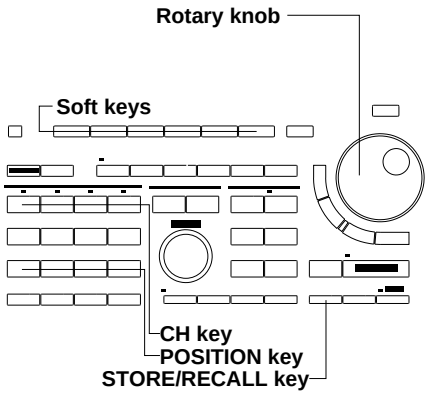


- **PR201: Printed by Canon Laser Shot A404F**



11.1 Storing and Recalling Displayed Waveforms

Keys and Procedure



1. Press the **STORE/RECALL key** to display the data type selection menu.
2. Press the "**Wave**" soft key to display the store/recall setting menu.

Data Type	
WAVE...	SETUP...

Storing a waveform

3. Press the "**STORE**" soft key to display the waveform store setting menu. The default setting is "**STORE**".

Function(WAVE)		Source	Destn	EXEC	To
STORE	RECALL	TRACE1	MEM #1		TopMenu

4. Press the "**Source**" soft key to display the source selection menu.
5. Press the soft key corresponding to the trace No. to be stored.

		Source			
Function(	TRACE1	TRACE2	TRACE3	TRACE4	To
STORE	RECALL				TopMenu

6. Press the "**Destn**" soft key to display the memory selection menu.
7. Press the soft key corresponding to the memory in which the waveform is to be stored.

	Destination				
Function(WAVE)	MEM #1	MEM #2	MEM #3	MEM #4	
STORE RECALL					

8. Press the "**EXEC**" soft key to execute waveform storing.

Recalling a waveform

3. After step 2 has been completed, press the "**RECALL**" soft key to display the waveform recalling menu.

Function(WAVE)		Source	Destn	EXEC	To
STORE	RECALL	MEM #1	LOAD1		TopMenu

4. Press the "**Source**" soft key to display the recall memory selection menu.
5. Press the soft key corresponding to the memory No. from which the waveform is to be recalled.

		Source			
Function(	MEM #1	MEM #2	MEM #3	MEM #4	To
STORE	RECALL				TopMenu

6. Press the "**Destn**" soft key to display the trace No. selection menu.
7. Press the soft key corresponding to the trace No. to be recalled.

	Destination				
Function(WAVE)	LOAD1	LOAD2	LOAD3	LOAD4	
STORE RECALL					

8. Press the "**EXEC**" soft key to execute waveform recalling.

Function(WAVE)		Source	Destn	EXEC	To
STORE	RECALL	MEM #1	LOAD1		TopMenu

Moving a recalled waveform

9. Press the **POSITION key** of the channel corresponding to the number of the recalled waveform. The vertical position setting menu appears.
10. Press the "**Knob**" soft key to select "**MEM**".
11. Press the soft key corresponding to the desired position.
12. Use the rotary knob to fine adjust the position.

Position To					Knob	LOAD1 Position 0.0div
-3div	-1div	0div	+1div	+3div	CH MEM	

Canceling the display of the recalled waveform

13. Press the **CH key** of the channel corresponding to the number of the recalled waveform. The recall waveform ON/OFF menu appears. Note that by alternately pressing the **CH key** the acquisition waveform also (dis)appears.

14. Press the "**MEM**" soft key to select "**OFF**" and the recalled waveform will be canceled. Selecting "**ON**" results in displaying the recalled waveform.

Explanation

Selecting the waveform to be stored: Source

The waveform to be stored can be selected from any displayed waveform (either input signal waveforms or computed waveforms) at Trace 1 to 4. X-Y waveforms cannot be stored.

Selecting the destination memory: Destn

The destination memory can be selected from the four internal memories "MEM #1" to "MEM #4". Be aware that when storing the data, previous data will be overwritten and thus lost.

Selecting the waveform to be recalled: Source

Waveforms can be recalled from the internal memories "MEM #1" to "MEM #4".

Selecting the display destination for recalled waveforms: Destn

Waveforms destination can be selected from the four traces "LOAD1" to "LOAD4" . The waveforms will be displayed at the 0div location on the voltage axis.

Moving waveforms

You can move the position of input signal waveforms and recalled waveforms seperately. When displaying recalled waveforms, press the POSITION key corresponding to the recalled waveform and select which waveform (either the input signal or the recalled one) should be moved.
When you want to move the input signal waveform, press the "Knob" soft key and select "CH".
When you want to move the recalled waveform, press the "Knob" soft key and select "MEM".

Restrictions on the recalled waveforms

It is not possible to change either the voltage axis or the time axis sensitivity of the recalled waveforms. The conditions when the waveform was stored, are kept.
It is also not possible to perform computation and expansion on the recalled waveforms.
However, it is possible to move the recalled waveforms using the POSITION key and to perform cursor measurements and waveform parameter measurements.

Points to note when storing and recalling

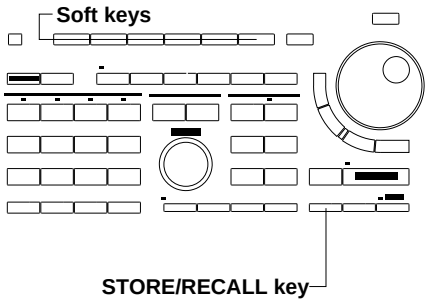
- The waveform that is stored is the P-P data displayed on the screen, not the acquisition data.
- Waveform data located within ±5.12 div of the center of the waveform display frame is stored. Thus, if the stored waveform exceeds this range vertically, the part exceeding the range will not be displayed if the waveform is recalled and moved vertically.

Note

Initializing does not result in loss of stored waveforms.

11.2 Storing and Recalling Setting Parameters

Keys and Procedure



1. Press the **STORE/RECALL key** to display the data type selection menu.
2. Press the "**SETUP...**" soft key to display the store/recall setting menu.

Data Type	
WAVE...	SETUP...

Storing setting parameters

3. Press the "**STORE**" soft key to display the setting parameters storing menu. The default setting is "**STORE**".

Function(SETUP)		Destn		EXEC	To
STORE	RECALL	*MEM #1*			TopMenu

4. Press the "**Destn**" soft key to display the memory selection menu.
5. Press the soft key corresponding to the memory in which the setting parameters are to be stored.

Function(SETUP)		Destination			
STORE	RECALL	MEM #1	MEM #2	MEM #3	MEM #4

6. Press the "**EXEC**" soft key to execute storing.

Recalling setting parameters

3. After step 2 has been completed, press the "**RECALL**" soft key to display the setting parameters recalling menu.

Function(SETUP)		Source		EXEC	To
STORE	RECALL	*MEM #1*			TopMenu

4. Press the "**Source**" soft key to display the recall memory selection menu.
5. Press the soft key corresponding to the memory No. from which the setting parameters are to be recalled.

Function(SETUP)		Source			
STORE	RECALL	MEM #1	MEM #2	MEM #3	MEM #4

6. Press the "**EXEC**" soft key to execute recalling.

Function(SETUP)		Source		EXEC	To
STORE	RECALL	*MEM #1*			TopMenu

Explanation

Parameters that are stored

Settings made using the soft key menu and rotary knob as well as the acquisition START/STOP state and channel ON/OFF state are stored.

Selecting the destination memory: Destn

The destination memory can be selected from the four internal memories "MEM #1" to "MEM #4". Be aware that when storing the data, previous data will be overwritten and thus lost. Note that the internal memory where the waveforms are stored is a different memory.

Selecting the setting parameters to be recalled: Source

Setting parameters can only be recalled from the internal memories "MEM #1" to "MEM #4" in which setting parameters are present.

Note

Initializing does not result in loss of stored setting parameters.

12.1 Floppy Disks

Types of floppy Disk which can be used

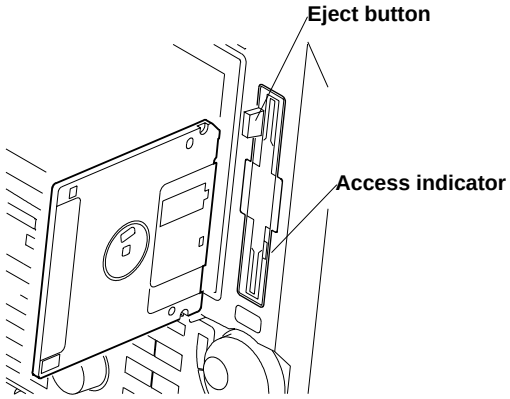
The following types of 3.5-inch floppy disks can be used. Floppy disks can also be formatted using this instrument.
2HD type : MS-DOS format, 1.2 MB or 1.44 MB
2DD type : MS-DOS format, 640 KB or 720 KB

Inserting a Floppy Disk into the Drive

Hold the floppy disk with the label facing up and the shuttered-side facing towards the drive, then insert it into the floppy drive. Insert it until the eject button pops up.

Removing the floppy disk from the drive

Make sure that the access indicator is not lit, then push the eject button.



CAUTION

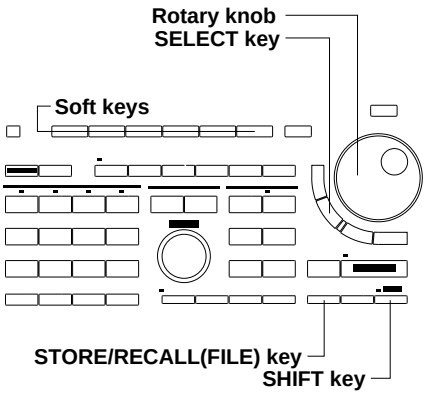
Never remove the floppy disk while the access indicator of the floppy disk drive is lit, or damage to the magnetic head of the drive or loss of data on the floppy disk may result.

General Handling Precautions

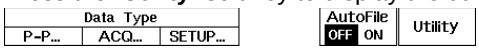
For general handling precautions, refer to the instructions supplied with the floppy disk.

12.2 Formatting a Floppy Disk

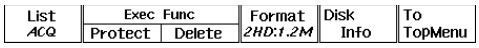
Keys and Procedure



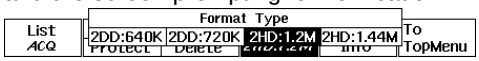
1. Press the **SHIFT + STORE/RECALL (FILE) key** to display the data save/load menu.
2. Press the "**Utility**" soft key to display the utility selection menu.



3. Press the "**Format**" soft key to display the format selection menu.



4. Press the soft key corresponding to the desired type of format and the screen prompting for verification will appear.

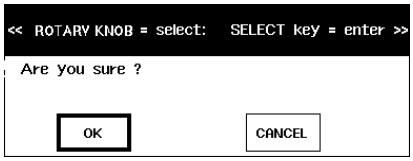


Formatting

5. After having selected "**OK**" using the rotary knob, press the **SELECT key**. When formatting is complete, the message "Execution completed" appears.

Canceling

5. After having selected "**CANCEL**" using the rotary knob, press the **SELECT key**.



Explanation

Formatting the floppy disk

The following four MS-DOS format types are available.

2DD:640K Formats a 2DD floppy disk with 8 sectors to hold 640 KB.
2DD:720K Formats a 2DD floppy disk with 9 sectors to hold 720 KB.
2HD:1.2M Formats a 2HD floppy disk with 8 sectors to hold 1.2 MB.
2HD:1.44M Formats a 2HD floppy disk with 18 sectors to hold 1.44 MB.

Checking the format

If the floppy disk has already been formatted, select "Disk Info" after step 2 (on the previous page) and the following information will be displayed. If the floppy disk has not been formatted, or if it has been formatted in a format other than one of the above, the error message "Storage media is defective" will be displayed.

- Type of disk;
- Total disk space;
- Used disk space;
- Available on disk;
- Number of Setup data files;
- Number of P-P data files;
- Number of ACQ(bin) data files;
- Number of ACQ(ascii) data files;
- Number of Image data files.

Points to note concerning formatting

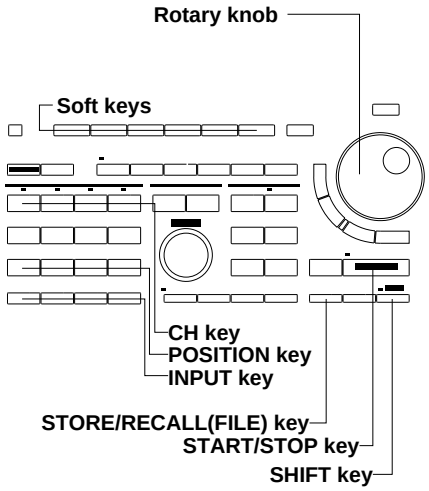
- The following three directories are created automatically when a floppy disk is formatted using this instrument.
  - **DL_WAVE** Directory for “BIN” (binary) waveform data
  - **DL_SETUP** Directory for “SETUP” (setting parameters)
  - **DL_MISC** Directory for “P-P” and “ASCII” waveform data, as well as “HP-GL”, “PS” (Postscript), “TIFF” and “BMP” screen image data
- Floppy disks formatted in a format other than those specified on the previous page cannot be used.
- If an error message appears when formatting has been completed, the floppy disk may be damaged.
- Formatting the floppy disk will erase all data on the disk. Be careful.

CAUTION

Never remove the floppy disk while the access indicator of the floppy disk drive is lit, or damage to the magnetic head of the drive or loss of data on the floppy disk may result.

12.3 Saving and Loading Waveform Data

Keys and Procedure



1. Press the **SHIFT + STORE/RECALL (FILE) key** to display the data save/load menu.

Turning ON/OFF the auto naming function

2. Press the "**AutoFile**" soft key to select "**ON**" or "**OFF**". For more details concerning this function, refer to the explanation later on.

Saving P-P waveform data

3. Press the "**P-P**" soft key to display the save/load setting menu and a list of files.

Data Type		
P-P...	ACQ...	SETUP...

AutoFile	
OFF ON	Utility

4. Press the "**SAVE**" soft key to display the saving menu.

5. Press the "**Source**" soft key to display the source waveform setting menu.

Function(P-P)		Source	FileName	EXEC	To
SAVE	LOAD	*TRACE1*			TopMenu

6. Press the soft key corresponding to the waveform to be saved.

	Source				
Function	TRACE1	TRACE2	TRACE3	TRACE4	ALL
SAVE	LOAD				TopMenu

7. Press the "**FileName**" soft key to display the keyboard.

8. Use the keyboard to enter the filename. For details regarding the usage of the keyboard, refer to page 4-8.

9. Press the "**EXEC**" soft key to start saving.

Function(P-P)		Source	FileName	EXEC	To
SAVE	LOAD	*TRACE1*	*ABC*		TopMenu

Loading P-P waveform data

10. Press the "**LOAD**" soft key to display the loading menu.

11. Press the "**Destn**" soft key to display the destination setting menu.

Function(P-P)		Destn	EXEC	To
SAVE	LOAD	*LOAD1*		TopMenu

12. Press the soft key corresponding to the destination of the waveform to be loaded.

	Destination			
Function(P-P)	LOAD1	LOAD2	LOAD3	LOAD4
SAVE LOAD				TopMenu

13. Use the rotary knob to select the file to be loaded.

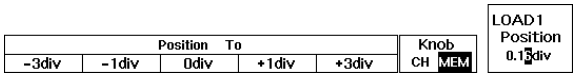
ABC	95/05/03 11:24:26
DEF	95/05/03 11:25:24
GHI	95/05/03 11:26:00
JKL	95/05/03 11:26:34
MNO	95/05/03 11:27:26

14. Press the "**EXEC**" soft key to start loading.

Function(P-P)		Destn	EXEC	To
SAVE	LOAD	*LOAD1*		TopMenu

Moving loaded P-P waveforms

15. Press the **POSITION key** of the channel corresponding to the number of the loaded waveform.
16. Press the "**Knob**" soft key to select "**MEM**".
17. Press the soft key corresponding to the desired position.
18. Use the rotary knob to fine adjust the position.



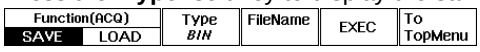
Canceling the display of the loaded waveform

19. Press the **CH key** of the channel corresponding to the number of the loaded waveform. The load ON/OFF menu appears. Note that by alternately pressing the **CH key** the acquisition waveform also (dis)appears.
20. Press the "**MEM**" soft key to select "**OFF**" and the loaded waveform will be canceled. Selecting "**ON**" results in displaying the loaded waveform.

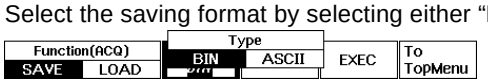
Saving ACQ waveform data

3. Press the "**ACQ...**" soft key to display the save/load setting menu and a list of files.

4. Press the "**SAVE**" soft key to display the saving menu.
5. Press the "**Type**" soft key to display the saving format menu.

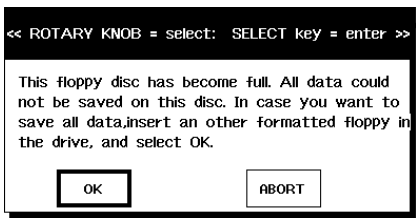


6. Select the saving format by selecting either "**BIN**" or "**ASCII**".



7. Press the "**FileName**" soft key to display the keyboard.
8. Use the keyboard to enter the filename. For details regarding the usage of the keyboard, refer to page 4-8.
9. Press the "**EXEC**" soft key to start saving.

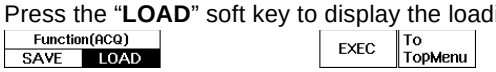
10. For DL1540CL, if waveform data is to large to fit on the floppy disk, the unit will display the message shown below when the disk becomes full. To continue the save: Insert another formatted disk into the drive, select "**OK**" with the rotary knob, and press the **SELECT key**. (The save will then continue on the new disk, under the same filename as on the previous disk.) If you want to terminate the save instead, select "**ABORT**" with the knob, then press **SELECT key**.



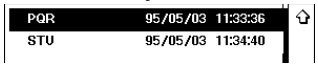
Loading ACQ waveform data

Note that only BIN data can be loaded.

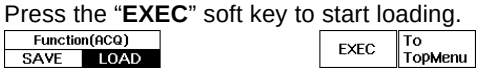
11. Press the "**LOAD**" soft key to display the loading menu.



12. Use the rotary knob to select the file to be loaded.



13. Press the "**EXEC**" soft key to start loading.



For DL1540L, if you have saved ACQ data to multiple floppy disks, you can opt to load all of this data or only part of it (for example, data from one disk only). If you do a partial load, the waveform display will not appear over the entire time axis, but only over a portion of it. If you want to display waveforms over the full span of the time axis, insert the floppy disk(s) with the remaining ACQ data and repeat Steps 11 to 13 as necessary (repeating the same filename at Step 5).

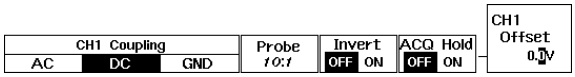
Moving loaded ACQ waveforms

14. The way to move these waveforms is exactly the same as for input signal waveforms. For details, refer to page 5-7.

Canceling/holding the display of the loaded waveform

15. Press the **INPUT key** of the channel corresponding to the number of the loaded waveform. The acquisition hold menu appears.

16. Press the "**ACQ Hold**" soft key to select "**OFF**". Then when you press the **START/STOP key** to start data acquisition, the loaded ACQ waveform will be canceled. When you select "**ON**", the loaded ACQ waveform will not be canceled, even when you start data acquisition. In this case, the channel display appears in the left upper side of the screen.



17. The way to display the ACQ waveforms and cancel them is exactly the same as for input signal waveforms. For details, refer to page 5-1.

Explanation

Auto naming function: AutoFile

If “AutoFile” has been set to “ON”, a number (3 digits, starting from “001”) will be assigned to the waveform data automatically when the data is saved. It is possible to insert a common file name (up to five characters) before the assigned number by specifying the file name using “FileName”.

Selecting the data format in which to save data: Data Type

The data format can be selected from the following.

P-P Converts the displayed waveform data (P-P compressed data) to binary data and saves it.

ACQ Converts the waveform data stored in the acquisition memory to either binary or ascii data and saves it.

BIN : Converts to binary data

ASCII : Converts to ascii data

Computed waveforms can only be saved in the P-P format.

When the trigger mode is in single (N) mode, displayed P-P data will be saved.

Saving the waveform data (ACQ) in ASCII data format while displaying the power spectrum (FFT), also saves the computed result of the power spectrum (FFT).

Selecting the waveform to be saved: Source

When P-P is selected as the data type, the waveform to be saved can be selected from the following. X-Y waveforms cannot be saved.

TRACE1 to 4 One of the input signal waveforms and computed waveforms displayed as trace Nos. 1 to 4 is output.

ALL TRACE All displayed waveforms are output.

When ACQ is selected as the data type, the waveforms to be saved are the input signal waveforms displayed as trace.

About the saved data

For a description of the format of the data to be saved, refer to Appendix 5 “Output Data Format used When Saving Waveform Data” (App-12).

Data is saved in the directory which corresponds to the data’s format type, with one of the following extensions added. The directory is created automatically when the floppy disk is formatted by the instrument or when data is saved.

Data format	Directory name	Extension
P-P	DL_MISC	.WVF
ACQ BIN	DL_WAVE	.WVF
ACQ ASCII	DL_WAVE	.CSV

When saving data, a header file (which contains information in ASCII format necessary for analysis of the saved data) is also saved. The file name used for the data is also assigned to the header file, and a “.HDR” extension is added. The header file is saved in the same directory as the corresponding data.

Data size

Data size will vary according to the save format, the number of waveforms (channels), the record length, and other such factors.

For DL1540CL, if acquisition-memory record length is long, an ACQ data save may require more than one floppy disk. In this case you should be sure to format a sufficient number of floppy disks before beginning the save. If you insert an unformatted disk during the save procedure, an error message will appear and the save will abort, so that you will have to reexecute the save from the beginning.

The “approx. 7 K” shown below denotes memory used for storage of setting data. Values are given in bytes.

Data format	Data size
P-P	4096 x CH x N + approx. 300
ACQ	record length of acquisition memory x CH x N + approx. 7 K

* “N” indicates the number of trigger repetitions in single (N) mode; for any other mode, N=1.

Checking the free space on a floppy disk
Refer to page 12-3 for a description of this procedure.

