

DL 1540C/1540CL
Digital Oscilloscope

OPERATION GUIDE

Foreword

Thank you for purchasing the YOKOGAWA DL1540C/1540CL Digital Oscilloscope.

This operation guide explains the basic operations of the digital oscilloscope focusing mainly on the DL1540C. It is written so that even first-time users can easily start operating the instrument. The differences between the specifications of other oscilloscope and the DL1540 is: DL1540L allows the user to select the record length(up to 2M words). Accordingly, there are also slight differences in the function/operation.

In addition to this Operation Guide, two more manuals are provided with the DL 1540C/1540CL:

- User's Manual, IM 701530-01E, which covers all the functions of the instrument; and
- Communication Interface User's Manual, IM 701530-11E, which explains the communication functions in detail.

Use these manuals together with this Operation Guide.



- The contents of this guide 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.

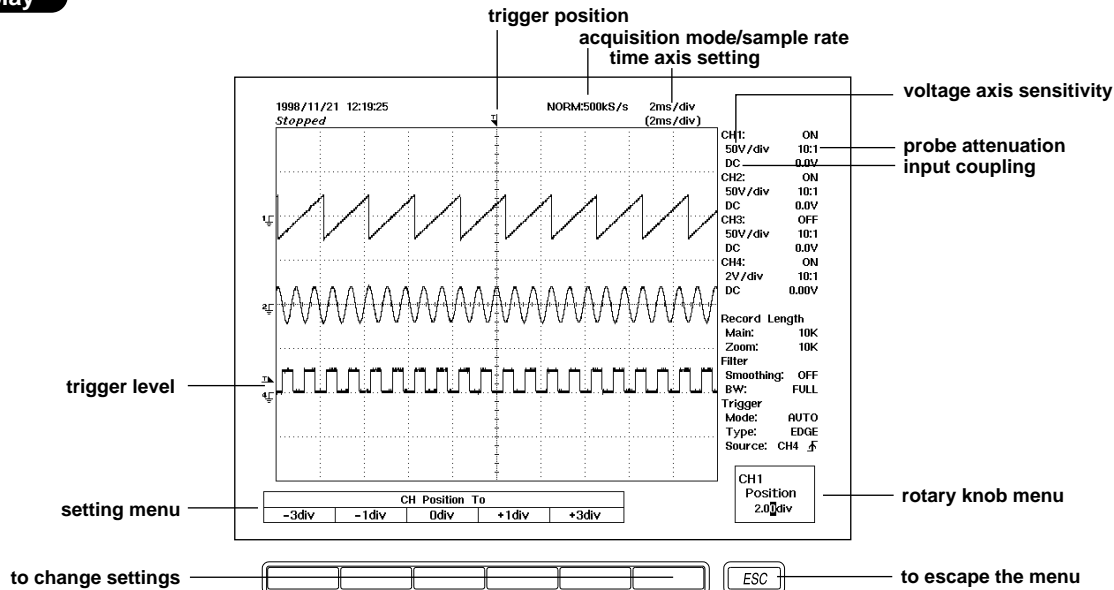
Revisions

1st Edition: December 1998

Quick Reference

Basic operations

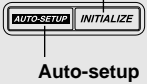
Display



Page 4

Auto-setup / Initializing settings

Initializing settings



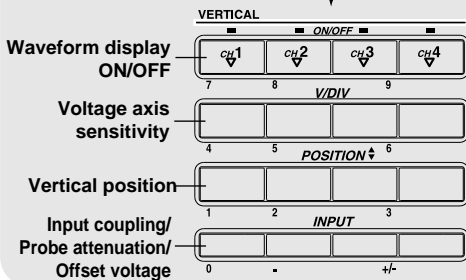
Page 10,11

Waveform acquisition



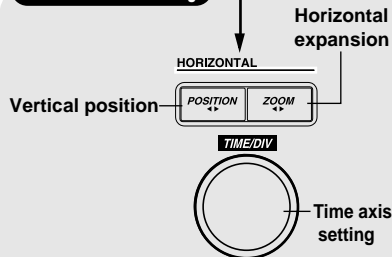
Page 5

Vertical axis settings



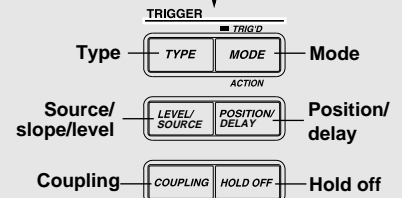
Page 6,7

Horizontal axis settings



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Trigger settings

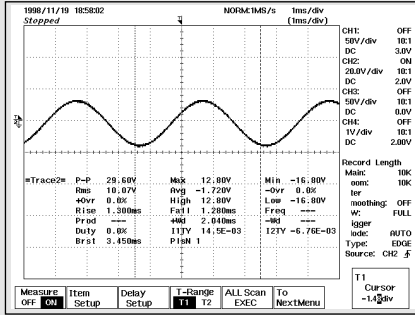


Useful functions

For other functions and more details on the functions mentioned hereafter, please refer to User's Manual, IM 701530-01E.

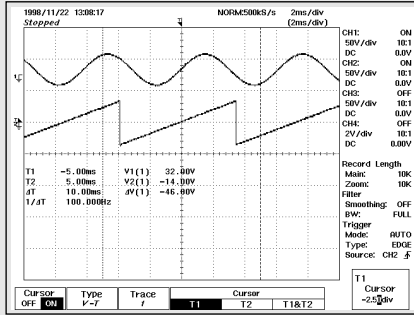
Auto measurement § 8.3

Measures items such as time of triggering, pulse width etc. automatically



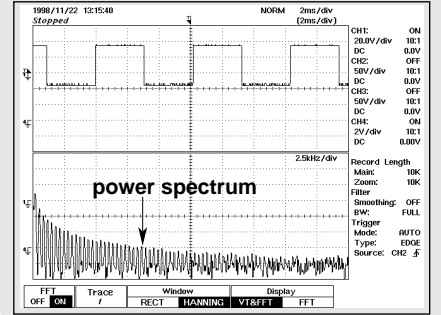
Cursor measurement § 8.1,8.2

Measures items such as time/voltage difference between two voltage points of the waveform using cursors

