User's Guide

RIGOL

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DS1000B Series Digital Oscilloscopes

DS1062/4B，DS1102/4B，DS1202/4B

Safety Notices

Review the following safety precautions carefully to avoid any personal injuries or damages to the instrument and any products connected to it. To avoid potential hazards, please use the instrument as specified by this manual only.

The instrument should be serviced by Authorized personnel only.

To Avoid Fire or Personal Injury.

Use Proper Power Cord. Use the power cord designed for the instrument and authorized in your country only.

Ground The Instrument. The oscilloscope is grounded through the grounding conductor of the power cord. To avoid electric shock the instrument, grounding conductor(s) must be grounded properly, before making connections to the input or output terminals of the instrument.

Connect The Probe. The probes' ground terminals are at the same voltage level of the instrument ground. Do not connect the ground terminals to a high voltage.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and marks on the instrument. Follow the user's guide for further ratings information before making connections to the instrument.

Do Not Operate Without Covers. Do not operate the instrument with covers or panels removed.

Use Proper Fuse. Use the fuse of the type, voltage and current ratings as specified for the instrument.

Avoid Circuit or Wire Exposure. Do not touch exposed connections and components when power is on.

Do Not Operate With Suspected Failures. If suspected damage occurs with the instrument, have it inspected by qualified service personnel before further operations.

Provide Proper Ventilation. Refer to the installation instructions for proper ventilation of the instrument.

Do not Operate in Wet/Damp Conditions.

Do not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

The disturbance test of all the models meet the limit values of A in the standard of EN 61326: 1997+A1+A2+A3, but can't meet the limit values of B.

Measurement Category

The DS1000B series Digital Oscilloscope is intended to be used for measurements in Measurement Category I.

Measurement Category Definitions

Measurement Category I is for measurements performed on circuits not directly connected to MAINS. Examples are measurements on circuits not derived from MAINS, and specially protected (internal) MAINS derived circuits. In the latter case, transient stresses are variable; for that reason, the transient withstand capability of the equipment is made known to the user.

WARNING

IEC Measurement Category I. The input terminals may be connected to circuit terminal in IEC Category I installations for voltages up to 300 VAC. To avoid the danger of electric shock, do not connect the inputs to circuit's voltages above 300 VAC.

Transient overvoltage is also present on circuits that are isolated from mains. The DS1000B series Digital Oscilloscopes is designed to safely withstand occasional transient overvoltage up to 1000 Vpk. Do not use this equipment to measure circuits where transient overvoltage could exceed this level.

Safety Terms and Symbols

Terms in This Guide. These terms may appear in this guide:

WARNING: Warning statements identify conditions or practices that could result in injury or loss of life.

CAUTION: Caution statements identify conditions or practices that could result in damage to this product or other property.

Terms on the Product: These terms may appear on the product.

DANGER indicates an injury hazard may be immediately accessible.

WARNING indicates an injury hazard may be not immediately accessible.

CAUTION indicates that a potential damage to the instrument or other property might occur.

Symbols on the Product: These symbols may appear on the Instrument:

Hazardous Voltage

Refer to Instructions

Protective Earth Terminal

Chassis Ground

Earth Ground

General-Purpose Oscilloscopes

RIGOL DS1000B series digital oscilloscopes offer exceptional waveform viewing and measurements in a compact, lightweight package. The DS1000B series is ideal for production test, field service, research, design, education and training involving applications of analog circuit tests and troubleshooting.

Product features:

- Dual Channel or Four Channels, Bandwidth of per channel:
  200MHz (DS1202/4B)
  100MHz (DS1102/4B)
  60MHz (DS1062/4B)
- 2GSa/s real-time sampling rate and 50GSa/s equivalent sampling rate.
- Color TFT 5.7 inch LCD, 320×240 pixels resolution.
- USB storage and direct printing, software upgrade via USB interface.
- Adjustable waveform intensity, more effective waveform viewing.
- One-touch automatic setup, ease of use (AUTO).
- Storage and recurrence of Waveforms and setups, supports CSV, 8 or 24 bits bitmap and PNG format.
- Delayed Scan Function, easy to give attention to both details and overview of a waveform.
- 22 Automatic measurements.
- Automatic cursor tracking measurements.
- Waveform recorder, record and replay dynamic waveforms.
- Supports fast offset calibration of an oscilloscope.
- Built-in FFT function.
- Digital filters, includes LPF, HPF, BPF, BRF.
- Pass/Fail detection Function, optically isolated Pass/Fail output.
- Add, Subtract and Multiply Mathematic Functions of waveforms.
- Advanced trigger types include: Edge, Video, Pulse width, Pattern, Alternative.
- Adjustable trigger sensitivity.
- Multiple Language User Interface.
- Pop-up menu makes it easy to read and easy to use.
- Built-in help systems with multinational languages.
- Easy-to-use file system supports Chinese & English characters file name input.
- Conform to LXI consortium instrument standard class C.

Contents

Chapter 1 : Getting Started

This chapter covers the following topics:

- The front panel and user interface
- To inspect the instrument
- To perform a functional check
- To compensate the probes
- To display a signal automatically
- To understand the vertical system
- To understand the horizontal system
- To trigger the oscilloscope
- To understand the quick function

The Front Panel and User Interface

Being familiar with the front panel of an oscilloscope is the first priority when you get a new type digital oscilloscope. This chapter will bring you a brief introduction and description of the front panel operations of DS1000B series digital oscilloscopes. It is a great help for your understanding to the layout of the knobs and keys and how to use them. Read the chapter carefully before further operations.

Figure 1-1, the front Panel; the knobs are used most often and are similar to the knobs on other oscilloscopes. There are five gray buttons defined as No.1 to No.5 from up to bottom on the right side of the display which are menu operating buttons. The buttons not only allow you to use some of the functions directly but also bring up soft button menus on the screen, which enable the access to many measurement features associated with the advanced functions, mathematics, and reference or to run control features.

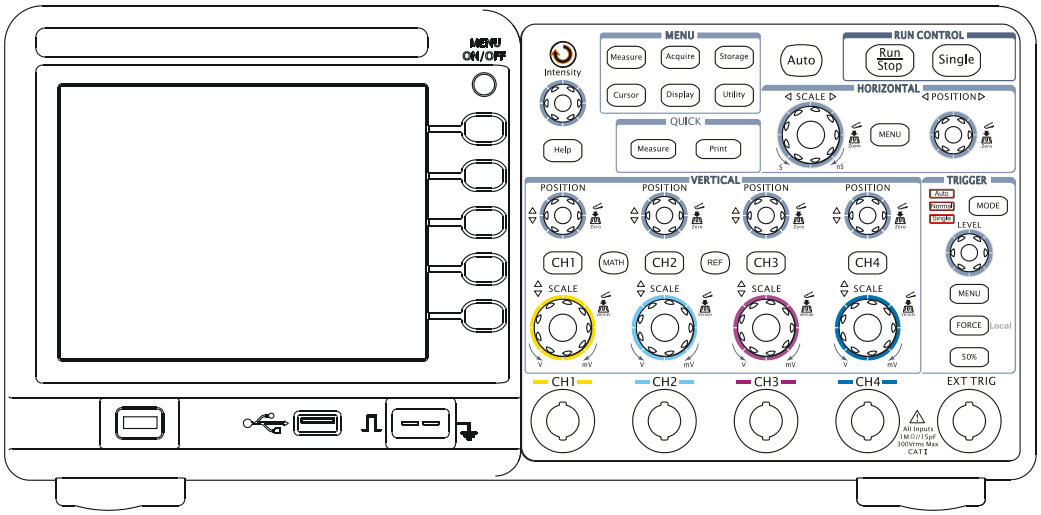


Figure 1-1
DS1000B Series Oscilloscope's Front Panel

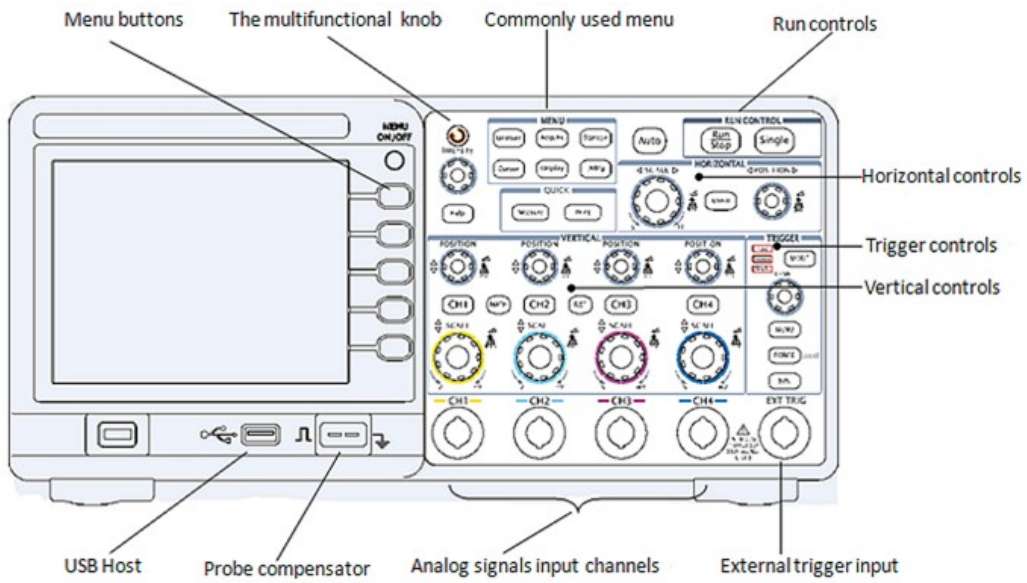


Figure 1-2
Front Panel Controls

Notation definitions in this User's Guide:

Throughout this guide, notation symbols of buttons and knobs are the same of those on front-panel.

- A box around the name of the key denotes MENU function buttons on front-panel, such as Measure.
- (↺) denotes the multi-function knob◎.
- ◎POSITION denotes the three POSITION knobs (two channels) or five POSITION knobs (four channels)
- ◎SCALE denotes the three or five SCALE knobs according to the quantities of the channels of different types of oscilloscopes.
- ◎LEVEL denotes the LEVEL knob.
- The name with a drop shadow denotes the menu operating key, such as **Waveform** soft key in Storage menu.

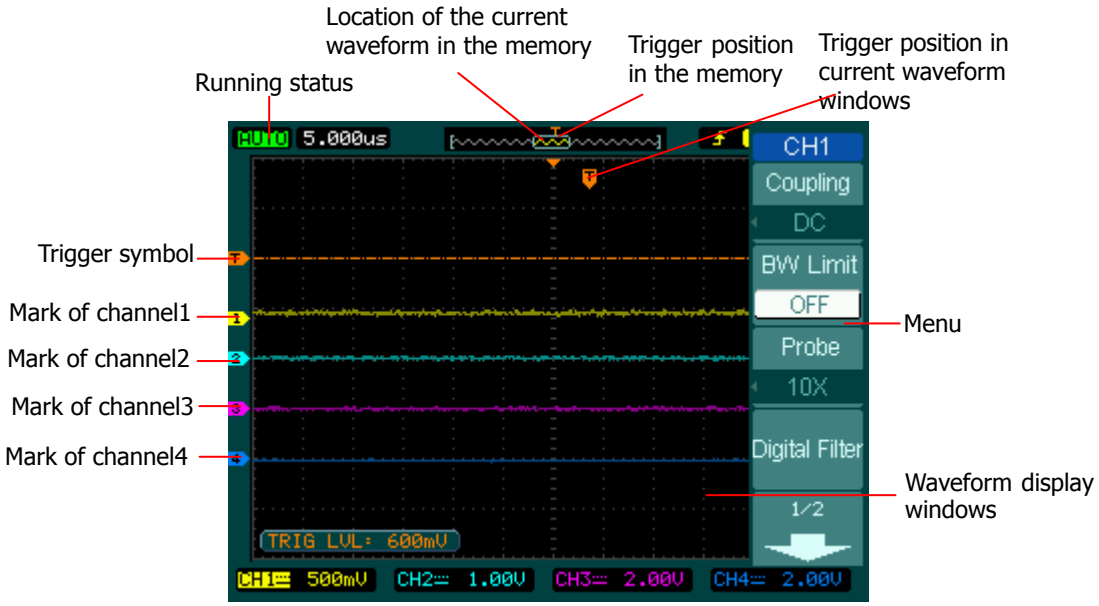


Figure 1-3
Display screen

To Inspect the Instrument

After receiving a new DS1000B series oscilloscope, please inspect the instrument as follows:

1. **Inspect the shipping container for damage.**
   Keep the damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically.

2. **Check the accessories.**
   Accessories supplied with the instrument are listed in "Accessories" in this guide. If the contents are incomplete or damaged notify the **RIGOL** Sales Representative.

3. **Inspect the instrument.**
   In case there is any mechanical damage or defect, or the instrument does not operate properly or fails performance tests, notify the **RIGOL** Sales Representative.

   If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier as well as the **RIGOL** sales office. Keep the shipping materials for the carrier's inspection.

   RIGOL offices will arrange for repair or replacement at **RIGOL**'s option without waiting for claim settlement.

To Perform a Functional Check

Perform this quick functional check to verify that the instrument is operating correctly.

1. Turn on the instrument.

- Use the power cord designed for the oscilloscope only.
- Use a power source that delivers 100 to 240 V, 45Hz to 440Hz.
- Turn on the instruments, and wait until the display shows the waveform window.
- Push the Storage button, select **Storage** in the top menu box and push the **Factory** menu box, then continue pressing **Load.**

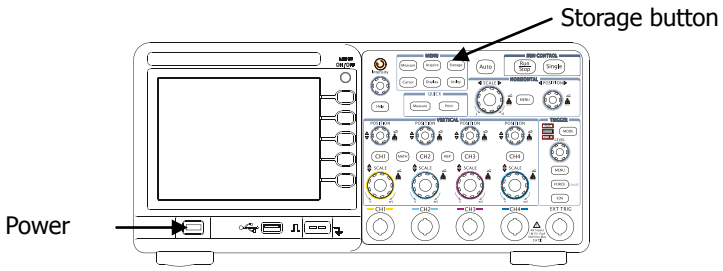


Figure 1-4
Turn on the instrument

WARNNING:
To avoid electric shock, be sure the oscilloscope is properly grounded.

2. Input a signal to a channel of the oscilloscope

① Set the attenuation switch on the probe to 10X and connect the probe to Channel 1 on the oscilloscope.
To do this:

- Align the slot in the probe connector with the socket on the Bayonet Nut Connector (BNC) connector of CH1 or CH2.
- Push to connect, and twist to the right to lock the probe in place.
- Attach the probe tip and ground lead to the PROBE COMP connector.

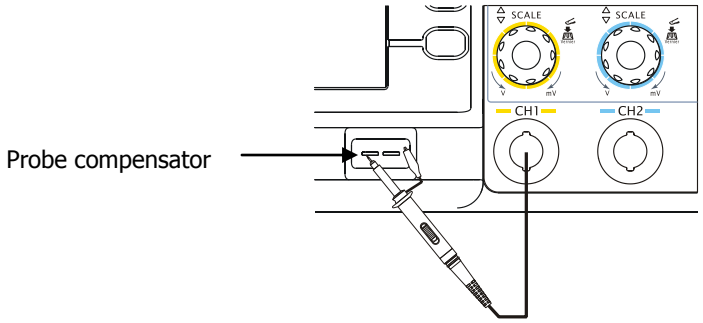


Figure 1-5
Attach the probe

② Set the probe attenuation of the oscilloscope to 10X. To do this, push CH1→**Probe**→**10X**.

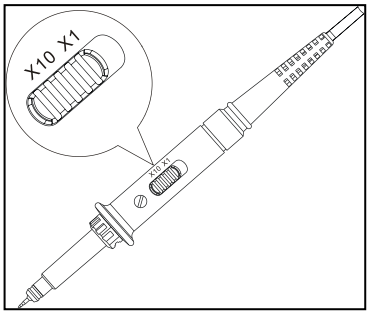


Figure 1-6
Set the probe

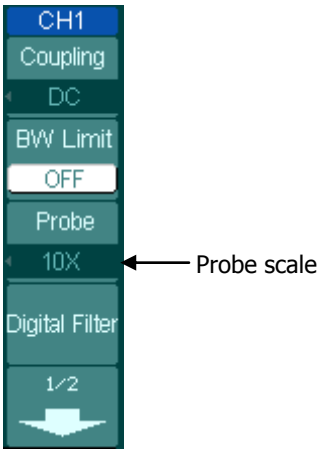


Figure 1-7
The CH1 menu

③ Push the AUTO button. Within a few seconds, a square wave will be displayed on the screen.

④ Push the OFF button or push the CH1 button again to turn off Channel 1.
Push the CH2, CH3, CH4 buttons to turn on channel 2, channel3, channel4, repeat steps 2 and 3.

NOTE: The signal output from Probe compensator should only be used for probe compensation, not for calibration.

To Compensate the Probes

Perform this adjustment to match the characteristics of the probe and the channel input. This should be performed whenever attaching a probe to any input channel at the first time.

1. From CH1 menu, set the Probe attenuation to 10X (press CH1→**Probe**→**10X**). Set the switch to 10X on the probe and connect it to CH1 of the oscilloscope. When using the probe hook-tip, inserting the tip into the hook-tip firmly to ensure a tight connection.
   Attach the probe tip to the connector of the Probe compensator and link the reference wire cramp with the ground connector of the probe compensator, Select CH1, and then press AUTO.

2. Check the shape of the displayed waveform.

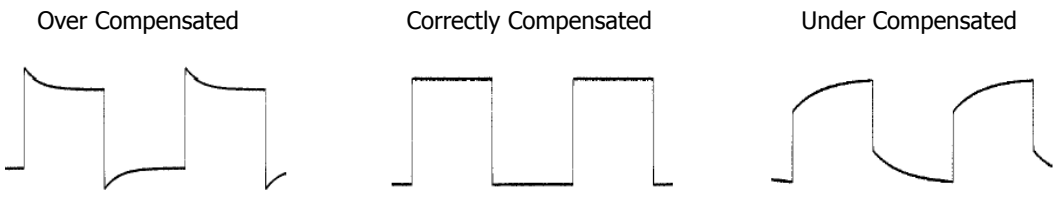


Figure 1-8
Check the shape

3. If necessary, use a non-metallic tool to adjust the variable capacitor of the probe for the flattest square wave being displayed on the oscilloscope.

4. Repeat if necessary.

WARNNING: To avoid electric shock while using the probe, be sure the perfection of the insulated cable, and do not touch the metallic portions of the probe head while it is connected with a voltage source.

To Display a Signal Automatically

The DS1000B series oscilloscope has an automated feature to display the input signal in best-fit status. The input signal should be 50 Hz or higher and a duty cycle is greater than 1%.

Press the AUTO button, the oscilloscope automatically sets up VERTICAL, HORIZONTAL and TRIGGER controls to display the input signal. Adjust the controls manually to get the best results if necessary.