Moving loaded P-P waveforms
Pressing the **POSITION key** of the channel corresponding to the number of the loaded waveform prompts you to select whether you want to move the input signal waveform or the loaded waveform.
“CH” at the “Knob” setting selects to move input signal waveforms;
“MEM” at the “Knob” setting selects to move loaded P-P waveforms.

Entering a file name
The following points must be kept in mind when entering a file name.
- A file name must always be specified;
- Up to eight characters can be entered. However, in case of GO/NO-GO or acquisition-on-trigger only the first four will be valid;
- For details regarding the characters which can be used, refer to page 4-8;
- The same name cannot be assigned to different data files of the same data type. (Overwrite inhibit). However, restarting the GO/NO-GO determination or acquisition-on-trigger function will result in overwriting the old files.

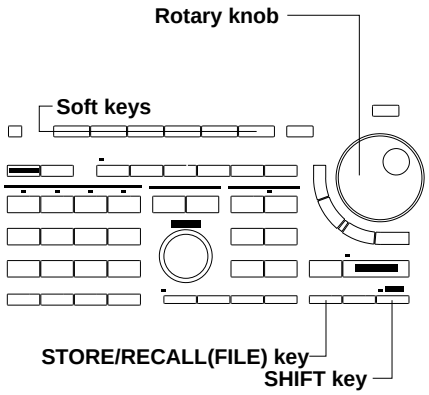
Points to note when saving/loading waveform data
- Acquisition stops when saving or loading is started;
- Only waveform data located within ±5.12 div of the center of the waveform display frame is saved. Thus, if the saved waveform exceeds this range vertically, the part exceeding this range will not be displayed if the waveform is subsequently loaded and scrolled vertically;
- For DL1540CL, floppy disks having less than 20 K free capacity cannot be used for ACQ-waveform data saves.
- When “ACQ” data is loaded, the setting parameters will change to their values at the time of saving;
- If “P-P” data is loaded, expansion of the waveform and waveform computation are not possible.
- If the extension of the waveform data file is changed using a personal computer, it will be impossible to load the data.
- As for “ACQ” data, only “BIN” data will be loaded.
- For more details regarding the display of the waveform information while displaying loaded P-P waveform or ACQ waveform data, refer to page 7-17.
- When you load waveform data (ACQ and P-P), be aware of the restrictions of some models;
  - DL1540C : Can only load waveform data saved by the DL1540C.
  - DL1540CL : Can load waveform data saved by theDL1540C and DL1540CL.

CAUTION

Never remove the floppy disk while the access indicator of the floppy disk drive is lit, or damage to the magnetic head of the drive or loss of data on the floppy disk may result.

12.4 Saving and Loading Setting Parameters

Keys and Procedure



1. Press the **SHIFT + STORE/RECALL (FILE) key** to display the data save/load menu.

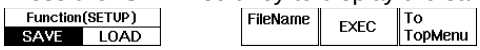
Turning ON/OFF the auto naming function

2. Press the "**AutoFile**" soft key to select "**ON**" or "**OFF**". For more details concerning this function, refer to the explanation later on.

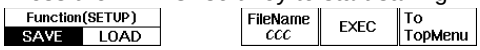
Saving setting parameters

3. Press the "**SETUP...**" soft key to display the save/load setting menu and a list of files.

4. Press the "**SAVE**" soft key to display the saving menu.



5. Press the "**FileName**" soft key to display the keyboard.
6. Use the keyboard to enter the filename. For details regarding the usage of the keyboard, refer to page 4-8.
7. Press the "**EXEC**" soft key to start saving.

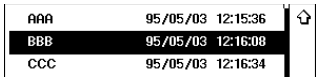


Loading setting parameters

3. Press the "**SETUP...**" soft key to display the save/load setting menu and a list of files.

4. Press the "**LOAD**" soft key to display the loading menu.

5. Use the rotary knob to select the file to be loaded.



6. Press the "**EXEC**" soft key to start loading.

Explanation

Auto naming function: AutoFile
If “AutoFile” has been set to “ON”, a file name No. (3 digits, starting from “001”) will be assigned to the data automatically when the data is saved. It is possible to insert a common file name (up to five characters) before the assigned file name No. by specifying the file name using “FileName”.

Setting parameters which can be saved
Settings made using the soft key menu and rotary knob, as well as the START/STOP state and the channel’s ON/OFF state are saved. If a zone waveform has been registered in GO/NO-GO and the following settings have been made, the zone waveform will also be saved.
Mode : ON
Type : ZONE

About saved setting parameters
When setting parameters are saved, the extension “SET” is automatically added, the “DL_SETUP” directory is created automatically, and the data is saved into this directory.

Data size
Approximately 10 K bytes are used for each set of setting parameters. However, if GO/NO-GO zone waveforms are included, approximately 4 K bytes extra are required for each zone waveform.

Checking the free space on a floppy disk
Refer to page 12-3 for a description of this procedure.

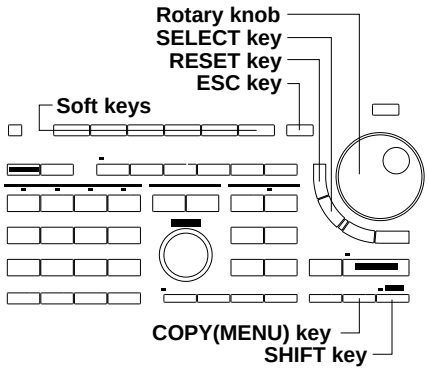
Entering a file name
The following points must be kept in mind when entering a file name.
- A file name must always be specified;
- Up to eight characters can be entered.
- All the characters on the keyboard can be used. However, the following file names cannot be used due to MS-DOS restrictions;
  AUX, CON, PRN, NUL, CLOCK
- The same name cannot be assigned to different data files of the same data type. (Overwrite inhibit).

Points to note when saving/loading setting parameters
- Setting parameters can be saved even if acquisition is in progress (i.e. while the START indicator is lit).
- Once the loaded setting parameters have been canceled, the original setting parameters cannot be restored.
- If the extension of the setting parameter file is changed using a personal computer, it will be impossible to load the data.

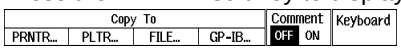
Never remove the floppy disk while the access indicator of the floppy disk drive is lit, or damage to the magnetic head of the drive or loss of data on the floppy disk may result.

12.5 Saving Screen Image Data

Keys and Procedure



1. Press the **SHIFT + COPY (MENU) key** to display the hard copy setting menu.
2. Press the "**FILE...**" soft key to display the image setting menu.

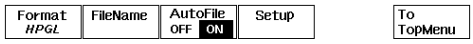


Turning ON/OFF the auto naming function

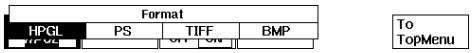
3. Press the "**AutoFile**" soft key to select "**ON**" or "**OFF**". For more details concerning this function, refer to the explanation later on.

Saving screen image data

4. Press the "**Format**" soft key to display the image data setting menu.



5. Press the soft key corresponding to the desired format. In case you selected "**HPGL**" or "**PS**", continue with step 6. In case you selected "**TIFF**" or "**BMP**", continue with step 19.



6. Press the "**Setup**" soft key to display the output setting menu.

Selecting the paper size

7. After having selected the "**Paper Size**" setting using the rotary knob, press the the **SELECT key** to select the desired paper size. In case you selected "**PS**" at step 5, there is no need to use the rotary knob and you may continue with step 18.

Selecting the pen speed

8. After having selected the "**Pen Speed**" setting using the rotary knob, press the the **SELECT key** to select from "**NORMAL**" or "**SLOW**".

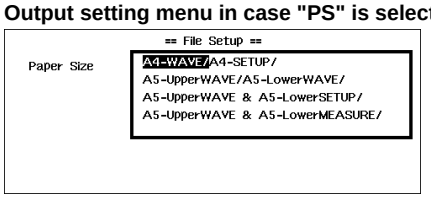
Selecting the XY Mode

9. After having selected the "**XY Mode**" setting using the rotary knob, press the the **SELECT key** to select from "**DOT**" or "**LINE**".

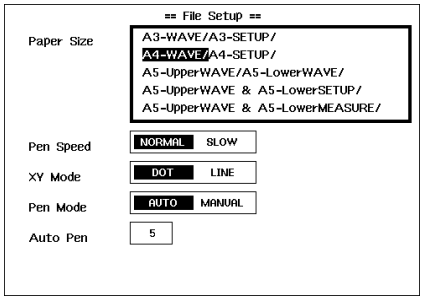
Assigning pens

10. After having selected the "**Pen Mode**" setting using the rotary knob, press the the **SELECT key** to select from "**AUTO**" or "**MANUAL**". In case you selected "**MANUAL**", continue with step 14.
11. After having selected "**AUTO**", and after having selected the "**Auto Pen**" setting using the rotary knob, press the **SELECT key** to display the setting frame.
12. Use the rotary knob to set the number of pens. Press the **RESET key** to return the default value.
13. Press the **SELECT key** or the **ESC key** to close the setting frame. Continue with step 18.
14. After having selected "**MANUAL**", use the rotary knob and the **SELECT key** to select the "**Grid Pen**" setting, the "**TRACE1 Pen - TRACE4 Pen**" setting and the "**LOAD1 Pen - LOAD4 Pen**" setting.
15. Use the rotary knob to set the pen numbers. Press the **RESET key** to return the default value.
16. Press the **SELECT key** or the **ESC key** to close the setting frame.
17. Repeat steps 14 to 16 to set other items of the "**MANUAL**" setting.
18. Press the **ESC key** to close the setting menu.

Output setting menu in case "PS" is selected

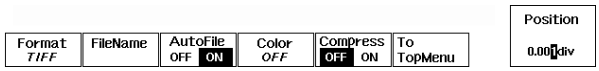


Output setting menu in case "HPGL" is selected

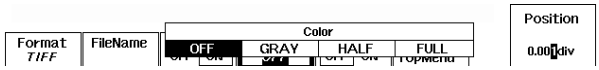


Selecting the image color (with TIFF or BMP only)

19. Press the "**Color**" soft key to display the image color selection menu.



20. Press the soft key corresponding to the desired image color. For details regarding the explanation of the image color.



Data compression (with TIFF or BMP only)

21. Press the "**Compression**" soft key to set compression "**ON**" or "**OFF**".

Entering the filename

22. Press the "**FileName**" soft key to display the keyboard.

23. Use the keyboard to enter the filename. For details regarding the usage of the keyboard, refer to page 4-8.

Outputting

24. Press the **COPY key**.

Explanation

Auto naming function: AutoFile

If "AutoFile" has been set to "ON", a number (3 digits, starting from "001") will be assigned to the data automatically when the data is saved. It is possible to insert a common file name (up to five characters) before the assigned number by specifying the file name using "FileName".

Selecting the data output format: Format

The data output format can be selected from the following formats.

HP-GL Saves image data in HP-GL format.
PS Saves image data in PostScript format.
TIFF Saves image data in TIFF format.
BMP Saves image data in BMP format.

About saved image data

When saving image data, extensions are automatically added. The "DL_MISC" directory is created automatically, and the data is saved into this directory. The extensions are as follows.

HPGL ".HGL" **TIFF** ".TIF"
PS ".PS" **BMP** ".BMP"

Selecting the paper size

These "Setup" settings are necessary for printing out image data from a PC or such to a plotter. The contents of printing, paper size, printing size and printing location depend on the format of the data and can be selected from the following types. Also refer to page 10-4.

For HPGL format:

Setting	Output item	Output size	Output location
A3-WAVE	Screen hardcopy	A3	Middle
A3-SETUP	Set-up parameters	A3	Middle
A4-WAVE	Screen hardcopy	A4	Middle
A4-SETUP	Set-up parameters	A4	Middle
A5-Upper WAVE	Screen hardcopy	A5	Upper half
A5-Lower WAVE	Screen hardcopy	A5	Lower half
A5-Upper WAVE &	Screen hardcopy	A5	Upper half
A5-Lower SETUP	Set-up parameters	A5	Lower half
A5-Upper WAVE &	Screen hardcopy	A5	Upper half
A5-Lower MEASURE	waveform measurement data	A5	Lower half

For PS format:

Setting	Output item	Output size	Output location
A4-WAVE	Screen hardcopy	A4	Middle
A4-SETUP	Set-up parameters	A4	Middle
A5-Upper WAVE	Screen hardcopy	A5	Upper half
A5-Lower WAVE	Screen hardcopy	A5	Lower half
A5-Upper WAVE &	Screen hardcopy	A5	Upper half
A5-Lower SETUP	Set-up parameters	A5	Lower half
A5-Upper WAVE &	Screen hardcopy	A5	Upper half
A5-Lower MEASURE	waveform measurement data	A5	Lower half

For TIFF/BMP format:
No selections are possible; the output size is approx. 12 x 8 cm.

Contents to be saved

In the HP-GL and PS format, the following types of screen image data are not saved.

- Snapshot waveforms
- Soft key menu and rotary knob menu
- Messages (except “Stopped” and “RUNNING)

In the TIFF and BMP format, data will be saved exactly as in case of the short copy. Refer to page 10-4 for more details.

Data size when saving

In case of saving a V-T Waveform, with two waveforms and grid displayed:

HPGL : approx. 25 Kbyte **TIFF** : approx. 300 Kbyte
PS : approx. 70 Kbyte **BMP** : approx. 300 Kbyte

Checking the free space on a floppy disk

Refer to page 12-3 for a description of this procedure.

Image color type (with TIFF or BMP only)

OFF : Same image as the "SHORT" (Short copy)" printing type described on page 10-4.
GRAY: 4-bit gray scale image.
HALF: Image using the same colors as the screen (except grid, scale, etc. are in black and no background).
FULL : Image using the same colors as the screen.

Data compression (with TIFF or BMP only)

Data of TIFF and BMP formats can be output by compression, using respectively LZW and RLE.

Entering a file name

The following points must be kept in mind when entering a file name.

- A file name must always be specified;
- Up to eight characters can be entered;
- All the characters on the keyboard can be used. However, the following file names cannot be used due to MS-DOS restrictions;
  AUX, CON, PRN, NUL, CLOCK
- The same name cannot be assigned to different data files of the same data type. (Overwrite inhibit).

Points to not when using data saved in Post Script format

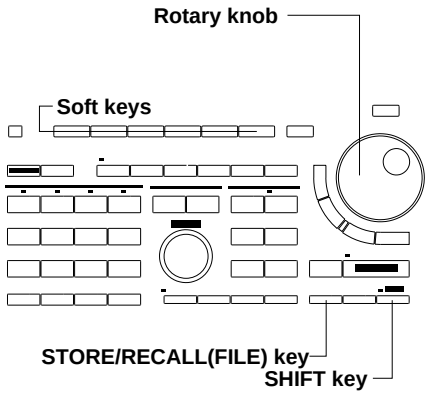
There is no problem printing out data saved in PostScript format on a PostScript printer. However, if the PostScript data is used in a file created by DTP application software, the waveform image will probably not appear on the computer’s screen. Instead a gray box indicating the size of the image will probably appear.

CAUTION

Never remove the floppy disk while the access indicator of the floppy disk drive is lit, or damage to the magnetic head of the drive or loss of data on the floppy disk may result.

12.6 Deleting and Protecting Saved Data

Keys and Procedure



1. Press the **SHIFT + STORE/RECALL (FILE) key** to display the data save/load menu.
2. Press the "**Utility**" soft key to display the utility selection menu.

Data Type		
P-P...	ACQ...	SETUP...

AutoFile	
OFF ON	Utility

3. Press the "**List**" soft key to display the list selection menu.

List	Exec Func		Format	Disk	To
P-P	Protect	Delete	2HD:1.2M	Info	TopMenu

4. Press the soft key corresponding to the desired list.

Change Data List			Format	Disk	To
P-P	ACQ	SETUP	2HD:1.2M	Info	TopMenu

5. Use the rotary knob to select the file to protect/save.

PQR	95/05/03 14:04:52	
ABC	95/05/03 14:05:30	
DEF	95/05/03 14:06:08	

Deleting

6. Press the "**Delete**" soft key.

Protecting

6. Press the "**Protect**" soft key. A "🔓" symbol will be added before the file name of the protected file.

List	Exec Func		Format	Disk	To
ACQ	Protect	Delete	2HD:1.2M	Info	TopMenu

Canceling protection

7. After step 4 has been performed, use the rotary knob to select the file at the beginning of which a "🔓" symbol is added.

PQR	95/05/03 14:04:52	
🔓DEF	95/05/03 14:06:08	

8. Press the "**Protect**" soft key and the protection will be canceled. The "🔓" symbol before the file name will be deleted.

List	Exec Func		Format	Disk	To
ACQ	Protect	Delete	2HD:1.2M	Info	TopMenu

Explanation

Deleting data

Waveform data and setting parameters saved on a floppy disk can be deleted one file at a time.

Protecting data

A protection function is used to protect saved data from being deleted by mistake. If an attempt is made to delete protected data, an error message will be displayed and the data will not be deleted.

A "🔓" symbol is displayed before the names of protected files to distinguish them from un-protected files.

Selecting the data list: Change Data List

File lists are displayed by data type and data format and are grouped as follows.

P-P Displayed waveform data (P-P compressed);
ACQ Data being saved in the acquisition memory;
SETUP Setting parameters.

Points to note when protecting or deleting data

- Protection setting cannot be performed if the floppy disk is write-protected. An error message will appear if an attempt is made to protect or delete files.
- It is not possible to delete more than one file at once.
- This protection setting is effective against deletion of data, but not against initialization (formatting). Take care not to accidentally delete files by reformatting a floppy file.

CAUTION

Never remove the floppy disk while the access indicator of the floppy disk drive is lit, or damage to the magnetic head of the drive or loss of data on the floppy disk may result.

13.1 Connecting a SCSI Device

The method for connecting a SCSI device to the DL1540CL varies depending on whether or not the internal hard disk option is installed. See below.

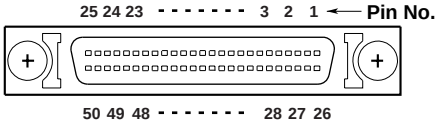
For Models with the Internal Hard Disk

SCSI specifications (/C8 option)

Item	Specifications
Interface standard	SCSI(Small Computer System Interface), ANSI X3.131-1986
Connector type	Half pitch 50 pins (pin type)
Electrical specifications	Single end. See the figure below for pin configuration. Terminator is built in.

Pin No.	Signal Name
1 to 12	GND
13	NC
14 to 25	GND
26	-DB0
27	-DB1
28	-DB2
29	-DB3
30	-DB4
31	-DB5
32	-DB6
33	-DB7
34	-DBP
35 to 37	GND

Pin No.	Signal Name
38	TERMPWR
39, 40	GND
41	-ATN
42	GND
43	-BSY
44	-ACK
45	-RST
46	-MSG
47	-SEL
48	-C/D
49	-REQ
50	-I/O



Items necessary for connection

Cable

Use a commercially sold cable that is 3 m or less in length, that has a ferrite core on each end of the cable, and that has a characteristic impedance between 90 and 132 Ω.

Connection procedure

1. Connect the SCSI cable to the SCSI connector on the rear panel of the instrument.
2. Set the SCSI ID number of the connected device to the External SCSI ID number specified on the instrument. The default value is “5.”
3. Turn ON the SCSI device and the instrument (in that order).

SCSI devices that can be connected

Most SCSI devices (MO disk drive, hard disk, and ZIP) can be connected to the instrument, but there are some exceptions. For example, a hard disk with a capacity of up to 2 GB can be used. For details on which devices can be connected, ask your YOKOGAWA dealer.

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

Note

- When connecting multiple SCSI devices in a chain, attach a SCSI terminator to the device at the other end of the chain.
- To format the internal hard disk, use the formatting functions provided by the instrument.

For Models without the Internal Hard Disk

You will need the SCSI interface unit (700930, sold separately).

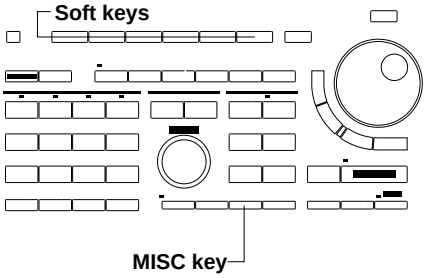
For the procedure to connect the SCSI device, see IM700930-01E.

13.2 About the Internal Hard Disk (for /C8 option only)

CAUTION

When using the instrument in a vibrating environment, turn OFF the motor rotation of the internal hard disk.

Keys and Procedure



1. Press the **MISC key** to display the MISC top menu.
2. Press the "**To NextMenu**" soft key.

3. Press the "**SCSI**" soft key to display the motor ON/OFF menu.

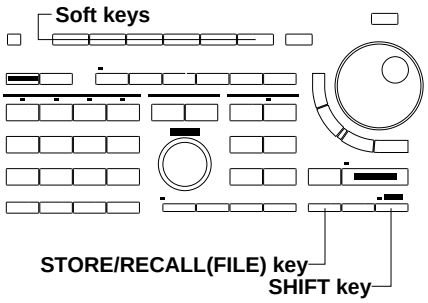
4. Press the "**Motor Sw**" soft key to select "**ON**" or "**OFF**."

Explanation

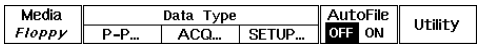
You can turn ON/OFF the motor rotation of the internal hard disk on this instrument. By turning the motor OFF, you can protect the internal hard disk from vibrations.

13.3 Selecting the SCSI Device or the Internal Hard Disk

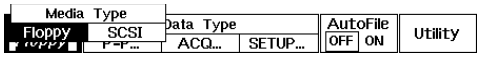
Keys and Procedure



1. Press **SHIFT + STORE/RECALL(FILE) key** to display the data save/load settings menu.
2. Press the "**Media**" soft key to display the media selection menu.