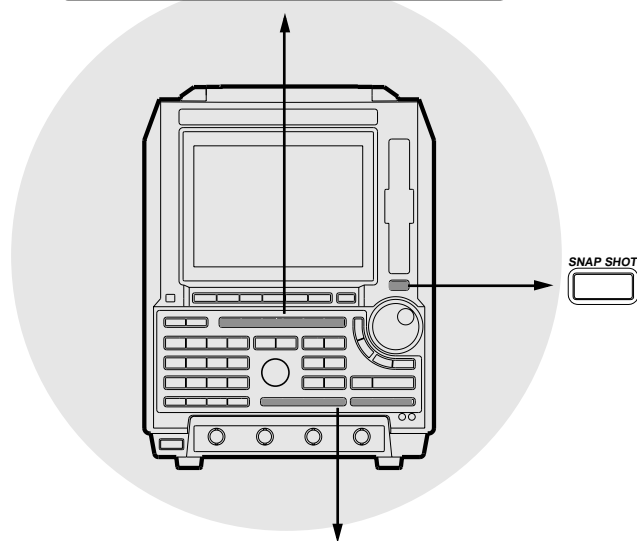


Waveform computation § 8.5,8.6

Displays a waveform resulting from arithmetic computation of data of two channels, or displays the power spectrum using FFT computation



FILTER MEASURE CURSOR GO/NO-GO MATH DISPLAY

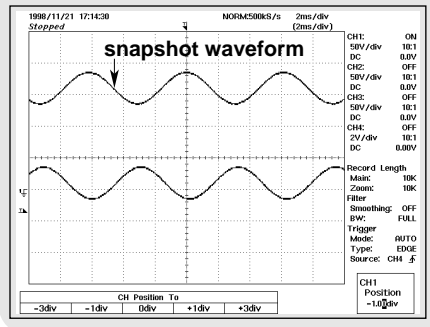


REMOTE LOCAL CAL MISC HISTORY STORE/RECALL COPY

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Snapshot § 4.4

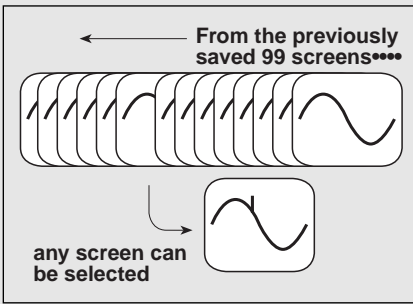
Saves the displayed waveform by one touch



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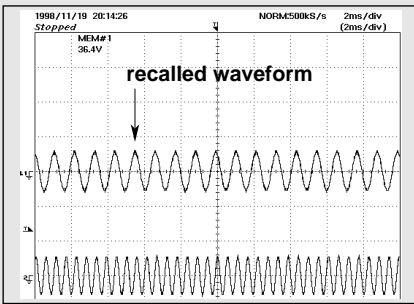
History memory § 7.5

Returns any of the 99 previously saved waveforms



Storing/Recalling displayed waveforms § 11.1

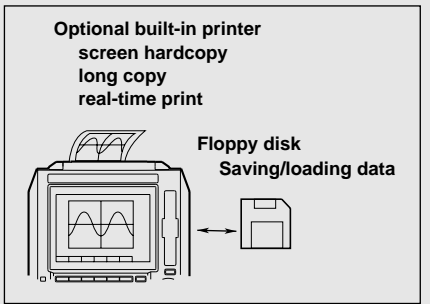
Stores the waveform into the internal memory, and displays it again later which allows comparison with the currently displayed one



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Printing/Saving displayed waveforms § 10.2, 12.5

Prints out the displayed waveforms on the optional built-in printer, and saves the waveform data to the floppy disk





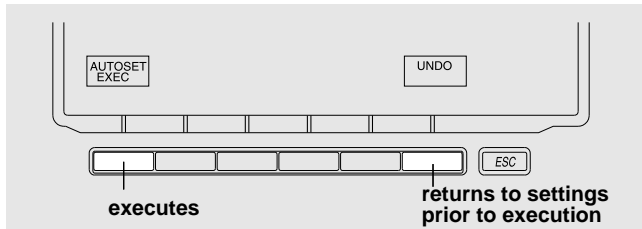
Viewing waveforms using the auto setup function

When carrying out this operation, settings such as the voltage axis, time axis, trigger settings and so on will be automatically set so that they match the input signal.

This function is useful when you want to display an input signal quickly or when you are not sure what settings to make since you do not know what sort of signal is to be input.

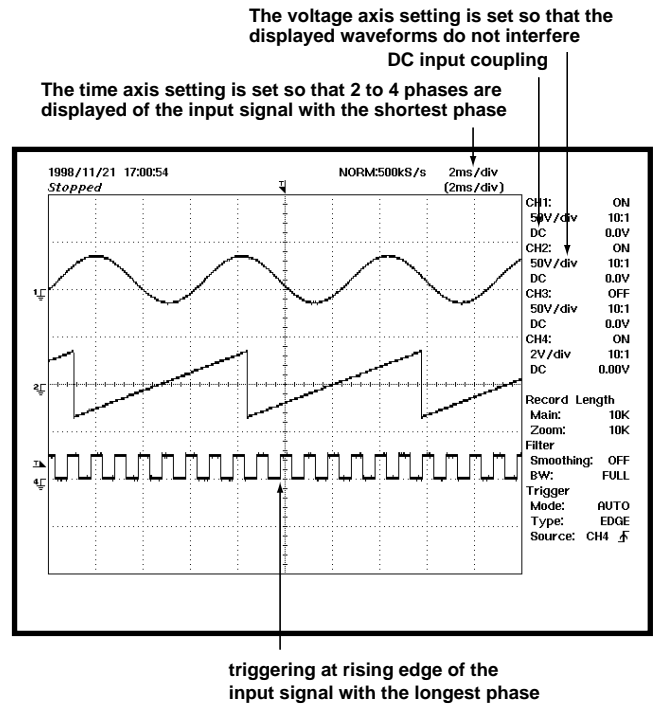
OPERATION

1. Press the **AUTO SETUP** key.
2. Press the **AUTOSET EXEC** soft key.



- Input conditions which are suitable for the auto setup function are
frequency: approx. 40Hz to 150MHz
amplitude: approx. 50mV or higher (probe attenuation is 1:1)
type: repetitive waveforms
- Starts waveform acquisition even if waveform acquisition was stopped.
- Displays only the channels to which an input signal is applied.

Example of a display after auto set-up execution



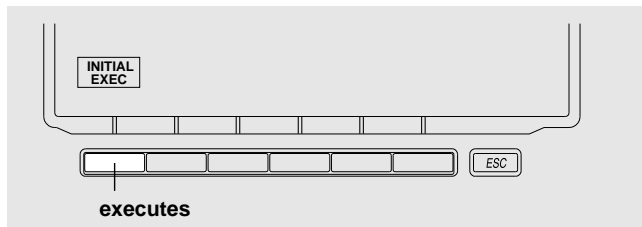
Initializing settings

Initialization restores the settings made using the front panel keys to their default values (factory settings).