Using the automatic setting:

1. Connect a signal to the oscilloscope (such as channel 1) as described above.

2. Press AUTO.
   The oscilloscope may change the current settings to display the signal; adjusts the vertical and horizontal scaling, the trigger coupling, type, position, level, and mode.

To Understand the Vertical System

As shown in Figure 1-9, there are several series buttons and knobs in the **VERTICAL** control area. The following exercises will gradually conduct you to be familiar with the using of the vertical parameters settings.

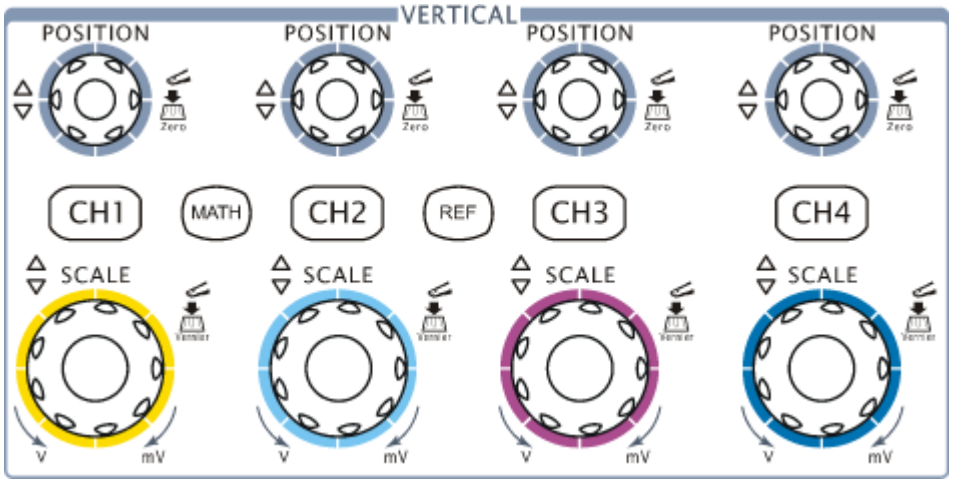


Figure 1-9
The vertical control window

1. Center the signal on the display with the POSITION knob.

The POSITION knob moves the signal vertically, and it is calibrated. Note that turning the POSITION knob, a voltage value is displayed for a short time indicating its value with respect to the ground reference located at the center of the screen. Also notice that the ground symbol on the left side of the display moves in conjunction with the POSITION knob.

Measurement hints

If the channel is DC coupled, measuring the DC and AC components of the signal by simply noting its distance from the ground symbol.

If the channel is AC coupled, the DC component of the signal is blocked, allow you to use greater sensitivity to display the AC component of the signal.

Vertical offset back to 0 shortcut key

Turn the POSITION knob to change the vertical display position of channel and press the POSITION knob to set the vertical display position back to 0 as a shortcut key, this is especially helpful when the trace position is far out of the screen and want it to get back to the screen center immediately.

2. Change the vertical setup and notice that each change affects the status bar differently.

- Change the vertical sensitivity with the SCALE knob and notice the change in the status bar at the bottom of the display.
- When you Press CH1, CH2, CH3, CH4, MATH, REF, the operating menus, symbols, waveforms and status information of corresponding channel and settings will be displayed on the screen. The current selected channel will be shut down when you press the key associated with the channel one more time.

Coarse/Fine Shortcut key

The Coarse/Fine vertical control can be set by simply pressing the vertical SCALE knob.

To Understand the Horizontal System

Figure 1-10 shows the **HORIZONTAL** controls: MENU button, POSITION and SCALE knobs of horizontal system. Following the exercise to familiarize with the buttons, knobs, and status bar.

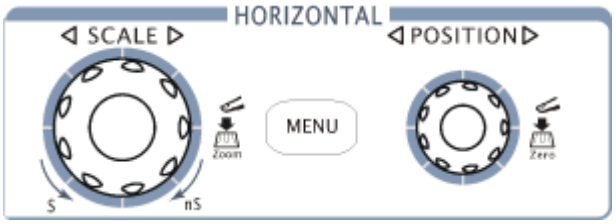


Figure 1-10
The horizontal system

1. Turn the SCALE knob and notice the change in the status bar.

The horizontal SCALE knob changes the sweep speed in a 1-2-5 step sequence, and displays the value at the upper-left of the display. The time base ranges of the DS1000B series is from 5 ns/div* to 50 s/div.

*** NOTE:** The speed of horizontal scan varies by different models.

Delayed Scan Shortcut key

To press the SCALE knob in the horizontal control area on the front-panel is another way to enter or exit Delayed Scan mode and it is equal to the menu operations, MENU→**Delayed**→**ON**.

2. The horizontal POSITION knob moves displayed signal horizontally on the waveform window.

The horizontal POSITION knob adjusts the trigger offset of signal, when turning the knob; you can note that the waveform moves horizontally in conjunction with the knob.

Horizontal offset back to 0 shortcut key

Press the POSITION knob to set the horizontal offset to 0 as a shortcut key, this is especially helpful when the trigger point is far out of the screen and want it to get back to the screen center immediately.

3. Press the MENU key to display the Time menu.

You can enter or exit the Delayed Scan mode, toggle the display mode among Y-T, X-Y or ROLL mode, and turn the horizontal POSITION knob to adjust trigger offset.

Horizontal position control

Trig-Offset: Denotes the real position of the trigger point relative to the midpoint of the memory. In this setting, the trigger position will be changed horizontally when you turning the POSITION knob.

To Trigger the Oscilloscope

Figure 1-11 shows the **TRIGGER** control: MODE, MENU, FORCE, 50% and a LEVEL knob. Following the exercises to familiarize with the buttons, trigger level knob and status bar.

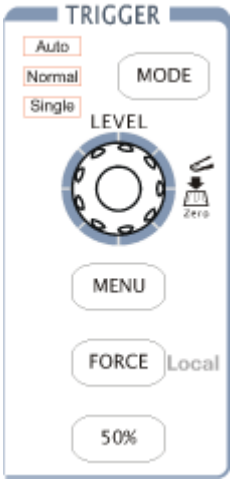


Figure 1-11
The trigger control window

Three kinds of trigger modes can be switched among Auto, Normal and Single with pressing MODE button.

1. Use LEVEL knob to change the settings of trigger level.

Turning the LEVEL knob, you will observe a nacarat trigger line, a trigger sign and a trigger level value displaying pane on the screen moving up and down. When you stop turning the LEVEL knob, the trigger line, trigger sign and trigger value pane will disappear in five seconds. During the same time of moving the trigger line, you will notice that the displayed value of trigger level has been changed on the screen.

Trigger Level back to 0 Shortcut key

Turn the LEVEL knob to change the trigger level value and press the LEVEL knob to set trigger level back to 0 as a shortcut key.

2. Change the trigger setup and notice these changes in the status bar.

Press MENU button in the Trigger control area.
A soft button menu appears on the display showing the trigger setting choices as shown in Figure 1-12.

- Press No.1 menu operating button to choose trigger mode as **Edge**.
- Press No.2 menu operating button to choose trigger source as **CH1**.
- Press No.3 menu operating button to choose slope type as .
- Press No.4 menu operating button to choose sweep mode as **Auto**.
- Press No.5 menu operating button to enter secondary menu of Trigger **Set Up**, so as to perform a further configuration about Trigger Coupling modes, trigger sensitivities, and trigger holdoff time.

Figure 1-12

NOTE: The change of trigger mode, source selection and slope type will lead to the change of the status bar on the upper-right of the screen.

3. Press 50%

Press the 50% button to set the trigger level to the center of the signal's amplitude.

4. Press FORCE

Start an acquisition even if no valid trigger signal has been found, usually used in "Normal" or "Single" trigger mode. This button has no effect if the acquisition is already stopped.

Key point:

Holdoff: A time interval before the oscilloscope responses to next trigger signal. During this Holdoff period, the trigger system becomes "blind" to trigger signals. This function helps to view complex signals such as an AM waveform. Press Holdoff button to activate (↻) knob, then turn it to adjust Holdoff time.

To Understand the Quick Function

The following figure shows that there are two buttons in the **QUICK** function area. The exercise below will gradually conduct you to familiarize the settings of the buttons.

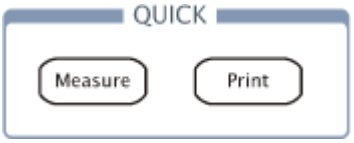


Figure 1-13
The quick function menu

1. Firstly, you need to press the button Measure form the main **MENU**, then press the button associated with **QuickMea**, you will navigate into the quick measurement setting menu. Three measuring items can be pre-set from the 22 measurements. Now, Press Measure button from the quick control area to enter quick measurement, three measuring parameters pre-defined will be displayed on the screen.

2. Use Print button to perform a quick print, you can set screen quantities need to be printed or store datum to the USB disk.

Chapter 2 : Operating Your Oscilloscope

By now, a user should understand the VERTICAL, HORIZONTAL and TRIGGER control systems and know how to determine the system setup from the status bar of a DS1000B series digital oscilloscope. This chapter will go through all groups of front-panel buttons, knobs and menus; and further the knowledge of the operation by hints in this guide. It is strongly recommended to perform all of the following exercises to get the most of the powerful measurement capabilities of the oscilloscope.

The following topics will be elaborated in this chapter:

- To set up the vertical system (CH1, CH2, CH3, CH4, MATH, REF , Vertical POSITION, Vertical SCALE)
- To set up the horizontal system (MENU, Horizontal POSITION, Horizontal SCALE)
- To set up the trigger system (MODE, LEVEL, MENU, FORCE, 50%)
- To set up the sampling system (Acquire)
- To set up the display system (Display)
- To save and recall waveforms or setups (Storage)
- To set up utility (Utility)
- To measure automatically (Measure)
- To measure with cursors (Cursor)
- To use run control buttons (Auto, Run/Stop, Single)

To Set up the Vertical System

To Set the Channels

Each channel of DS1000B series digital oscilloscope has an independent operation menu and it will pop-up after pressing any button among CH1, CH2, CH3, CH4. The settings of all items in the menu are shown in the table below.

Figure 2-1

Table 2-1 The Channel menu (Page 1/2)

Menu	Settings	Comments
Coupling	AC	Restraint the DC component of the input signal and passes the AC component with frequency higher than 5Hz.
	DC	Passes both AC and DC components of the input signal
	GND	Disconnect the input signal.
BW Limit	ON	Limit the channel's bandwidth to 20MHz to reduce display noise.
	OFF	Get full bandwidth.
Probe	0.001X . . 1000X	Set up the oscilloscope's probe attenuation factor to make the vertical scale readout correct.
Digital filter		Set up digital filter (See table 2-4).
↓	1/2	Go to the next menu page (The followings are the same, no more explanation).

Figure 2-2

Table 2-2 The Channel menu (Page 2/2)

Menu	Settings	Comments
	2/2	Back to the previous menu page (The followings are the same, no more explanation).
Volts/Div	Coarse Fine	To change the Volts/Dive settings in a 1-2-5 sequence from 2mv/div to 10v/div with SCALE knob. To change the Volts/Dive settings in small steps between the coarse settings.
Invert	ON OFF	Turn on the invert function. Restore to original display of the waveform.
Unit	V/ A/ W/ U	Set "V", "A", "W" or "U" as the unit of vertical channel.

To set up channel coupling

To use Channel 1 as an example, input a square wave signal with DC shift. Press CH1→**Coupling**→**DC** to set "DC" coupling. Both the AC component and the DC component of the input signal will pass.

The waveform is displayed as Figure 2-3:

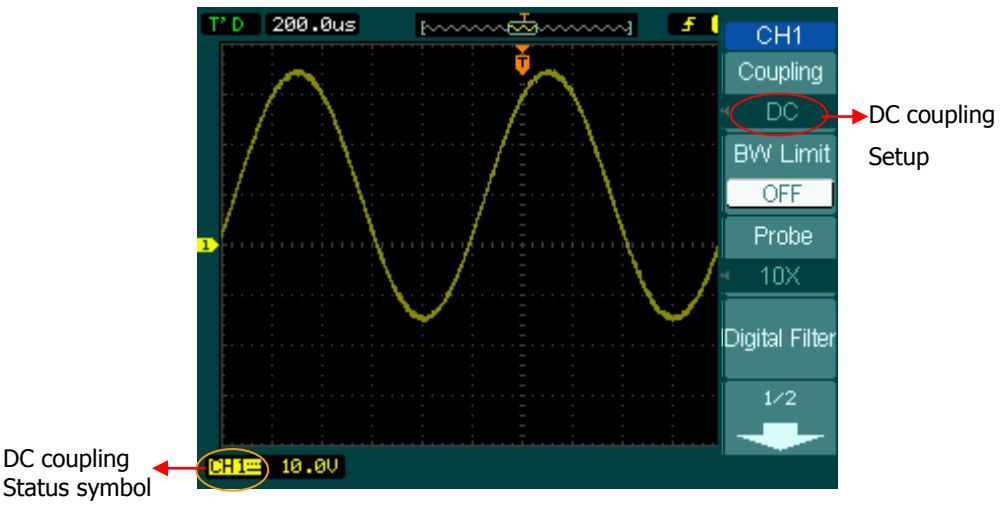


Figure 2-3
Waveform display

Press CH1→**Coupling**→**AC**, to set "AC" coupling. It will pass AC component of the input signal with frequency higher than 5 Hz and restraint DC component of the input signal.

The waveform is displayed as Figure 2-4:

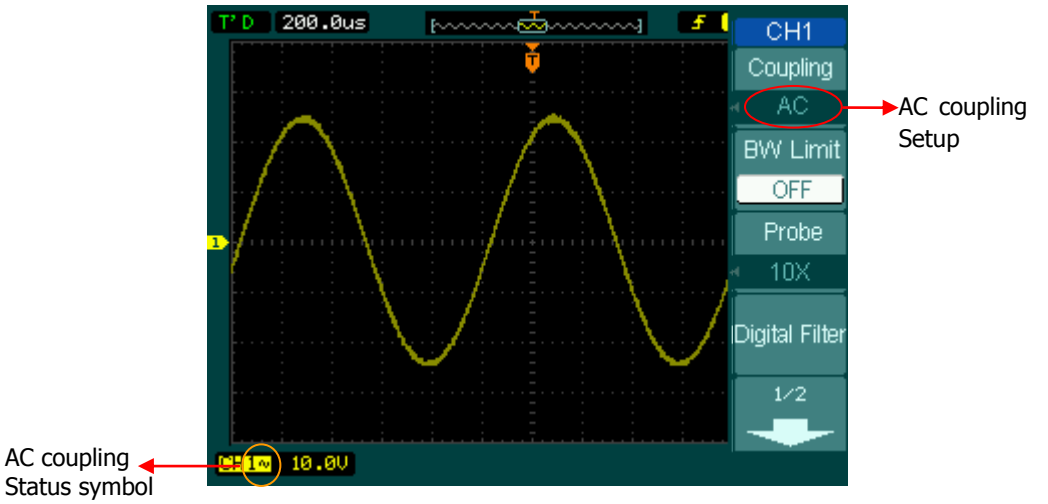


Figure 2-4
Waveform display

Press CH1→**Coupling**→**GND**, to set "GND" coupling, it disconnects the input signal.

The screen displays as Figure 2-5:

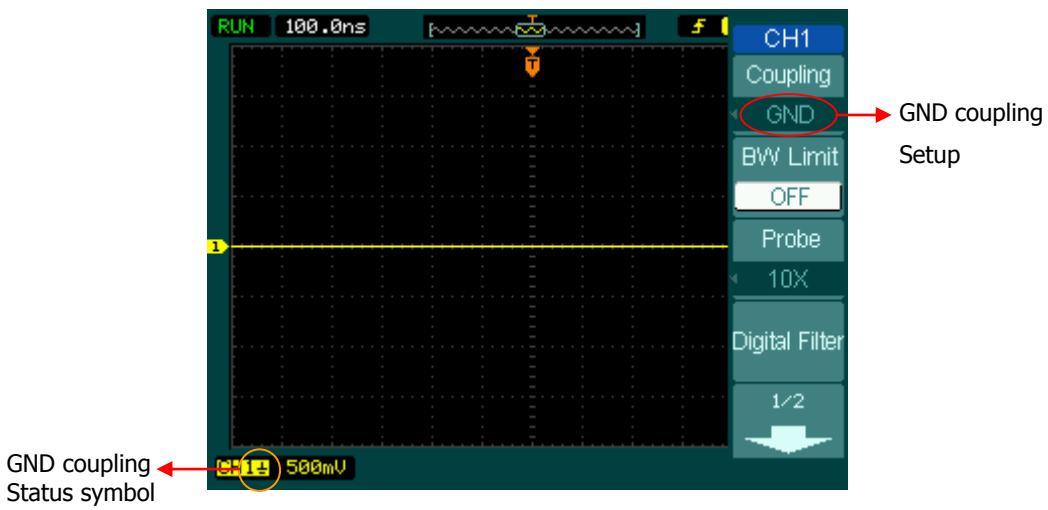


Figure 2-5
Screen display

To set up the channel bandwidth limit

Take Channel 1 for an example, input a signal containing high frequency component.

Press CH1→**BW Limit**→**OFF**, to set up bandwidth limit to "OFF" status. The oscilloscope is set to full bandwidth and passing the high frequency component in the signal.

The waveform is displayed as Figure 2-6:

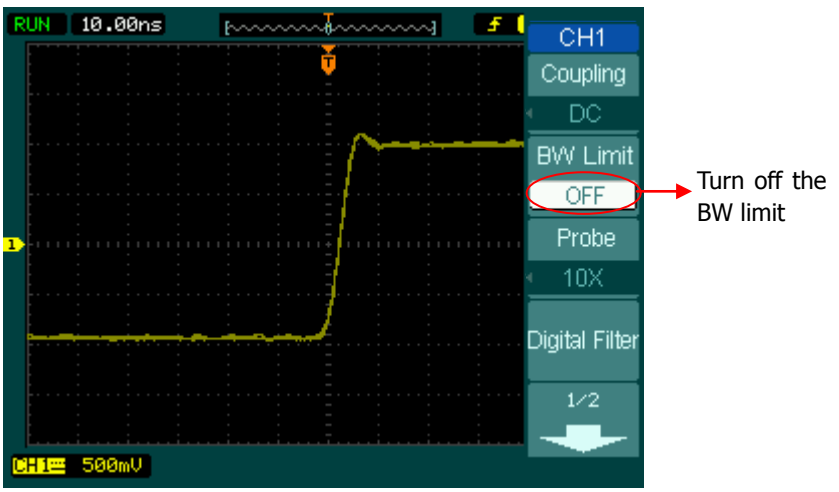


Figure 2-6
Turn off the BW limit

Press CH1→**BW Limit**→**ON**, to set up bandwidth limit to "ON" status. It will restraint the frequency component higher than 20MHz.