3. Press the "**SCSI**" or "**HD**" soft key to select the SCSI device or the internal hard disk as the media.



Explanation

Selecting the Media

Select from the following:

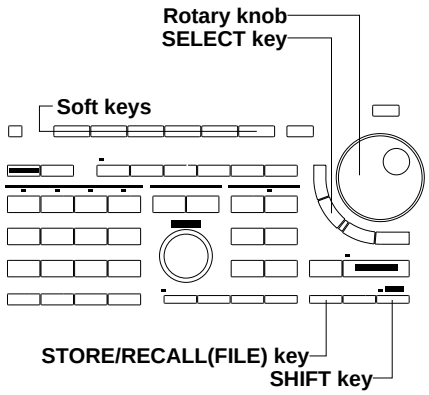
- **Floppy** : Floppy disk
- **SCSI** : SCSI device. Refer to Section 16.1 for information on the different types of SCSI devices.
- **HD** : Internal hard disk

Note

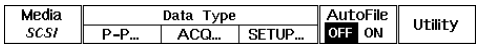
- When this instrument and the SCSI device are not connected properly the media selection menu does not appear.
- On models with the internal hard disk (DL1540CL /C8 option), you can select not only the SCSI device, but also the internal hard disk as the data save and load destination.

13.4 Formatting the Media

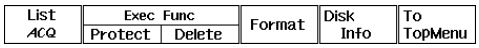
Keys and Procedure



1. Following the steps described in section 13.1, select the SCSI device or the internal hard disk as the media.



2. Press the "**Utility**" soft key to display the utility selection menu.



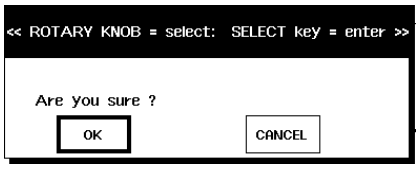
3. Press the "**Format**" soft key to display the format selection menu.

Formatting

4. After having selected "**OK**" using the rotary knob, press **SELECT key**. When formatting is complete, the message "Execution completed" appears.

Canceling

4. After having selected "**CANCEL**" using the rotary knob, press the **SELECT key**.



Explanation

Checking the format

If the media has already been formatted, select “Disk Info” after step 2 (on the previous page) and the following information will be displayed. If the media has not been formatted, or if it has been formatted in uncorrect format, the error message “Storage media is defective” will be displayed.

- Type of disk;
- Total disk space;
- Used disk space;
- Available on disk;
- Number of Setup data files;
- Number of P-P data files;
- Number of ACQ(bin) data files;
- Number of ACQ(ascii) data files;
- Number of Image data files.

Points to note concerning formatting

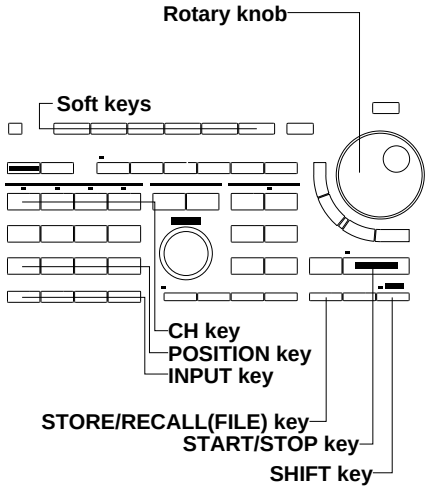
- The following three directories are created automatically when a medium is formattedusing this instrument.
  DL_WAVE Directory for “BIN” (binary) waveform data
  DL_SETUP Directory for “SETUP” (setting parameters)
  DL_MISC Directory for “P-P” and “ASCII” waveform data, as well as “HP-GL”, “PS” (Postscript), “TIFF” and “BMP” screen image data
- There are cases when a medium which has been formatted with another equipment such as a PC can not be used.
- If an error message appears when formatting has been completed, the medium may be damaged.
- Formatting the medium will erase all data on the disk. Be careful.

CAUTION

Never turn OFF the SCSI device or remove the disk (media) such as a MO or a PD while the access indicator of the SCSI device is lit. Otherwise, damage to the SCSI device or the disk may result.

13.5 Saving and Loading Waveform Data

Keys and Procedure



1. Following the steps described in section 13.1, select the SCSI device or the internal hard disk as the media.

Turning ON/OFF the auto naming function

2. Press the "**AutoFile**" soft key to select "**ON**" or "**OFF**". For more details concerning this function, refer to the explanation later on.

Saving P-P waveform data

3. Press the "**P-P**" soft key to display the save/load setting menu and a list of files.

Media	Data Type			AutoFile	Utility
SCSI	P-P...	ACQ...	SETUP...	OFF ON	

4. Press the "**SAVE**" soft key to display the saving menu.

5. Press the "**Source**" soft key to display the source waveform setting menu.

Function(P-P)		Source	FileName	EXEC	To
SAVE	LOAD	*TRACE1*			TopMenu

6. Press the soft key corresponding to the waveform to be saved.

	Source				
SAVE	TRACE1	TRACE2	TRACE3	TRACE4	ALL

7. Press the "**FileName**" soft key to display the keyboard.

8. Use the keyboard to enter the filename. For details regarding the usage of the keyboard, refer to page 4-8.

9. Press the "**EXEC**" soft key to start saving.

Function(P-P)		Source	FileName	EXEC	To
SAVE	LOAD	*TRACE1*	*ABC*		TopMenu

Loading P-P waveform data

10. Press the "**LOAD**" soft key to display the loading menu.

11. Press the "**Destn**" soft key to display the destination setting menu.

Function(P-P)		Destn	EXEC	To
SAVE	LOAD	*LOAD1*		TopMenu

12. Press the soft key corresponding to the destination of the waveform to be loaded.

	Destination			
Function(P-P)	LOAD1	LOAD2	LOAD3	LOAD4
SAVE LOAD				TopMenu

13. Use the rotary knob to select the file to be loaded.

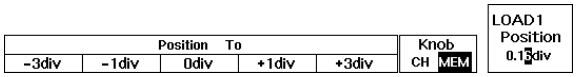
ABC	96/05/03 11:24:26
DEF	96/05/03 11:25:24
GHI	96/05/03 11:26:00
JKL	96/05/03 11:26:34
MNO	96/05/03 11:27:26

14. Press the "**EXEC**" soft key to start loading.

Function(P-P)		Destn	EXEC	To
SAVE	LOAD	*LOAD1*		TopMenu

Moving loaded P-P waveforms

15. Press the **POSITION key** of the channel corresponding to the number of the loaded waveform.
16. Press the "**Knob**" soft key to select "**MEM**".
17. Press the soft key corresponding to the desired position.
18. Use the rotary knob to fine adjust the position.

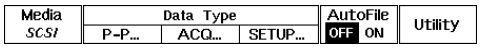


Canceling the display of the loaded waveform

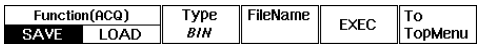
19. Press the **CH key** of the channel corresponding to the number of the loaded waveform. The load ON/OFF menu appears. Note that by alternately pressing the **CH key** the acquisition waveform also (dis)appears.
20. Press the "**MEM**" soft key to select "**OFF**" and the loaded waveform will be canceled. Selecting "**ON**" results in displaying the loaded waveform.

Saving ACQ waveform data

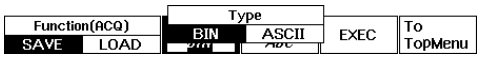
3. Press the "**ACQ...**" soft key to display the save/load setting menu and a list of files.



4. Press the "**SAVE**" soft key to display the saving menu.
5. Press the "**Type**" soft key to display the saving format menu

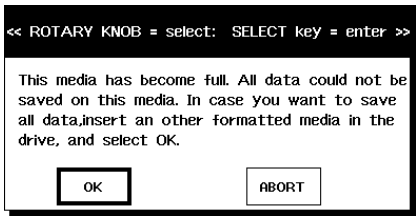


6. Select the saving format by selecting either "**BIN**" or "**ASCII**".



7. Press the "**FileName**" soft key to display the keyboard.
8. Use the keyboard to enter the filename. For details regarding the usage of the keyboard, refer to page 4-8.
9. Press the "**EXEC**" soft key to start saving.

10. For DL1540CL, if waveform data is too large to fit on the medium, the unit will display the message shown below when the disk becomes full. To continue the save: Insert another formatted medium in to the drive, select "**OK**" with the rotary knob, and press the **SELECT key**. (The save will then continue on the new medium, under the same filename as on the previous medium.) If you want to terminate the save instead, select "**ABORT**" with the knob, then press **SELECT key**.

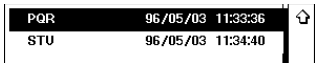


Loading ACQ waveform data

Note that only BIN data can be loaded.

11. Press the "**LOAD**" soft key to display the loading menu.

12. Use the rotary knob to select the file to be loaded.



13. Press the "**EXEC**" soft key to start loading.

If you have saved ACQ data to multiple media, you can opt to load all of this data or only part of it (for example, data from one disk only). If you do a partial load, the waveform display will not appear over the entire time axis, but only over a portion of it. If you want to display waveforms over the full span of the time axis, insert the medium (media) with the remaining ACQ data and repeat Steps 11 to 13 as necessary (selecting the same filename at Step 12).

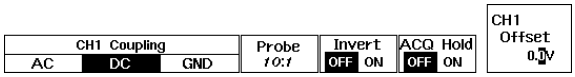
Moving loaded ACQ waveforms

14. The way to move these waveforms is exactly the same as for input signal waveforms. For details, refer to page 5-7.

Canceling/holding the display of the loaded waveform

15. Press the **INPUT key** of the channel corresponding to the number of the loaded waveform. The acquisition hold menu appears.

16. Press the "**ACQ Hold**" soft key to select "**OFF**". Then when you press the **START/STOP key** to start data acquisition, the loaded ACQ waveform will be canceled. When you select "**ON**", the loaded ACQ waveform will not be canceled, even when you start data acquisition. In this case, the channel display appears in the left upper side of the screen.



17. The way to display the ACQ waveforms and cancel them is exactly the same as for input signal waveforms. For details, refer to page 5-1.

Explanation

Auto naming function: AutoFile

If “AutoFile” has been set to “ON”, a number (3 digits, starting from “001”) will be assigned to the waveform data automatically when the data is saved. It is possible to insert a common file name (up to five characters) before the assigned number by specifying the file name using “FileName”.

Selecting the data format in which to save data: Data Type

The data format can be selected from the following.

P-P Converts the displayed waveform data (P-P compressed data) to binary data and saves it.

ACQ Converts the waveform data stored in the acquisition memory to either binary or ascii data and saves it.

BIN : Converts to binary data

ASCII : Converts to ascii data

Computed waveforms can only be saved in the P-P format.

When in single (N) mode, displayed P-P data will be saved.

Saving the waveform data (ACQ) in ASCII data format while displaying the power spectrum (FFT), also saves the computed result of the power spectrum (FFT).

Selecting the waveform to be saved: Source

When P-P is selected as the data type, the waveform to be saved can be selected from the following. X-Y waveforms cannot be saved.

TRACE1 to 4 One of the input signal waveforms and computed waveforms displayed as trace Nos. 1 to 4 is output.

ALL TRACE All displayed waveforms are output.
When ACQ is selected as the data type, the waveforms to be saved are the input signal waveforms displayed as trace.

About the saved data

For a description of the format of the data to be saved, refer to Appendix 5 “Output Data Format used When Saving Waveform Data” (App-12).

Data is saved in the directory which corresponds to the data’s format type, with one of the following extensions added. The directory is created automatically when the medium is formatted by the instrument or when data is saved.

Data format	Directory name	Extension
P-P	DL_MISC	.WVF
ACQ BIN	DL_WAVE	.WVF
ACQ ASCII	DL_MISC	.CSV

When saving data, a header file (which contains information in ASCII format necessary for analysis of the saved data) is also saved. The file name used for the data is also assigned to the header file, and a “.HDR” extension is added. The header file is saved in the same directory as the corresponding data.

Data size

Data size will vary according to the save format, the number of waveforms (channels), the record length, and other such factors.

For DL1540CL, if acquisition-memory record length is long, an ACQ data save may require more than one medium. In this case you should be sure to format another medium before beginning the save. If you insert an unformatted disk during the save procedure, an error message will appear and the save will abort, so that you will have to reexecute the save from the beginning.

The “approx. 7K” shown below denotes memory used for storage of setting data. Values are given in bytes.

Data format	Data size
P-P	4096 x CH x N + approx. 300
ACQ	record length of acquisition memory x CH x N + approx. 7K

* “N” indicates the number of trigger repetitions in single (N) mode; for any other mode, N=1.

Checking the free space on a medium
Refer to page 13-5 for a description of this procedure.

Moving loaded P-P waveforms
Pressing the POSITION key of the channel corresponding to the number of the loaded waveform prompts you to select whether you want to move the input signal waveform or the loaded waveform.

"CH" at the "Knob" setting selects to move input signal waveforms;
"MEM" at the "Knob" setting selects to move loaded P-P waveforms.

Entering a file name
The following points must be kept in mind when entering a file name.

- A file name must always be specified;
- Up to eight characters can be entered. However, in case of GO/NO-GO or acquisition-on-trigger only the first four will be valid;
- For details regarding the characters which can be used, refer to page 4-8;
- The same name cannot be assigned to different data files of the same data type. (Overwrite inhibit). However, restarting the GO/NO-GO determination or acquisition-on-trigger function will result in overwriting the old files.

Points to note when saving/loading waveform data

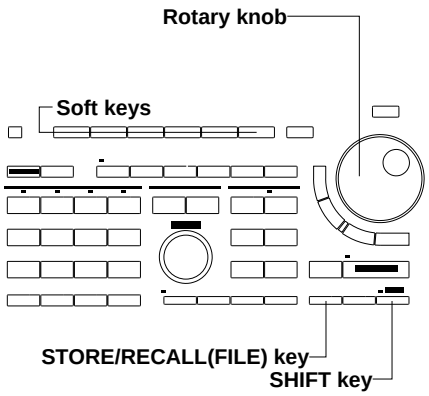
- Acquisition stops when saving or loading is started;
- Only waveform data located within ±5.12 div of the center of the waveform display frame is saved. Thus, if the saved waveform exceeds this range vertically, the part exceeding this range will not be displayed if the waveform is subsequently loaded and scrolled vertically;
- For DL1540CL, medias having less than 20K free capacity cannot be used for ACQ-waveform data saves.
- When "ACQ" data is loaded, the setting parameters will change to their values at the timeof saving;
- If "P-P" data is loaded, expansion of the waveform and waveform computation are not possible.
- If the extension of the waveform data file is changed using a personal computer, it will be impossible to load the data.
- As for "ACQ" data, only "BIN" data will be loaded.
- For more details regarding the display of the waveform information while displaying loaded P-P waveform or ACQ waveform data, refer to page 7-15.

CAUTION

Never turn OFF the SCSI device or remove the disk (media) such as a MO or a PD while the access indicator of the SCSI device is lit. Otherwise, damage to the SCSI device or the disk may result.

13.6 Saving and Loading Setting Parameters

Keys and Procedure



1. Following the steps described in section 13.1, select the SCSI device or the internal hard disk as the media.

Turning ON/OFF the auto naming function

2. Press the "**AutoFile**" soft key to select "**ON**" or "**OFF**". For more details concerning this function, refer to the explanation later on.

Saving setting parameters

3. Press the "**SETUP...**" soft key to display the save/load setting menu and a list of files.

Media	Data Type			AutoFile	Utility
SCSI	P-P...	ACQ...	SETUP...	OFF ON	

4. Press the "**SAVE**" soft key to display the saving menu.

Function(SETUP)		FileName	EXEC	To TopMenu
SAVE	LOAD			

5. Press the "**FileName**" soft key to display the keyboard.

6. Use the keyboard to enter the filename. For details regarding the usage of the keyboard, refer to page 4-8.

7. Press the "**EXEC**" soft key to start saving.

Function(SETUP)		FileName	EXEC	To TopMenu
SAVE	LOAD	*CCC*		

Loading setting parameters

8. Press the "**SETUP...**" soft key to display the save/load setting menu and a list of files.

Media	Data Type			AutoFile	Utility
SCSI	P-P...	ACQ...	SETUP...	OFF ON	

9. Press the "**LOAD**" soft key to display the loading menu.

Function(SETUP)		EXEC	To TopMenu
SAVE	LOAD		

10. Use the rotary knob to select the file to be loaded.

AAA	96/05/03	12:15:36
BBB	96/05/03	12:16:08
CCC	96/05/03	12:16:34

11. Press the "**EXEC**" soft key to start loading.

Function(SETUP)		EXEC	To TopMenu
SAVE	LOAD		

Explanation

Auto naming function: AutoFile
If “AutoFile” has been set to “ON”, a file name No. (3 digits, starting from “001”) will be assigned to the data automatically when the data is saved. It is possible to insert a common file name (up to five characters) before the assigned file name No. by specifying the file name using “FileName”.

Setting parameters which can be saved
Settings made using the soft key menu and rotary knob, as well as the START/STOP state and the channel’s ON/OFF state are saved. If a zone waveform has been registered in GO/NO-GO and the following settings have been made, the zone waveform will also be saved.
Mode : ON
Type : ZONE

About saved setting parameters
When setting parameters are saved, the extension “SET” is automatically added, the “DL_SETUP” directory is created automatically, and the data is saved into this directory.

Data size
Approximately 10 K bytes are used for each set of setting parameters. However, if GO/NO-GO zone waveforms are included, approximately 4 K bytes extra are required for each zone waveform.

Checking the free space on a medium
Refer to page 13-5 for a description of this procedure.

Entering a file name
The following points must be kept in mind when entering a file name.
- A file name must always be specified;
- Up to eight characters can be entered.
- All the characters on the keyboard can be used. However, the following file names cannot be used due to MS-DOS restrictions;
  AUX, CON, PRN, NUL, CLOCK
- The same name cannot be assigned to different data files of the same data type. (Overwrite inhibit).

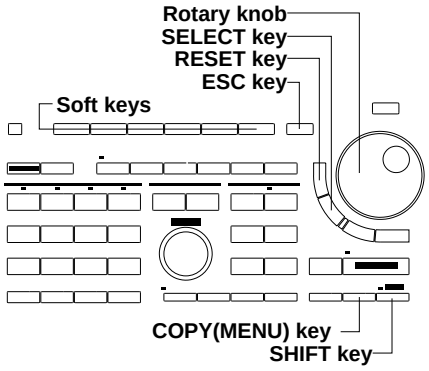
Points to note when saving/loading setting parameters
- Setting parameters can be saved even if acquisition is in progress (i.e. while the START indicator is lit).
- Once the loaded setting parameters have been canceled, the original setting parameters cannot be restored.
- If the extension of the setting parameter file is changed using a personal computer, it will be impossible to load the data.

CAUTION

Never turn OFF the SCSI device or remove the disk (media) such as a MO or a PD while the access indicator of the SCSI device is lit. Otherwise, damage to the SCSI device or the disk may result.

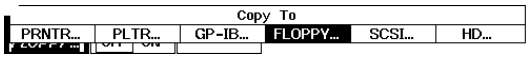
13.7 Saving Screen Image Data

Keys and Procedure



1. Following the steps described in section 13.1, select the SCSI device or the internal hard disk as the media.
2. Press the **SHIFT + COPY (MENU) key** to display the copy setting menu.

3. Press the "**Copy To**" soft key to display the image file setting menu.



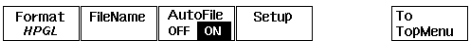
4. Press the "**SCSI**" or "**HD**" soft key to set the SCSI device or the internal hard disk as the save destination.

Turning ON/OFF the auto naming function

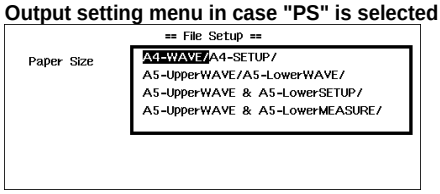
5. Press the "**AutoFile**" soft key to select "**ON**" or "**OFF**". For more details concerning this function, refer to the explanation later on.

Saving screen image data

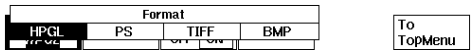
6. Press the "**Format**" soft key to display the image data setting menu.



Output setting menu in case "PS" is selected

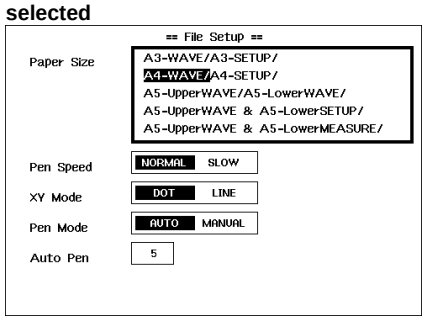


7. Press the soft key corresponding to the desired format. In case you selected "**HPGL**" or "**PS**", continue with step 6. In case you selected "**TIFF**" or "**BMP**", continue with step 19.



8. Press the "**Setup**" soft key to display the output setting menu.

Output setting menu in case "HPGL" is selected



Selecting the paper size

9. After having selected the "**Paper Size**" setting using the rotary knob, press the the **SELECT key** to select the desired paper size. In case you selected "**PS**" at step 5, there is no need to use the rotary knob and you may continue with step 18.

Selecting the pen speed

10. After having selected the "**Pen Speed**" setting using the rotary knob, press the the **SELECT key** to select from "**NORMAL**" or "**SLOW**".

Selecting the XY Mode

11. After having selected the "**XY Mode**" setting using the rotary knob, press the the **SELECT key** to select from "**DOT**" or "**LINE**".

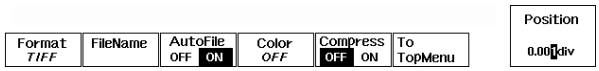
Assigning pens

12. After having selected the "**Pen Mode**" setting using the rotary knob, press the the **SELECT key** to select from "**AUTO**" or "**MANUAL**". In case you selected "**MANUAL**", continue with step 14.
13. After having selected "**AUTO**", and after having selected the "**Auto Pen**" setting using the rotary knob, press the **SELECT key** to display the setting frame.
14. Use the rotary knob to set the number of pens. Press the **RESET key** to return the default value.
15. Press the **SELECT key** or the **ESC key** to close the setting frame. Continue with step 18.