Initialization is useful when you want to make settings suitable for the input signals.

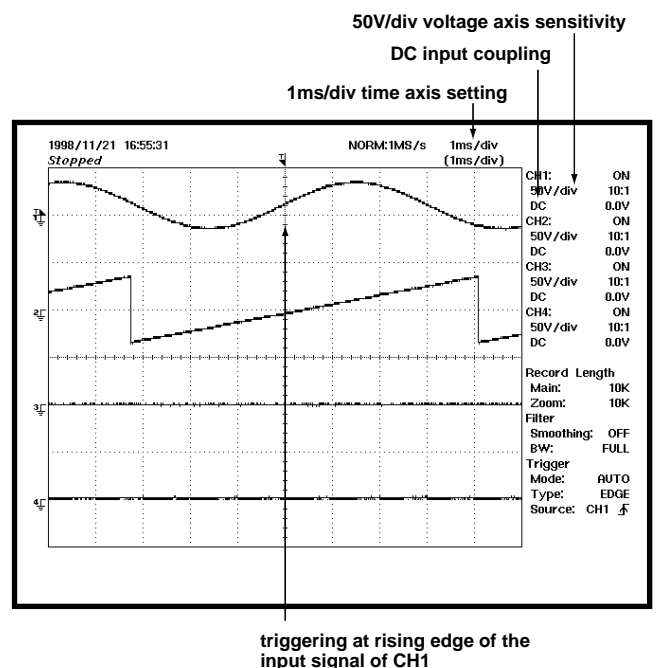
OPERATION

1. Press the **INITIALIZE** key.
2. Press the **INITIAL EXEC** soft key.



- Displays waveforms for all channels.
- Sets the probe attenuation to 10:1.
- Starts waveform acquisition automatically even if waveform acquisition was stopped.

Example of a display after initialization



Vertical Axis Settings



Setting operations for input coupling, probe attenuation and offset voltage are not explained here. Refer to User's Manual, IM 701530-01E.

Changing the displayed amplitude of the waveform (voltage axis setting)

The displayed amplitude can be adjusted by changing the voltage value (V/div) which corresponds to 1 div of the grid. Each channel can be set individually.

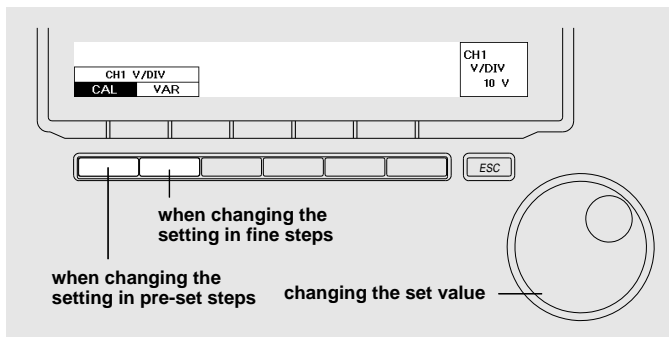
The following two setting methods are available.

CAL : Settings are according to a 1-2-5 step, and therefore become like "1V/div" - "2V/div" - "5V/div".

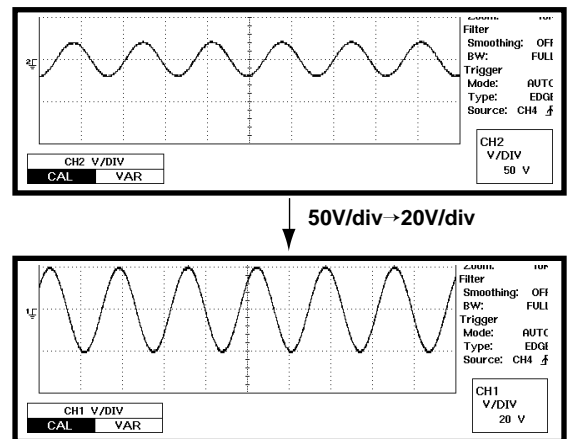
VAR : Settings can be fine adjusted using the value at the CAL setting as the center.

OPERATION

1. Press the **V/DIV** key of the channel to be set.
2. Press the **CAL** or **VAR** soft key.
3. Turn the rotary knob.



Example of changing V/div



Changing the vertical position

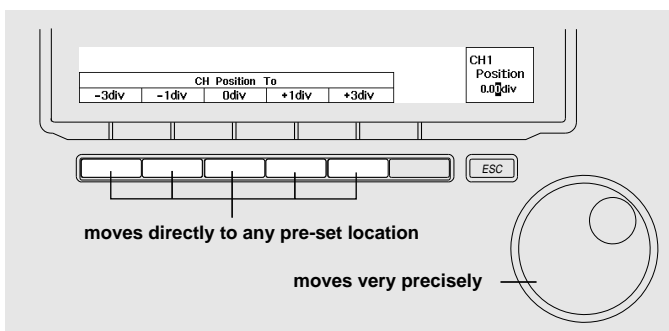
With the following operation you can move the waveform up or down. The following two methods are available.

Pressing the soft key: Moves the waveform directly to the location corresponding with the soft key.

Turning the rotary knob: Moves the waveform very precisely.

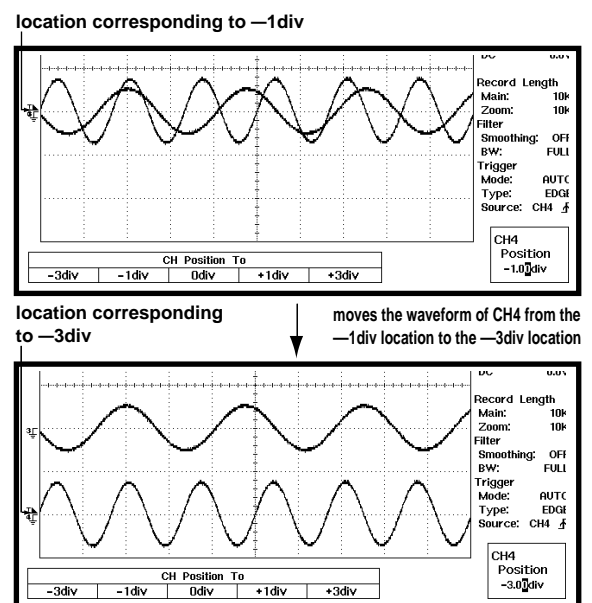
OPERATION

1. Press the **POSITION** key of the channel to be set.
2. Press the soft key corresponding to the location to which you want to move, or turn the rotary knob.