The waveform is displayed as Figure 2-7:

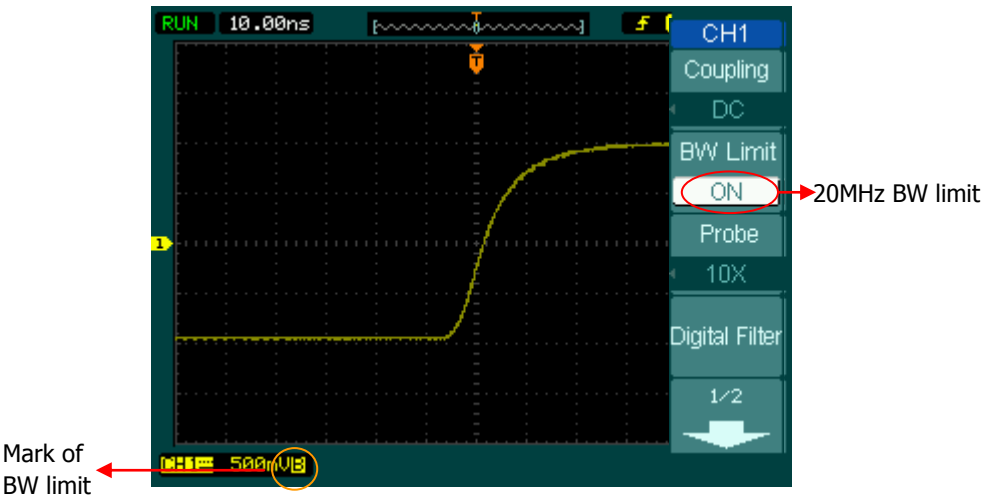


Figure 2-7
Turn on the BW limit

To set up Probe Attenuation

The oscilloscope allows selecting the attenuation factor for the probe. The attenuation factor changes the vertical scaling of the oscilloscope so that the measurement results reflect the actual voltage levels at the probe tip.

To change (or check) the probe attenuation setting, press the CH1, CH2, CH3 or CH4 button (according to which channel is in using). Toggle the **Probe** soft button to match the attenuation factor of the probe.

This setting remains in effect until changed again.

Figure 2-8 shows an example for using a 1000:1 probe and its attenuation factor.

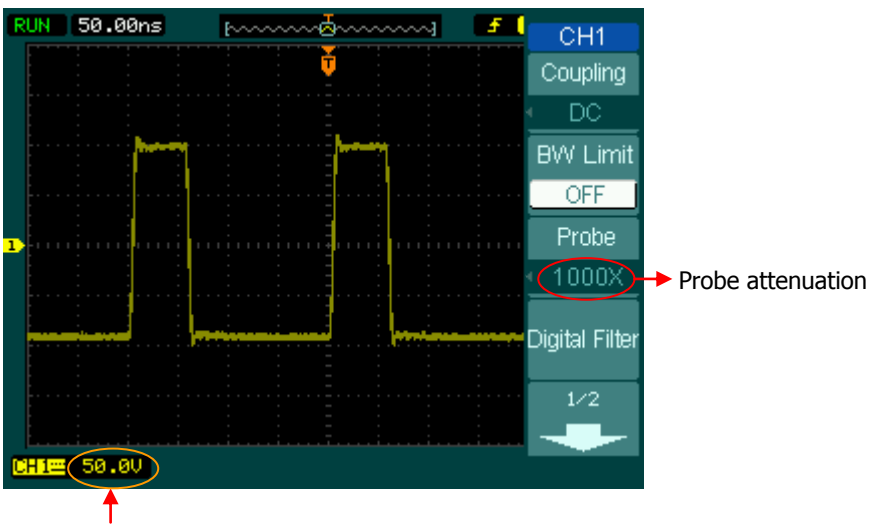


Figure 2-8 Using a 1000:1 probe

Table 2-3 Probe setting

Probe attenuation factors	Corresponding settings
1:1000，1:100，1:10	0.001X，0.01X，0.1X
1:1，2:1，5:1	1X，2X，5X
10:1，20:1，50:1	10X，20X，50X
100:1，200:1，500:1	100X，200X，500X
1000:1	1000X

To change the Volts/Div settings

The **Volts/Div** control has **Coarse** or **Fine** configuration. The Vertical Sensitivity is 2mv/div - 10V/div.

Coarse: It is the default setting of Volts/Div in a 1-2-5-step sequence from 2mV/div, 5mV/div, 10mV/div, to 10 V/div.

Fine: This setting changes the vertical scale to small steps between the coarse settings. It will be helpful to adjust the waveform in smooth steps.

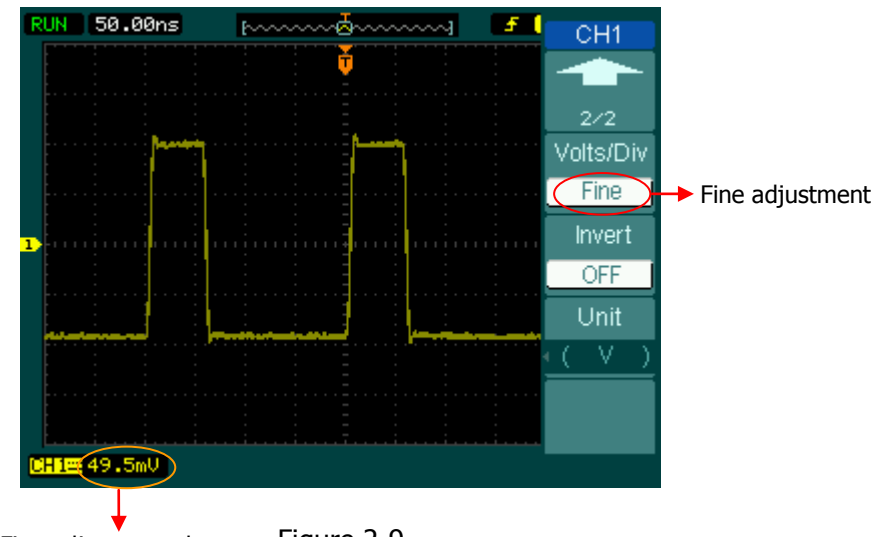


Figure 2-9 Fine configurations

Coarse/Fine Shortcut key:

To change Coarse/Fine setting, not only by menu operation but also by pressing vertical SCALE knob.

To invert a waveform

Invert turns the displayed waveform 180 degrees with respect to the ground level. When the oscilloscope is triggered on the inverted signal, the trigger is also inverted.

Figure 2-10 and Figure 2-11 show the changes before and after the inversion respectively.

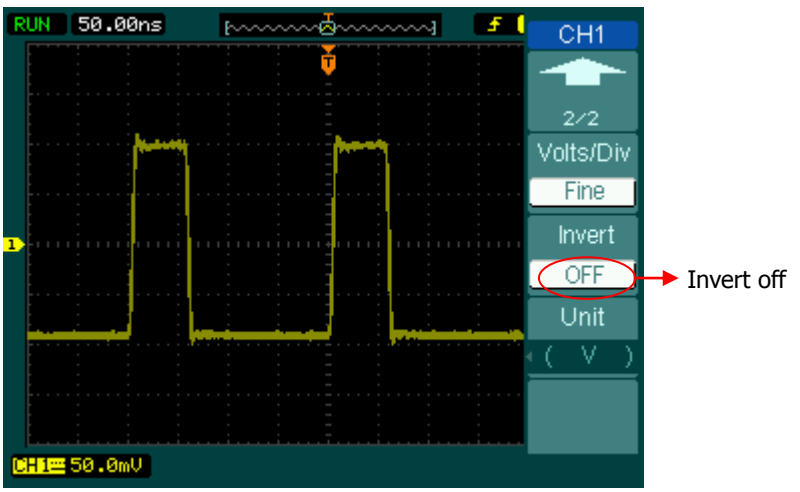


Figure 2-10
The waveform before inversion

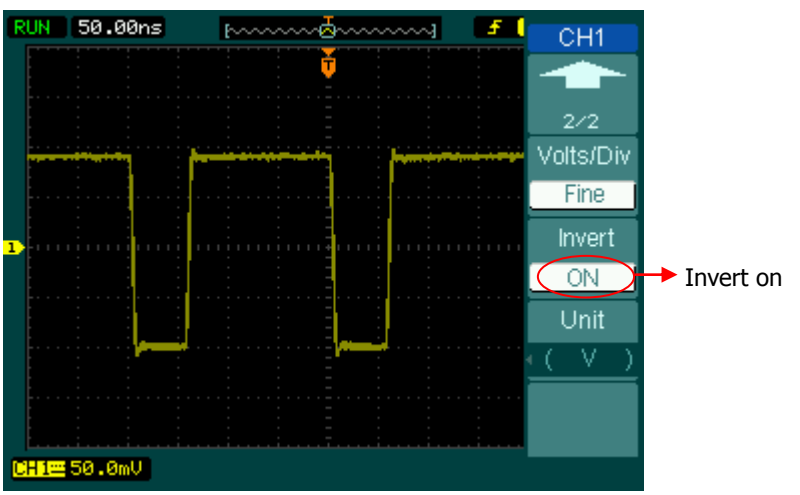


Figure 2-11

The waveform after inversion

To configure the Digital Filter

Press CH1→ **Digital filter**, it will display the digital filter menu. Turn the digital filter on or off as shown in the following figure. Turn (↻) knob to adjust the upper and lower limit of frequency after turning on the digital filter.

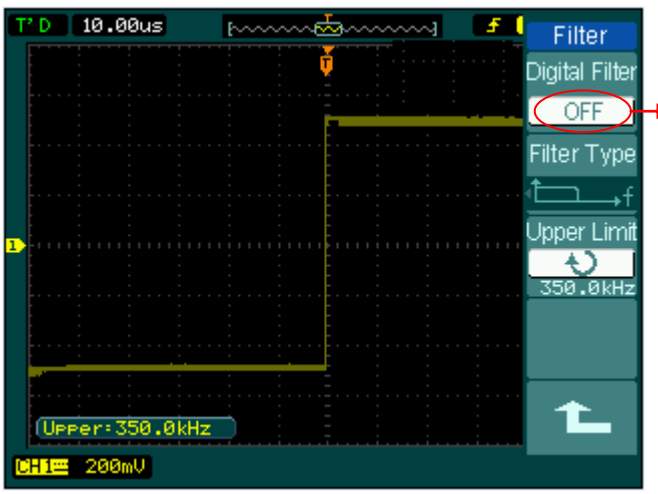


Figure 2-12
Turn off digital filter

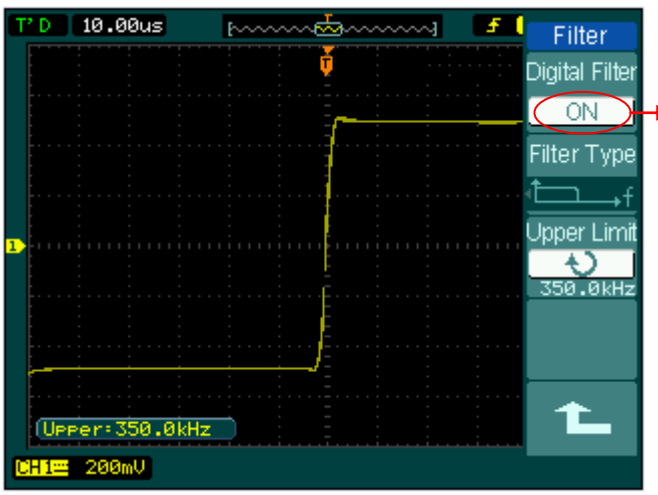
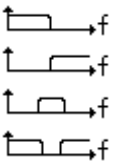


Figure 2-13

Turn on digital filter

Figure 2-14

Table 2-4 The Filter menu

Menu	Settings	Comments
Digital Filter	On Off	Turn on the digital filter. Turn off the digital filter.
Filter Type		Setup as LPF (Low Pass Filter). Setup as HPF (High Pass Filter). Setup as BPF (Band Pass Filter). Setup as BRF (Band Reject Filter).
Upper limit	 <frequency>	Turn () knob to set upper limit high limit.
Lower limit	 <frequency>	Turn () knob to set lower limit.
		Back to higher level menu (The followings are the same, no more explanation).

To Use Math Functions

The mathematic functions include "add", "subtract", "multiply" and "FFT" for Channel 1, Channel 2, Channel3 and Channel4. The mathematic result can be measured by the grid and the cursor.

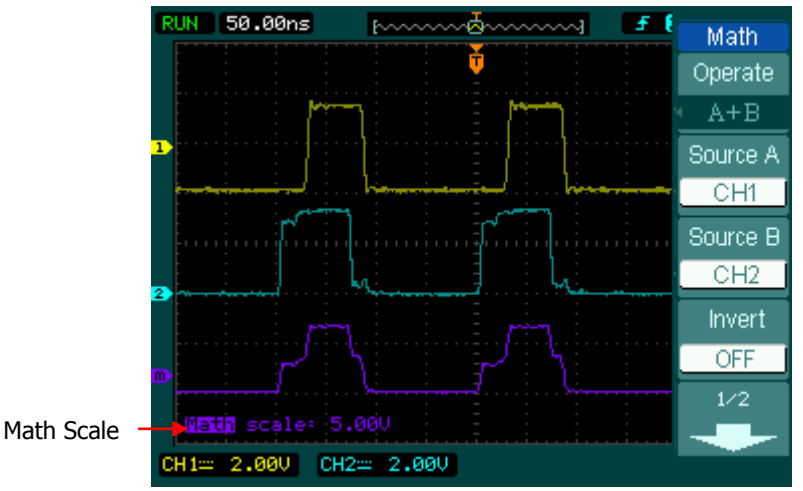


Figure 2-15

The Math function

Figure 2-16

Table 2-5 The Math menu (Page 1/2)

Menu	Settings	Comments
Operate	A+B A-B A×B FFT	Add source A and source B. Subtract source B from source A. Multiply source B by source A. Fast Fourier Transform.
Source A	CH1, CH2, CH3, CH4	Define CH1, CH2, CH3 or CH4 as source A.
Source B	CH1, CH2, CH3, CH4	Define CH1, CH2, CH3 or CH4 as source B.
Invert	ON OFF	Invert the MATH waveform. Restore to original waveform display.

Figure 2-17

Table 2-6 The Math menu (Page 2/2)

Menu	Settings	Comments
		The multifunctional knob (↺) adjusts the vertical position of the Math waveform.
		The multifunctional knob (↺) adjusts the vertical amplitude of the Math waveform.

Using FFT function

The FFT (Fast Fourier Transform) process converts a time-domain signal into its frequency components mathematically. FFT waveforms are useful in the following applications:

- Measuring harmonic content and distortion in systems
- Characterizing noise in DC power supplies
- Analyzing vibration

Figure 2-18 Table 2-7 The FFT menu (Page 1/2)

Menu	Settings	Comments
Operate	A+B A-B A×B FFT	Add source A to source B. Subtract source B from source A. Multiply source B by source A. Fast Fourier Transform.
Source	CH1, CH2, CH3, CH4	Define CH1, CH2, CH3 or CH4 as FFT source.
Window	Rectangle Hanning Hamming Blackman	Select window for FFT.
Display	Split Full screen	Display FFT waveform on half screen. Display FFT waveform on full screen.

Figure 2-19 Table 2-8 The FFT menu (Page 2/2)

Menu	Settings	comments
		The multifunctional knob (↻) adjusts the vertical position of Math
		The multifunctional knob (↻) adjusts the vertical amplitude of Math
Vertical scale	Vrms dBVrms	Set Vrms as vertical scale unit Set dBVrms as vertical scale unit

Key points for FFT

1. Signals that have a DC component or offset can cause incorrect FFT waveform component magnitude values. To minimize the DC component, choose AC Coupling on the source signal.
2. To reduce random noise and aliases components in repetitive or single-shot events, set the oscilloscope acquisition mode to Average.
3. To display FFT waveforms with a large dynamic range, use the dBVrms scale. The dBVrms scale displays component magnitudes using a log scale.

Selecting an FFT Window

DS1000B series oscilloscope provides four FFT windows. Each window is a trade-off between frequency resolution and amplitude accuracy. It depends on the desired measurement and the source signals characteristics to determine the window to use. Use the following guidelines to select the best window.

Table 2-9 FFT Windows

Window	Features	Best for measuring
Rectangle	Best frequency resolution and worst amplitude accuracy. This is essentially the same as no window.	Transients or bursts, the signal levels before and after the event are nearly equal. Equal-amplitude sine waves with fixed frequencies. Broadband random noise with a relatively slow varying spectrum.
Hanning	Better frequency resolution, poorer amplitude accuracy than Rectangular.	Sine, periodic, and narrow-band random noise.
Hamming	Hamming has slightly better frequency resolution than Hanning.	Transients or bursts where the signal levels before and after the events are significantly different.
Blackman	Best amplitude accuracy, worst frequency resolution.	Single frequency waveforms, to find higher order harmonics.

Key points:

FFT Resolution: The FFT resolution is the quotient between sampling rate and the number of FFT points. With a fixed FFT points, the lower sampling rate, the better the resolution.

Nyquist Frequency

The highest frequency that any real-time digitizing oscilloscope can acquire without aliasing. It's normally half of the sample rate. This frequency is called the Nyquist frequency. Frequency above the Nyquist frequency will be under sampled, causing a situation known as aliasing.

To Use REF Function

Reference Waveforms are saved waveforms to be selected for display. The reference function will be available after saving the selected waveform to non-volatile memory. During the actual measurement process, you can use DS1000B series digital oscilloscope to observe the waveforms of correlative components. It will help you to determine the cause of malfunction when you compare the measured waveform with the reference waveform. The method is particularly useful under the circumstance of having reference waveforms.

Press REF button to display the Reference waveform menu.

Figure 2-20 Table 2-10 REF menu when using internal memory (Page 1/3)

Menu	Settings	Comments
Channel	REF 1 REF 2 REF 3 REF 4	Turn on or turn off one to four REF channels
Current	REF 1 REF 2 REF 3 REF 4	Select the current REF channel which is optional from REF1 to REF4. (According to the available channel, for example, if only REF1 is turned on, then only REF1 can be chosen as the current channel.)
Source	CH1, CH2, CH3, CH4, MATH	Select CH1, CH2, CH3,CH4,MATH as the source channel whose input waveforms will be compared with the reference waveforms.
location	Internal external	Select memory location in scope. Select memory location out scope.

Figure 2-21 Table 2-11 REF menu when using internal/external memory (Page 2/3)

Menu	Settings	Comments
Save		Save REF waveform to outer memory location.
		The multifunctional knob ( ) adjusts the vertical position of REF
		The multifunctional knob ( ) adjusts the vertical amplitude of REF

Figure 2-22 Table 2-12 REF menu when using internal memory (Page 3/3)

Menu	settings	comments
Reset		Reset REF waveform.
Imp./Exp.		Go to import menu (see table 2-14).

Figure 2-23 Table 2-13 REF menu when using external memory (Page 3/3)

Menu	settings	comments
Reset		Reset REF waveform.
Import		Go to import menu (see table 2-18).