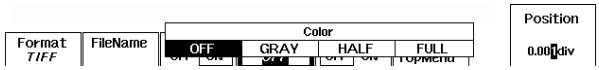
16. After having selected “**MANUAL**”, use the rotary knob and the **SELECT key** to select the “**Grid Pen**” setting, the “**TRACE1 Pen - TRACE4 Pen** ” setting and the “**LOAD1 Pen - LOAD4 Pen**” setting.
17. Use the rotary knob to set the pen numbers. Press the **RESET key** to return the default value.
18. Press the **SELECT key** or the **ESC key** to close the setting frame.
19. Repeat steps 16 to 18 to set other items of the “**MANUAL**” setting.
20. Press the **ESC key** to close the setting menu.

Selecting the image color (with TIFF or BMP only)

20. Press the “**Color**” soft key to display the image color selection menu.



21. Press the soft key corresponding to the desired image color. For details regarding the explanation of the image color.



Data compression (with TIFF or BMP only)

22. Press the “**Compression**” soft key to set compression “**ON**” or “**OFF**”.

Entering the filename

22. Press the “**FileName**” soft key to display the keyboard.
23. Use the keyboard to enter the filename. For details regarding the usage of the keyboard, refer to page 4-8.

Outputting

24. Press the **COPY key**.

Explanation

Auto naming function: AutoFile

If “AutoFile” has been set to “ON”, a number (3 digits, starting from “001”) will be assigned to the data automatically when the data is saved. It is possible to insert a common file name (up to five characters) before the assigned number by specifying the file name using “FileName”.

Selecting the data output format: Format

The data output format can be selected from the following formats.

HP-GL Saves image data in HP-GL format.
PS Saves image data in PostScript format.
TIFF Saves image data in TIFF format.
BMP Saves image data in BMP format.

About saved image data

When saving image data, extensions are automatically added. The “DL_MISC” directory is created automatically, and the data is saved into this directory. The extensions are as follows.

HPGL “.HGL” **TIFF** “.TIF”
PS “.PS” **BMP** “.BMP”

Selecting the paper size

These “Setup” settings are necessary for printing out image data from a PC or such to a plotter. The contents of printing, paper size, printing size and printing location depend on the format of the data and can be selected from the following types. Also refer to page 10-4.

For HPGL format:

Setting	Output item	Output size	Output location
A3-WAVE	Screen hardcopy	A3	Middle
A3-SETUP	Set-up parameters	A3	Middle
A4-WAVE	Screen hardcopy	A4	Middle
A4-SETUP	Set-up parameters	A4	Middle
A5-Upper WAVE	Screen hardcopy	A5	Upper half
A5-Lower WAVE	Screen hardcopy	A5	Lower half
A5-UpperWAVE &	Screen hardcopy	A5	Upper half
A5-LowerSETUP	Set-up parameters	A5	Lower half
A5-UpperWAVE &	Screen hardcopy	A5	Upper half
A5-LowerMEASURE	waveform measurement data	A5	Lower half

For PS format:

Setting	Output item	Output size	Output location
A4-WAVE	Screen hardcopy	A4	Middle
A4-SETUP	Set-up parameters	A4	Middle
A5-Upper WAVE	Screen hardcopy	A5	Upper half
A5-Lower WAVE	Screen hardcopy	A5	Lower half
A5-UpperWAVE &	Screen hardcopy	A5	Upper half
A5-LowerSETUP	Set-up parameters	A5	Lower half
A5-UpperWAVE &	Screen hardcopy	A5	Upper half
A5-LowerMEASURE	waveform measurement data	A5	Lower half

For TIFF/BMP format:

No selections are possible; the output size is approx. 12 x 8 cm.

Contents to be saved

In the HP-GL and PS format, the following types of screen image data are not saved.

- Snapshot waveforms
- Soft key menu and rotary knob menu
- Messages (except “Stopped” and “RUNNING)

In the TIFF and BMP format, data will be saved exactly as in case of the short copy. Refer to page 10-4 for more details.

Data size when saving

In case of saving a V-T Waveform, with two waveforms and grid displayed:

HPGL : approx. 25Kbyte **TIFF** : approx. 300Kbyte
PS : approx. 70Kbyte **BMP** : approx. 300Kbyte

Checking the free space on a medium

Refer to page 13-5 for a description of this procedure.

Image color type (with TIFF or BMP only)

OFF : Same image as the “SHORT (short copy)” printing type described on page 10-4.
GRAY: 4-bit gray scale image.
HALF: Image using the same colors as the screen (except grid, scale, etc. are in black and no background).
FULL : Image using the same colors as the screen.

Data compression (with TIFF or BMP only)

Data of TIFF and BMP formats can be output by compression, using respectively LZW and RLE.

Entering a file name

The following points must be kept in mind when entering a file name.

- A file name must always be specified;
- Up to eight characters can be entered;
- All the characters on the keyboard can be used. However, the following file names cannot be used due to MS-DOS restrictions;
  AUX, CON, PRN, NUL, CLOCK
- The same name cannot be assigned to different data files of the same data type. (Overwrite inhibit).

Points to not when using data saved in Post Script format

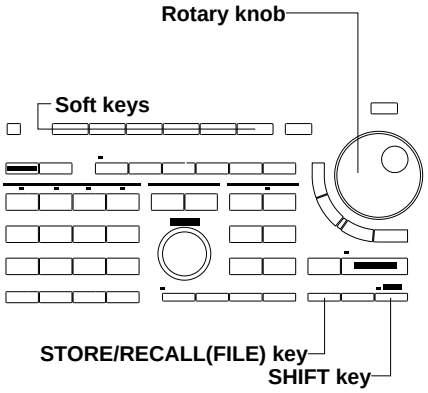
There is no problem printing out data saved in PostScript format on a PostScript printer. However, if the PostScript data is used in a file created by DTP application software, the waveform image will probably not appear on the computer's screen. Instead a gray box indicating the size of the image will probably appear.

CAUTION

Never turn OFF the SCSI device or remove the disk (media) such as a MO or a PD while the access indicator of the SCSI device is lit. Otherwise, damage to the SCSI device or the disk may result.

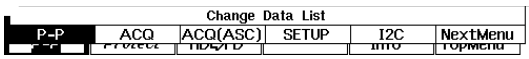
13.8 Deleting and Protecting Saved Data

Keys and Procedure

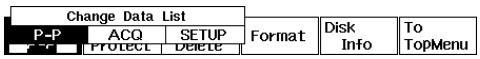


1. Following the steps described in section 13.1, select the SCSI device or the internal hard disk as the media.
2. Press the "**Utility**" soft key to display the utility selection menu.

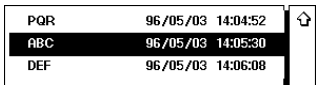
3. Press the "**List**" soft key to display the list selection menu.



4. Press the soft key corresponding to the desired list.



5. Use the rotary knob to select the file to protect/save.

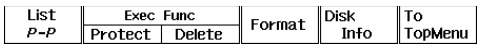


Deleting

6. Press the "**Delete**" soft key.

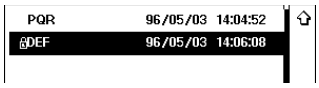
Protecting

6. Press the "**Protect**" soft key. A "🔓" symbol will be added before the file name of the protected file.

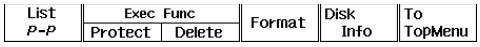


Canceling protection

7. After step 4 has been performed, use the rotary knob to select the file at the beginning of which a "🔓" symbol is added.



8. Press the "Protect" soft key and the protection will be canceled. The "🔓" symbol before the file name will be deleted.



Explanation

Deleting data

Waveform data and setting parameters saved on a medium can be deleted one file at a time.

Protecting data

A protection function is used to protect saved data from being deleted by mistake. If an attempt is made to delete protected data, an error message will be displayed and the data will not be deleted.

A "🔓" symbol is displayed before the names of protected files to distinguish them from un-protected files.

Selecting the data list: Change Data List

File lists are displayed by data type and data format and are grouped as follows.

P-P	Displayed waveform data (P-P compressed).
ACQ	Binary data being saved in the acquisition memory.
ACQ(ASC)	ASCII data of the data residing in the acquisition memory.
I2C	Data consisting of the I^2C-bus analysis results.
HPGL	Screen image data saved using the HP-GL command.
PS	Screen image data saved in PS format.
TIFF	Screen image data saved in TIFF format.
BMP	Screen image data saved in BMP format.
SETUP	Setting parameters.

Points to note when protecting or deleting data

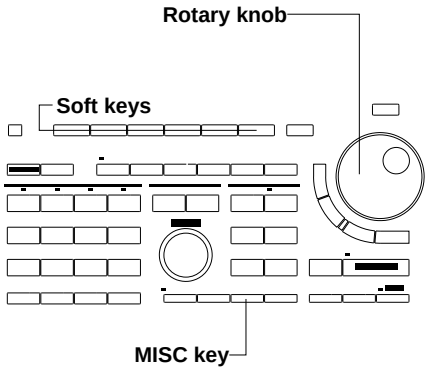
- Protection setting cannot be performed if the medium is write-protected. An error message will appear if an attempt is made to protect or delete files.
- It is not possible to delete more than one file at once.
- This protection setting is effective against deletion of data, but not against initialization (formatting). Take care not to accidentally delete files by reformatting a medium file.

CAUTION

Never turn OFF the SCSI device or remove the disk (media) such as a MO or a PD while the access indicator of the SCSI device is lit. Otherwise, damage to the SCSI device or the disk may result.

13.9 Changing the SCSI ID Number (on Models with the Internal Hard Disk)

Keys and Procedure



1. Press the **MISC key** to display the MISC top menu.
2. Press the "**To NextMenu**" soft key.

3. Press the "**SCSI**" soft key to display the ID number setting menu.

4. Turn the rotary knob to change the ID number.

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.
The default values are as follows:

DL1540CL /C8	:	6
SCSI device (External SCSI ID)	:	5
Built-in hard disk	:	4

* The ID numbers of the DL1540CL and built-in hard disk cannot be changed.

Range of SCSI ID numbers
0, 1, 2, 3, and 5.

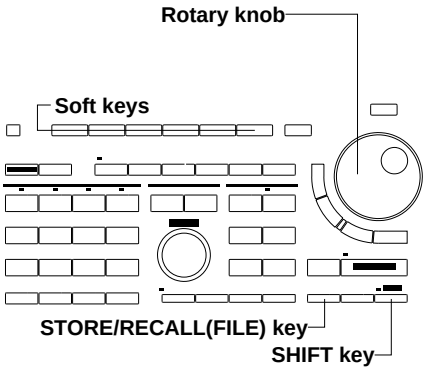
Terminator
The terminator is always turned ON. It cannot be changed.

Notes when setting the ID number

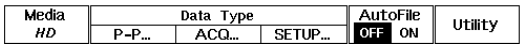
- The SCSI ID numbers of external SCSI devices cannot be set to the same numbers as the instrument or the internal hard disk.
- Various data are saved or loaded from the SCSI device that has the same ID number as the "External SCSI ID." Set the ID number of the device to which you wish to save or load various data.
- If you change the External SCSI ID, also change the SCSI ID on the device. For the procedure used to change the SCSI ID on the external device, see the instruction manual that is provided with the device.

13.10 Copying the Data Saved on the Internal Hard Disk (option) to the Floppy Disk

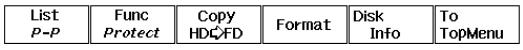
Keys and Procedure



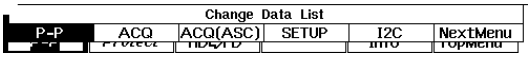
1. Following the steps described in section 13.1, select the internal hard disk as the media.



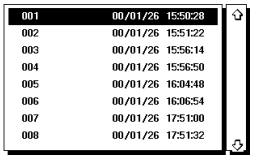
2. Press the "**Utility**" soft key to display the utility selection menu.



3. Press the "**List**" soft key to display the list selection menu.



4. Press the soft key corresponding to the desired list.



5. Turn the rotary knob to select the name of the file to be copied.
6. Press the "**Copy HD→FD**" soft key to execute the copy operation.

Explanation

Selecting the data list: Change Data List

The file list used to specify the data to be copied is displayed according to the data format.

Select from the following:

- P-P : Displayed waveform data (P-P compressed).
- ACQ : Binary data stored in the acquisition memory.
- ACQ(ASC) : ASCII data of the data residing in the acquisition memory
- SETUP : Setting parameters. For details, see "Setting parameters which can be saved" on page 13-12 in the User's Manual IM701530-01E.
- I2C : Data consisting of the I^2C-bus analysis results.
- HPGL : Screen image data saved using the HP-GL command.
- PS : Screen image data saved in PS format.
- TIFF : Screen image data saved in TIFF format.
- BMP : Screen image data saved in BMP format.

13.11Connecting a PC to the DL1540CL /C8

A PC can be connected to the SCSI interface connector (/C8 option), allowing the PC to access the internal hard disk (/C8 option).

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 ferrite core on each end of the cable, and that has a characteristic impedance between 90 and 132 Ω.

Make sure to follow the connection procedures below ("Connecting the DL1540CL and the PC"). Otherwise, media of other SCSI devices connected to the PC can be damaged.

Connecting the DL1540CL and the PC

1. Turn OFF the DL1540CL and the PC.
2. Connect the DL1540CL and the PC with the SCSI cable.
3. Turn ON the DL1540CL first.
4. Turn ON the PC.

Precautions to be taken while the devices are connected

- **Newly created file during connection**

  Sometimes the PC will not recognize a new file that is created on the DL1540CL while the DL1540CL and the PC are connected.

  In such case, reconnect the devices according to the procedures given in "Connecting the DL1540CL and the PC."

  The files will be recognized by taking the following steps, if the PC is running Windows 95/98.

  1. On Windows 95/98, open the "Settings" tab in the properties dialog box for the connected drive, and check the Removable* box.
  2. Reboot the PC.
  3. After creating a new file on the DL1540CL, select "Refresh" in the file list window (Explorer, for example).

  * 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."

- **Drive letter**

  If the PC connected to the DL1540CL has two or more hard disks or if the hard disk is partitioned into multiple drives, the drive letters (D:, E:, etc.) may change when the DL1540CL is connected. For details, see the instruction manual that came with the PC or the drive.

  The drive letter for the DL1540CL cannot be changed.

  Examples

  - The PC uses one hard disk as a single drive

Before connection	C:(HDD)
After connection	C:(HDD)
	D: (DL1540CL /C8)

  - The PC uses one hard disk as two drives (partitions)

Before connection	C:(HDD)
	D:(HDD)
After connection	C:(HDD)
	D: (DL1540CL /C8)
	E:(HDD)

  In the actual case, this will vary depending on how the hard disk is partitioned and the type of interface (IDE, SCSI, etc) and drive.

Note

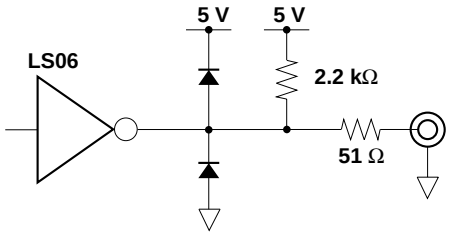
- The DL1540CL can only be connected at the end of the SCSI chain. The internal hard disk has a built-in terminator.
- Do not format the internal hard disk using the PC.

14.1 Using a Trigger Output Signal

Trigger Output Circuit

Output level : TTL
Output logic : Negative (trailing edge)
Output delay time: 150 ns max.
Output hold time : 2 μs min. for low level, 2 μs min. for high level

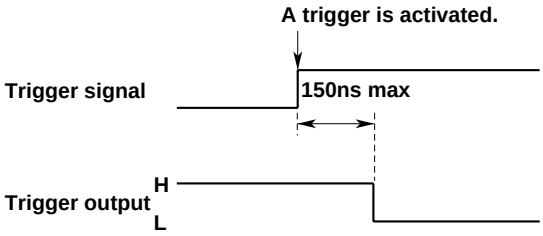
Output Circuit



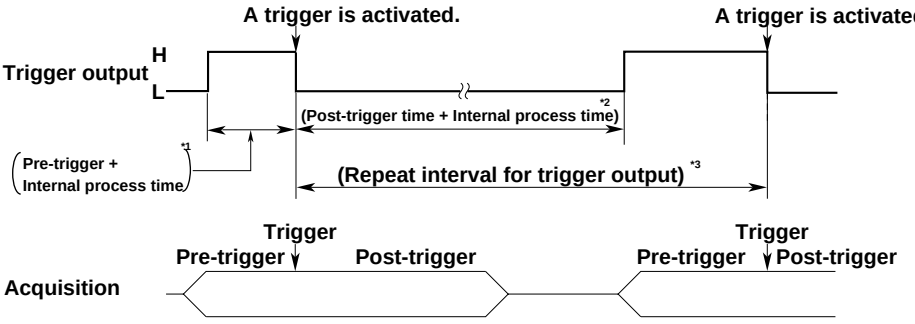
Trigger Output Terminal

The TRIG OUT terminal is situated on the rear panel.

Output timing



Hold Time for Low and High Level



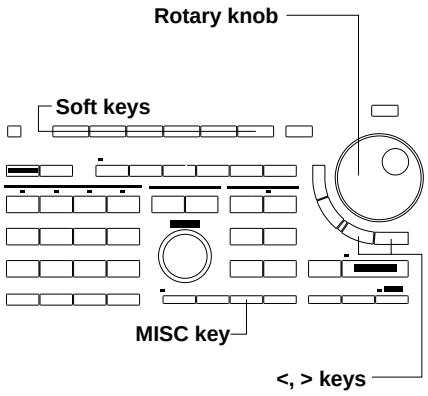
*1: Duration during which the trigger output level is HIGH
Consists of the pre-trigger time and internal process time. (2 μs or longer)
*2: Duration during which the trigger output level is LOW
Consists of the post-trigger time and internal process time. (2 μs or longer)
*3: (Repeat interval)
The minimum repeat interval for trigger output differs according to the selected mode.
Real-time sampling mode : Approx. 17 ms
Equivalent sampling mode : Approx. 10 μs
Single (N) mode : Approx. 300 μs

CAUTION

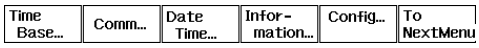
Never apply an external voltage to the TRIG OUT terminal, as damage to the instrument may result.

14.2 Downloading Waveform Data to an AG Arbitrary Waveform Generator

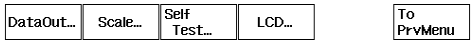
Keys and Procedure



1. Press the **MISC key** to display the MISC menu.
2. Press the "**To NextMenu**" soft key.

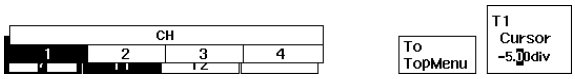


3. Press the "**DataOut...**" soft key to display the download menu.



4. Press the "**CH**" soft key to display the channel selection menu.

5. Press the soft key corresponding to the desired channel to be downloaded.



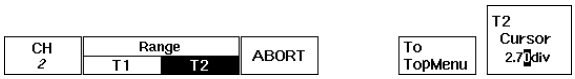
6. Set the downloading range by selecting either "**T1**" or "**T2**" soft key, and setting the vertical cursor position using the rotary knob. You can also use the **<** or **>** keys.

Executing the download funtion

7. Press the "**EXEC**" soft key. The name of the soft key will change to "**ABORT**".

Aborting the download function

8. Press the "**ABORT**" soft key. The name of the soft key will change to "**EXEC**".



Explanation

Download setting: Dataout...

Downloading data from this instrument should only be done after having set downloading settings at the YOKOGAWA AG series arbitrary waveform generator. For details regarding the settings and/or operation of the YOKOGAWA AG series, refer to its corresponding instruction manual.

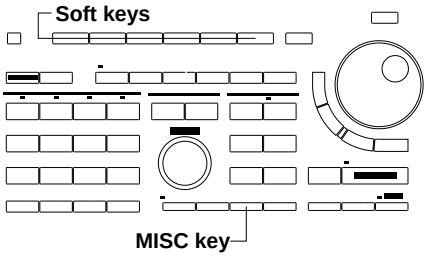
When executing downloading, the setting of this instrument will change to "talking mode" in the case of GP-IB. When downloading is finished, or when the "ABORT" soft key is pressed, the previous setting will return.

The range of determination is set by the two cursors T1 and T2. The setting lies within

–5.00 div at the left side to +5.00 div at the right side measured from the center of the display.

14.3 Checking the System Condition

Keys and Procedure



1. Press the **MISC key** to display the MISC menu.
2. Press the "**Information**" soft key to display the ROM check screen.

Time Base...	Comm...	Date Time...	Infor-mation...	Config...	To NextMenu

3. Press any key, or move any knob on the front panel.
   The setting parameter information screen will be displayed.

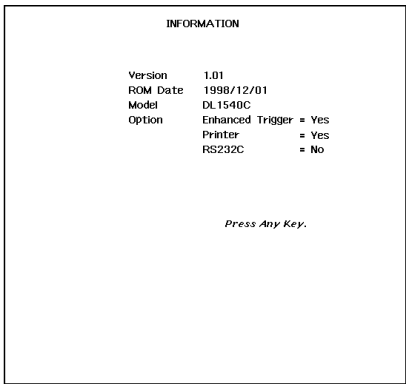
Returning to the MISC menu

4. Press any key, or move any knob on the front panel.

Explanation

ROM check screen

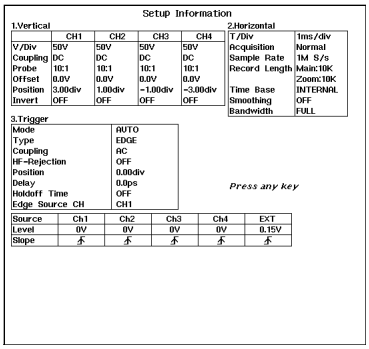
The ROM check screen, as shown below, enables you to check the ROM version, the date the ROM was programmed, the model type and whether options are installed. An example for DL1540C is shown below.



Setting parameter information screen

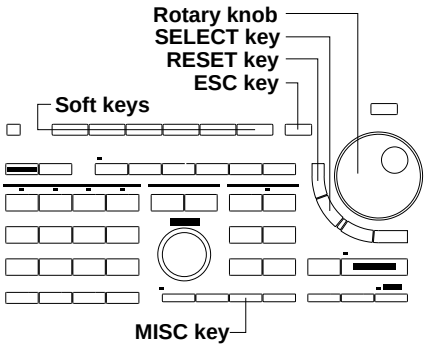
The set-up information screen, shown below, enables you to check the most important setting parameters.