- The amount of movement corresponding to one click of the rotary knob can be changed using the <> keys beneath the rotary knob.
- The smallest amount of movement is 0.02div.

Example of moving the vertical position



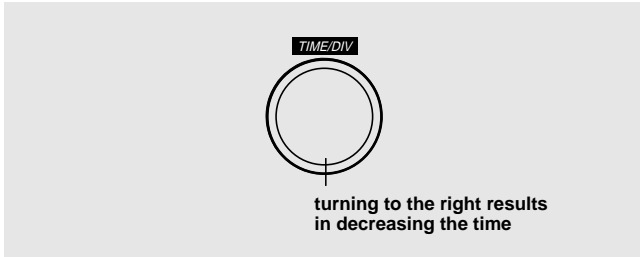
Horizontal Axis Settings

Changing the time axis setting

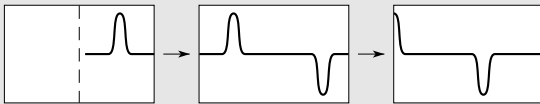
Changes the time per 1 div of the grid (Time/div).

The setting ranges from 5ns/div to 50s/div. Since the display in the horizontal direction shows 10div, the time range for which a waveform can be displayed becomes the "time axis setting x 10". The setting range for DL1540CL varies depending on the maximum display record length (refer to page 11).

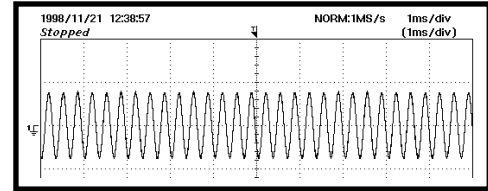
OPERATION 1. Turn the time axis setting knob.



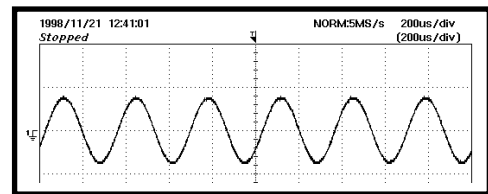
When the time axis setting lies within 50ms/div to 50s/div, the display mode becomes the roll mode where the waveform flows over the screen from right to left, as shown below.



Example of changing the Time/div



1ms/div → 200μs/div



Changing the horizontal position

When the roll mode is active, usually waveform data of two screens are memorized. When a range of two screens is present, you can observe the waveform which lies outside of the screen by moving the display range in horizontal direction.

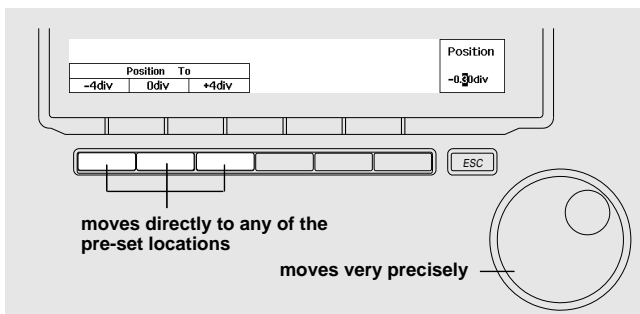
The following two methods are available. When the roll mode is active, press the START/STOP key first to stop data acquisition and then carry out the operation.

Pressing the soft key : Moves the waveform directly to the location corresponding with the soft key.

Turning the rotary knob : Moves the waveform very precisely.

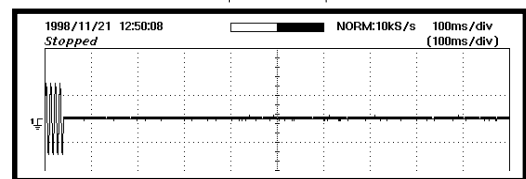
For the DL1540CL, you can select the record length. Depending on the record length you select, the length of the data recorded, even in the roll mode, may be less than two-screen's worth of area. The record length is briefly described on Page 11. For more details, refer to User's Manual, IM 701530-01E.

- ### OPERATION
1. Press the POSITION ◀▶ key of the channel to be set.
 2. Press the soft key corresponding to the location to which you want to move, or turn the rotary knob.

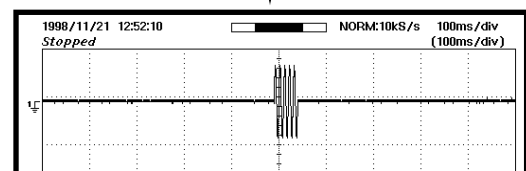


Example of moving the horizontal position

shows the displayed range as a bar



moves from +5div location to 0div location



Expanding the waveform

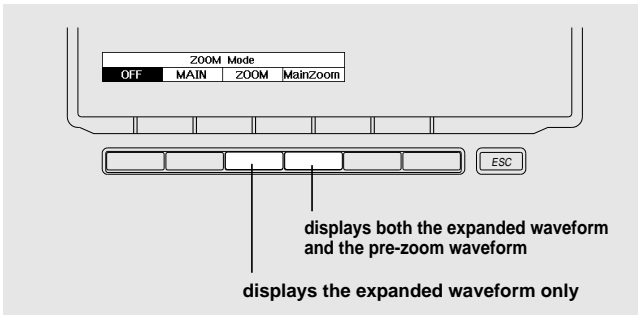
A part of the displayed waveform can be expanded in the time axis direction.

You can then display the expanded waveform only, or display the expanded waveform together with the pre-zoom waveform. The part of the waveform to be expanded can also be shifted.