To Import and Export

Press REF →**Imp./Exp.** and go to the following menu.

Figure 2-24

Table 2-14 The Imp./Exp. Menu

Menu	Settings	Comments
Explorer	Path Directory File	Switch to Path, directory or file.
Export		Export the REF file from internal memory to external memory (see table 2-15).
Import		Import the REF file to internal memory.
Delete File		Delete file.

The screen of Import and Export as follows

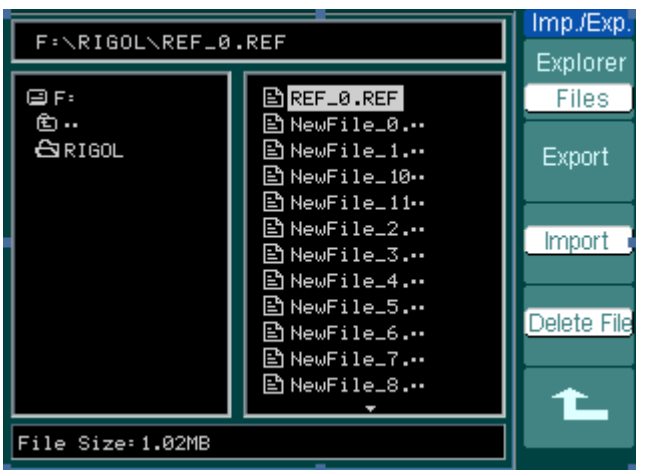


Figure 2-25
Import of export the figure

Export

Press REF→**Imp./Exp.**→ **Export** and go to the following menu.

Figure 2-26

Table 2-15 The Export menu

Menu	Settings	Comments
↑ ↓		Move the input focus point of files' name up and down.
⊂⊃		Move the focus point to next location.
×		To delete chosen letter.
Save		Execute the operation.

The screen of Export is as follows.

Figure 2-27
Figure export

Save to External Memory

Press REF→**Save** and navigate to the following menu.

Figure 2-28

Table 2-16 The Save menu

Menu	Settings	Comments
Explorer	Path Directory File	Switch among Path, Directory and File.
New File (Folder)		Set up new file in Path and File. Set up new folder in directory.
Delete File (Folder)		Delete chosen file (Folder).

The screen of Save is as follows:

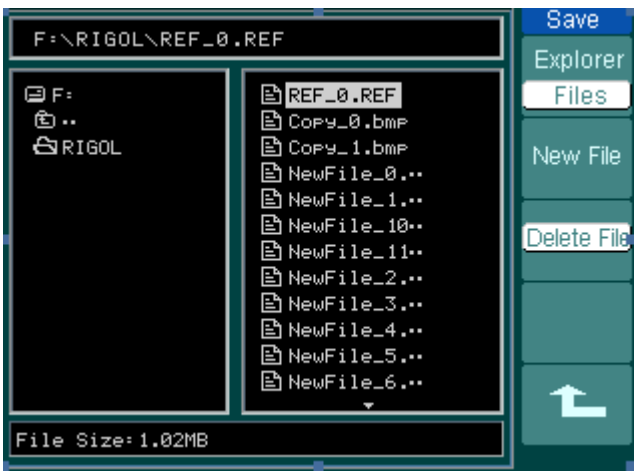


Figure 2-29
The figure of save

New File (or New Folder)

Press REF→**Save**→**New File** (or **New Folder**) and go to the following menu.

Figure 2-30

Table 2-17 The New File menu

Menu	Settings	Comments
↑ ↓		Move the focus point of file name up and down.
⇄		Move the focus point to the next location.
✕		To delete chosen letter.
Save		Execute the saving operation.

The screen of File Name input is as follows:

Figure 2-31
File Name inputting interface

Import

Press REF→**Import** and go to the following menu.

Figure 2-32

Table 2-18 The Import menu

Menu	Settings	Comments
Explorer	Path Directory File	Switch among Path, Directory and File.
Import		Import the REF file into internal memory.

The screen of Import is as follows:

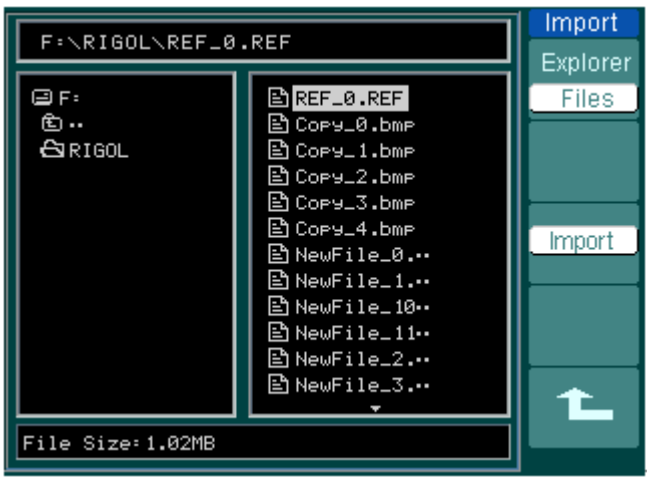


Figure 2-33
The figure of import

To Display a Reference Waveform

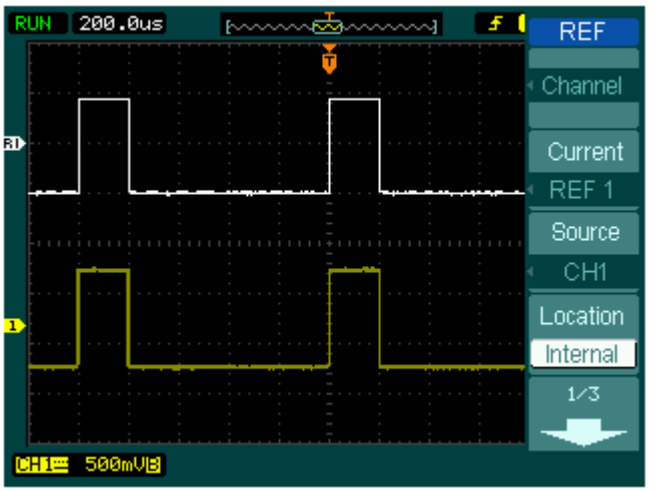


Figure 2-34
Reference waveform display

- Push REF button to show the reference waveform menu.
- Continue Pressing button No.1 to turn on or turn off one to four reference channels.
- Select a REF channel as the current reference channel from the channels activated by step 2.
- Continue pressing button No.3 to select a signal source channel from CH1, CH2, CH3, CH4 and MATH.(If the MATH is not available ,press MATH button to activate MATH)
- Turn vertical knob POSITION , multifunctional knob , vertical knob SCALE to adjust the waveform (derived from step 4) to a suitable position and expand or express the waveform horizontally to a proper situation.
- Access page 1 of **REF** menu, Press button No.4 to select the saving location of REF waveform.
- Access page 2 of **REF** menu, and then press button No.2 to save the current waveform on the screen to internal or external memory as a reference waveform.

NOTE:

The Reference function is not available in X-Y mode.

Turn on or off Channels

CH1, CH2, CH3, CH4 and Ext. trigger channels are input channels. All functions applied will base on operating the instrument with channels, so MATH and REF can be regarded as relatively isolated channels.

Press the corresponding button (for example: CH1, CH2, CH3, CH4, MATH, REF) on the front panel to turn the channels on. The backlight indicates the channel is currently active. When a channel is currently selected, press the button with respect to the channel again will turn it off and the backlight goes off. When a channel is not currently selected, press the button associated with the channel will select the channel as the current channel.

Table 2-19 The Channels menu

Channel Mode	Settings	Status Indicator
Channel 1 (CH1)	ON Selected OFF	CH1 (yellow letters with black background) CH1 (black letters with yellow background) No indicator
Channel 2 (CH2)	ON Selected OFF	CH2 (sky blue letters with black background) CH2 (black letters with blue background) No indicator
Channel 3(CH3)	ON Selected OFF	CH3（pink letters with black background） CH3（black letters with pink background） No indicator
Channel4(CH4)	ON Selected OFF	CH4（black letter with navy blue background） CH4（navy blue letter with black background） No indicator
MATH	ON Selected OFF	Math (black letter) Math (purple letter) No indicator

To Apply the Vertical Knobs

Use the vertical controls to display signal waveforms by adjusting the vertical SCALE knob, and the POSITION knob, and setting the input parameters.

1. Using vertical POSITION knob.
   The vertical POSITION control changes the vertical position of signal waveforms in all channels (excluding MATH and REF). The resolution changes according to the vertical level set. Pressing this knob will clear the channel's vertical offset to zero.

2. Using vertical SCALE knob.
   The vertical SCALE control changes the vertical sensitivity of signal waveforms in all channels (excluding MATH and REF). If the Volts/Div is set to "Coarse", the waveform scales in a 1-2-5 step sequence from 2 mV ,5mv,10mv…to 10 V. If the Volts/Div is set to "Fine", it scales to small steps between the coarse settings. Turn the knob clockwise to decrease the vertical scale, turn the knob counter-clockwise to increase the vertical Volts/Div setting. You can toggle between "coarse" and "Fine" setting through pressing the SCALE knob.

3. Channels(excluding Math and REF) would be adjustable by the vertical POSITION and SCALE only when they are selected.

4. During the vertical positioning, a position message is displayed on the left bottom of the screen, in the same color along with the corresponding channel. The unit is V (Volts).

To Set up the Horizontal System

The oscilloscope shows the time per division in the scale readout. With the horizontal control buttons and knobs, you can change the horizontal time base and trigger offset which indicates the horizontal location of trigger in the memory.

The horizontal controls change the horizontal scale and position of waveforms. The horizontal center of the screen is the time reference for waveforms. Changing the horizontal scale causes the waveform to be expanded or compressed with respect to the screen center.

Horizontal position changes the displayed waveform position, relative to the trigger point.

The Horizontal Knobs

POSITION: The horizontal POSITION knob adjusts the horizontal position of all channel (including Math) waveforms. The resolution of this control varies with the time base. Pressing this button clears the trigger offset and moves the trigger point to the horizontal center of the screen.

SCALE: Use SCALE to select the horizontal time/div (scale factor) for the main or the Delayed Scan time base. When Delayed Scan is enabled, it changes the width of the window zone by changing the Delayed Scan time base.

Horizontal Menu.

Press the horizontal MENU button to display the horizontal menu. The settings of this menu are listed in the following table.

Figure 2-35 Table 2-20 The Horizontal menu

Menu	Settings	Comments
Delayed	ON OFF	Turn on the Delayed Scan mode. Turn off the Delayed Scan mode.
Time Base	Y-T X-Y Roll	Show the relative relation between vertical voltage and horizontal time. Show CH1 amplitude value at X axis; show CH2 amplitude value at Y axis. In Roll Mode, the waveform display updates from right to left.
Trig-offset Reset		Adjust the trigger position to the center of the memory.

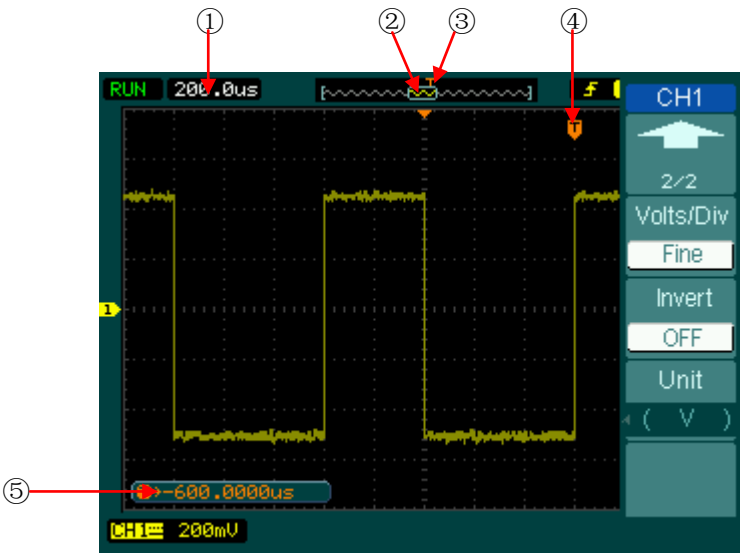


Figure 2-36
Status bar and mark for Horizontal control

Marks Indicator

① The horizontal time base (main time base).

② The position of the current waveform window in the memory.

③ The trigger position in the memory.

④ The trigger position in the current waveform windows.

⑤ The trigger's horizontal offset with respect to the center of the window.

Key Points

Y-T: The conventional oscilloscope display format. It shows that the voltage of a waveform record (on the vertical axis) varies along with time (on the horizontal axis).

X-Y: XY format displays channel 1 in the horizontal axis and channel 2 in the vertical axis.

Roll Mode: In this mode, the waveform display rolls from right to left. No trigger or horizontal offset control of waveforms is available during Roll Mode, and it's only available when set to 500ms/div or slower.

Slow Scan Mode: This mode is available when the horizontal time base is set to 50ms or slower. In this mode, the oscilloscope acquires sufficient data for the left part to the trigger point, then wait for trigger, when trigger occurs, it continue to draw the rest part from the trigger point to the end of the right side. When choosing this mode to view low frequency signals, it is recommended that the channel coupling be set as **DC**.

Time/Div: Horizontal scale. If the waveform acquisition is stopped (using the Run/Stop button), the Time/Div control expands or compresses the waveform.

Delayed Scan:

The Delayed Scan is a magnified portion of the main waveform window. Use Delayed Scan to locate and horizontally expand part of the main waveform window for a more detailed (higher horizontal resolution) analysis of signal. The Delayed Scan time base setting cannot be set slower than the Main time base setting.

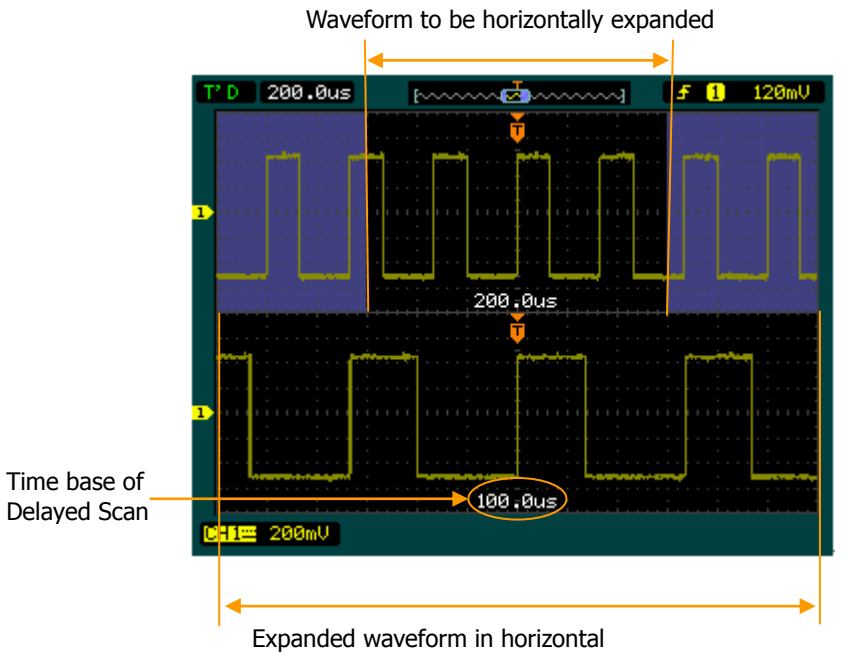


Figure 2-37
Delayed Scan windows

The following steps show you how to use Delayed Scan.

1. Connect a signal to the oscilloscope and obtain a stable display.
2. Press horizontal MENU→**Delayed**→**ON** or press horizontal SCALE knob to enter Delayed Scan mode.

The screen will be split into two parts. The upper half displays the main waveform window and the lower half displays an expanded portion of the main waveform window. This expanded portion of the main window is called the Delayed Scan window. Two blocks shaded at the upper half; the un-shaded portion is expanded in the lower half. The horizontal POSITION and SCALE knobs control the size and position of the Delayed Scan. The value at top of the screen is the main time base and the value on the center bottom means the Delayed Scan time base.

- Use the horizontal POSITION knob to change the position of the expanded portion.
- Turn the horizontal SCALE knob to adjust the Delayed Scan resolution.
- To change the main time base, turn off the Delayed Scan mode.
- Since both the main and Delayed Scan waveform windows are displayed, each waveform window occupies a half of the original waveform window. They are both compressed vertically to a half size, the same as the vertical divisions.

Delayed Scan Shortcut Key:
Delayed Scan function can be activated not only by menu but also by pressing horizontal SCALE knob.

X-Y Format

This format is useful for studying phase relationships between two signals.

Channel 1 in the horizontal axis(X) and channel 2 in the vertical axis(Y), the oscilloscope uses a none-trigger acquisition mode, data is displayed as dots.

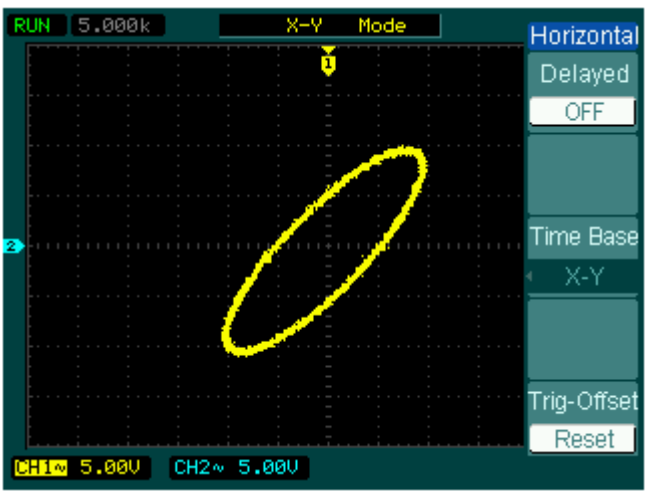


Figure 2-38
X-Y display format

NOTE: The X-Y display format is only suitable for CH1, CH2, CH3; CH4.In the normal condition, the oscilloscope can acquire waveforms with any sampling rate. You can also adjust the sampling rate and the vertical scaling of the channel when you use the X-Y display format. You can reduce the sampling rate so as to display a better Lissajous figure.

The following modes or functions will not work in X-Y format.

- Cursor Measurements（excluding manual mode ）
- REF and MATH Operations
- Delayed Scan Mode
- Vector Display Mode
- Horizontal POSITION knob
- Trigger Controls(excluding MODE button)

To Set up the Trigger System

The trigger determines when the oscilloscope starts to acquire data and display a waveform. When a trigger is set up properly, it can convert unstable displays or blank screens into meaningful waveforms.

When the oscilloscope starts to acquire a waveform, it collects enough data so that it can draw the waveform to the left of the trigger point. The oscilloscope continues to acquire data while waiting for the trigger condition to occur. After it detects a trigger, the oscilloscope continues to acquire enough data so that it can draw the waveform to the right of the trigger point.