The information given on the screen can also be printed. For a description of the procedure, refer to page 10-3 and 10-9. An example for DL1540C is shown below.

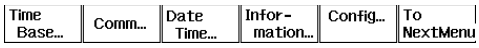


14.4 Adjusting the Printer Density

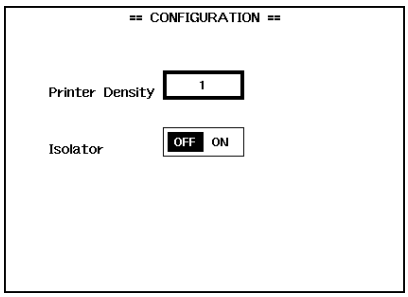
Keys and Procedure



1. Press the **MISC key** to display the MISC menu.
2. Press the "**Config...**" soft key.



3. Press the **SELECT key** to display the density setting frame.
4. Use the rotary knob to select the desired density level. Pressing the **RESET key** results in displaying the default value.
5. Press either the **SELECT key** or the **ESC key** to close the density setting frame.



Explanation

Setting the printer density: Printer Density

This setting controls the printing density of hard copies on the built-in printer.

Setting range : 0 to 3

Default setting : 1

Note

When you press the soft key [Config...] , the setting menu for the isolator (700926) will appear as well. For details regarding the isolator and its operation, refer to the accessory user's manual of the isolator.

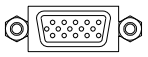
14.5 Using a Video Signal Output (VIDEO OUT)

CAUTION

- **Before connecting the monitor to the instrument, be sure to turn OFF the power to both monitor and instrment.**
- **Never short-circuit the RGB VIDEO OUT terminal or apply an external voltage, otherwise damage to the instrument may result.**

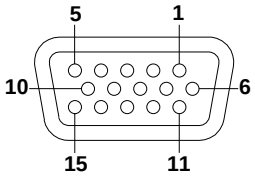
VIDEO OUT terminal

RGB
VIDEO OUT (VGA)



The instrument's screen can be displayed on a monitor via this terminal. Only a VGA monitor or a multi-synchronous monitor which is capable of displaying VGA can be used.

Specification



D-Sub 15-pin receptacle

Pin No.	Signal Name	Specification
1	Red	0.7 Vp-p
2	Green	0.7 Vp-p
3	Blue	0.7 Vp-p
4	–	
5	–	
6	GND	
7	GND	
8	GND	
9	–	
10	GND	
11	–	
12	–	
13	Horizontal synchronous signal	Approx.31.5 kHz, TTL negative
14	Vertical synchronous signal	Approx.60 kHz,, TTL negative
15	–	

Connecting to the monitor

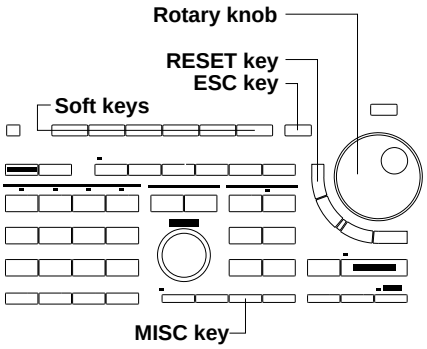
1. Turn of the power to both the monitor and the instrument.
2. Connect the monitor to the insrument using an analog RGB cable.
3. Turning ON both the monitor and the instrument displays the instrment's screen on the monitor.

Note

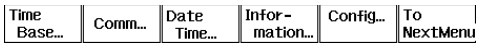
- To redudce the power consumption, set “Video Out” to “OFF” when not in use. The initial val ue of “Video Out” is “OFF.”
- The picture on the monitor may become unstable if the instrument or other equipment is broght too close the monitor.
- Some monitors may display a picture from which the sides are missing.

14.6 Setting the Brightness of the LCD

Keys and Procedure



1. Press the **MISC key** to display the MISC menu.
2. Press the "**To Next Menu**" soft key.



Setting the Brightness

3. Press the "**LCD**" soft key.

4. Use the rotary knob to select the desired density level. Pressing the **RESET key** results in displaying the default value.

Turning off the backlight

5. Press the "**LCD**" soft key to turn OFF the backlight. Pressing any key turns the backlight ON again.

Explanation

Setting the brightness of the LCD:LCD Brightness

Adjusts the brightness of the back light of the LCD.

Setting range : 4 steps from 1 to 4 (darkest [1] to brightest [4])

Default setting : 3

15.1 Troubleshooting

- For corrective actions when a message appears on the display, refer to Section 15.2 “Error Messages and Corrective Actions” (page 15-2).
- If maintenance service is required, or if the instrument still does not operate even after the proper corrective action has been taken, contact your nearest YOKOGAWA representative as listed on the back cover of this manual.

Symptom	Possible Cause	Corrective Action	Reference Page
The power does not come ON.	The source voltage is outside the rated range.	Connect the instrument to a source of the correct voltage.	3-3
	Fuse is blown.	Verify it the fuse is blown, check the cause and replace the fuse.	15-7
Nothing is displayed.	Instrument is faulty.	While holding down the INITIALIZE key, turn ON the power.	3-4
Display appears abnormal.	Instrument is faulty.	Reset the instrument to its factory settings.	4-4
The phase of the waveform of CH2 is shifted.	The phase shift is set.	Set the phase shift to 0 div.	8-18
Keys do not function.	Instrument is in remote mode.	Press the LOCAL key to activate local mode.	—
	Other causes	While holding down the INITIALIZE key, turn ON the power.	—
No trigger is caused.	Trigger settings are incorrect.	Make correct trigger settings for the input signal.	Chapter 6
Measured values are abnormal.	Insufficient warm-up time	Allow instrument to warm up for at least 30 minutes after the power is turned ON.	—
	No calibration has been performed.	Perform calibration.	4-6
	The probe has not been calibrated.	Calibrate the probe.	3-6
	Incorrect probe attenuation	Set the correct attenuation.	5-4
	Offset voltage is in use.	Set the offset voltage to "0".	5-2
	Waveform inversion is ON.	Turn waveform inversion OFF.	5-5
No data is output to the internal printer.	Printer head is damaged or worn out.	Maintenance service is required.	—
No data is output to the external printer.	The type or format of printer do not match.	Match the type and format of printer.	—
	The printer is not set to the on-line.	Set to the on-line mode.	
	The printer cable is not connect properly.	Connect the cable properly.	
	The chart paper of printer is not set.	Set the chart paper to the printer.	
No data is output to the plotter.	The plotter is not set to listen-only mode.	Set the plotter to listen-only mode.	—
	The communication interface cable is not properly connected.	Connect the cable properly.	—
	The RS-232-C setting parameters do not match.	Set the RS-232-C setting parameters correctly.	—
Data cannot be saved on a floppy disk.	Floppy disk has not been formatted.	Format the disk. The disk must be formatted if it is a new disk.	12-2
	The floppy disk is not inserted properly.	Push the disk until the eject button pops up.	12-1
Data cannot be loaded on a floppy disk.	The floppy disk is not inserted properly.	Push the disk until the eject button pops up.	12-1
Making settings and performing operation control are not possible via the communication interface.	The GP-IB addresses / RS-232-C parameters set in the program differ from those used by the instrument.	Make sure that the correct addresses / parameters are set for both program and instrument.	*
	Instrument is not being used according to its electrical and mechanical specifications.	Use the instrument according to these specifications.	*

* Refer to the Communication Interface User's Manual (IM 701530-11E).

15.2 Error Messages and Corrective Actions

Message Type

There are two types of messages which are displayed on the screen.

Status message

Displays the currently executing operation and the results.

Error/warning message

Displayed if an invalid setting has been made or if the instrument is defective.

When Maintenance Service is Required

Contact your nearest YOKOGAWA representative as listed on the back cover of this manual.

Status Message

No.	Message	Reference Page
0	Calibration is in progress.	4-6
1	Auto setup is in progress.	4-2
2	Saving file is in progress.	12-4, 9, 11
3	Loading file is in progress.	12-4, 9
4	Deleting file is in progress.	12-14
5	Disk formatting is in progress.	12-2
6	A directory list is currently being created.	12-3
7	Set-up data has been stored in the internal memory.	11-3
8	Displayed waveform has been stored in the internal memory.	11-1
9	Printer output is aborted.	10-3, 11
10	GO/NO-GO is aborted.	9-5, 6, 10, 11
11	Trigger action is aborted.	6-15, 16
12	DATA output is aborted.	13-4
13	Exit from GO/NO-GO mode.	9-5, 6, 10, 11
14	Execution completed.	–
15	Making bitmap data is in progress.	12-11, 13-13
16	Copying file is in progress.	13-3

Error/Warning Message

In addition to the messages given below, there are also some other error/warning messages (code Nos. 100 to 500). These messages are described in the Communication Interface User's Manual (IM701530-11E).

If an error message other than those given below is displayed, the instrument may be defective. In this case, inform your nearest YOKOGAWA representative and inform him the number of the message which appears.

No.	Message	Reference Page
601	Invalid file name	4-8
602	No floppy disk inserted.	12-1
603	No SCSI	—
604	Storage media is defective.	12-3
605	File not found.	—
606	Floppy disk is write-protected.	—
609	File name already exists.	—
610	Reserved file name or illegal character.	4-8
611	Directory is full. No more files can be created.	12-3
612	Insufficient space for creating a file.	12-3
614	File is write-protected.	12-14
615	Formatting error.	—
646-654	Storage media is defective.	12-3
656	File attribute error.	—
659	It is not possible to load the file using this ROM version or this Model.	—
662	It is not possible to load an ASCII type file.	—

No.	Message	Reference Page
675	ACQ data (BIN/ASCII) cannnot be saved since insufficient space is available (less than 20K)	—
700	Specified operation is currently in progress. Execute again after the current operation has been completed.	—
701	It is not possible to start acquisition since the specified operation is in progress.	—
702	It is not possible to save X-Y waveform data.	12-7
703	Designated trace is not displayed.	5-1
704	No set-up data has been stored.	11-3
705	No displayed waveform has been stored.	11-1
706	It is not possible to perform a snapshot during X-Y waveform display.	4-5
707	The roll chart is not secured.	10-2
708	No roll chart.	10-2
709	Printer is overheating. Turn OFF the power immediately. Contact your nearest YOKOGAWA representative.	—
710	It is not possible to execute a self test since a storage media operation or printer operation, or GO/NO-GO operation, or trigger action operaton is in progress.	—
711	It is not possible to perform this operation since GO/NO-GO is active. Stop GO/NO-GO and try again.	9-1, 8
712	No printer installed.	2
713	It is not possible to perform this operation since the trigger action is active. Stop the trigger action and try again.	6-15
714	It is not possible to perform the real time printout in this time range. Set time range to 500ms/div or below.	10-10
715	It is not possible to perform the real time printout during Zoom/MainZoom waveform display, X-Y waveform display, FFT waveform display or during loading/recalling a waveform.	10-10
716	(For DL1540C) It is not possible to perform the real time printout with NORM/SGL (S)/ SGL (L)/ N-SGL as the trigger mode or with history mode. (For DL1540CL) It is not possible to perform the real time printout with NORM/SINGLE/ N-SGL as the trigger mode or with history mode.	10-10
717	It is not possible to display a time stamp during acquisition.	7-9
718	It is not possible to use the ALL display during acquisition.	7-9
720	It is not possible to perform the real time printout using the external clock as timebase.	10-10
721	It is not possible to perform this action while averaging or history mode is active.	—
722	CAL-OUT is not connected.	—
723	Low temperature error has been detected in printer.	—
724	It is not possible to execute measurement of acquisition data (All Scan EXEC) because automatic measurement of waveform parameter is OFF, or because data acquisition is in progress.	8-11
725	(For DL1540CL) It is not possible to perform the real time printout since the record length 1K words.	10-10
800	(For DL1540C) It is not possible to set the time range during SGL(L)/N-SGL as the trigger mode or history mode. (For DL1540CL) It is not possible to carry out this time range setting, because the trigger mode is N-SGL, the history mode is active or the record length is 400K/1M/2M words.	5-11, 6-13, 14, 7-10
801	It is not possible to select an external clock in Envelope mode.	5-9
802	Delay time was set to “0s” as an external clock was selected.	5-9
803	It is not possible to set a delay time since an external clock has been selected.	5-9

No.	Message	Reference Page
804	(For DL1540C) It is not possible to set SGL(S)/SGL(L)/N-SGL as the trigger mode or history mode while averaging mode is active. (For DL1540CL) It is not possible to set SINGLE/N-SGL as the trigger mode or history mode while averaging mode is active.	6-13, 14, 7-9
805	(For DL1540C) It is not possible to set averaging mode while SGL(S)/SGL(L)/N-SGL as the trigger mode or history mode is active. (For DL1540CL) It is not possible to set averaging mode while SINGLE/N-SGL as the trigger mode or history mode is active.	7-2
806	It is not possible to turn ON the smoothing function in Envelope mode.	7-3
807	It is not possible to set Envelope mode while smoothing function is turned ON.	7-2
808	It is not possible to edit a zone waveform during dual display, X-Y waveform display, FFT waveform display or during loading/recalling a waveform.	9-6, 7
809	The operation is not possible in GO/NO-GO zone type.	—
810	The trace to be edited is not currently displayed.	9-6
811	Zone data does not exist.	9-2, 7
812	It is not possible to set FFT mode in Envelope mode.	8-20
813	It is not possible to set Envelope mode in FFT mode.	7-2
814	It is not possible to set FFT mode within the repetitive sampling range.	8-20
815	It is not possible to set the repetitive sampling range in FFT mode.	7-1
816	(For DL1540C) It is not possible to set history mode in SGL(S)/SGL(L)/N-SGL as the trigger mode. (For DL1540CL) It is not possible to set history mode in SINGLE/N-SGL as the trigger mode.	7-9
817	(For DL1540C) It is not possible to set SGL(S)/SGL(L)/N-SGL as the trigger mode in history mode. (For DL1540CL) It is not possible to set SINGLE/N-SGL as the trigger mode in history mode.	7-8
818	It is not possible to change a GP-IB address when talk-only mode is active.	*
819	Set the correct date and time.	3-7
820	No keys can be operated during real time printing except the START/STOP and COPY key.	10-10
821	It is not possible to set Envelope mode during an external clock.	7-2
822	(For DL1540C) It is not possible to set SGL(L)/N-SGL as the trigger mode or history mode in the time range. (For DL1540CL) At this time range setting, It is not possible to set N-SGL trigger mode, the history mode or the record length to 400K/1M/2M words.	5-11,6-13, 14, 7-10
823	The trace to be operated is not currently loaded/recalled.	—
824	It is not possible to set H-position during roll mode acquisition.	5-12
825	The operation is not possible in acquisition hold.	12-6
826	The operation is not possible while Isolator is not connected.	—
827	The operation is not possible while Isolator is connected.	—

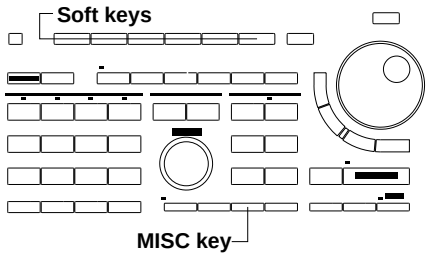
* Refer to the Communication Interface User's Manual (IM701530-11E).

No.	Message	Reference Page
828	(For DL1540CL) A record length of 400K/1M/2M words can only be set when the trigger mode is SINGLE.	7-2
829	(For DL1540CL) A record length of 2M words can only be set when the CH3 and CH4 are both OFF.	7-2
830	(For DL1540CL) Since the record length is 400K/1M/2M words, the trigger mode can only be set to SINGLE.	6-13
831	(For DL1540CL) Since the record length is 2M words, CH3 and CH4 cannot be set ON.	7-2
835	It is not possible to set GO/NO-GO gone type in color accumulation mode.	Chapter 9
836	No keys can be operated since GO/NO-GO operation is in progress except the GO/NO-GO Mode and ABORT key.	Chapter 9
837	No keys can be operated since trigger action operation is in progress except the START/STOP and ABORT key.	6-15
838	This key cannot be operated when the zone wave edit mode is in progress.	9-1
842	Turn On the internal hard disk motor.	13-2
900	The back-up lithium battery has run out. The back-up function is no longer valid. To have the battery replaced, contact your nearest YOKOGAWA representative as listed on the back cover of this manual.	3-4
901	Cooling fan has stopped. Turn OFF the power immediately.	—
905	Isolator cannot be used.	

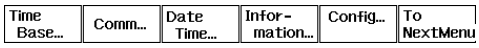
15.3 Self Test

The self test function is available in the MISC menu. This function can be used when the instrument seems to be defective. Contact your nearest YOKOGAWA representative and proceed according to his instructions. Do not use this function unless the instrument is defective.

Keys and Procedure



1. Press the **MISC key** to display the MISC menu.
2. Press the "**To NextMenu**" soft key.



3. Press the "**Self Test...**" soft key to start selftesting.

15.4 Replacing the Power Supply Fuse

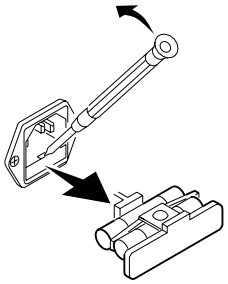
WARNING

Before replacing the fuse, make sure to turn OFF the power supply and disconnect the power source. Use ony specified fuses which should only be obtained from your sales representative. The usage of other fuses might cause fire.

Specifications

Maximum rated voltage	250 V
Maximum rated current	3.15 A
Type	Time lag
Approved standard	VDE/SEMKO
Part No.	A1351EF

Procedure



1. Turn the power switch OFF.
2. Remove the power cord from the power supply.
3. Pull out the fuse holder by placing a screw driver under the tab and pulling the holder forward.
4. Remove the blown fuse located at the front of the fuse holder. Note that the other fuse is a spare one.
5. Make sure the ratings of the new fuses are correct and install them.
6. Click the holder back into its place.

15.5 Recommended Parts for Replacement

The 3-year warranty applies only to the main unit of this instrument (starting from the day of delivery) and doesn't cover any other items nor expendable items (items which wear out). In order to use the instrument over a prolonged period of time, we recommend periodic replacement. Contact your nearest Yokogawa sales representative for replacement parts. Addresses may be found on the back cover of this manual.

Parts name	Replacement interval
Built-in printer	after printing 120 rolls (parts No. B9850NX) continuously
LCD back light	Approx. 2500 hours when used continuously

Parts Name	Warranty Period
Internal hard disk	One year after purchase (data are excluded)

16.1 Input Section

Item	Specifications
No. of input channels	4 (CH1 to CH4) : analog input
Input coupling	AC, DC, GND
Input connector	BNC connector
Input impedance	1 MΩ ±1.5%, approx. 25 pF
Voltage axis sensitivity setting range*1	1 mV/div to 5 V/div (in multiples of 1, 2 and 5)
Maximum input voltage (when frequency is 1 kHz or lower)	250 V(DC+ACpeak) or 177 Vrms CAT I and II
Maximum DC offset setting range (probe attenuation 1:1)	5 V/div to 1 V/div : ±100 V 500 mV/div to 100 mV/div: ±10 V 50 mV/div to 1 mV/div : ±1 V
Vertical axis accuracy*1 *2	
DC accuracy	1 mv/div : ± (5 % of 8 div + 1 LSB) 100 mv/div : ± (1.5 % of 8 div + 1 LSB) others : ± (2.5 % of 8 div + 1 LSB)
Offset voltage axis accuracy	5 V/div to 1 V/div : ± (2.5 % of setting + 20 mV) 500 mV/div to 100 mV/div: ± (1 % of setting + 2 mV) 50 mV/div to 1 mV/div : ± (2.5 % of setting + 0.2 mV)
Frequency characteristics *2 (–3 dB point when sine wave of amplitude ±4 div is input)	5 V/div to 10 mV/div Repetitive : DC to 150 MHz Single : DC to 80 MHz (when using CH1/2 simultaneously measuring) : DC to 40 MHz (when using 3/4 Ch. simultaneously measuring 5 mV/div Repetitive : DC to 80 MHz Single : DC to 80 MHz (when using CH1/2 simultaneously measuring) : DC to 40 MHz (when using 3/4 Ch. simultaneously measuring) 2 mV/div, 1 mV/div : DC to 20 MHz
–3 dB point when AC coupling used	10 Hz or below (1 Hz or below in case the accessory 10:1 probe is being used)
Inter-channel skew (under the same conditions)	2 ns or less
Residual noise level *3	±0.7 mV or ±0.12 div (typical value*5), whichever greater
Inter-channel isolation (same voltage axis sensitivity, DC to 150 MHz)	–40 dB (typical value*5)
A/D converter resolution	8 bit (25 LSB/div)
Probe attenuation	1:1, 10:1, 100:1, 1000:1
Bandwidth limit	Bandwidth limit can be turned ON/OFF for 20 MHz
Maximum sampling rate	real-time sampling mode 2 channels measurement : 200 MS/s (CH1/CH2) 3/4 channels measurement : 100 MS/s repetitive sampling mode : 20 GS/s
Maximum Record length	(For DL1540C) When trigger mode is single long mode 2 channels measurement : 120 K (100 K*4)W/CH (for CH1/CH2 only) 3/4 channels measurement : 56 K (50 K*4)W/CH When in roll mode : 20 K (10 K*4)W/CH In other cases : 10 K (10 K*4)W/CH (For DL1540CL) 2 channels measurement : 2 MW/CH (for CH1/CH2 only) 3/4 channels measurement : 1 MW/CH

*1 Voltage axis sensitivity of 1 mV/div can be achieved by digital zooming (2 mV/div x 2).

*2 Measured with the internal clock selected as the timebase and the voltage axis sensitivity set to “CAL”, after calibration following a 30-minute warm-up, under the standard operating conditions stipulated on page 16-8.

*3 Measured with the input short-circuited, record length set to 10 KW, acquisition mode set to normal mode and accumulation function OFF.

*4 Record length displayed on the screen

*5 Typical values are described in terms of typical of average performance. However, they cannot be guaranteed.