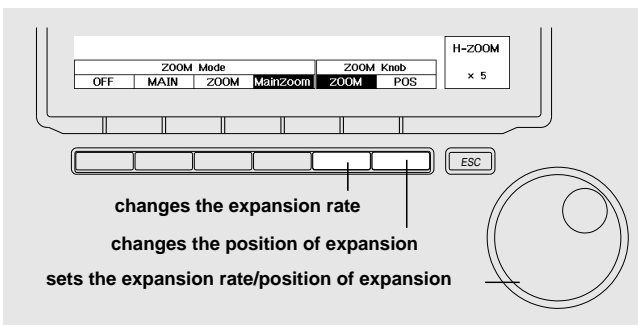
OPERATION

1. Press the ZOOM ◀▶ key.

2. Press the soft key corresponding to the desired way of displaying the waveform.

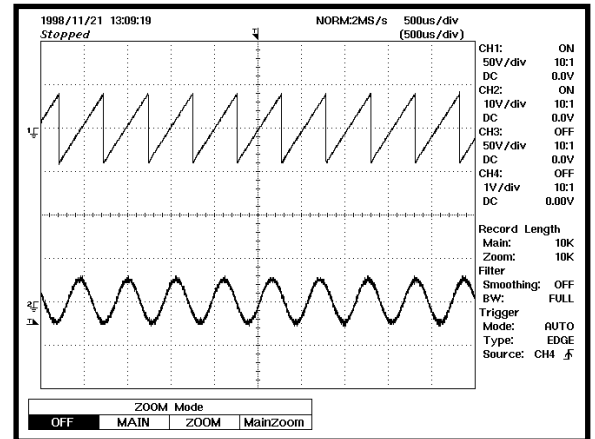


3. Press the soft key corresponding to the desired position to which you want to move, or turn the rotary knob.

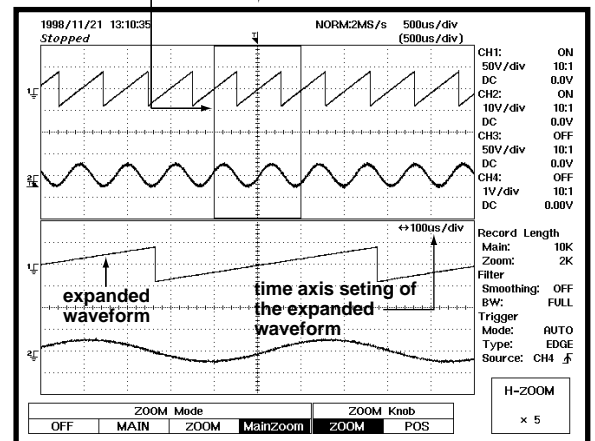


- Waveforms can be expanded until the number of data points displayed in 1 div of the time axis becomes 10.
- When less than 50 data points are displayed per 1 div, interpolation between these points will occur. Be aware that these interpolated data are not sampled data!

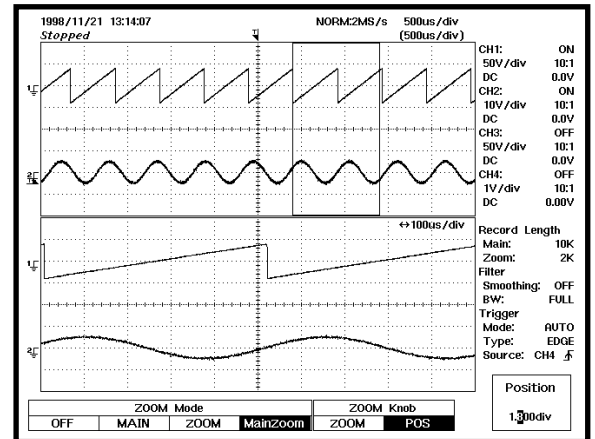
Example of expansion



both the expanded and pre-zoom waveform are displayed, and the expansion rate is "X5"



shifting the position of expansion to the right



Setting a Trigger

A trigger lets you decide which conditions must occur before the signal you want to observe becomes displayed on the screen. Many different trigger settings are possible, but here a brief explanation is given about the setting operation of the trigger source, slope, level, mode and position for the trigger type being the edge trigger. With the edge trigger, a waveform becomes displayed on the screen when the level of the input signal exceeds a fixed level (called trigger level)

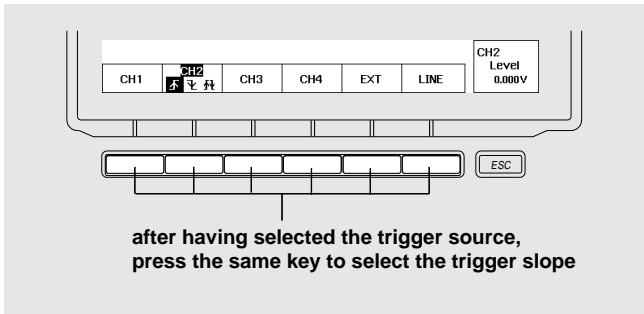
Changing the trigger source/slope/level

The input signal used as the object of examination is called the trigger source. Besides the input signals of CH1 to CH4, the external input signal (EXT) and the commercial power source voltage signal (LINE) can be set as the trigger source. In comparing the level of the trigger source with the trigger level, you can decide when this results in updating the displayed waveform. This is called the trigger slope setting. The following three settings are available.

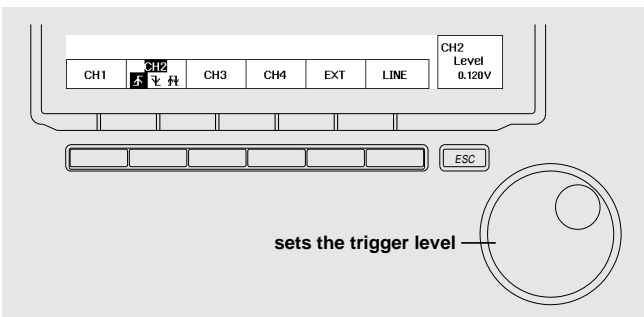
- [] : Updates the displayed waveform when the level of the trigger source changes from a level below the trigger level to one above the trigger level.
- [] : Updates the displayed waveform when the level of the trigger source changes from a level above the trigger level to one below the trigger level.
- [] : Updates the displayed waveform in either of the above cases.

OPERATION

1. Press the LEVEL/SOURCE key.
2. Press the soft key corresponding to the desired trigger source.
3. Press the same soft key to select the trigger slope.

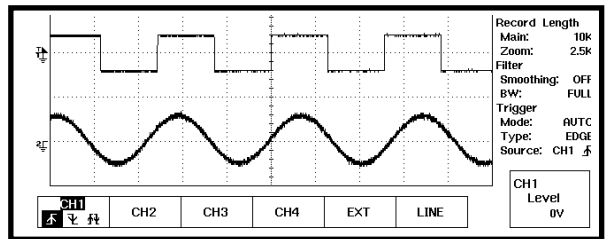


4. Turn the rotary knob to set the trigger level.

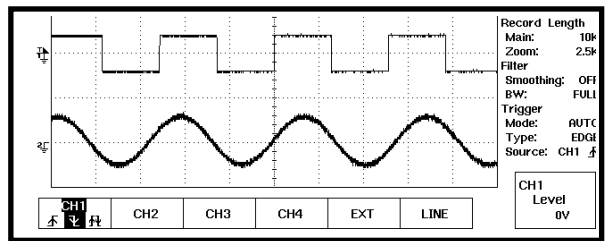


Apart from the edge trigger, a window trigger, TV trigger, OR trigger (option), pattern trigger (option) and width trigger (option) can be selected as the trigger type.