The trigger control area on the front panel includes a knob and four buttons:

MODE: With the button, three kinds of trigger mode can be toggled among Auto, Normal, and Single.

LEVEL: Use the knob to adjust the trigger level; press the knob to reset the trigger level to zero.

50%: Specify the trigger level to the vertical midpoint between the peaks of the trigger signal by pressing the instant execute button.

FORCE: Force to create a trigger signal and the function is mainly used in Normal and Single mode

MENU: The button that activates the trigger controls menu.

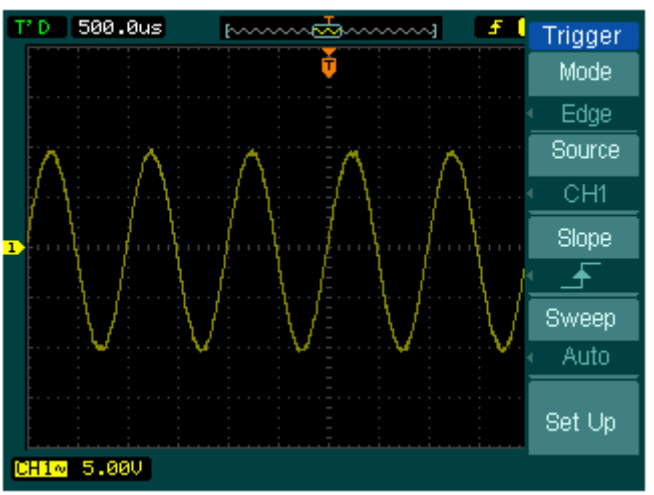


Figure 2-39
Trigger controls

Trigger Modes

The oscilloscope provides five trigger modes: Edge, Pulse, Video, Pattern and Alternative.

Edge: An edge trigger occurs when the trigger input passes through a specified voltage level in the specified slope direction.

Pulse: Use this trigger mode to catch pulses with certain pulse width.

Video: Use video trigger mode on fields or lines for standard video signals.

Pattern: Recognising trigger by searching specified code.

Alternative: Trigger on non-synchronized signals.

Edge Trigger

An edge trigger determines whether the oscilloscope finds the trigger point on the rising or the falling edge of a signal. Select Edge trigger Mode to trigger on Rising edge, falling edge or rising & falling edge.

Figure 2-40 Table 2-21 The Trigger menu

Menu	Settings	Comments
Source	CH1	Select CH1 as trigger source.
	CH2	Select CH2 as trigger source.
	CH3	Select CH3 as trigger source.
	CH4	Select CH4 as trigger source.
	EXT	Select EXT TRIG as trigger source.
	EXT/5	Select attenuated EXT TRIG/5 as trigger source.
	AC Line	Select power line as trigger source.
Slope	Rising edge	Trigger on rising edge.
	Falling edge	Trigger on falling edge.
	↑↓ Rising & Falling edges	Trigger on both ring & falling edge.
Sweep	Auto	Acquire waveform even no trigger occurred.
	Normal	Acquire waveform when trigger occurred.
	Single	When trigger occurs, acquire one waveform then stop.
Set up		To go to Set Up menu, see table 2-36

Pulse Width Trigger

Pulse trigger occurs according to the width of pulse. The abnormal signals can be detected through setting up the pulse width condition.

Figure 2-41 Table 2-22 The Trigger menu (Page 1/2)

Menu	Settings	Comments
Source	CH1	Select CH1 as trigger source.
	CH2	Select CH2 as trigger source.
	CH3	Select CH3 as trigger source
	CH4	Select CH4 as trigger source l
	EXT	Select EXT TRIG as trigger source
	EXT/5	Select attenuated EXT TRIG/5 as trigger source.
When	(+Pulse width more than)	To select pulse condition.
	(+Pulse width less than)	
	(+Pulse width equal to)	
	(-Pulse width less than)	
	(-Pulse width more than)	
	(-Pulse width equal to)	
Settings	<Width>	To set required pulse width.

Figure 2-42 Table 2-23 The Trigger menu (Page 2/2)

Menu	Settings	Comments
Sweep	Auto	Acquire waveform even no trigger occurred.
	Normal	Acquire waveform when trigger occurred.
	Single	When trigger occurs, acquire one waveform and then stop.
Set Up		To go to Set Up menu, see table 2-36.

Note: The Pulse width adjust range is 20ns ~ 10s. When the condition is met, it will trigger and acquire the waveform.

Video Trigger

Choose video trigger to trigger on fields or lines of NTSC, PAL, or SECAM standard video signals. Trigger coupling preset to DC.

Figure 2-43 Table 2-24 The Video Trigger menu (Page 1/2)

Menu	Settings	Comments
Source	CH1	Selects CH1 as trigger source.
	CH2	Selects CH2 as trigger source.
	CH3	Selects CH3 as trigger source.
	CH4	Selects CH4 as trigger source.
	EXT	Select EXT TRIG as trigger source.
	EXT/5	Select EXT TRIG/5 as trigger source.
Polarity	Normal polarity	Triggers on positive going sync pulses.
	Inverted polarity	Triggers on negative going sync pulses.
Sync	All Lines	Trigger on all lines.
	Line Num	Trigger on a specified line.
	Odd field	Select to trigger on odd field.
	Even field	Select to trigger on even field.

Figure 2-44 Table 2-25 The Video Trigger menu (Page 2/2 when Sync is set as the specified line)

Menu	Settings	Comments
Line Num	< Line sync >	Select the specified line number for sync.
Standard	PAL/SECM NTSC	Select Video standard.
Sweep	Auto Normal Single	Force the oscilloscope to trigger in the absence of trigger condition. Lets oscilloscope to trigger in the suitable trigger condition. Lets oscilloscope to trigger one time in the suitable trigger condition, and then stop.
Set Up		To go to set up menu, see Table 2-36.

Figure 2-45 Table 2-26 The Video Trigger menu (Page 2/2 When the Sync is set as All lines, Odd field and Even field)

Menu	Settings	Comments
Standard	PAL/SECAM NTSC	Select Video standard.
Sweep	Auto Normal Single	Force the oscilloscope to trigger in the absence of trigger condition. Lets oscilloscope to trigger in the suitable trigger condition. Lets oscilloscope to trigger one time in the suitable trigger condition, and then stop.
Set Up		To go to set up menu, see Table 2-36.

Key points:

Sync Pulses: When Normal Polarity is selected, the trigger always occurs on negative-going sync pulses. If the video signal has positive-going sync pulses, use the inverted Polarity.

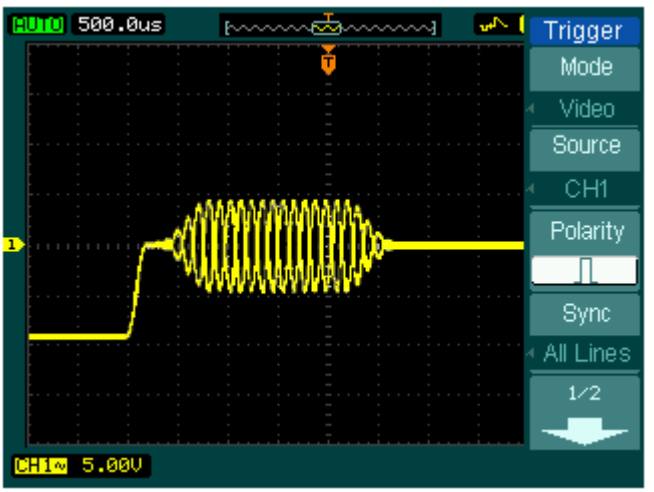


Figure 2-46
Video Trigger: Line Synchronization

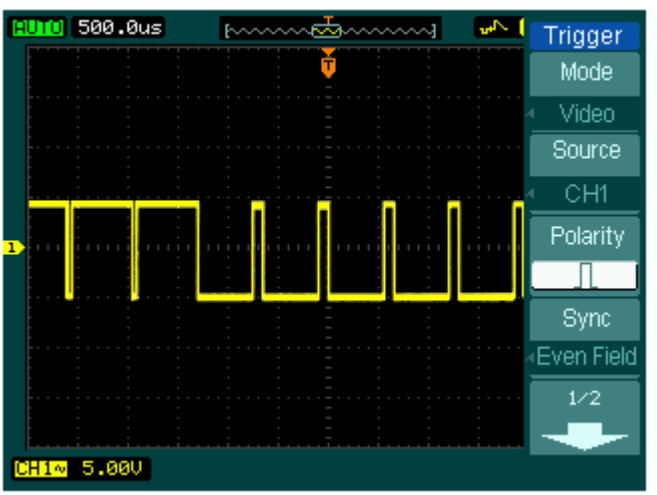


Figure 2-47
Video Trigger: Field Synchronization

Pattern Trigger

Pattern trigger recognises the trigger condition through inspecting the code preset which means the logic values or the logic combination.Every channel has its own logic value,such as,logic high value,logic low value,and the neglect value.

Figure 2-48 Table 2-27 The Pattern Trigger menu

Menu	Settings	Comments
Channel	CH1	To select CH1 as trigger source
	CH2	To select CH2 as trigger source
	CH3	To select CH3 as trigger source
	CH4	To select CH4 as trigger source
	EXT	To set EXT as trigger source
	EXT/5	To set EXT/5 as trigger source to expand trigger level range.
Code	H	To set the code of the selected channel as logic high value.
	L	To set the code of the selected channel as logic low value.
	X	To set the code of the selected channel as neglect value.
		To specify trigger to the rising edge of signal
		To specify trigger to the falling edge of signal
Sweep	Auto	Acquire waveform even no trigger occurred.
	Normal	Acquire waveform when trigger occurred.
	Single	When trigger occurs, acquire one waveform then stop.
Set up		To go to set up menu, see Table 2-36.

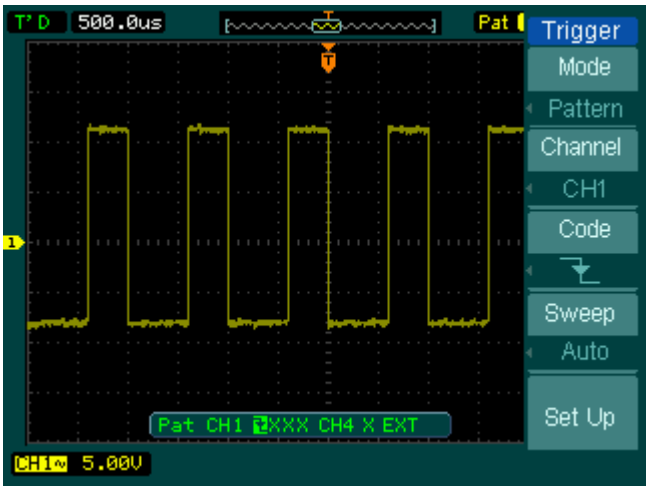


Figure 2-49
Pattern trigger: set code as falling edge

Alternative Trigger

When alternative trigger is on, the trigger sources come from two vertical channels. This mode can be used to observe two non-related signals. You can choose two different trigger modes for the two vertical channels. The options are as follows: Edge, Pulse and video. The info of the trigger level of the two channels will be displayed on the upper-right of the screen.

Figure 2-50

Table 2-28 The Alternative trigger menu (Page 1/2 Trigger Type: Edge)

Menu	Settings	Comments
Alt Channel	CH1-CH2 CH1-CH3 CH1-CH4 CH2-CH3 CH2-CH4 CH3-CH4	To specify the current alternative trigger channels as any two channels selected form CH1, CH2, CH3, CH4.
select	CH1, CH2 CH3, CH4	To select vertical channel among CH1, CH2, CH3, CH4 in alternative trigger mode so as to configure further settings.
Type	Edge Pulse Video	Choose trigger type for the current channel.

Figure 2-51

Table 2-29 The Alternative trigger menu (Page 2/2 Trigger Type: Edge)

Menu	settings	comments
Edge type	(rising edge) (falling edge) (both rising edge and falling edge)	Trigger on rising edge. Trigger on falling edge. Trigger on both ring & falling edge.
Set up		To go to set up menu. See Table 2-36

Figure 2-52 Table 2-30 The Alternative trigger menu (Page 1/2 Trigger Type: Pulse)

Menu	Settings	Comments
Alt Channel	CH1-CH2 CH1-CH3 CH1-CH4 CH2-CH3 CH2-CH4 CH3-CH4	To specify the current alternative trigger channels as any two channels selected form CH1, CH2, CH3, CH4.
select	CH1, CH2, CH3, CH4	To select vertical channel among CH1, CH2, CH3, CH4 in alternative trigger mode so as to configure further settings.
type	Edge trigger Pulse trigger Video trigger	Select trigger type for current channel.

Figure 2-53 Table 2-31 The Alternative trigger menu (Page 2/2 Trigger Type: Pulse)

Menu	Settings	Comments
When	(+Pulse width less than) (+Pulse width more than) (+Pulse width equal to) (-Pulse width less than) (-Pulse width more than) (-Pulse width equal to)	To set trigger conditions.
Settings	<Pulse width >	To set up width value of the pulse.
Set Up		To go to set up menu. See Table 2-36.

Figure 2-54

Table 2-32 The Alternative trigger menu
(Page 1/2 Trigger Type: Video)

Menu	Settings	Comments
Alt Channel	CH1-CH2 CH1-CH3 CH1-CH4 CH2-CH3 CH2-CH4 CH3-CH4	To specify the current alternative trigger channels as any two channels selected form CH1, CH2, CH3, CH4.
select	CH1, CH2, CH3, CH4	To select vertical channel among CH1, CH2, CH3, CH4 in alternative trigger mode so as to configure further settings.
Type	Edge trigger Pulse trigger Video trigger	To select trigger type for current channel.

Figure 2-55

Table 2-33 The Alternative trigger menu
(Page 2/2 Trigger Mode: Video)

Menu	Settings	Comments
Polarity	Normal polarity Inverted polarity	Trigger on negative going sync pulses. Trigger on positive going sync pulses.
Sync	ALL lines Line Num	Trigger on all lines. Trigger on a specified line.
	Odd field Even field	Select to trigger on odd field or even field.
Standard	PAL/SECM NTSC	Select Video standard.
Set Up		To go to set up menu, see Table 2-36.

Trigger Settings

Set up different trigger settings according to different trigger modes. When in the mode of Video and Alternative, only trigger sensitivity, trigger holdoff time, holdoff reset is adjustable.

Figure 2-56 Table 2-34 The Trigger Set Up menu

(Page 1/2 Settings for trigger coupling, trigger sensitivity and Holdoff)

Menu	Settings	Comments
Coupling	DC AC LF Reject	Allow all signals pass. Block DC signals. Reject DC and low frequency signals.
HF reject	On off	Passes high frequency component. Blocks high frequency component, passes low frequency component.
Sensitivity	<Sensitivity Setting>	Set trigger sensitivity.
Holdoff	<Holdoff Setting>	Set time slot before another trigger event.

Figure 2-57 Table 2-35 Restore the trigger holdoff time to default (page 2/2)

Menu	Settings	comments
Holdoff		Reset Holdoff time to 100ns.

When Settings for "sensitivity" and "Hold off" in the Video and Alternative trigger mode, the menu is shown below.

Figure 2-58 Table 2-36 The Trigger Set Up menu

Menu	Settings	Comments
Sensitivity	<Sensitivity Setting>	Set trigger sensitivity.
Holdoff	<Holdoff Setting>	Set time slot before another trigger event.
Holdoff Reset		Reset Holdoff time to 100ns.

Trigger Holdoff

You can use trigger Holdoff to stabilize a complex waveform, such as a pulse sequence. Holdoff time is the oscilloscope's waiting period before starting a new trigger. During Holdoff, oscilloscope will not trigger until Holdoff ends. For instance: To trigger on the first pulse on a group of them, users can set the holdoff time to Pulse cluster width.

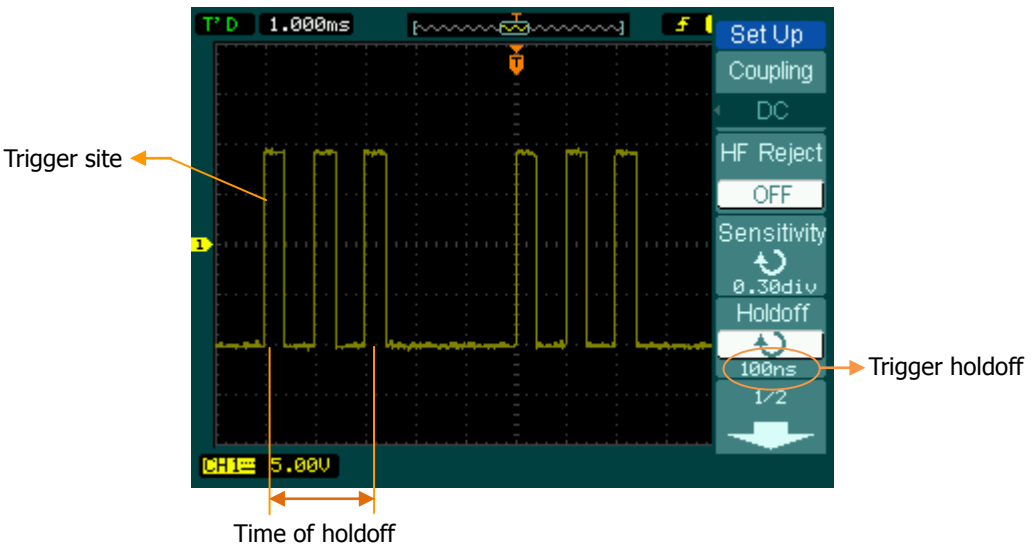


Figure 2-59
Trigger Holdoff

To use trigger Holdoff:

1. Press the MENU button of the trigger control system to display the Menu.
2. Press **Set Up** key to display trigger set up menu.
3. Turn the multi function knob (↻) to change Holdoff time until waveform is stable.
4. Press Trigger **Hold off reset** to reset the Holdoff time to its default value.

Trigger Key points

1. Trigger Source:

Trigger occurs from several sources: Input channels (CH1, CH2, CH3, CH4), AC Line, Ext, Ext/5.

- **CH1, CH2, CH3, CH4:**

  It is the most commonly used trigger source. The channel works when it is selected as a trigger source whatever displayed.

- **Ext Trig:**

  The instrument can be triggered from an external source while acquiring data from CH1, CH2, CH3, and CH4. For example, be a trigger source with an external clock or a signal from another part of the test circuit. The Ext, Ext/5 trigger sources use an external trigger signal connected to the EXT TRIG connector. Ext uses the signal directly; it has a trigger level range of -0.6 V to +0.6 V. The EXT/5 trigger source attenuates the signal by 5X, which extends the trigger level range to -3V to +3 V allowing the oscilloscope to trigger on a larger signal.

- **AC Line:**

  AC power can be used to display signals related to the power line frequency, such as lighting equipment and power supply devices. The oscilloscope gets triggered on its AC power input, but an AC trigger signal is not required. When AC Line is selected as a trigger source, the oscilloscope automatically set coupling to DC, set trigger level to 0V.