16.2 Trigger Section

Item	Specifications	
Trigger source	CH1, CH2, CH3 and CH4 (signal which is input to each input terminal), LINE (commercial power source signal), EXT (signal input to the TRIG IN terminal)	
Trigger type	Edge trigger	: Activates a trigger on the edge of a single trigger source.
	Window Trigger	: Activates a trigger when the source level of channel 1either enters a previously set range of voltages or protrudes from a previously set range of voltages.
	TV Trigger	: Activates a trigger for the video signal in NTSC, PAL or HDTV (studio standard high-vision signal) broadcasting systems. Only CH1 is available for this function. Designation of field No. and line No. is possible.
	OR Trigger (optional)	: Activates a trigger when one of the trigger source conditions becomes true. The edge trigger condition can be selected for each trigger source.
	Pattern trigger (optional)	: Activates a trigger when all the multiple trigger source conditions become true. Trigger condition can be selected from High or Low for each trigger source. Clock signal can also be selected.
	Width trigger (optional)	: Activates a trigger when the pulse width is greater or smaller than the specified width. Setting range below pulse width: 5 ns, 10 ns to 9.999 s Setting range above pulse width: 30 ns to 9.999 s
	*OR, PATTERN and WIDTH are provided as optional.	
Trigger mode	Auto	: Acquires waveform automatically if no trigger is activated for more than approx. 100 ms.
	Auto-level	: Automatically sets the trigger level to the median of the amplitude if no trigger is activated for more than approx. 100 ms.
	Normal	: Acquires waveform only when a trigger is activated.
	Single	: Acquires waveform only once when a trigger is activated.
	Single (N)	: Acquires waveform when a trigger is activated the specified number of times.
Trigger slope	Rise, fall and rise/fall	
Trigger coupling	DC or AC for trigger source.	
HF rejection	Bandwidth limit (approx. DC to 15 kHz) for the trigger source can be turned ON/OFF.	
Trigger level	Setting range	: ±10 div from the center of the waveform display frame
	Setting resolution	: 1/50 div
	Accuracy*1	: ±(1 div + 10% of trigger level)
Trigger sensitivity (when frequency of trigger source is DC to 150 MHz)	1 divp-p	
Trigger position	0, ±4 div from the center of waveform display frame (Settable from –5 div to +5 div in steps of 1/50 div)	
Trigger delay setting range	0 to 9.999 s (normal delay)	
Inter channel trigger skew*2 (when vertical sensitivity is the same)	5 ns or less	

*1 Measured with the internal clock selected as the timebase and the voltage axis sensitivity set to “CAL”, after calibration following a 30-minute warm-up, under the standard operating conditions stipulated on page 16-8.

*2 Measured with a voltage axis sensitivity of 50 mV/div when a pulse of amplitude of 5 div p-p and rise time of 1 ns is input. Trigger coupling: DC, HF rejection : OFF

16.3 Time Axis

Item	Specifications
Time axis setting range	5 ns/div to 50 s/div
Time axis accuracy*	± (0.01 % + 500 ps)
External clock	External clock can be selected from the following two signals. • Input signal to “EXT CLOCK IN” Connector type : BNC Maximum input voltage : ±6 V Input frequency range : 40 Hz to 15 MHz (only for continuous clock) Input level : TTL/CMOS level recommended (0.3 Vp-p or greater at the end of the connector, ±0.15 V or greater relative to the threshold level) Input impedance : Approx. 1 MΩ Threshold level : 1.5 V or 0.15 V Minimum pulse width : 25 ns or more for both High and Low levels • Input signal to CH4 Input frequency range : 40 Hz to 40 MHz (only for continuous clock) Input level : 2 divp-p or higher Threshold level : Set by the trigger level (CH4) Minimum pulse width : 5 ns or more for both High and Low levels

* Measured after 30-minute warm-up, under the standard operating conditions stipulated on page 16-8.

16.4 Display

Item	Specifications
Display	Size: 6.4, display method: colored TFT LCD, display resolution: 640 dots (horizontal) x 480 dots (vertical)
Display area	Voltage axis: 8 div Time axis: 10 div , 501 dots (horizontal) x 401 dots (vertical) or 501 dots (horizontal) x 401 dots (vertical)
Display resolution	Voltage axis: 50 dots/div (A/D converter resolution equivalent: 25 LSB/div) Time axis: 50 dots/div (compressed)
Maximum display update interval	60 times/s
Max. No. of displayed waveforms	8 waveforms

* In some cases, up to 0.02% of the pixels of the LCD can be defective (with respect to the total number of display pixels).

16.5 Functions

Item	Specifications
Auto set-up	Makes the voltage axis, time axis, and trigger settings automatically.
Initialization	Automatically resets settings to the factory settings.
Snapshot	Retains the waveform displayed when the SNAP SHOT key is pressed.
Clear trace	Clears snapshot and accumulated waveforms.
Calibration	Automatic calibration and manual calibration are available.
Waveform display ON/OFF	Display ON/OFF function is available for each of the channels CH1 to CH4.
Waveform inversion	Inverts waveforms about the ground level.
Vertical position setting	Moves waveforms vertically within ±4 div of the center of the waveform display frame.
Horizontal position setting	Moves display positions horizontally within ±5 div of the center of the waveform display frame.
Acquisition mode	Normal, envelope and averaging modes are available.
Sampling mode	For some time-axis settings, the user can switch between real-time sampling and repetitive sampling.
Record length	For DL1540CL, 1 KW, 10 KW, 100 KW, 400 KW, 1 MW, or 2 MW(selectable). For DL1540C, automatically set according to Time axis/Sample rate/Trigger mode/ Acquisition mode.
Sequential store function	Stores waveforms only a specified number of times (up to 100) in case of real time sampling mode.
History memory	Stores 100 acquisition data in case of real time sampling mode.
Waveform expansion	Displayed waveforms can be expanded in the time axis direction.
Display interpolation	Interpolation method can be selected from straight line, sine, pulse and OFF (no ÇR interpolation).
Smoothing	Displays waveforms obtained by moving averaging on sets of 5 data points.
Input filter	20 MHz
Accumulation	Time for performing accumulation can be selected from 100 ms to 60 s, and INFINITE.
X-Y waveform display	Two waveforms (CH1-X axis/CH2-Y axis) can be displayed simultaneously.
Graticule/Scale	Allows selection of scale from frame and grid, turns display of the scale ON/OFF, turns the % marker ON/OFF.
Intensity adjustment	Intensity can be adjusted for each displayed item.
Cursor measurements	Uses the vertical and horizontal cursors to measure the voltage and time at the cursor position, as well as the difference in voltage and time between the cursor positions.
Automated measurements	All 21 items of one channel, or any selected item at each channel, can be displayed. Displayble items depend at the number of displayed waveforms. In addition to measurement of displayed data, measurement of actual data within acquisition memory is also supported.
Waveform computation	Performs subtraction, addition and multiplication between channels CH1 and CH2.
Phase shift	Performs waveform computation with the phase of CH2 shifted.
FFT computation	Displays the power spectrum after having selected the time frame from rectangular or hanning.
GO/NO-GO judgment	The following two types of GO/NO-GO are available. • Judgment is made using the zone on the screen (simultaneous judgment of four waveforms is possible). • Judgment is made using the automatically measured waveform parameters.
Screen hardcopy and additional information print-out	Outputs screen hardcopy and additional information (setup and waveform parameters) to the built- in printer (optional) or to an external HP-GL plotter via the GP-IB interface.
Real-time printing	Prints out waveforms, similar to a recorder.
Action-on-trigger	Records data automatically when a trigger is activated. Selectable whether a hardcopy is printed out on the built-in printer or whether the data will be stored to a floppy disk.
Data Storage/Recall	Stores and recalls waveform data and set-ups from the internal memory and floppy disk. DL1540C/DL1540CL can use a SCSI device through the SCSI interface unit 700930 (sold separately).
Calibration signal	Approx. 1 kHz / 1 V

16.6 Rear Panel Input/Output Section

Item	Specifications	
External trigger input (EXT TRIG IN)*1	Connector type	: BNC
	Input band	: DC to 15 MHz
	Input impedance	: Approx. 1 MΩ
	Maximum input voltage	: ±6 V
	Trigger level	: 1.5 V or 0.15 V
	Input amplitude	: TTL/CMOS level recommended (0.3 Vp-p or greater at the end of the connector, ±0.15 V or greater relative to the threshold level)
	Input pulse width	: 25 ns or more for both High and Low levels
Trigger output (TRIG OUT)	Connector type	: BNC
	Output level	: TTL
	Output logic	: Negative (trailing edge)
	Output delay time	: 200 ns max.
	Output hold time	: 20 µs min. for low level, 200 ns min. for high level
GO/NO-GO input/output (NO-GO OUT, GO OUT)	Connector type	: Half-pitch interface cable (DDK: DHA-RB50-S132)*2 Straight type, 6-polar modular (HIROSE: TM3RA1-66(01))*3
	Output level	: TTL
	Output logic	: Negative
	Output	: NO-GO OUT signal, GO OUT signal
	Output timing	: Refer to page 9-13.
RGB video signal outoput (RGB VIDEO OUT)	Connector type	: D-sub15 pin receptacle
	Output type	: VGA compatible

*1 The external trigger input terminal (EXT TRIG IN) is also used as the external clock input terminal (EXT CLOCK IN). For specifications of the external clock input, refer to page 16-3.

*2 Applies to models other than the DL1540CL with the /C8 option.

*3 Applies to the DL1540CL with the /C8 option.

16.7 Communication Interface

For details regarding the GP-IB/RS-232-C interface, refer to the “Communication Interface User’s Manual” (IM 701530-11E).

GP-IB Interface

Item	Specifications
Interface	GP-IB
Electrical and mechanical specifications	Conforms to IEEE St’d 488-1978 (JIS C 1901-1987).
Interface function	SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT0, C0
Protocol	Conforms to IEEE St’d 488.2-1987.
Code	ISO (ASCII) code
Mode	Addressable mode/talk-only mode
Address setting	Listener and talker addresses 0 to 30 are settable.
Remote mode clear	Remote mode can be cleared by pressing the LOCAL key (except when local lock-out has been set).

RS-232-C Interface

DL1540C/DL1540CL can use a SCSI device through the RS-232-C interface unit 700927 (sold separately).

Item	Specifications
Connector type	DELC-J9PAF-13L6(JAE or equivalent)
Electrical specifications	Conforms to EIA RS-232-C Standard.
Connection format	point to point
Communication format	full duplex
Synchronizing format	Start-stop asynchronous transmission
Baud rate	75/ 150/ 300/ 600/ 1200/ 2400/ 4800/ 9600/ 19200

SCSI (Small Computer System Interface)

You need to be using a model with the internal hard disk (DL1540CL /C8 option) or the SCSI interface unit 700930 (sold separately).

tem	Specifications
Interface standard	Conforms to ANSI X3.131-1986 for SCSI (Small Computer System Interface)
Connector shape	Half pitch 50 pins (Converting to the pin type is possible with the SCSI adapter accessory)*1 Half pitch 50 pins (pin type, FUJITSU: FCN-234D50-G/C)*2
Electrical specifications	Single end (see IM700930-01E for pin configurations)*1 Single end, built-in terminator (always ON)*2
SCSI Devices that can be Used*3 format in	HD Drives : SCSI HD drives for MS-DOS ver.3.3 or later, or SCSI HD drives that can EZ-SCSI. MO Drives : 128/230/640 MB drives. MO media uses Semi IBM format. ZIP Drives PD Drives

*1 Applies to models other than the DL1540CL with the /C8 option.
*2 Applies to the DL1540CL with the /C8 option.
*3 SCSI devices which can send and receive data over the SCSI and which can set the ID number to “5” can be used (on models with the /C8 option, SCSI devices set to an ID other than “5” can also be used). There are exceptions as in the case when the media used on the SCSI device is formatted with another equipment such as a PC, or when the pin configuration of the connector is different. The specifications of each SCSI device are shown above. For details, contact your nearest YOKOGAWA dealer.

16.8 Built-in Printer (optional)

Item	Specifications
Printing system	Thermal line dot method
Dot density	6 dots/mm
Paper width	112 mm
Real-time printout	max. chart speed of 16.7 mm/s (speed drops at time axis settings slower than 500ms/div)

16.9 Built-in Floppy Disk Drive

Item	Specifications
Drive size	3.5 inch
No. of drives	1
Format type	640 KB, 720 KB, 1.2 MB and 1.44 MB (MS-DOS compatible)

16.10Internal Hard Disk (for /C8 option)

Item	Specifications
No. of drives	1
Capacity	2.1 GB (IBM format)

* Can be mounted on a PC (Windows 95/98 compatible) via the SCSI.

16.11General Specifications

Item	Specifications
Safety standard*	Complying standard :EN61010 • Overvoltage category II • Pollution degree 2
Emission*	Complying Standard : EN55011:Class A, Group1 This is a Class A product(for industrial environment). In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures. • Cable conditions • External trigger/clock input terminal Connected BNC cable(3D2W), with both side's Ferrite Cores(TDK:ZCAT2035-0930A) • Trigger output terminal Same as above for the External trigger/clock input terminal • Connecter for half pitch interface Connected the cable B9920TA(the dedicated cable for RS-232-C Unit-700927)
Immunity*	Complying Standard : EN50082-2:1995 • Susceptibility under immunity condition Noise increase : < ±60 mV SCSI interface : No effect • Testing Condition 100 Msps 20 mV/div PeakDetect(Envelope)Mode 20 MHzBWL, Channel Input terminated with 50 Ω. • Cables Condition The applied BNC cable must be shorter than 3 meters. The applied analog RGB cable, used for RGB video signal output, must be shorter than 3 meters.
Standard operating conditions	Ambient temperature : 23 ±2 °C Ambient humidity : 55 ±10 % RH Power voltage and frequency fluctuation : Less than 1 % of the rated voltage/frequency
Warm-up time	30 min. or more
Storage conditions	Temperature : –20 to 60 °C Humidity : 20 to 85 % RH (no condensation allowed)
Operating conditions	Temperature : 5 to 40 °C Humidity : 20 to 85 % RH (without printer) : 35 to 85 % RH (with printer) (No condensation allowed in either case)
Storage altitude	3000 m or below
Operating altitude	2000 m or below
Rated supply voltage	100 to 120 VAC/200 to 240 VAC
Permitted supply voltage range	90 to 132 VAC/180 to 264 VAC
Rated supply voltage frequency	50/60 Hz
Permitted supply voltage frequency	48 to 63 Hz
Power Supply Fuse	250 V, 3.15 A, Time lag, VDE/SEMKO approved
Maximum power consumption (when the built-in printer is used)	240 VA (100 to 120 VAC)/300 VA (200 to 240 VAC) (when the built-in printer is not used; refer to page 3-3)

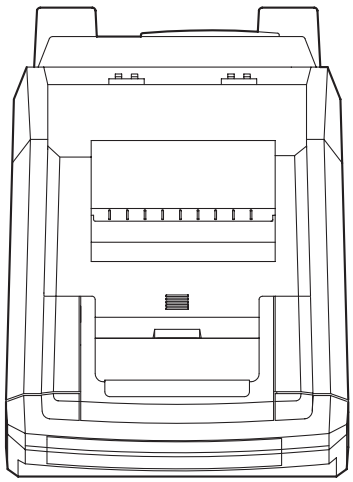
* Applies to products manufactured after Jan. 1999 having the CE Mark. For all other products, please contact your nearest YOKOGAWA representative.

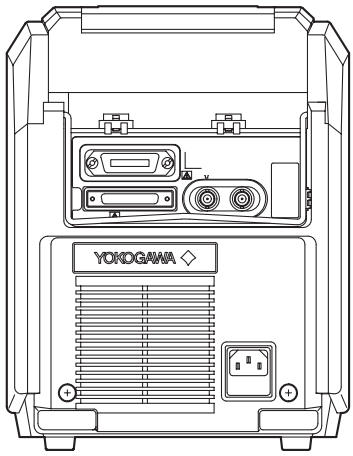
Item	Specifications
Withstand voltage (between power supply and case)	1.5 kVAC for 1 minute
Insulation resistance (between power supply and case)	10 MΩ or more at 500 VDC
External dimensions	Approx. 217 (W) x 268 (H) x 278 (D) mm (projections excluded).
Weight (without printer, only main body)	DL1540C : Approx. 4.9 kg; DL1540CL : Approx. 5.2 kg
Cooling method	Forced air cooling, air discharged from the rear and left side
Installation position	Horizontal (one on top of another not allowed), vertical (using supports)
Battery back-up	Set-up data and internal clock are backed up by a built-in lithium battery Battery life is approx. 10 years (at ambient temperature of 23°C)
Accessories	• Power cord (1) • Printer connecting cable (1, supplied with DL1520-C3 only) • 150 MHz probe (10:1, 1:1 selectable) (2, or 4 if two optional probes are added) • Power supply fuse (in fuse holder) (2, including a spare one) A1351EF • Front cover (1) • Roll chart (1, supplied only when the instrument is equipped with a printer) • User's Manual (1, this manual) • Operation Guide (1) • Communication Interface User's Manual (1)

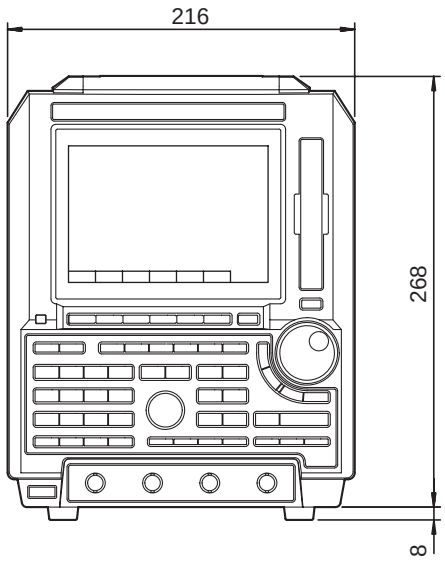
16.12External Dimensions

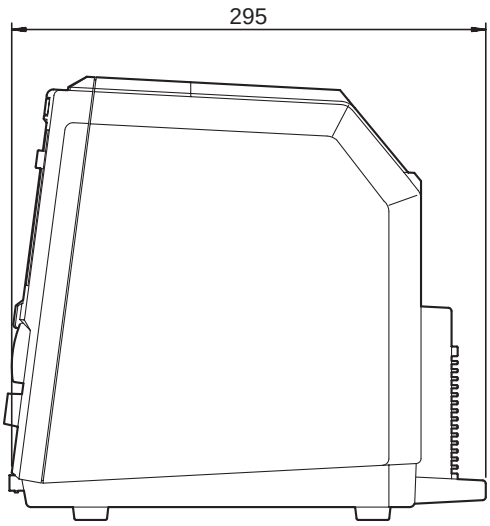
Unit : mm

Rear View









If not specified, the tolerance is ±3%. However, in cases of less than 10mm, the tolerance is ±0.3mm.

Appendix 1 Menu Map

The following menus are displayed when initialization is performed (i.e. when factory settings are restored). The menus for DL1540C are shown below as examples.

Key Operation & First menu

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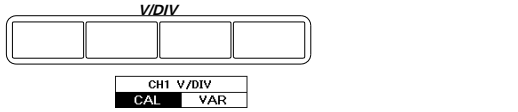

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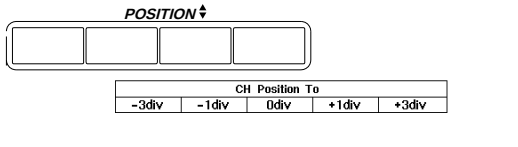

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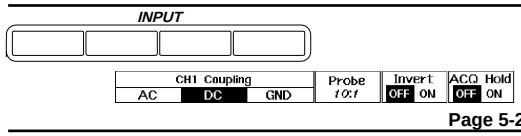

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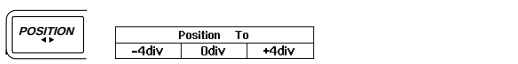

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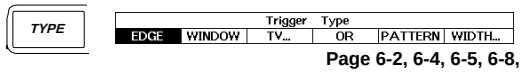

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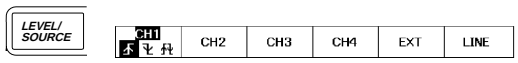

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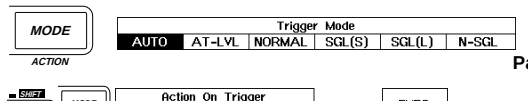

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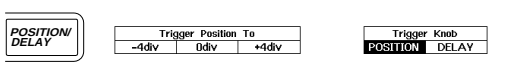

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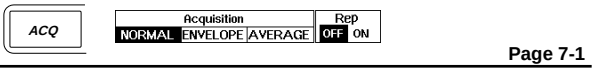
Key Operation & First menu



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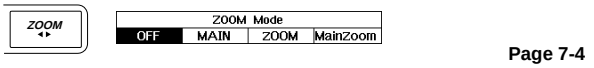

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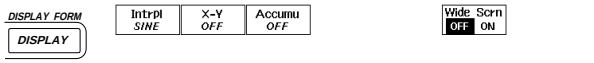

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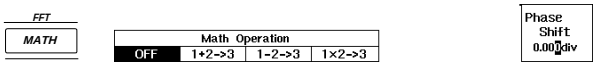

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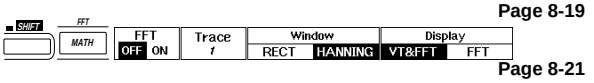

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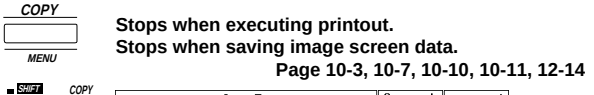

Stops when executing printout.
Stops when saving image screen data.