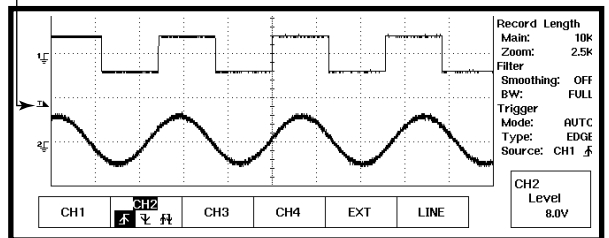
Operation example of setting the trigger source/slope/level



changing the trigger slope to []



changing the trigger source to CH2 and then the trigger level



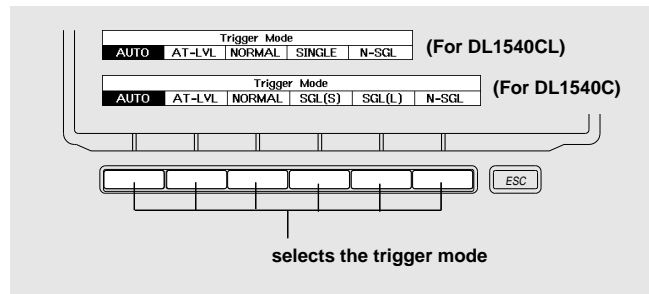
Changing the trigger mode

The trigger mode lets you decide the way the waveform is displayed when the trigger conditions become true (which is called activating a trigger). A selection can be made from the following six modes.

- AUTO** : Updates the displayed waveform automatically when no trigger has been activated during a specified time.
- AUTO-LVL** : When no trigger has been activated during a specified time, the trigger level is automatically set to the median. Then when a trigger is activated, the waveform display is updated.
- NORMAL** : Updates the displayed waveform only when a trigger is activated.
- SGL(S)** : When a trigger is activated, the waveform is updated only once and then waveform acquisition stops. (SINGLE for the DL1540CL)
- SGL(L)** : Same as the above mentioned SGL(S) mode, except that the amount of acquired data is large. (Not provided for the DL1540CL)
- N-SGL** : Updates the displayed waveform only a pre-set number of times when a trigger occurs and then waveform acquisition stops.

OPERATION

1. Press the **MODE** key.
2. Press the soft key corresponding to the desired mode.

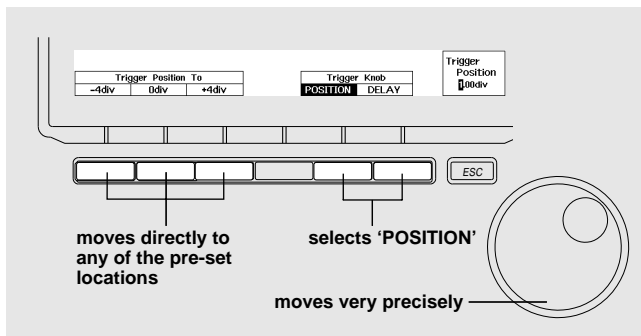


Changing the trigger position

This setting lets you decide where on the time axis the data which were sampled at the triggering time (trigger point) will be displayed. The default setting is the center of the screen.

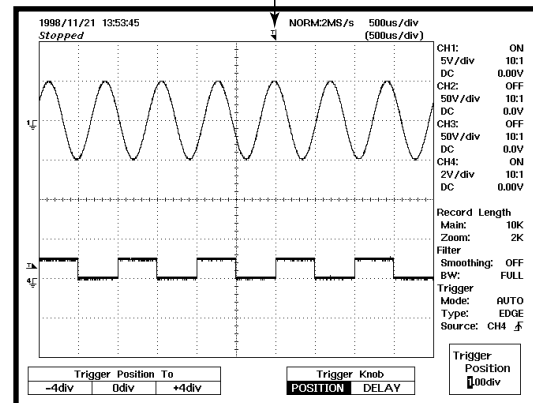
OPERATION

1. Press the **POSITION/DELAY** key.
2. Press the soft key corresponding to the desired position to which you want to move.

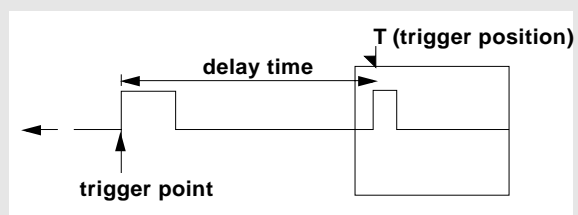


Examples of changing the trigger position

moves the trigger position to the +1div location
trigger position mark



Although the display usually shows the waveform before and after the trigger point, using the delay function, it is possible to display the acquired waveform after a fixed time period elapses, as shown in the figure on the right.



Setting Waveform Acquisition

Changing the acquisition mode

When storing sampled data into the acquisition memory, it is possible to perform different kinds of data processing and display the resulting waveform.

The following three data processing modes are available.

Normal : No special data processing is being performed.

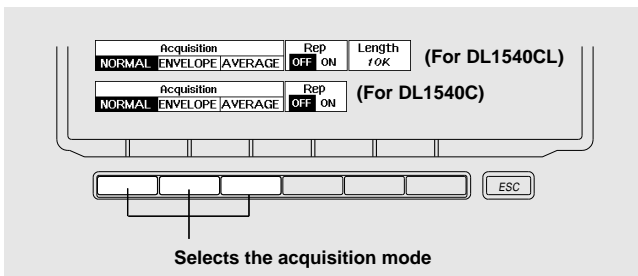
Envelope : Without decreasing the sample rate, local maximum/minimum values are obtained at a fixed interval, and the resulting waveform is displayed.

Average : Obtains the average of waveform data of the same timing (the same time in relation to the trigger point) and the resulting waveform is displayed.

OPERATION

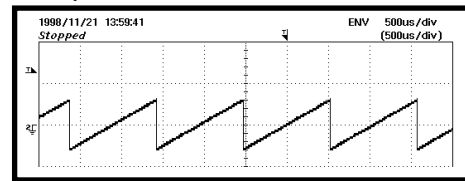
1. Press the ACQ key.