2. Sweep Mode:

The sweep mode determines how the oscilloscope behaves in the absence of a trigger event. The oscilloscope provides three trigger modes: Auto, Normal, and Single.

- **Auto:**

  This sweep mode allows the oscilloscope to acquire waveforms even when it does not detect a trigger condition. If no trigger condition occurs while the oscilloscope is waiting for a specific period (as determined by the time-base

setting), it will force itself to trigger.

When forcing invalid triggers, the oscilloscope cannot synchronize the waveform, and the waveform seems to roll across the display. If valid triggers occur, the display becomes stable on the screen.

Any factor results in the instability of waveforms can be detected by Auto Trigger, such as the output of Power supply.

NOTE: When horizontal control is set under 50 ms/div, Auto mode allows the oscilloscope not to capture trigger signal.

- **Normal:**

  The Normal mode allows the oscilloscope to acquire a waveform only when it is triggered. If no trigger occurs, the oscilloscope keeps waiting, and the previous waveform will remain on the display.

- **Single:**

  In Single mode, after pressing the RUN/STOP key, the oscilloscope waits for trigger. While the trigger occurs, the oscilloscope acquires one waveform then stop.

3. Coupling:

Trigger coupling determines which signal component passing to the trigger circuit. Coupling types include AC, DC, LF Reject and HF Reject.

- **AC:** AC coupling blocks DC components and attenuate signal lower than 10 Hz.
- **DC:** DC coupling passes both AC and DC components.
- **LF Reject:** LF Reject coupling blocks DC component, and attenuates all signal with a frequency lower than 10 kHz.
- **HF Reject:** HF Reject coupling attenuates all signals with a frequency higher than 100 kHz.

4. Pre-trigger/delayed trigger:

The data is collected before and after trigger.

The trigger position is typically set at the horizontal center of the screen. In the full-screen display the 6div data of pre-trigger and delayed trigger can be

surveyed. More data (14div) of pre-trigger and 1s delayed trigger can be surveyed by adjusting the horizontal POSITION knob.

This feature is very useful to study the events that led up to the trigger point. Everything on the right of the trigger point is called post-trigger information. The delay range (pre-trigger and post-trigger information) depends on the sweep speed selected.

3. Adjustable trigger sensitivity

To avoid the influence of noise from the physical world, and get the stable trigger, the trigger circuit has adopted Stickiness. In DS1000B series, the stickiness is adjustable from 0.1div-1.0div, which means when it sets to 1.0div; the trigger circuit will not affect any signal with peak-peak amplitude less than 1.0div, so as to avoid the influence of the noise.

To Set up the Sampling System

Figure 2-60 shows, the Acquire button at the MENU of the front panel.

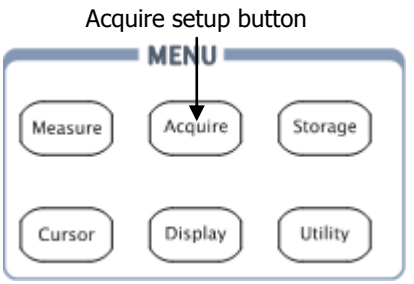


Figure 2-60
The Acquire setup button

Press the Acquire button, the interface menu shows as follows:

Figure 2-61

Table 2-37 The Acquire menu

Menu	Settings	Comments
Acquisition	Normal Average Peak Detect	Normal Acquisition mode. Average Acquisition mode. Peak Detect Acquisition mode.
Sampling	Real-Time Equ-Time	Real-time sampling mode. Equivalent sampling mode.
Sinx/x	ON OFF	Set the interpolation as Sinx/x. Set the interpolation as linearity.
Sa Rate		Display sampling rate.

The waveform displayed on the screen will change in conjunction with the setting of Acquire menu.

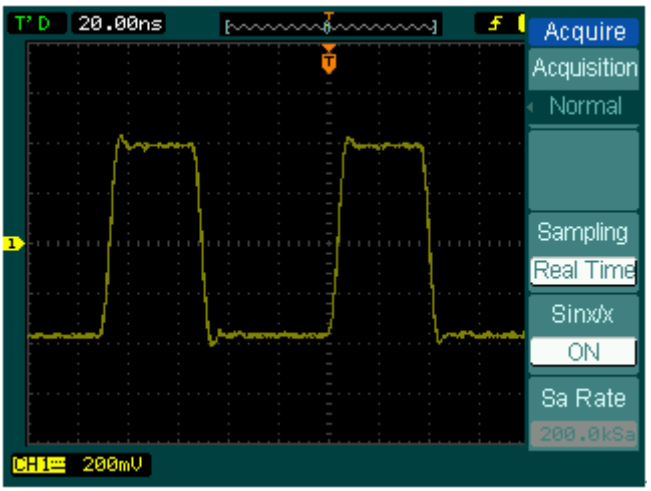


Figure 2-62

Signal that contains noise, and without average sampling

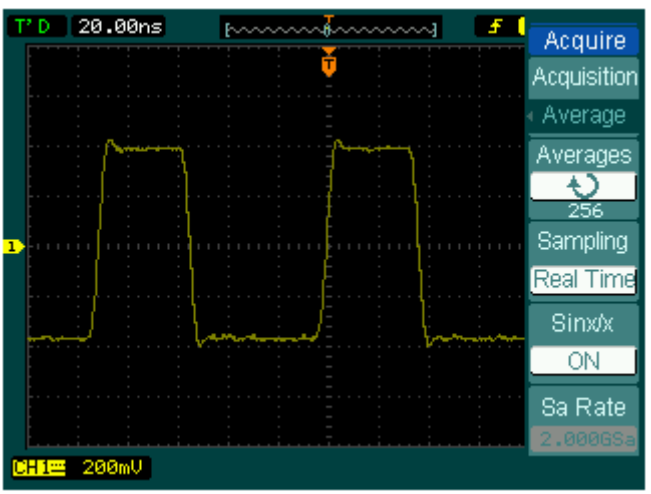


Figure 2-63

Display signal after average 256 times sampling

Note:

- Select **Real-time** acquisition to observe the single-shot or pulse signals.
- Select **Equ-Time** to observe high frequency repetitive signals.

- To reduce the displayed random noise, select the **Average** Acquisition. This mode would make the screen refresh slower.
- To Avoid signal aliasing, select **Peak Detect** Acquisition.

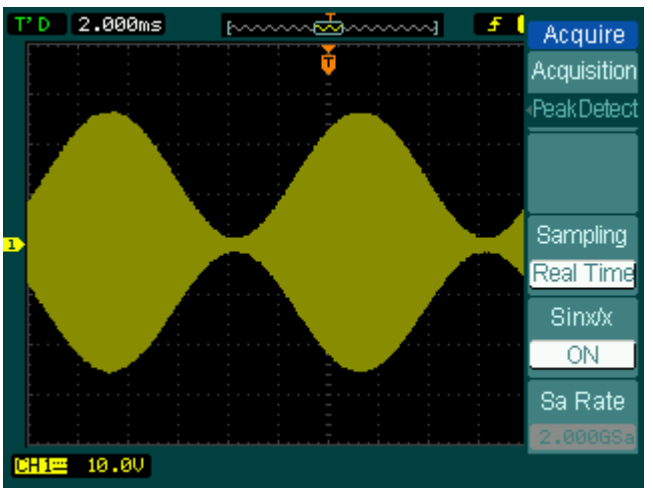


Figure 2-64
Signal with Peak Detect Acquisition

The Peak Detect effect is shown as the figure above.

Stop Acquisition: When the scope is acquiring waveforms, the waveforms is in a live status; when acquisition is stopped, frozen waveform will be displayed, the position and scale can still be adjusted by vertical control and horizontal control.

Key Points

Real-time Sampling:

DS1000B has Real-time sampling rate up to 2GSa/s. At the time base 50ns or faster, the oscilloscopes use the sine(x)/x interpolation to expand the horizontal time base.

Equivalent sampling:

Known as Repetitive sampling to get up to 20ps of horizontal resolution (equivalent 50Gsa/s). This mode is good for observing repetitive signals, and it is not recommended for single-shot or pulse.

Normal:

Oscilloscope acquires signal by equal time interval.

Average Acquisition:

Apply averaging to your signal to remove uncorrelated noise and improve measurement accuracy. Reduces random or uncorrelated noise in the signal display. The averaged waveform is a running average over a specified number of acquisitions from 2 to 256.

Peak Detect:

Peak Detect mode captures the maximum and minimum values of a signal, and finds highest and lowest record points over many acquisitions.

To Set up the Display System

The menu button for the display system on the front panel is shown in the following figure.

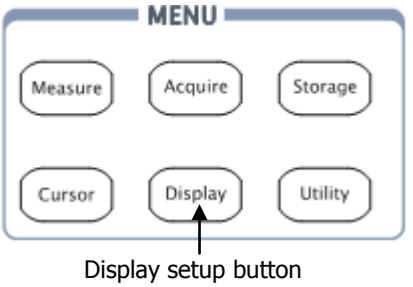


Figure 2-65
The display setup button

Press the Display button, the interface menu for settings shows as follows.

Figure 2-66

Table 2-38 The Display menu (Page 1/3)

Menu	Setting	Comments
Type	Vectors Dots	Display waveforms as vectors. Display waveforms as dots.
Clear		Clear all existing waveforms from screen.
Persist	Infinite OFF	The sample points remain displayed until turn the persistence "OFF". Turn off the persistence function.
Intensity	↻ <percentage>	Set up waveform intensity.

Figure 2-67

Table 2-39 The Display menu (Page 2/3)

Menu	Settings	Comments
Grading	On Off	The waveform is displayed in multiple levels of pixel intensity.
Grid	  	Display grids and coordinates on the screen. Turn off the grids. Turn off the grids and coordinates.
Menu Display	1s 2s 5s 10s 20s Infinite	Set the time before menu fades away. The menu will be hidden after the set time of last button pressing.

Figure 2-68

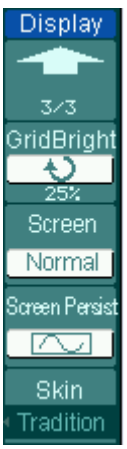


Table 2-40 The Display menu (Page 3/3)

Menu	Settings	Comments
GridBright	 <percentage>	Set up grid brightness.
Screen	Normal Inverted	Set to normal mode. Set to invert color display mode.
Screen persist	 	To show the last acquired waveform when the acquisition is stopped. To show the accumulated acquired waveforms when the acquisition is stopped.
Skin	Classical Modern Tradition Succinct	To set the display screen of the oscilloscope

Key points:

Display type: Display type includes Vector and Dot. In vectors type, oscilloscope connects dots through digital interpolation including both linearity and sin(x)/x. Sin(x)/x interpolation is suitable for Real-time sampling and will be more effective at 50ns or faster time base.

Refresh rate: It is an important performance of digital oscilloscopes. It means the number of display refreshing per second and it will affect the ability to observe signal.

Adjusting waveform intensity

Turn the multifunctional knob (↻) to adjust waveform intensity.

To Store and Recall

Figure 2-69 shows the menu button for the storage system on the front panel.

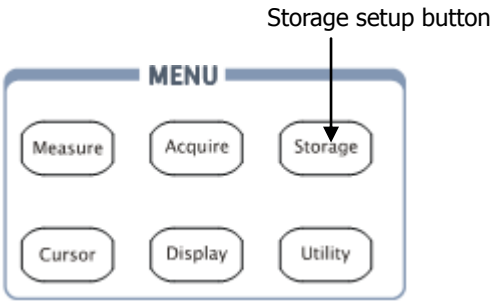


Figure 2-69
The Storage setup button

Press the Storage button to show the menu for the settings of the storage system. Waveforms and setups can be stored in and recalled from both internal memory and external memory. The waveform files, setup files, 8 or 24 bits format bitmap files, CSV format files and PNG (Portable Network Graphics format) files in external memory can be created and deleted. System supports English/Chinese file name input.

Waveform and setup menus are as follows:

Figure 2-70

Table 2-41 The Storage menu

Menu	Settings	Comments
Storage	Waveform	Store or recall waveform.
	Setups	Store or recall instrument setups.
	8-Bitmap	Create or delete 8bits bitmap files.
	24-Bitmap	Create or delete 24bits bitmap files.
	PNG	Create or delete PNG format files.
	CSV	Create or delete CSV files.
	Factory	Recall factory setups.
Internal		Go to menu for internal memory operation (see Table 2-46).
External		Go to menu for external memory operation (see Table 2-47).
Disk Mana.		Go to disk manage menu (see Table 2-48).

For factory default setups, the menu is as follows:

Figure 2-71

Table 2-42 The Storage menu

Menu	Settings	Comments
Storage	Waveform	Store or recall waveform.
	Setups	Store or recall instrument setups.
	8-Bitmap	Create or delete 8bits bitmap files.
	24-Bitmap	Create or delete 24bits bitmap files.
	PNG	Create or delete PNG format files.
	CSV	Create or delete CSV files.
	Factory	Recall factory setups.
Load		Recall factory setups or files.
Disk Mana.		Go to disk manage menu (see Table 2-48).

For bitmap, the menu is as follows:

Figure 2-72 Table 2-43 The Storage menu

Menu	Settings	Comments
Storage	Waveform	Store or recall waveform.
	Setups	Store or recall setups.
	8-Bitmap	Create or delete 8bits Bitmap files.
	24-Bitmap	Create or delete 24bits Bitmap files.
	PNG	Create or delete Portable Network Graphics format files.
	CSV	Create or delete CSV files.
	Factory	Recall factory setups.
Para Save	On Off	Save the current oscilloscope settings in different format with the same file name.
External		Go to menu for external memory operation (see Table 2-47).
Disk Mana.		Go to disk manage menu (see Table 2-48).

For CSV, the menu is as follows.

Figure 2-73 Table 2-44 The Storage menu

Menu	Settings	Comments
Storage	Waveform	Store or recall waveform.
	Setups	Store or recall instrument setups.
	8-Bitmap	Create or delete 8bits bitmap files.
	24-Bitmap	Create or delete 24bits bitmap files.
	PNG	Create or delete PNG format files.
	CSV	Create or delete CSV files.
	Factory	Recall factory setups.
Data Depth	Displayed	Save currently displayed waveform data to CSV file.
	Maximum	Save the whole waveform data in memory to CSV file.
Para Save	On	Save the current oscilloscope settings in different format with the same file name.
	Off	
External		Go to menu for external memory operation (see Table 2-47).
Disk Mana.		Go to disk manage menu (see Table 2-48).

For PNG, the menu is as follows.

Figure 2-74

Table 2-45 The Storage menu

Menu	Settings	Comments
Storage	Waveform	Store or recall waveform.
	Setups	Store or recall instrument setups.
	8-Bitmap	Create or delete 8bits bitmap files.
	24-Bitmap	Create or delete 24bits bitmap files.
	PNG	Create or delete PNG format files.
	CSV	Create or delete CSV files.
	Factory	Recall factory setups.
Para Save	On	Save the current oscilloscope settings in different format with the same file name.
	Off	
External		Go to menu for external memory operation (see Table 2-47).
Disk Mana.		Go to disk manage menu (see Table 2-48).

Internal Memory

Press Storage→**Internal** to go to the following menu.

Figure 2-75

Table 2-46 The Memory menu

Menu	Settings	Comments
Internal	Int_00 (N) . . . Int_09 (N)	Set up the location of files in internal memory.
Load		Recall waveform files and setup files from the internal memory location.
Save		Save waveform files and setup files to the internal memory location.
Delete Files		Delete selected files.

External Memory

Press Storage→ **External** to go to the following menu.

Figure 2-76

Table 2-47 The Memory menu

Menu	Settings	Comments
Explorer	Path Directory File	Switch among Path, Directory and File.
New File (Folder)		To create new file or folder.(see table 2-13)
Delete File (Folder)		Delete file (Folder).
Load		Recall waveform and setup from USB storage device.

File system is as follows:

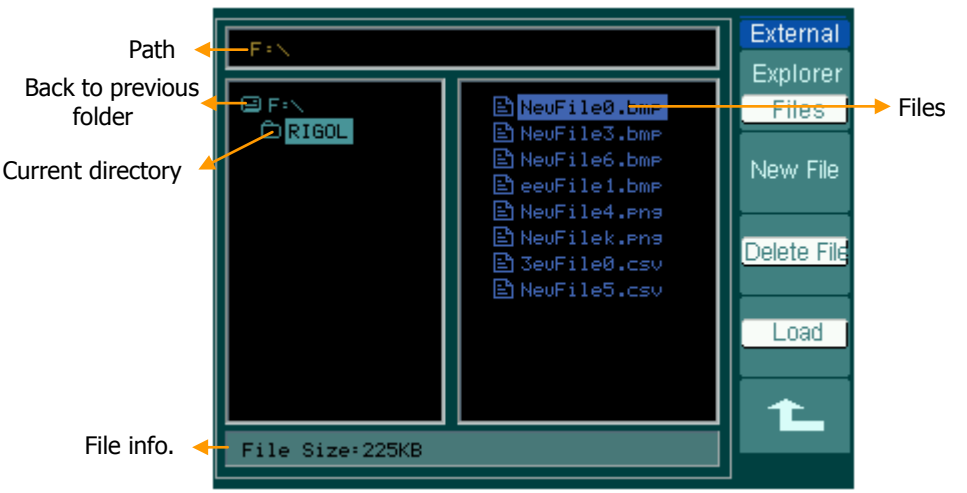


Figure 2-77
File system display screen

U-disk Selection:

Figure 2-78
U-disk selection

DS1000B series have two USB Host ports on the front and rear panel. When both ports were inserted USB flash drive, the screen will appear a U-disk selection interface as Figure 2-78.

Turn the multifunction knob to choose the driver. The front one marked "F:", the rear one "G:".

Disk Management

Press Storage→**Disk Mana.** to go to the following menu.

Figure 2-79

Table 2-48 The Disk Management menu (Page 1/2)

Menu	Settings	Comments
Explorer	Path Directory File	Switch among Path, Directory and File.
New folder		To create new folder (same as new files, see table 2-13).
Delete File		Delete selected file.
Load		Recall waveform, setup, recorded waveform, Pass/Fail file.

Figure 2-80

Table 2-49 The Disk Management menu (Page 2/2)

Menu	Settings	Comments
Rename		To rename a file (see Table 2-50).
Disk info		Display disk information.

Rename

Press Storage→**Disk Mana.**→**Rename** to go to the following menu.

Figure 2-81

Table 2-50 The Rename menu

Menu	Settings	Comments
↑ ↓		To move the input focus point of file name up and down.
⇄		To move the focus point to the next location.
✕		To delete chosen letter.
OK		Rename the file.