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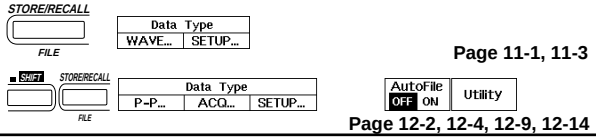

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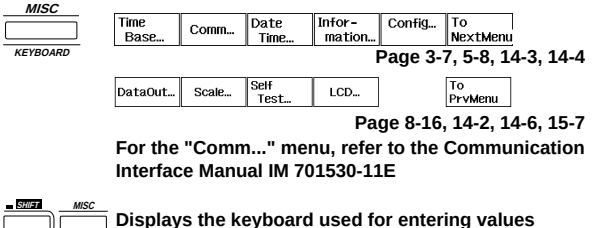

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For the "Comm..." menu, refer to the Communication Interface Manual IM 701530-11E

Displays the keyboard used for entering values

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Appendix 2 Relationship between the Time Axis Setting, Sample Rate and Record Length (for DL1540C)

The record length varies according to the time axis setting as shown below.

trigger mode : auto, auto level, normal, single short
hysterisys : OFF

Rep: Repetitive sampling mode

T/div	When Mode other than Envelope Mode is Active								When Envelope Mode is Active	
	At Least One of CH3, CH4 is ON				CH3, CH4 are Both OFF					
	Rep: "OFF"		Rep: "ON"		Rep: "OFF"		Rep: "ON"			
	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)
50s	20	10K(20K)	20	10K(20K)	20	10K(20K)	20	10K(20K)	100M[10 x 2]	5K x 2(10K x 2)
20s	50	10K(20K)	50	10K(20K)	50	10K(20K)	50	10K(20K)	100M[25 x 2]	5K x 2(10K x 2)
10s	100	10K(20K)	100	10K(20K)	100	10K(20K)	100	10K(20K)	100M[50 x 2]	5K x 2(10K x 2)
5s	200	10K(20K)	200	10K(20K)	200	10K(20K)	200	10K(20K)	100M[100 x 2]	5K x 2(10K x 2)
2s	500	10K(20K)	500	10K(20K)	500	10K(20K)	500	10K(20K)	100M[250 x 2]	5K x 2(10K x 2)
1s	1k	10K(20K)	1k	10K(20K)	1k	10K(20K)	1k	10K(20K)	100M[500 x 2]	5K x 2(10K x 2)
500ms	2k	10K(20K)	2k	10K(20K)	2k	10K(20K)	2k	10K(20K)	100M[1k x 2]	5K x 2(10K x 2)
200ms	5k	10K(20K)	5k	10K(20K)	5k	10K(20K)	5k	10K(20K)	100M[2.5k x 2]	5K x 2(10K x 2)
100ms	10k	10K(20K)	10k	10K(20K)	10k	10K(20K)	10k	10K(20K)	100M[5k x 2]	5K x 2(10K x 2)
50ms	20k	10K(20K)	20k	10K(20K)	20k	10K(20K)	20k	10K(20K)	100M[10k x 2]	5K x 2(10K x 2)
20ms	50k	10K	50k	10K	50k	10K	50k	10K	100M[25k x 2]	5K x 2
10ms	100k	10K	100k	10K	100k	10K	100k	10K	100M[50k x 2]	5K x 2
5ms	200k	10K	200k	10K	200k	10K	200k	10K	100M[100k x 2]	5K x 2
2ms	500k	10K	500k	10K	500k	10K	500k	10K	100M[250k x 2]	5K x 2
1ms	1M	10K	1M	10K	1M	10K	1M	10K	100M[500k x 2]	5K x 2
500µs	2M	10K	2M	10K	2M	10K	2M	10K	100M[1M x 2]	5K x 2
200µs	5M	10K	5M	10K	5M	10K	5M	10K	100M[2.5M x 2]	5K x 2
100µs	10M	10K	10M	10K	10M	10K	10M	10K	100M[5M x 2]	5K x 2
50µs	20M	10K	20M	10K	20M	10K	20M	10K	100M[10M x 2]	5K x 2
20µs	50M	10K	50M	10K	50M	10K	50M	10K	100M[10M x 2]	2K x 2
10µs	100M	10K	100M	10K	100M	10K	100M	10K	**Changes to normal mode, even when envelope mode has been set.**	
5µs	100M	5K	200M	10K	200M	10K	200M	10K		
2µs	100M	2K	500M	10K	200M	4K	500M	10K		
1µs	100M	1K	1G	10K	200M	2K	1G	10K		
500ns	100M	500	2G	10K	200M	1K	2G	10K		
200ns	100M	200	5G	10K	200M	400	5G	10K		
100ns	100M	100	10G	10K	200M	200	10G	10K		
50ns	20G	10K	20G	10K	20G	10K	20G	10K		
20ns	20G	4K	20G	4K	20G	4K	20G	4K		
10ns	20G	2K	20G	2K	20G	2K	20G	2K		
5ns	20G	1K	20G	1K	20G	1K	20G	1K		

*1 The displayed record length given in ( ) refers to the record length stored in the acquisition memory.
Only when the trigger mode is auto or auto level, data of a record length given in ( ) is stored.
In case where no value in ( ) is given, the displayed record length and the record length stored in the acquisition memory are the same.

*2 The sample rate given in ( ) for the envelope mode is the rate at which data are acquired after having been sampled at 100MS/s and having taken the minimum and maximum values.

*3 In the envelope mode, the minimum / maximum values are displayed in a pair.

*4 For the setting enclosed by the bold line, repetitive sampling mode is active.

(For DL1540C)
trigger mode : single long
hysterisys : OFF

T/div	When Mode other than Envelope Mode is Active				When Envelope Mode is Active			
	At Least One of CH3, CH4 is ON		CH3, CH4 are Both OFF		At Least One of CH3, CH4 is ON		CH3, CH4 are Both OFF	
	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)
50s	100	50K(56K)	200	100K(120K)	100M[50 x 2]	25K x 2(28K x 2)	100M[100 x 2]	50K x 2(60K x 2)
20s	200	40K(56K)	500	100K(120K)	100M[100 x 2]	20K x 2(28K x 2)	100M[250 x 2]	50K x 2(60K x 2)
10s	500	50K(56K)	1k	100K(120K)	100M[250 x 2]	25K x 2(28K x 2)	100M[500 x 2]	50K x 2(60K x 2)
5s	1k	50K(56K)	2k	100K(120K)	100M[500 x 2]	25K x 2(28K x 2)	100M[1k x 2]	50K x 2(60K x 2)
2s	2k	40K(56K)	5k	100K(120K)	100M[1k x 2]	20K x 2(28K x 2)	100M[2.5k x 2]	50K x 2(60K x 2)
1s	5k	50K(56K)	10k	100K(120K)	100M[2.5k x 2]	25K x 2(28K x 2)	100M[5k x 2]	50K x 2(60K x 2)
500ms	10k	50K(56K)	20k	100K(120K)	100M[5k x 2]	25K x 2(28K x 2)	100M[10k x 2]	50K x 2(60K x 2)
200ms	20k	40K(56K)	50k	100K(120K)	100M[10k x 2]	20K x 2(28K x 2)	100M[25k x 2]	50K x 2(60K x 2)
100ms	50k	50K(56K)	100k	100K(120K)	100M[25k x 2]	25K x 2(28K x 2)	100M[50k x 2]	50K x 2(60K x 2)
50ms	100k	50K(56K)	200k	100K(120K)	100M[50k x 2]	25K x 2(28K x 2)	100M[100k x 2]	50K x 2(60K x 2)
20ms	200k	40K(56K)	500k	100K(120K)	100M[100k x 2]	20K x 2(28K x 2)	100M[250k x 2]	50K x 2(60K x 2)
10ms	500k	50K(56K)	1M	100K(120K)	100M[250k x 2]	25K x 2(28K x 2)	100M[500k x 2]	50K x 2(60K x 2)
5ms	1M	50K(56K)	2M	100K(120K)	100M[500k x 2]	25K x 2(28K x 2)	100M[1M x 2]	50K x 2(60K x 2)
2ms	2M	40K(56K)	5M	100K(120K)	100M[1M x 2]	20K x 2(28K x 2)	100M[2.5M x 2]	50K x 2(60K x 2)
1ms	5M	50K(56K)	10M	100K(120K)	100M[2.5M x 2]	25K x 2(28K x 2)	100M[5M x 2]	50K x 2(60K x 2)
500µs	10M	50K(56K)	20M	100K(120K)	100M[5M x 2]	25K x 2(28K x 2)	100M[10M x 2]	50K x 2(60K x 2)
200µs	20M	40K(56K)	50M	100K(120K)	100M[10M x 2]	20K x 2(28K x 2)	100M[10M x 2]	20K x 2(40K x 2)
100µs	50M	50K(56K)	100M	100K(120K)	100M[10M x 2]	10K x 2(20K x 2)		
50µs	100M	50K(56K)	200M	100K(120K)				
20µs	100M	20K(40K)	200M	40K(80K)				
10µs	100M	10K(20K)	200M	20K(40K)				
5µs	100M	5K(10K)	200M	10K(20K)				
2µs	100M	2K(4K)	200M	4K(8K)				
1µs	100M	1K(2K)	200M	2K(4K)				
500ns	100M	500(1K)	200M	1K(2K)				
200ns	100M	200(400)	200M	400(800)				
100ns	100M	100(200)	200M	200(400)				

Changes to normal mode, even when envelope mode has been set.

*1 The displayed record length given in ( ) refers to the record length stored in the acquisition memory.
Only when the trigger mode is auto or auto level, data of a record length given in ( ) is stored.
In case where no value in ( ) is given, the displayed record length and the record length stored in the acquisition memory are the same.

*2 The sample rate given in ( ) for the envelope mode is the rate at which data are acquired after having been sampled at 100MS/s and having taken the minimum and maximum values.

*3 In the envelope mode, the minimum / maximum values are displayed in a pair.

(For DL1540C)
trigger mode : single (N) or with history function ON

T/div	When Mode other than Envelope Mode is Active				When Envelope Mode is Active	
	At Least One of CH3, CH4 is ON		CH3, CH4 are Both OFF			
	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)
50s	2	1K x 100	2	1K x 100	100M[1 x 2]	500 x 2 x 100
20s	5	1K x 100	5	1K x 100	100M[2.5 x 2]	500 x 2 x 100
10s	10	1K x 100	10	1K x 100	100M[5 x 2]	500 x 2 x 100
5s	20	1K x 100	20	1K x 100	100M[10 x 2]	500 x 2 x 100
2s	50	1K x 100	50	1K x 100	100M[25 x 2]	500 x 2 x 100
1s	100	1K x 100	100	1K x 100	100M[50 x 2]	500 x 2 x 100
500ms	200	1K x 100	200	1K x 100	100M[100 x 2]	500 x 2 x 100
200ms	500	1K x 100	500	1K x 100	100M[250 x 2]	500 x 2 x 100
100ms	1k	1K x 100	1k	1K x 100	100M[500 x 2]	500 x 2 x 100
50ms	2k	1K x 100	2k	1K x 100	100M[1k x 2]	500 x 2 x 100
20ms	5k	1K x 100	5k	1K x 100	100M[2.5k x 2]	500 x 2 x 100
10ms	10k	1K x 100	10k	1K x 100	100M[5k x 2]	500 x 2 x 100
5ms	20k	1K x 100	20k	1K x 100	100M[10k x 2]	500 x 2 x 100
2ms	50k	1K x 100	50k	1K x 100	100M[25k x 2]	500 x 2 x 100
1ms	100k	1K x 100	100k	1K x 100	100M[50k x 2]	500 x 2 x 100
500µs	200k	1K x 100	200k	1K x 100	100M[100k x 2]	500 x 2 x 100
200µs	500k	1K x 100	500k	1K x 100	100M[250k x 2]	500 x 2 x 100
100µs	1M	1K x 100	1M	1K x 100	100M[500k x 2]	500 x 2 x 100
50µs	2M	1K x 100	2M	1K x 100	100M[1M x 2]	500 x 2 x 100
20µs	5M	1K x 100	5M	1K x 100	100M[2.5M x 2]	500 x 2 x 100
10µs	10M	1K x 100	10M	1K x 100	100M[5M x 2]	500 x 2 x 100
5µs	20M	1K x 100	20M	1K x 100	100M[10M x 2]	500 x 2 x 100
2µs	50M	1K x 100	50M	1K x 100	100M[10M x 2]	200 x 2 x 100
1µs	100M	1K x 100	100M	1K x 100	**Changes to normal mode, even when envelope mode has been set.**	
500ns	100M	500 x 100	200M	1K x 100		
200ns	100M	200 x 100	200M	400 x 100		
100ns	100M	100 x 100	200M	200 x 100		

*1 The displayed record length given in ( ) refers to the record length stored in the acquisition memory. Only when the trigger mode is auto or auto level, data of a record length given in ( ) is stored. In case where no value in ( ) is given, the displayed record length and the record length stored in the acquisition memory are the same.

*2 The sample rate given in ( ) for the envelope mode is the rate at which data are acquired after having been sampled at 100MS/s and having taken the minimum and maximum values.

*3 In the envelope mode, the minimum / maximum values are displayed in a pair.

*4 The displayed record length x100 shows the number of repeated waveform acquisition out of 100 in the single (N) mode or hysterisys function.

Appendix 3 Relationship between the Time Axis Setting, Sample Rate and Record Length (for DL1540CL)

Displayed record length varies according to the time-axis setting, as omdicated below.

When "Maximum Displayable Record Length" is set to 1KW

Rep: Repetitive sampling mode

		When Mode other than Envelope Mode is Active								When Envelope Mode is Active	
		At Least One of CH3, CH4 is ON				CH3, CH4 are Both OFF					
		Rep: "OFF"		Rep: "ON"		Rep: "OFF"		Rep: "ON"			
	T/div	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)
Roll mode display	50s	2	1K(2K)	2	1K(2K)	2	1K(2K)	2	1K(2K)	100M[1 x 2]	500 x 2(1K x 2)
	20s	5	1K(2K)	5	1K(2K)	5	1K(2K)	5	1K(2K)	100M[2.5 x 2]	500 x 2(1K x 2)
	10s	10	1K(2K)	10	1K(2K)	10	1K(2K)	10	1K(2K)	100M[5 x 2]	500 x 2(1K x 2)
	5s	20	1K(2K)	20	1K(2K)	20	1K(2K)	20	1K(2K)	100M[10 x 2]	500 x 2(1K x 2)
	2s	50	1K(2K)	50	1K(2K)	50	1K(2K)	50	1K(2K)	100M[25 x 2]	500 x 2(1K x 2)
	1s	100	1K(2K)	100	1K(2K)	100	1K(2K)	100	1K(2K)	100M[50 x 2]	500 x 2(1K x 2)
	500ms	200	1K(2K)	200	1K(2K)	200	1K(2K)	200	1K(2K)	100M[100 x 2]	500 x 2(1K x 2)
	200ms	500	1K(2K)	500	1K(2K)	500	1K(2K)	500	1K(2K)	100M[250 x 2]	500 x 2(1K x 2)
	100ms	1k	1K(2K)	1k	1K(2K)	1k	1K(2K)	1k	1K(2K)	100M[500 x 2]	500 x 2(1K x 2)
	50ms	2k	1K(2K)	2k	1K(2K)	2k	1K(2K)	2k	1K(2K)	100M[1k x 2]	500 x 2(1K x 2)
	20ms	5k	1K	5k	1K	5k	1K	5k	1K	100M[2.5k x 2]	500 x 2
	10ms	10k	1K	10k	1K	10k	1K	10k	1K	100M[5k x 2]	500 x 2
	5ms	20k	1K	20k	1K	20k	1K	20k	1K	100M[10k x 2]	500 x 2
	2ms	50k	1K	50k	1K	50k	1K	50k	1K	100M[25k x 2]	500 x 2
	1ms	100k	1K	100k	1K	100k	1K	100k	1K	100M[50k x 2]	500 x 2
	500µs	200k	1K	200k	1K	200k	1K	200k	1K	100M[100k x 2]	500 x 2
	200µs	500k	1K	500k	1K	500k	1K	500k	1K	100M[250k x 2]	500 x 2
	100µs	1M	1K	1M	1K	1M	1K	1M	1K	100M[500k x 2]	500 x 2
	50µs	2M	1K	2M	1K	2M	1K	2M	1K	100M[1M x 2]	500 x 2
	20µs	5M	1K	5M	1K	5M	1K	5M	1K	100M[2.5M x 2]	500 x 2
	10µs	10M	1K	10M	1K	10M	1K	10M	1K	100M[5M x 2]	500 x 2
	5µs	20M	1K	20M	1K	20M	1K	20M	1K	100M[10M x 2]	500 x 2
	2µs	50M	1K	50M	1K	50M	1K	50M	1K	100M[10M x 2]	200 x 2
	1µs	100M	1K	100M	1K	100M	1K	100M	1K		
	500ns	100M	500	200M	1K	200M	1K	200M	1K		
	200ns	100M	200	500M	1K	200M	400	500M	1K	**Changes to normal mode, even when envelope mode has been set.**	
	100ns	100M	100	1G	1K	200M	200	1G	1K		
	50ns	2G	1K	2G	1K	2G	1K	2G	1K		
	20ns	5G	1K	5G	1K	5G	1K	5G	1K		
	10ns	10G	1K	10G	1K	10G	1K	10G	1K		
	5ns	20G	1K	20G	1K	20G	1K	20G	1K		

*1 The displayed record length given in ( ) refers to the record length stored in the acquisition memory.
Only when the trigger mode is auto or auto level, data of a record length given in ( ) is stored.
In case where no value in ( ) is given, the displayed record length and the record length stored in the acquisition memory are the same.

*2 The sample rate given in ( ) for the envelope mode is the rate at which data are acquired after having been sampled at 100MS/s and having taken the minimum and maximum values.

*3 In the envelope mode, the minimum / maximum values are displayed in a pair.

*4 For the setting enclosed by the bold line, repetitive sampling mode is active.

When "Maximum Displayable Record Length" is set to 10KW

Rep: Repetitive sampling mode

		When Mode other than Envelope Mode is Active								When Envelope Mode is Active	
		At Least One of CH3, CH4 is ON				CH3, CH4 are Both OFF					
		Rep: "OFF"		Rep: "ON"		Rep: "OFF"		Rep: "ON"			
	T/div	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)
Roll mode display	50s	20	10K(20K)	20	10K(20K)	20	10K(20K)	20	10K(20K)	100M[10 x 2]	5K x 2(10K x 2)
	20s	50	10K(20K)	50	10K(20K)	50	10K(20K)	50	10K(20K)	100M[25 x 2]	5K x 2(10K x 2)
	10s	100	10K(20K)	100	10K(20K)	100	10K(20K)	100	10K(20K)	100M[50 x 2]	5K x 2(10K x 2)
	5s	200	10K(20K)	200	10K(20K)	200	10K(20K)	200	10K(20K)	100M[100 x 2]	5K x 2(10K x 2)
	2s	500	10K(20K)	500	10K(20K)	500	10K(20K)	500	10K(20K)	100M[250 x 2]	5K x 2(10K x 2)
	1s	1k	10K(20K)	1k	10K(20K)	1k	10K(20K)	1k	10K(20K)	100M[500 x 2]	5K x 2(10K x 2)
	500ms	2k	10K(20K)	2k	10K(20K)	2k	10K(20K)	2k	10K(20K)	100M[1k x 2]	5K x 2(10K x 2)
	200ms	5k	10K(20K)	5k	10K(20K)	5k	10K(20K)	5k	10K(20K)	100M[2.5k x 2]	5K x 2(10K x 2)
	100ms	10k	10K(20K)	10k	10K(20K)	10k	10K(20K)	10k	10K(20K)	100M[5k x 2]	5K x 2(10K x 2)
	50ms	20k	10K(20K)	20k	10K(20K)	20k	10K(20K)	20k	10K(20K)	100M[10k x 2]	5K x 2(10K x 2)
	20ms	50k	10K	50k	10K	50k	10K	50k	10K	100M[25k x 2]	5K x 2
	10ms	100k	10K	100k	10K	100k	10K	100k	10K	100M[50k x 2]	5K x 2
	5ms	200k	10K	200k	10K	200k	10K	200k	10K	100M[100k x 2]	5K x 2
	2ms	500k	10K	500k	10K	500k	10K	500k	10K	100M[250k x 2]	5K x 2
	1ms	1M	10K	1M	10K	1M	10K	1M	10K	100M[500k x 2]	5K x 2
	500µs	2M	10K	2M	10K	2M	10K	2M	10K	100M[1M x 2]	5K x 2
	200µs	5M	10K	5M	10K	5M	10K	5M	10K	100M[2.5M x 2]	5K x 2
	100µs	10M	10K	10M	10K	10M	10K	10M	10K	100M[5M x 2]	5K x 2
	50µs	20M	10K	20M	10K	20M	10K	20M	10K	100M[10M x 2]	5K x 2
	20µs	50M	10K	50M	10K	50M	10K	50M	10K	100M[10M x 2]	2K x 2
	10µs	100M	10K	100M	10K	100M	10K	100M	10K	**Changes to normal mode, even when envelope mode has been set.**	
	5µs	100M	5K	200M	10K	200M	10K	200M	10K		
	2µs	100M	2K	500M	10K	200M	4K	500M	10K		
	1µs	100M	1K	1G	10K	200M	2K	1G	10K		
	500ns	100M	500	2G	10K	200M	1K	2G	10K		
	200ns	100M	200	5G	10K	200M	400	5G	10K		
	100ns	100M	100	10G	10K	200M	200	10G	10K		
	50ns	20G	10K	20G	10K	20G	10K	20G	10K		
	20ns	20G	4K	20G	4K	20G	4K	20G	4K		
	10ns	20G	2K	20G	2K	20G	2K	20G	2K		
	5ns	20G	1K	20G	1K	20G	1K	20G	1K		

*1 The displayed record length given in ( ) refers to the record length stored in the acquisition memory.
Only when the trigger mode is auto or auto level, data of a record length given in ( ) is stored.
In case where no value in ( ) is given, the displayed record length and the record length stored in the acquisition memory are the same.

*2 The sample rate given in ( ) for the envelope mode is the rate at which data are acquired after having been sampled at 100MS/s and having taken the minimum and maximum values.

*3 In the envelope mode, the minimum / maximum values are displayed in a pair.

*4 For the setting enclosed by the bold line, repetitive sampling mode is active.