2. Press the soft key corresponding to the desired mode.

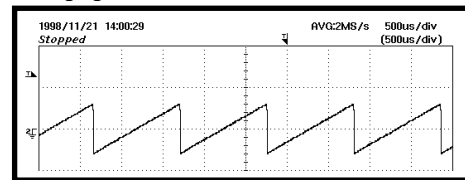


Example of acquisition modes

envelope mode



averaging mode



Changing the sampling mode

The following two methods are available to sample an input signal.

Real-time sampling mode : The input signal is sampled sequentially.

Repetitive sampling mode : Data is sampled from several waveforms and data is put in the correct order using the trigger point as reference.

(An apparent sample rate of up to 20GS/s can be used.)

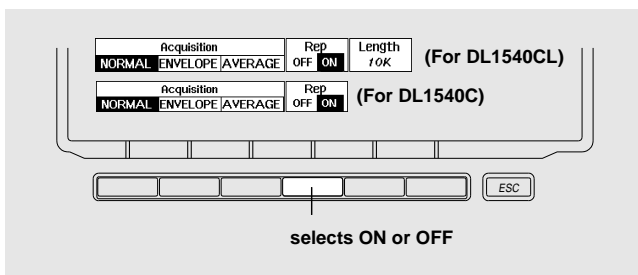
When the time axis setting is within 50s/div to 100ns/div, the real-time sampling mode is assigned and when the time axis setting is within 50ns/div to 5ns/div, the repetitive sampling mode is assigned. However, when the time axis setting lies within 5μs/div to 100ns/div, you can change the sampling mode from real-time to repetitive as follows.

For the DL1540CL, you can select the record length. Depending on the record length you selected, the range of the time axis setting for which you can change the sampling mode from real-time to repetitive varies. For details, refer to User's Manual, IM 701530-01E.

OPERATION

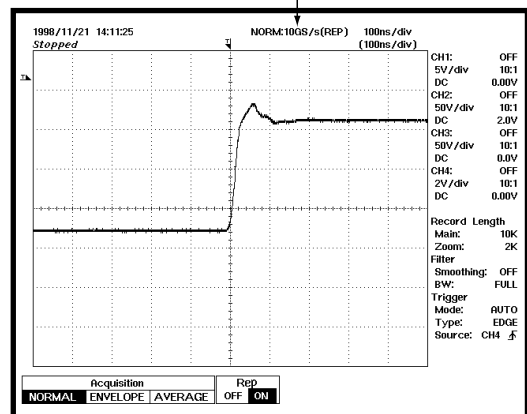
1. Press the ACQ key.

2. Press the REP soft key and select OFF when real-time sampling is desired, and ON when repetitive sampling is desired.



Example of a display in repetitive sampling mode

shows the repetitive sampling mode

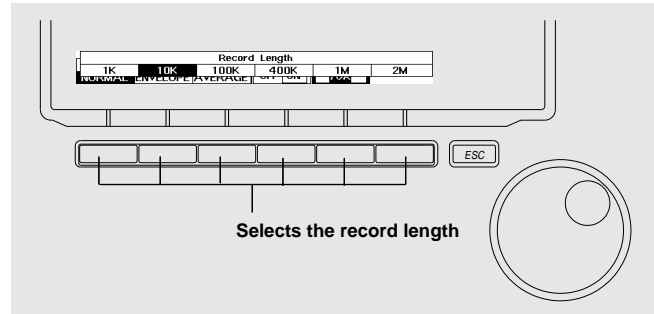


Selecting the recording length (maximum display record length) . . . for DL 1540CL

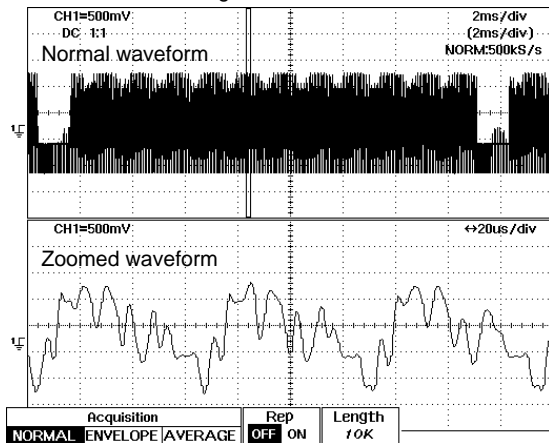
The record length governs the quantity of waveform data that can be stored in the acquisition memory. In contrast, the quantity of waveform data displayed on the screen from the waveform data in the acquisition memory is called the display record length. These lengths are given in units of words, where one word corresponds to one data sample of the waveform. The record length is usually the same as the display record length, though the record length may be longer than the display record length depending on the time axis setting. For the DL1540CL, the maximum display can be selected from 1K, 10K, 100K, 400K, 1M, and 2M(for DL1540CL only) words. Nevertheless, lengths of 400K, 1M, or 2M words have several restrictions; for details of these restrictions, refer to User's Manual, IM 701530-01E.

OPERATION

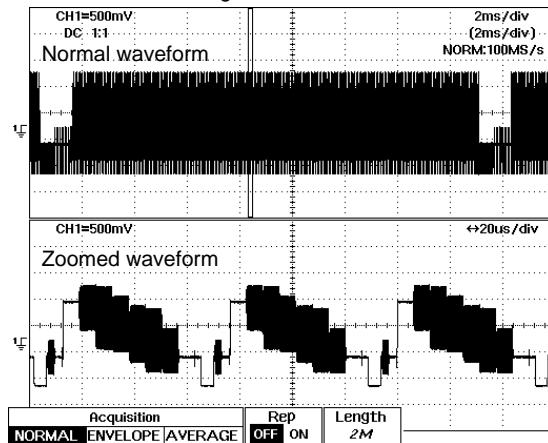
1. Press the ACQ key.
2. Press the Length soft key to retrieve the menu for selecting the maximum display record length.
3. Press the soft key corresponding to the desired maximum display record length.



- Example of one field of TV signal
- When the record length is 10K words



- When the record length is 2M words



With a record length of 2M words, one field of a TV signal can be captured without distortion.



Making a snapshot of the waveform

Using this function, the currently displayed waveform will be kept on the screen (called snapshot waveform). To clear the snapshot waveform, press the CLEAR TRACE key.