The Rename system screen is as follows:

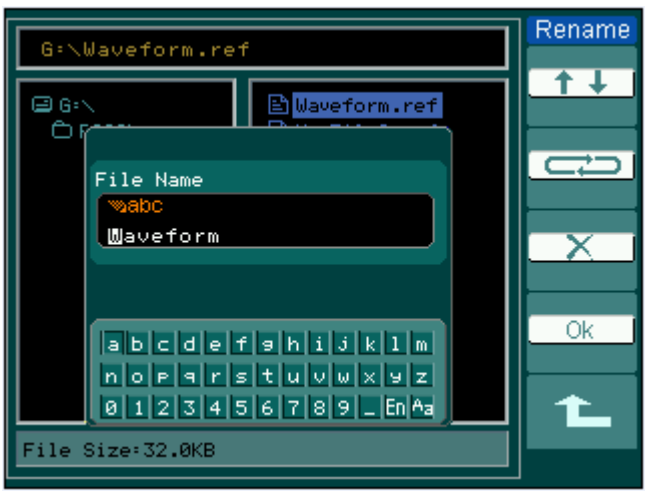


Figure 2-82
Rename the file

Factory

The oscilloscope has default settings and can be recalled at anytime by user.

Memory location

Specify the memory location to save/recall the waveforms and setups.

Load

Recall saved waveforms, setups and default settings.

Save

Save waveforms and setups.

NOTE:

1. Select **Save** stores not only the waveforms, but also the current settings of the oscilloscope
2. To ensure the setups being saved properly, only after the settings are changed for more than 5 seconds, user could turn off the instrument. The oscilloscope can store 10 settings permanently and can restore at anytime.

To Set up the Utility

The following figure shows the menu button for the Utility on the front panel.

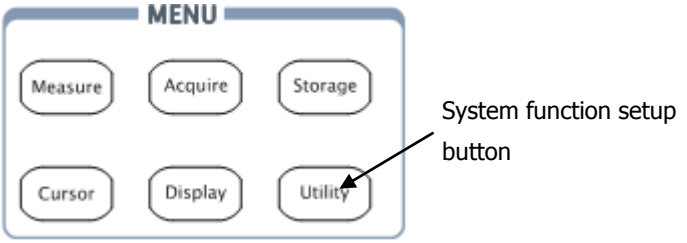


Figure 2-83
The Utility setup button

Press the Utility button to show the menu of the settings in the Utility system.

Figure 2-84

Table 2-51 The Utility menu (Page 1/3)

Menu	Setting	Comments
I/O setting		Setup I/O configuration.
Sound	(ON) (OFF)	Turn beeper sound on/off.
Counter	OFF ON	Turn off Frequency Counter. Turn on Frequency Counter.
Language	简体中文 繁体中文 English Japanese Français	Select languages. (More languages may be added in later firmware versions.)

Figure 2-85

Table 2-52 The Utility menu (Page 2/3)

Menu	Settings	Comments
Pass/Fail		Setup Pass/Fail test.
Record		Setup Waveform Recorder.
Print set		Setup printing.

Figure 2-86

Table 2-53 The Utility menu (Page 3/3)

Menu	Settings	Comments
Self-Cal		Execute Self-calibration.
System Info		Show the following information: Serial number, software version, installed module.
Preference		Go to preference menu.
Date/Time		Set the real date and time for system.

Note:

Self-Cal: Oscilloscope will calibrate parameter of vertical system (CH1, CH2, CH3, CH4 and Ext); horizontal system and trigger system .The oscilloscope can normally work under different environments.

The I/O Setup

Press Utility→**IO Setting** to go to the following menu.

Figure 2-87

Table 2-54 The I/O Setup menu

Menu	Display	Comments
LAN Set		Set network function, the local area network interface corresponds with the LXI standard.
USB Device	Auto Detect Computer PictBridge	Set USB device function, connect USB interface to the needed device.
GPIB#	<Address>	Set the GPIB address, the address range is from 0 to 30.

LAN Setting

Press **LAN Set** to enter the following interface.

Figure 2-88
LAN Setting interface

The black parts in the setting area are the current items can be set. Turn the multifunction knob to set the item on the cursor. IP information can be modify by using the multifunction knob.

Figure 2-89

Table 2-55 LAN Setting menus

Menu	Display	Comments
LAN Init	Load	Load the LAN initial data
↑ ↓		Move up/down the setting focus
⇄		Move left/right the setting focus

Press **Load** to load the LAN initial settings.

Figure 2-90 Table 2-56 LAN Setting menus

Menu	Display	Comments
OK		Load the LAN initial settings
Cancel		Cancel the operation

Key points:

DHCP: Dynamic Host Configuration Protocol

Auto IP: Auto IP

Manual: Manual IP

MAC: Medium Access Control Layer protocol

VISA: Virtual Instrument System Architecture

IP Configure Mode

IP Address

Subnet Mask

Gateway

DNS Server

Preference

Press Utility→**Preference** to go to the following menu

Figure 2-91

Table 2-57 The Preference menu

Menu	Display	Comments
Screen saver	5 hour . . 1 min OFF	Set up screen saver timer.
Expand	Ground Center	Set up waveform vertical expand reference.
Stickykey		Turn the sticky status of CH1, CH2, CH3, CH4, Math, and REF on or off.
Default load	Last set Default	Use the last setup in the next power on. Use the default setup of the system in the next power on.

Screen saver: This function extends the life of LCD backlighting system.

Expand reference: When changing the volts/div. for channels, the signal expands or compresses around the signal ground level, or the center of the screen. When **Center** is selected, the waveform will expand or compress around the center of the display. When **Ground** is selected, the channel ground level will remain the same position on the display and waveform will zoom about the ground level.

Sticky key: If sticky feature is turned ON, when adjusting positions (CH1, CH2，CH3，CH4, Math, Ref, Trigger level and Trigger offset), the waveform will stop at zero position until next adjustment, for the ease of getting back to initial positions.

Self-Calibration

The Self-Calibration adjusts the internal circuitry to get the best accuracy. Use these functions to calibrate the vertical and horizontal systems.

For maximum accuracy at any time, run this calibration if the ambient temperature changes by 5℃ or more.

Before running this procedure, do these steps:

1. Disconnect any probes or cables from all channel inputs, otherwise failure or damage to the oscilloscope may occur.
2. Push the Utility button and select **Self-Cal**.

The Self-Calibration screen is shown as in Figure 2-84.

Figure 2-92
The Self-Calibration menu

NOTE:
The oscilloscope must have been working or warm-up **at least 30-minutes** before running self-calibration to get best accuracy.

Pass/Fail

The Pass/Fail function monitors changes of signals and output pass or fail signals by comparing the input signal which is within the pre-defined mask.

Press Utility→**Pass/Fail** to go to the following menu.

Figure 2-93

Table 2-58 The Pass/Fail menu (Page 1/2)

Menu	Setting	Comments
Enable Test	ON OFF	Turn on Pass/Fail test. Turn off Pass/Fail test.
Source	CH1, CH2, CH3, CH4	Select Pass/Fail test on CH1, CH2, CH3 or CH4.
Operate	▶ (RUN) ■ (STOP)	Pass/Fail test stopped, press to run. Pass/Fail test running, press to stop.
Msg display	ON OFF	Turn on Pass/Fail information display. Turn off Pass/Fail information display.

Figure 2-94

Table 2-59 The Pass/Fail menu (Page 2/2)

Menu	Settings	Comments
Output	Fail Fail + Pass Pass+	Output when Fail condition detected. Output and beep when Fail condition detected. Output when Pass condition detected. Output and beep when Pass condition detected.
Stop on Output	ON OFF	Stop test when output occur. Continue test when output occur.
Mask Setting		Go to mask setting menu.

***Note: The beeper should be opened.**

Mask setting

Press Utility→**Pass/Fail**→**Mask Setting** to go to the following menu.

Figure 2-95

Table 2-60 The Mask setting menu (Page 1/2)

Menu	Settings	Comments
X Mask	<x div>	Set horizontal clearance to the waveform (0.04div-4.00div).
Y Mask	<y div>	Set vertical clearance to the waveform (0.04div-4.00div).
Create Mask		Create a test mask according to the above clearance.
Location	Internal External	Set the memory location of the mask files.

When using the internal memory to save, the operation menu is shown below.

Figure 2-96

Table 2-61 The Mask setting menu (Page 2/2)

Menu	Settings	Comments
Save		Store created test mask into internal memory（see table 2-10）.
Load		Recall mask setting file from internal memory (see table 2-57).
Imp./Exp.		Go to import/export menu (same as REF import/export menu. see table 2-12).

When using the external memory to save, the operation menu is shown below.

Figure 2-97

Table 2-62 The Mask setting menu (Page 2/2)

Menu	Settings	Comments
Save		Go to save menu (same as REF save menu, see table 2-10).
Load		Go to load menu (see Table 2-57).
Import		Go to import menu. (Same as REF import menu, see table 2-12).

Load

Press Utility→**Pass/Fail**→**Mask Setting**→**Load** to go to the following menu.

Figure 2-98

Table 2-63 The Load menu

Menu	Settings	Comments
Explorer	Path Directory File	Switch among Path, Directory and File.
Load		Recall the specified file.

NOTE: Pass/Fail function is unavailable in X-Y mode.

Print Setting

DS1000B series oscilloscopes support external printers. Press Utility→ **Print set** to enter to the following menu.

Normal mode

Press **PrintMod** button，choose the print mode as **Normal** ，and navigate into the following menu.

Figure 2-99 Table 2-64 The Print Set menu

Menu	Settings	Comments
PrintMod	Normal PictBridge	Set the print mode as normal. Set the print mode as PictBridge.
Print		Execute the print operation.
Inverted	ON OFF	Invert the color for print. Print original color.
Palette	Gray scale Color	Set up the print color.

PictBridge print mode

Press **PrintMod** button，choose the print mode as **PictBridge,** and navigate into the following menu.

Figure 2-100 Table 2-65 The print Set menu (Page 1/4)

Menu	Settings	Comments
PrintMod	Normal PictBridge	Set the print mode as normal. Set the print mode as PictBridge.
print		Execute the print operation.
Abort		Abort the printing.
Status		Inquire about the current status of the printer.

Figure 2-101

Table 2-66 The print setup menu (Page 2/4)

Menu	Settings	Comments
Paper size	Default, A2, A3, A4, A5, A6, B5	Select the paper size for printing.
File type	Default Exif/Jpeg Bmp	To specify the image type for printing as Exif/Jpeg or Bmp format.
copies	1~999	To set the print copies from 1to 999.

Figure 2-102

Table 2-67 The print setup menu (Page 3/4)

Menu	Settings	Comments
Print Quality	Default Normal Draft fine	To specify the print quality.
Data print	Default On Off	To turn on or off the print date.
inverted	On Off	Turn on the inversion of printing color Turn off then inversion of printing color

Figure 2-103

Table 2-68 The print setup menu (Page 4/4)

Menu	Settings	Comments
palette	Grayscale Color	To set the print image as grayscale or color.

Waveform Recorder

Waveform recorder records input waveforms from CH1, CH2, CH3 and CH4 with a maximum record length of 1000 frames. This performance can also be activated by the Pass/Fail test output, which makes this function especially useful to capture abnormal signals in long term without keeping an eye watching it.

Press Utility→**Record**→**Mode**→**Record** to go to the following menu

Waveform recorder: Record the waveforms with specified interval.

Figure 2-104

Table 2-69 The Record menu (Page 1/2)

Menu	Settings	Comments
Mode	OFF Record Play back Storage	Select record mode. Select play back mode. Select storage mode. Turn off all recorder functions.
Source	CH1, CH2 CH3, CH4 P/F-OUT	Select record source channel.
End Frame	<1-1000>	Set number of record frames.
Operate	(Run) (Stop)	Record stopped, press to Start recording. Press to stop recording.

Figure 2-105

Table 2-70 The Record menu (Page 2/2)

Menu	Settings	Comments
Interval	<1.00ms-1000s>	Set time interval between record frames.

Play back: Play back the recorded waveforms.

Figure 2-106

Table 2-71 The Record menu (Page 1/2)

Menu	Settings	Comments
Operate	▶ (Run) ■ (Stop)	Play stopped, press to Start playback. Press to stop playing.
Play mode		Set repeat play mode. Set single time play mode.
Interval	<1.00ms-20s>	Set up interval value between frames.

Figure 2-107

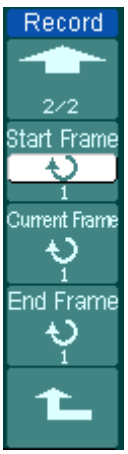


Table 2-72 The Record menu (Page 2/2)

Menu	Settings	Comments
Start Frame	<1-1000>	Set start frame.
Current Frame	<1-1000>	Select current frame to be played.
End Frame	<1-1000>	Set End frame.

Note: the Run/Stop button can also replay or continue the waveform display.

Storage:

Store recorded waveforms in non-volatile memory according to the setup frames.

Figure 2-108

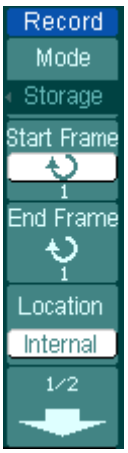


Table 2-73 The Storage menu (Page 1/2)

Menu	Settings	Comments
Start Frame	<1-1000>	Set first frame to be saved.
End Frame	<1-1000>	Set last frame to be saved.
Location	Internal external	Set up Store location.

When using the internal memory to save, the operation menu is shown below.

Figure 2-109

Table 2-74 The Storage menu

Menu	Settings	Comments
Save		Save recorded waveform to internal memory location.
Load		Recall recorded waveform from internal memory location.
Imp./Exp.		Go to import/export menu (Same as REF import/export menu).

When using the external memory to save, the operation menu is shown below.

Figure 2-110 Table 2-75 The Storage menu

Menu	Settings	Comments
Save		Go to save menu (same as REF save menu. see table 2-10).
Load		Go to load menu (see Table 2-57).
Import		Go to import menu. (Same as REF import menu, see table 2-12).

System information

Press Utility, go the following menu and Press **System info**.

Figure 2-111
Operation menu

System Info:

The system information includes: Product Model, Serial Number, Software Version and Installed Module of the oscilloscope. Follow the prompting message "<<Press 'RUN' Key to Exit the Test>>" to exit the information display interface.

Language

The DS1000B series oscilloscopes have multi-language user menu, choose as your desire.

Press Utility→**Language** to select the language. Press button No.4 until the desired language appears.

Figure 2-112
The language selection screen

Date and Time

DS1000B Series provide build-in system real-time date and time. Users can set the date and time as shown in the following figure.

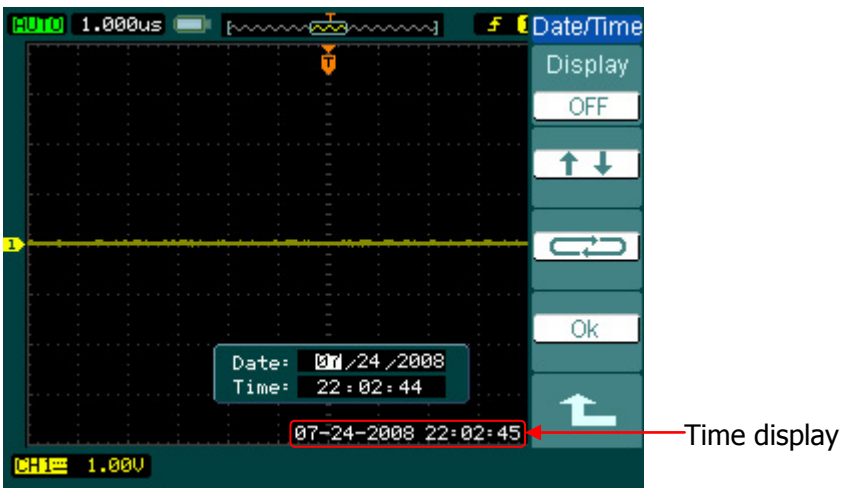


Figure 2-113
Date and time setting

Figure 2-114

Table 2-76 Time setting menu

Menu	Settings	Comments
Display	OFF ON	Close time display Open time display
↑ ↓		Move up/down the setting focus
⮌		Move left/right the setting focus
OK		Save the current settings

To Measure Automatically

The Measure button in the menu area activates the automatic measurement function. The instruction below shows the powerful measurement function of DS1000B series oscilloscopes.

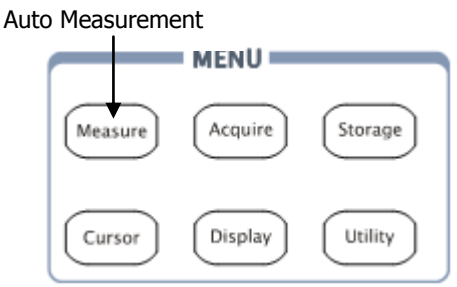


Figure 2-115
The Measure setup button

Menu explanation:

Press the Measure button to display the menu of the Automatic Measurements settings.

The oscilloscopes provide 22 auto measurements: Vpp, Vmax, Vmin, Vtop, Vbase, Vamp, Vavg, Vrms, Overshoot, Preshoot, Freq, Period, Rise Time, Fall Time,Delay A → B, Delay A → B, Phase A → B, Phase A → B, +Width, -Width, +Duty, -Duty (10 voltage and 12 timing measurements).

Figure 2-116 Table 2-77 The Measure menu (Page 1/2)

Menu	Settings	Comments
Source	CH1, CH2, CH3, CH4	Select CH1 or CH2 as source channel for measurement.
Voltage		Select measure voltage parameter.
Time		Select measure time parameter.
Clear		Clear measurement result on screen.

Figure 2-117 Table 2-78 The Measure menu (Page 2/2)

Menu	Settings	Comments
Display All	OFF ON	Turn off all measurements result. Turn on all measurements result.
QuickMea		To specify three quick measure items which you can choose among the above 22 measurements.
Delay/Phase Setup		To configure the delay and phase channels, in order to measure delay and phase value relative to time measurement between any two vertical channels form CH1 to CH4.

Quick Measurement Setup

Press Measure→**QuickMea** button，go to the quick measure menu。

Figure 2-118

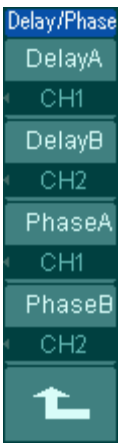
Table 2-79 The quick measure menu

Menu	Settings	Comments
Item1		To specify Item1, Item2 and Item3 respectively, each item can be chosen from 22 kind's measure items.
Item2		
Item3		

Delay/Phase Setup

Press Measure→**Delay/Phase Setup** button，and go to the delay/phase setup menu.

Figure 2-119 Table 2-80 The delay/phase setup menu.



Menu	Settings	Comments
DelayA	CH1 CH2 CH3 CH4	To set CHA of Delay measurement as one of CH1,CH2,CH3,CH4
DelayB		
PhaseA		To set CHA of Phase measurement as one of CH1,CH2,CH3,CH4
PhaseB		

Voltage Measurements

The DS1000B series oscilloscopes provide automatic voltage measurements including Vpp, Vmax, Vmin, Vavg, Vamp, Vrms, Vtop, Vbase, Overshoot and Preshoot. Figure 2-120 below shows a pulse with some of the voltage measurement points.