When "Maximum Displayable Record Length" is set to 100KW

Rep: Repetitive sampling mode

	When Mode other than Envelope Mode is Active								When Envelope Mode is Active	
	At Least One of CH3, CH4 is ON				CH3, CH4 are Both OFF					
	Rep: "OFF"		Rep: "ON"		Rep: "OFF"		Rep: "ON"			
T/div	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)
50s	200	100K(200K)	200	100K(200K)	200	100K(200K)	200	100K(200K)	100M[100 x 2]	50K x 2(100K x 2)
20s	500	100K(200K)	500	100K(200K)	500	100K(200K)	500	100K(200K)	100M[250 x 2]	50K x 2(100K x 2)
10s	1k	100K(200K)	1k	100K(200K)	1k	100K(200K)	1k	100K(200K)	100M[500 x 2]	50K x 2(100K x 2)
5s	2k	100K(200K)	2k	100K(200K)	2k	100K(200K)	2k	100K(200K)	100M[1k x 2]	50K x 2(100K x 2)
2s	5k	100K(200K)	5k	100K(200K)	5k	100K(200K)	5k	100K(200K)	100M[2.5k x 2]	50K x 2(100K x 2)
1s	10k	100K(200K)	10k	100K(200K)	10k	100K(200K)	10k	100K(200K)	100M[5k x 2]	50K x 2(100K x 2)
500ms	20k	100K(200K)	20k	100K(200K)	20k	100K(200K)	20k	100K(200K)	100M[10k x 2]	50K x 2(100K x 2)
200ms	50k	100K(200K)	50k	100K(200K)	50k	100K(200K)	50k	100K(200K)	100M[25k x 2]	50K x 2(100K x 2)
100ms	100k	100K(200K)	100k	100K(200K)	100k	100K(200K)	100k	100K(200K)	100M[50k x 2]	50K x 2(100K x 2)
50ms	200k	100K(200K)	200k	100K(200K)	200k	100K(200K)	200k	100K(200K)	100M[100k x 2]	50K x 2(100K x 2)
20ms	500k	100K	500k	100K	500k	100K	500k	100K	100M[250k x 2]	50K x 2
10ms	1M	100K	1M	100K	1M	100K	1M	100K	100M[500k x 2]	50K x 2
5ms	2M	100K	2M	100K	2M	100K	2M	100K	100M[1M x 2]	50K x 2
2ms	5M	100K	5M	100K	5M	100K	5M	100K	100M[2.5M x 2]	50K x 2
1ms	10M	100K	10M	100K	10M	100K	10M	100K	100M[5M x 2]	50K x 2
500µs	20M	100K	20M	100K	20M	100K	20M	100K	100M[10M x 2]	50K x 2
200µs	50M	100K	50M	100K	50M	100K	50M	100K	100M[10M x 2]	20K x 2
100µs	100M	100K	100M	100K	100M	100K	100M	100K		
50µs	100M	50K	100M	50K	200M	100K	200M	50K		
20µs	100M	20K	100M	20K	200M	40K	200M	20K		
10µs	100M	10K	100M	10K	200M	20K	200M	10K		
5µs	100M	5K	200M	10K	200M	10K	200M	10K		
2µs	100M	2K	500M	10K	200M	4K	500M	10K	**Changes to normal mode, even when envelope mode has been set.**	
1µs	100M	1K	1G	10K	200M	2K	1G	10K		
500ns	100M	500	2G	10K	200M	1K	2G	10K		
200ns	100M	200	5G	10K	200M	400	5G	10K		
100ns	100M	100	10G	10K	200M	200	10G	10K		
50ns	20G	10K	20G	10K	20G	10K	20G	10K		
20ns	20G	4K	20G	4K	20G	4K	20G	4K		
10ns	20G	2K	20G	2K	20G	2K	20G	2K		
5ns	20G	1K	20G	1K	20G	1K	20G	1K		

Roll mode display

*1 The displayed record length given in ( ) refers to the record length stored in the acquisition memory.
Only when the trigger mode is auto or auto level, data of a record length given in ( ) is stored.
In case where no value in ( ) is given, the displayed record length and the record length stored in the acquisition memory are the same.

*2 The sample rate given in ( ) for the envelope mode is the rate at which data are acquired after having been sampled at 100MS/s and having taken the minimum and maximum values.

*3 In the envelope mode, the minimum / maximum values are displayed in a pair.

*4 For the setting enclosed by the bold line, repetitive sampling mode is active.

When "Maximum Displayable Record Length" is set to 400KW (Selection of 400KW length is not available if T/div is set between 50ns and 5ns, or if trigger mode is other than "single.")

Rep: Repetitive sampling mode

T/div	When Mode other than Envelope Mode is Active				When Envelope Mode is Active	
	At Least One of CH3, CH4 is ON		CH3, CH4 are Both OFF			
	Rep: "ON" or "OFF"		Rep: "ON" or "OFF"			
	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)
50s	1k	400K(8div)	1k	400K(8div)	100M[500 x 2]	200K x 2
20s	2k	400K	2k	400K	100M[1k x 2]	200K x 2
10s	5k	400K(8div)	5k	400K(8div)	100M[2.5k x 2]	200K x 2
5s	10k	400K(8div)	10k	400K(8div)	100M[5k x 2]	200K x 2
2s	20k	400K	20k	400K	100M[10k x 2]	200K x 2
1s	50k	400K(8div)	50k	400K(8div)	100M[25k x 2]	200K x 2
500ms	100k	400K(8div)	100k	400K(8div)	100M[50k x 2]	200K x 2
200ms	200k	400K	200k	400K	100M[100k x 2]	200K x 2
100ms	500k	400K(8div)	500k	400K(8div)	100M[250k x 2]	200K x 2
50ms	1M	400K(8div)	1M	400K(8div)	100M[500k x 2]	200K x 2
20ms	2M	400K	2M	400K	100M[1M x 2]	200K x 2
10ms	5M	400K(8div)	5M	400K(8div)	100M[2.5M x 2]	200K x 2
5ms	10M	400K(8div)	10M	400K(8div)	100M[5M x 2]	200K x 2
2ms	20M	400K	20M	400K	100M[10M x 2]	200K x 2
1ms	50M	400K(8div)	50M	400K(8div)	100M[10M x 2]	80K x 2(8div)
500µs	100M	400K(8div)	100M	400K(8div)	**Changes to normal mode, even when envelope mode has been set.**	
200µs	100M	200K	200M	400K		
100µs	100M	100K	200M	200K		
50µs	100M	50K	200M	100K		
20µs	100M	20K	200M	40K		
10µs	100M	10K	200M	20K		
5µs	100M	5K	200M	10K		
2µs	100M	2K	200M	4K		
1µs	100M	1K	200M	2K		
500ns	100M	500	200M	1K		
200ns	100M	200	200M	400		
100ns	100M	100	200M	200		

Roll mode display

*1 The "(8div)" indication shown in the "Displayed record length" column indicates that the waveform display spans only 8 divisions of the screen's time axis. (No waveform appears over the two far-right divisions.) The displayed record length and acquisition-memory record length are equivalent.

*2 The sample rate given in ( ) for the envelope mode is the rate at which data are acquired after having been sampled at 100MS/s and having taken the minimum and maximum values.

*3 In the envelope mode, the minimum / maximum values are displayed in a pair.

*4 Regardless of the "Rep" setting, repetitive sampling is not used with 400KW maximum displayable record length. (A "Rep" setting of "ON" is ineffective.)

When "Maximum Displayable Record Length" is set to 1MW (Selection of 1MW length is not available if T/div is set between 50ns and 5ns, or if trigger mode is other than "single.")

Rep: Repetitive sampling mode

	T/div	When Mode other than Envelope Mode is Active				When Envelope Mode is Active	
		At Least One of CH3, CH4 is ON		CH3, CH4 are Both OFF			
		Rep: "ON" or "OFF"		Rep: "ON" or "OFF"			
		Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)
Roll mode display	50s	2k	1M	2k	1M	100M[1k x 2]	500K x 2
	20s	5k	1M	5k	1M	100M[2.5k x 2]	500K x 2
	10s	10k	1M	10k	1M	100M[5k x 2]	500K x 2
	5s	20k	1M	20k	1M	100M[10k x 2]	500K x 2
	2s	50k	1M	50k	1M	100M[25k x 2]	500K x 2
	1s	100k	1M	100k	1M	100M[50k x 2]	500K x 2
	500ms	200k	1M	200k	1M	100M[100k x 2]	500K x 2
	200ms	500k	1M	500k	1M	100M[250k x 2]	500K x 2
	100ms	1M	1M	1M	1M	100M[500k x 2]	500K x 2
	50ms	2M	1M	2M	1M	100M[1M x 2]	500K x 2
	20ms	5M	1M	5M	1M	100M[2.5M x 2]	500K x 2
	10ms	10M	1M	10M	1M	100M[5M x 2]	500K x 2
	5ms	20M	1M	20M	1M	100M[10M x 2]	500K x 2
	2ms	50M	1M	50M	1M	100M[10M x 2]	200K x 2
	1ms	100M	1M	100M	1M	**Changes to normal mode, even when envelope mode has been set.**	
	500µs	100M	500K	200M	1M		
	200µs	100M	200K	200M	400K		
	100µs	100M	100K	200M	200K		
	50µs	100M	50K	200M	100K		
	20µs	100M	20K	200M	40K		
	10µs	100M	10K	200M	20K		
	5µs	100M	5K	200M	10K		
	2µs	100M	2K	200M	4K		
	1µs	100M	1K	200M	2K		
	500ns	100M	500	200M	1K		
	200ns	100M	200	200M	400		
	100ns	100M	100	200M	200		

*1 The displayed record length and acquisition-memory record length are equivalent.

*2 The sample rate given in ( ) for the envelope mode is the rate at which data are acquired after having been sampled at 100MS/s and having taken the minimum and maximum values.

*3 In the envelope mode, the minimum / maximum values are displayed in a pair.

*4 Regardless of the "Rep" setting, repetitive sampling is not used with 1MW maximum displayable record length. (A "Rep" setting of "ON" is ineffective.)

When "Maximum Displayable Record Length" is set to 2MW (for DL1540L only)
(Selection of 2MW length is not available if T/div is set between
50ns and 5ns, if trigger mode is other than "single," or if CH3 or CH4 is ON.)

Rep: Repetitive sampling mode

	T/div	When Mode other than Envelope Mode is Active				When Envelope Mode is Active	
		At Least One of CH3, CH4 is ON		CH3, CH4 are Both OFF			
		Rep: "ON" or "OFF"		Rep: "ON" or "OFF"			
		Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)	Sample rate (S/s)	Displayed record length (word)
Roll mode display	50s	It is not possible to turn ON CH3 or CH4 if the maximum display record length (2MW) is selected.		5k(8div)	2M	100M[2.5k x 2]	1M x 2
	20s			10k	2M	100M[5k x 2]	1M x 2
	10s			20k	2M	100M[10k x 2]	1M x 2
	5s			50k(8div)	2M	100M[25k x 2]	1M x 2
	2s			100k	2M	100M[50k x 2]	1M x 2
	1s			200k	2M	100M[100k x 2]	1M x 2
	500ms			500k(8div)	2M	100M[250k x 2]	1M x 2
	200ms			1M	2M	100M[500k x 2]	1M x 2
	100ms			2M	2M	100M[1M x 2]	1M x 2
	50ms			5M(8div)	2M	100M[2.5M x 2]	1M x 2
	20ms			10M	2M	100M[5M x 2]	1M x 2
	10ms			20M	2M	100M[10M x 2]	1M x 2
	5ms			50M(8div)	2M	100M[10M x 2]	400K x 2(8div)
	2ms			100M	2M	Changes to normal mode, even when envelope mode has been set.	
	1ms			200M	2M		
	500µs			200M	1M		
	200µs			200M	400K		
	100µs			200M	200K		
	50µs			200M	100K		
	20µs			200M	40K		
	10µs			200M	20K		
	5µs			200M	10K		
	2µs			200M	4K		
	1µs			200M	2K		
	500ns			200M	1K		
	200ns			200M	400		
	100ns			200M	200		

*1 The displayed record length and acquisition-memory record length are equivalent.

*2 The sample rate given in ( ) for the envelope mode is the rate at which data are acquired after having been sampled at 100MS/s and having taken the minimum and maximum values.

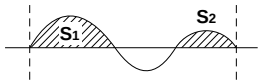
*3 In the envelope mode, the minimum / maximum values are displayed in a pair.

*4 Regardless of the "Rep" setting, repetitive sampling is not used with 2MW maximum displayable record length. (A "Rep" setting of "ON" is ineffective.)

Appendix 4 How to Calculate the Area of a Waveform

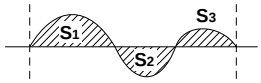
"Integ1TY"

Total area for positive side only: S_1+S_2



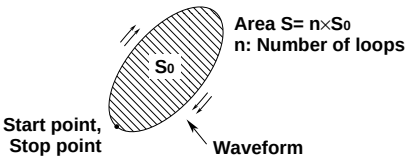
"Integ2TY"

Total area for both positive and negative sides: $S_1+S_3-S_2$

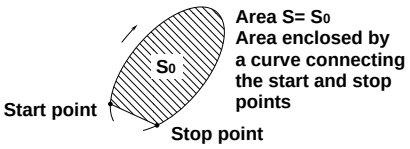


"Integ1XY"

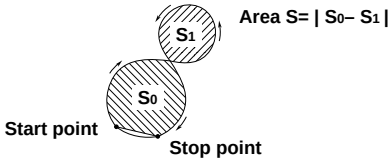
(1) Multiplc loops



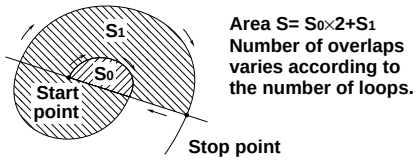
(2) Non-closed curve



(3) Loop tracing the shape of "8"



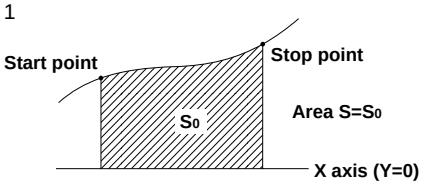
(4) Spiral loop



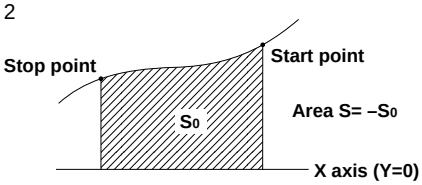
"Integ2XY"

(1) When only one Y data corresponds to X data

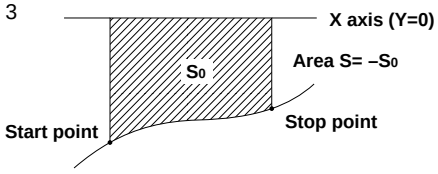
1



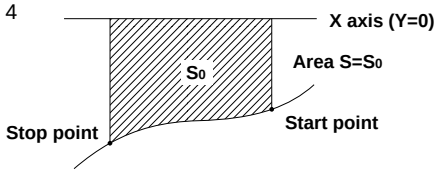
2



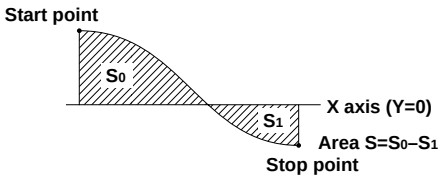
3



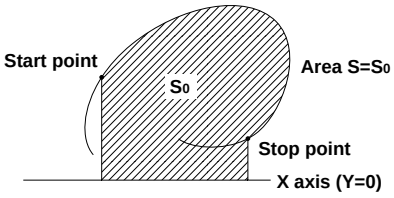
4

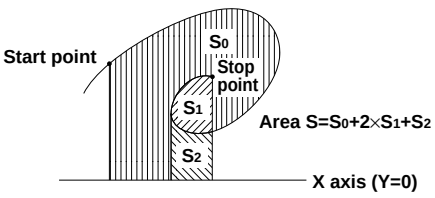


(2) When the waveform extends into the negative side



(2) When two or more Y data correspond to X data





App

Appendix

Appendix 5 Output Data Format used when Saving Waveform Data (Example DL1540CL)

Header Files (Files with the identifier of ".HDR")

The header file is always saved with the data, irrespective of the data type. The header file contains information in ASCII format used when saved waveforms are recalled for analysis. The same header file is used by all YOKOGAWA measuring instruments, so it may contain some data which is not necessary for this instrument. Only a brief description is given in this section. Detailed technical information on the header file is available from YOKOGAWA. If you need this information, contact your nearest YOKOGAWA representative.

```
//YOKOGAWA ASCII FILE FORMAT
$PublicInfo                    : Common information label
FormatVersion      1.01        : Version No. of header file format
Model              1540CL      : Model name
Endian             Big         : Endian mode (Big/Ltl)*1 for storage
DataFormat         Trace       : Storage format (Trace/Block) of binary file waveform data *2
GroupNumber        1           : Number of groups for display
TraceTotalNumber   1           : Total number of selected waveforms
DataOffset         0           : Start position of waveform data

$Group1                        : Group No. of displayed waveforms
TraceNumber        1           : Number of waveforms in the group
BlockNumber        3           : Maximum number of blocks in the group *3
TraceName          Ch2         : Waveform No.
BlockSize          10024       : Data size of each block of waveform-
VResolution        3.05176e-03 : Resolution co-efficient of Y axis conversion equation for each
                                 waveform *4
VOffset            0.00000e+00 : Offset co-efficient of Y axis conversion equation for each
                                 waveform*4
VDataType          IS2         : Type of waveform data of each waveform *5
VUnit              V           : Units used for Y axis of each waveform (no effect on data)
VPlusOverData      ?           : Upper limit of error data
VMinusOverData     ?           : Lower limit of error data
VIllegalData       -32768      : If any stored value in the binary data of any waveform
                                 matches this value, the data is illegal.
VMaxData           32736       : Maximum value of binary data for each waveform
VMinData           -32736      : Minimum value of binary data for each waveform
HResolution        1.00000e-06 : Resolution co-efficient of X axis conversion equation for each
                                 waveform *6
HOffset            1.00000e-03 : Offset co-efficient of X axis conversion equation for each
                                 waveform*6
HUnit              s           : Units used for X axis for each waveform (no effect on data)
Date               95/12/01    : The date when the trigger was activated
Time               01:18:54    : Time when the trigger was activated

$PrivateInfo                   : Information particular to model
ModelVersion       1.01        : Version No. of the model
MathBlockNo.       ?           : Block No. of block to be computed
FormMath1          ?           : Contents of Math1
DisplayPointNo.    9           : Display start point (the position from the beginning of the
                                 block)
TriggerPointNo.    300         : Trigger point (the position from the measurement start point)
PhaseShift         100         : Phase shift (number of data points)
(The following data is applicable to the DL1540CL only.)
$MediaInfo
MediaNo.           1           : Sequential number of divided save
MGroupNumber       1           : Number of groups in this medium.
MTraceTotalNumber  1           : Number of waveforms in this medium
```

```
$MGroup1
MTraceNumber    1          : Number of waveforms in this group
MBlockNumber    3          : Number of blocks in this group
MTraceName      Ch2        : Waveform ID within group
StartBlockNo.   1          : First block of saved data in group
StartPointNo.   1          : Data start point in first block
EndBlockNo.     3          : Last block of saved data in group
EndPointNo.     10024      : Data end point in last block of group
```

*1: Endian mode for storage (becomes "Big" on DL1500 series)
Big : Data for Motorola 68000 series.
Ltl : Data for Intel 86 series.

*2: Binary file storage format (becomes "Trace" on DL1500 series)
Trace : Groups into blocks, each block for a single waveform.
Block : Groups into blocks, each block for data sampled at the same time.

*3: Maximum number of blocks per group (or repetitions in the case of single (N) trigger mode)
Maximum number of blocks applies if the number of blocks varies from waveform to waveform.

*4: Y axis conversion equation for each waveform
Y axis value = VResolution x Raw data + VOffset

*5: Data type
ISn: n-byte signed integer ¨ “BIN”, “P-P”
FS10 : 10-byte signed real number ¨ “FLOAT”

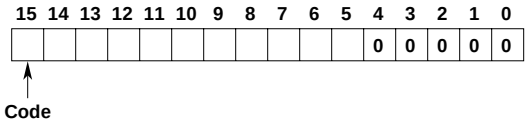
*6: X axis conversion equation for each waveform
X axis value = HResolution ¥ (Data No. - 1) + HOffset

Binary Data

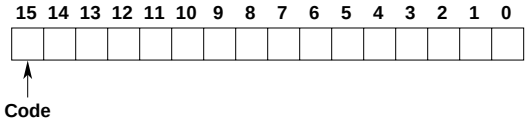
The data and file structures vary according to the type of data to be saved.

Data structure

Data other than averaging data

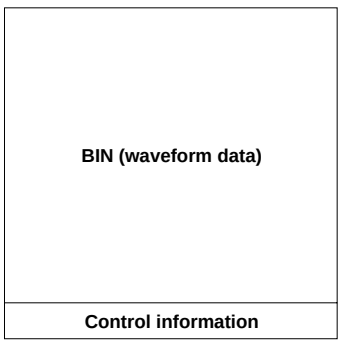


Averaging data

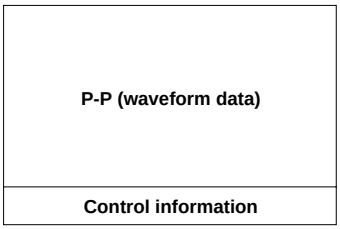


File structure

• BIN



• P-P DATA



ASCII Data

ASCII data consists of a mantissa part and an exponent part as shown below.

“Model”, “DL1540CL”
“BlockSize”, 512
“BlockNumber”, 1
“DisplayPointNo.”, 6
“DisplayBlockSize”, 500
“TriggerPointNo.”, 250
“Date”, “95/12/01”
“Time”, “18:17:11”
“SampleRate”, 100,”MHz”
“TraceName”, “Ch1”,”Ch2",”Ch3",”Ch4"
“Unit”, “V”,”V”,”V”,”V”

“MediaNo.”, 1
“StartBlockNo.”, 1
“StartPointNo.”, 1
“EndBlockNo.”, 1
“EndPointNo.”, 512

-4.200e+01, -2.000e+00, 2.400e+01, -2.000e+00
-4.200e+01, -2.000e+00, 2.400e+01, -2.000e+00
-4.200e+01, -2.000e+00, 2.200e+01, -2.000e+00
• • • •
• • • •
• • • •
• • • •
• • • •
3.800e+01, -2.000e+00, 2.200e+01, -2.000e+00
3.800e+01, -2.000e+00, 2.400e+01, -2.000e+00
3.800e+01, -2.000e+00, 2.400e+01, -2.000e+00

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