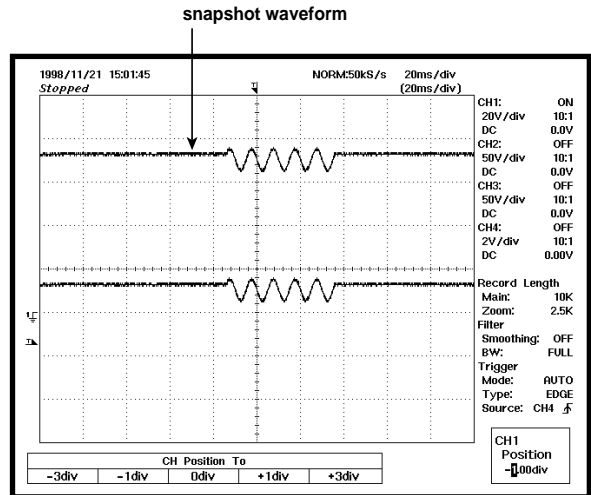
OPERATION 1. Press the **SNAPSHOT** key.



- Whenever you press the SNAPSHOT key, the currently displayed waveform will be kept on the screen and therefore several snapshot waveforms can be displayed at the same time.
- It is not possible to move a snapshot waveform over the screen, nor to measure voltages using cursors. However, it is possible to print the snapshot waveforms on the (optional) built-in printer or to save them as screen image data to a floppy.

Example of a display showing a snapshot waveform

After taking a snapshot, the currently displayed waveform is moved downwards



Using the history memory to display previous waveforms (Applicable to the DL1540C/DL1540CL)

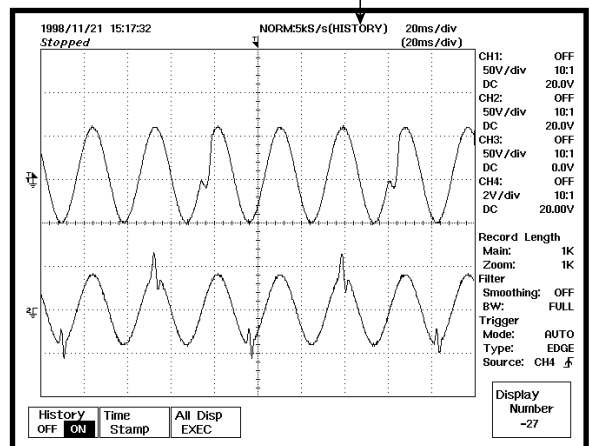
It is possible to keep waveform data of up to the previous 100 screens (On the DL1540CL, the number of screens depends on the maximum displayable record length) in the internal memory, which then can be displayed on the screen as required. The currently displayed waveform is kept being number 0, the one previously displayed being number -1, the one before that being -2, and the oldest waveform is kept being number -99. Selecting this number using the rotary knob results in displaying that particular waveform. Carry out the following steps to display previous waveforms, but make sure to first turn off data acquisition by pressing the START/STOP key.

1. Press the **HISTORY** key.
2. Press the soft key and select **ON**.
3. Turn the rotary knob to select the waveform which you want to display.

OPERATION

Example of a display showing a previously displayed waveform

displays the waveform number -27
shows that the history memory function is active



- When you press the "All Disp EXEC" soft key, all kept waveforms will appear on the screen.
- When conditions of waveform acquisition are changed while this function is in progress, the contents of the internal memory will be reset.

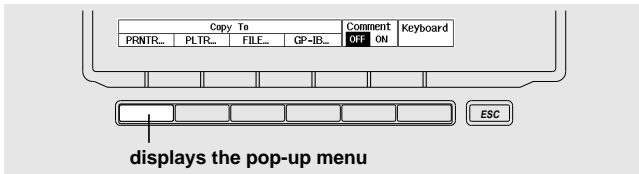


Printing out displayed waveforms

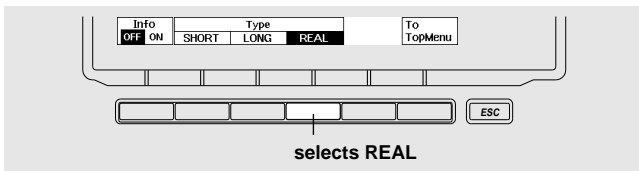
As a default setting, it is possible to print out a hardcopy of the screen to the (optional) built-in printer just by pressing the COPY key. When the time axis setting lies between 500ms/div to 50s/div, it is possible to print waveforms continuously in real time as a recorder as follows.

OPERATION

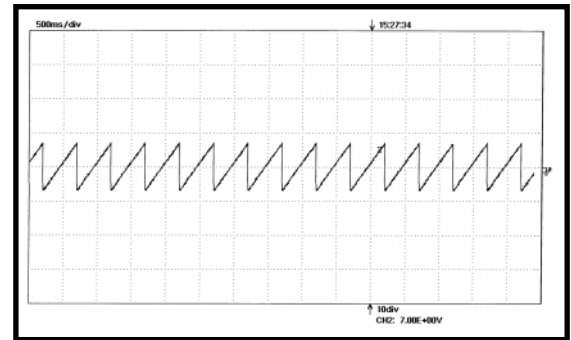
1. Press the **SHIFT** key.
2. Press the **COPY** key.
3. Press the **PRNTR** soft key to display the pop-up menu.



4. Press the **REAL** soft key.



Example of a real-time printout

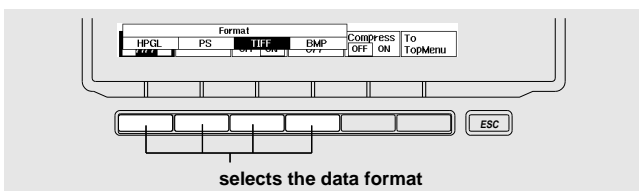


Saving displayed waveforms

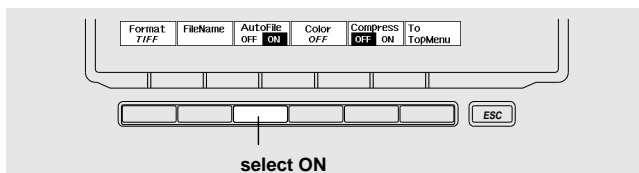
Whenever you press the COPY key after the following settings have been done, the displayed waveforms will be saved to the floppy disk. A file name will be assigned automatically.

OPERATION

1. Press the **SHIFT** key.
2. Press the **COPY** key.
3. Press the **FILE** soft key to display the pop-up menu.
4. Press the **FORMAT** soft key to display the pop-up menu.
5. Press the soft key corresponding to the desired data format.



6. Press the **AutoFile** soft key, and select **ON**.



Example of saved data