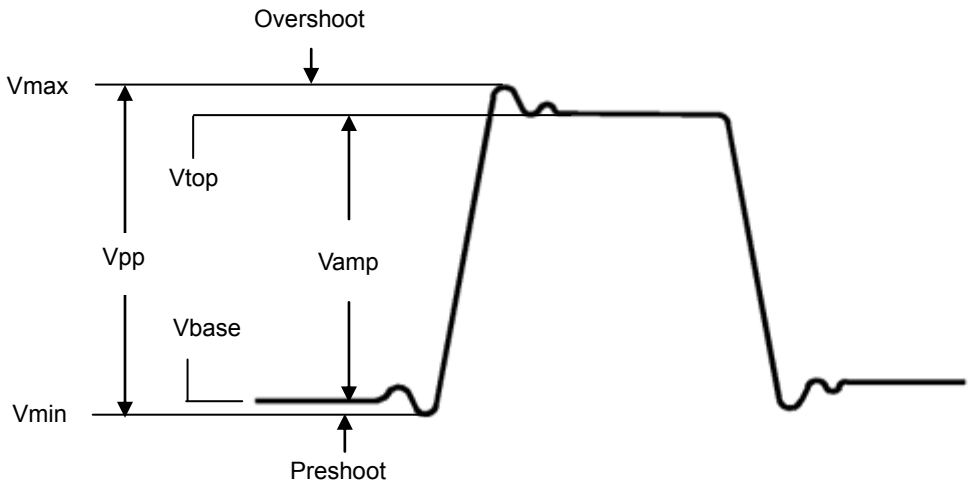


Figure 2-120 Voltage parameters

Vpp: Peak-to-Peak Voltage.

Vmax: The maximum amplitude. The most positive peak voltage measured over the entire waveform.

Vmin: The minimum amplitude. The most negative peak voltage measured over the entire waveform.

Vamp: Voltage between Vtop and Vbase of a waveform

Vtop: Voltage of the waveform's flat top, useful for square/pulse waveforms.

Vbase: Voltage of the waveform's flat base, useful for square/pulse waveforms.

Overshoot: Defined as (Vmax-Vtop)/Vamp, useful for square and pulse waveforms.

Preshoot: Defined as (Vmin-Vbase)/Vamp, useful for square and pulse waveforms.

Average: The arithmetic mean over the entire waveform.

Vrms: The true Root Mean Square voltage over the entire waveform.

Press Measure→**Voltage** button，and go to the following menu.

Figure 2-121

Table 2-81 The Voltage Measurement menu (Page 1/3)

Menu	Settings	Comments
Vmax		Measure maximum voltage of a waveform.
Vmin		Measure minimum voltage of a waveform.
Vpp		Measure Peak-to-Peak Voltage.
Vtop		Measure a flat top voltage of a square waveform.

Figure 2-122

Table 2-82 The Voltage Measurement menu (Page 2/3)

Menu	Settings	Comments
Vbase		Measure a flat base voltage of a square waveform.
Vamp		Measure voltage between Top and Base.
Vavg		Measure average voltage of a waveform.
Vrms		Measure Root Mean Square Voltage of a waveform.

Figure 2-123

Table 2-83 The Voltage Measurement menu (Page 3/3)

Menu	Settings	Comments
Overshoot		Measure overshoots in percentage of an edge.
Preshoot		Measure preshoot in percentage of an edge.

Time Measurements

The DS1000B series oscilloscopes provide 12 kinds timing parameters auto-measurements; Frequency, Period, Rise Time, Fall Time, +Width, -Width, Delay A→B↓, Delay A→B↑, +Duty and –Duty, Phase A→B↓,Phase A→B↑.

Figure 2-124 shows a pulse with some of the time measurement points.

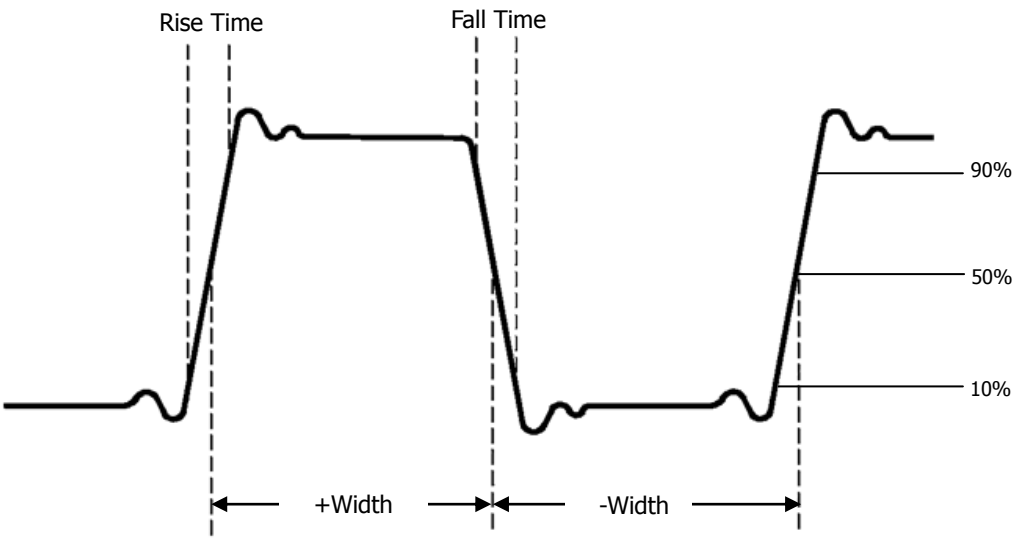


Figure 2-124 The time parameters

Rise Time: Time that the rising edge of the first pulse in the waveform takes to rise from 10% to 90% of its amplitude.

Fall Time: Time that the falling edge of the first pulse in the waveform takes to fall from 90% to 10% of its amplitude.

+Width: The width of the first positive pulse in 50% amplitude points.

-Width: The width of the first negative pulse in the 50% amplitude points.

Delay A→B↓: The time delays between the channel A and channel B at the rising edge.

Delay A→B↑: The time delays between the channel A and channel B at the falling edge.

Phase A→B↓: The phase between the channel A and channel B at the rising edge. Phase=(delay/source A period)×360°

Phase A→B↑: The phase between the channel A and channel B at the falling edge.

+Duty: +Duty Cycle, defined as +Width/Period

-Duty: -Duty Cycle, defined as -Width/Period.

Press Measure→**Time** button，and go to the following menu

Figure 2-125

Table 2-84 The Time Measurement menu (Page 1/3)

Menu	Settings	Comments
Period		Measure Period of a waveform.
Freq		Measure Frequency of a waveform.
Rise time		Measure Rise Time of a rising edge.
Fall time		Measure Fall Time of a falling edge.

Figure 2-126

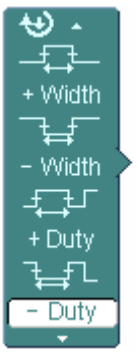


Table 2-85 The Time Measurement menu (Page 2/3)

Menu	Settings	Comments
+Width		Measure +Pulse Width of a pulse wave.
-Width		Measure –Pulse Width of a pulse wave.
+Duty		Measure +Duty Cycle of a pulse wave.
-Duty		Measure –Duty Cycle of a pulse wave.

Figure 2-127

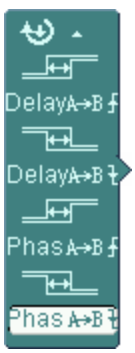


Table 2-86 The Time Measurement menu (Page 3/3)

Menu	Settings	Comments
Delay A→B		Measure the signals delay between two channels at the rising edge.
Delay A→B		Measure the signals delay between two channels at the falling edge.
Phase A → B		Measure the phase difference between two channels at the rising edge
Phase A → B		Measure the phase difference between two channels at the falling edge

NOTE: The 18 kind's results of the automatic measurements will be displayed on the bottom of the screen. Maximum 3 results could be displayed at the same time. When there is no room, the next new measurement result will make the previous results moving left out of screen.

Using Automatic Measurement as the following steps demonstration:

1. Select the signal channel for measuring. CH1, CH2, CH3, CH4 according to the interest.

   Press soft buttons as follows: Measure→**Source**→**CH1**, **CH2**, **CH3** , **CH4**.

2. To see all measurement values, Press No.2 button to set the **Display All** to **ON**. 18 measurement parameters will be displayed on the screen.

3. Select parameters page for measuring; press No.2 or No.3 button to select voltage or time parameters pages by pressing soft button as follows: Measure →**Voltage** or **time** →**Vmax**, **Vmin**……

4. To get the measured value on the screen; select the parameters of interest by pressing the soft button on the right of the menu, and read the data on the bottom of the screen.

   If the data is displayed as "*****", it means the parameter cannot be measured in current condition.

5. Clear the measure values: press No.4 button **Clear** to clear away all of the auto measure values would disappear from the screen.

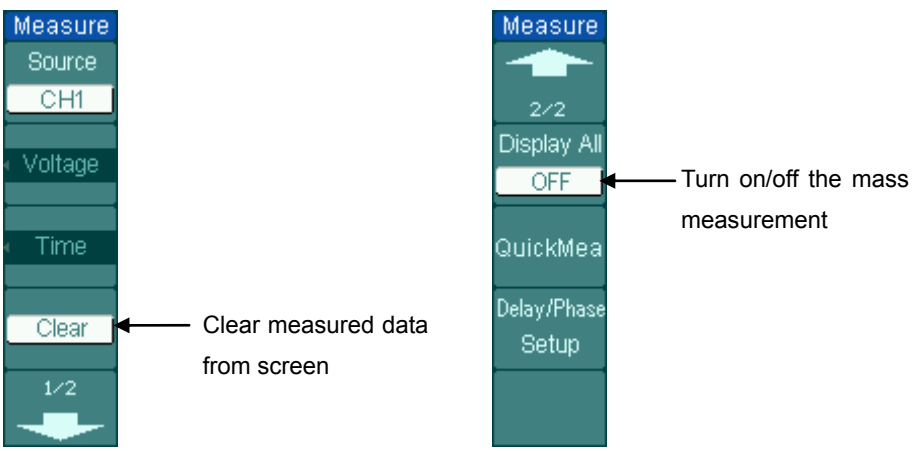


Figure 2-128 The explanation of the menu

To Measure with Cursors

Figure 2-124 shows the Cursor button on the front-panel.

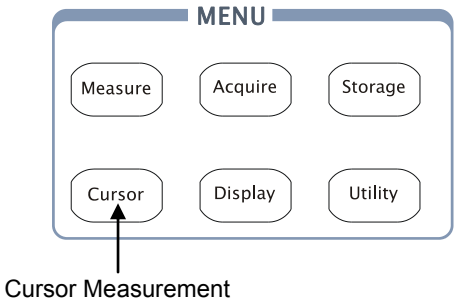


Figure 2-129
The Cursor setup button

The cursor measurement has three modes: Manual, Track and Auto Measure.

1. Manual

In this mode, the screen displays two parallel cursors. Move the cursors to make custom voltage or time measurements of the signal. The values are displayed on the boxes below the menu. Before using cursors, make sure to set the Signal Source as the channel for measuring.

2. Track

In this mode, the screen displays two cross cursors. The cross cursor sets the position on the waveform automatically. Adjust cursor's horizontal position on the waveform by rotating the multifunctional knob (↺). The oscilloscope displays the values of the coordinates on the boxes below the menu.

3. Auto Measure

This mode will take effect with Automatic Measurements. The instruments will display cursors while measuring parameters automatically. These cursors demonstrate the electrical meanings of these measurements.

NOTE:
The Auto Measure mode for Cursor measuring will take no effect without automatic measurements.

Manual Mode

Figure 2-130

Table 2-87 The Cursors menu

Menu	Settings	Comments
Mode	Manual	Adjust the cursor to measure X/Y parameters manually.
Type	X	Shown as vertical line to measure the horizontal parameters.
	Y	Shown as horizontal line to measure the vertical parameters.
Source	CH1 CH2 CH3 CH4 MATH	Select the measurement signal source.

In this mode, the oscilloscope measures the Y or X coordinate values of the cursors, and the increments between the two cursors.

To do manual Cursor Measurements, please do as the following steps:

1. Select the **Manual** mode for cursor measurement by pressing soft button as: Cursor→**Mode**→**Manual**.
2. Select channel **Source** for measurements by pressing soft button as: Cursor→**Source**→**CH1**, **CH2**, **CH3**, **CH4**, **MATH**.

   NOTE: While measuring the channel with MATH, the results are valued with "d" (division) as units.
3. Select the cursors type by pressing soft button as Cursor→**Type**→ **X** or **Y**.
4. Move the cursors to adjust the increment between the cursors:(Details in the following Table)

Table 2-88 The Cursor menu

Cursor	Increment	Operation
Cursor A	X	Turn the multifunctional knob (↻) to move cursor A horizontally.
	Y	Turn the multifunctional knob (↻) to move cursor A vertically.
Cursor B	X	Turn the multifunctional knob (↻) to move cursor B horizontally.
	Y	Turn the multifunctional knob (↻) to move cursor B vertically.

NOTE: Cursor could be moved only when the curse function menu is displayed.

5. To get measurement values:

Position of Cursor 1 (Time cursor centered on the midpoint of screen; Voltage cursor centered on channel ground level).
Position of Cursor 2 (Same as above).
Horizontal space between cursor 1 and 2 (△X): Time between cursors (1/△X), units in Hz, kHz, MHz, and GHz.
Vertical space between cursor 1 and 2 (△Y): Voltage between cursors.

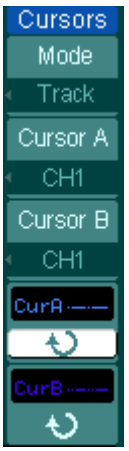
NOTE: The values will be automatically displayed on the right upper corner of screen when the cursor function menu is hidden or displaying other menus.

Key Points

Cursor Y: Cursors Y appear as horizontal lines on the display to measure vertical parameters. Usually it is used to measure the Volts. When the source is set as function, the units are assigned to the function.
Cursor X: Cursor X appears as vertical lines on the display to measure horizontal parameters. Usually it indicates the time of trigger excursion. When the source is set as FFT, X means frequency.

Track Mode

Figure 2-131 Table 2-89 Cursor descriptions



Menu	Settings	Comments
Mode	Track	Set Track mode in cursor measurement.
Cursor A	CH, CH2, CH, CH4, MATH None	Set Cursor A in conjunction with CH1, CH2 or turn off Cursor A.
Cursor B	CH, CH2, CH, CH4, MATH None	Set Cursor B in conjunction with CH1, CH2 or turn off Cursor B.
CurA (Cursor A)		Turn the multifunctional Knob ( ) to move cursor A Horizontally.
CurB (Cursor B)		Turn the multifunctional knob ( ) to move cursor B horizontally.

In cursor track mode, the cursors move together with the selected waveform.

To do Track mode Cursor Measurements, follow these steps:

1. Select the **Track** mode for cursor measurement by pressing soft button as: Cursor→**Mode**→**Track**.
2. Select channel **Source** for Cursor A and Cursor B by pressing soft button as: Cursor→**Cursor A** or **Cursor B**→**CH1**, **CH2**, **CH3**, **CH4** or **None**.
3. Move the cursors to adjust the horizontal positions of the cursors: (Details in the following Table)

Table 2-90 The Cursor usage

Cursor	Operation
Cursor A	Turn the multifunctional knob ( ) to move cursor A horizontally.
Cursor B	Turn the multifunctional knob ( ) to move Cursor B horizontally.

NOTE: Moving cursor horizontally is not allowed when other (not tracking cursor) menu is activated.

(4) To get measurement values:

Position of Cursor 1 (Time cursor centered on the midpoint of screen; Voltage cursor centered on channel ground level).

Position of Cursor 2 (Time cursor centered on the midpoint of screen; Voltage cursor centered on channel ground level).

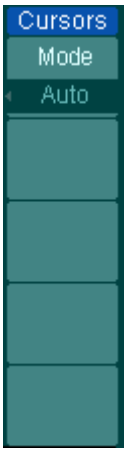
Read the horizontal space between Cursor 1 and 2 (△X): Time between cursors, units in seconds.

(1/△X), units in Hz, kHz, MHz, GHz.

Vertical space between cursor 1 and 2 (△Y): Voltage between cursors, units in V.

Auto mode

Figure 2-132 Table 2-91 The Mode setting



Menu	Settings	Comments
Mode	Auto	Display the cursors for the current automatic measuring. (See the following figure).

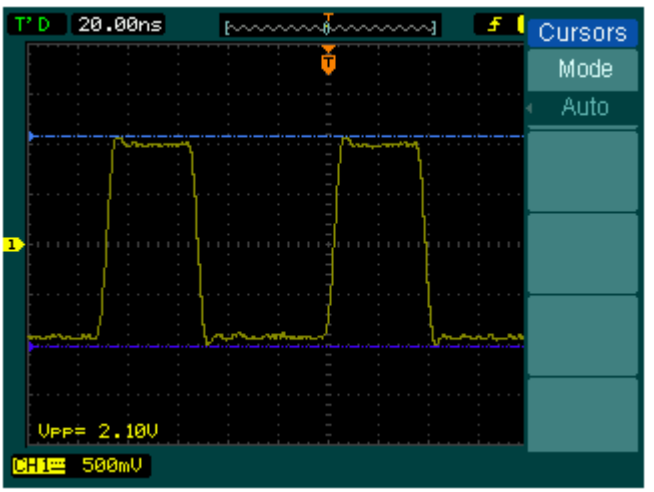


Figure 2-133
Auto Measure Mode of Cursor Measurement

There will be no cursor display if no parameters are chosen in Measure menu. The oscilloscope could move cursor automatically to measure 22 parameters in Measure menu.

To Use Run Control Buttons

The RUN control buttons include AUTO (auto setting) and Run/Stop.

Auto:

The AUTO features automatic adjustments to produce a stable display of the input signal. Press AUTO button, the following menu appears.

Figure 2-134 Table 2-92 The Auto menu

Menu	Settings	Comments
Multi-Cycle		Press to display multi-cycle waveform on the screen.
Single Cycle		Press to display single cycle waveform on the screen.
Rise Edge		Press to display the waveform's rising edge and measure its rise time automatically.
Fall Edge		Press to display falling edge of the waveform and measure its fall time automatically.
Undo		Press to cancel all the Auto Set actions, the oscilloscope will recover to its previous status.

Auto-Set functions

When the AUTO is pressed the oscilloscope is configured to the following defaults:

Table 2-93 The Auto menu

Menu	Settings
Display format	Y-T
Acquire mode	Normal
Vertical coupling	Adjust to AC or DC according to the signal.
Vertical "V/div"	Adjusted
Volts/Div	Coarse
Bandwidth limit	Full
Signal Invert	OFF
Horizontal position	Center
Horizontal "S/div"	Adjust to right position.
Trigger type	Edge
Trigger source	Find the channel with input signal automatically.
Trigger coupling	DC
Trigger voltage	Midpoint setting
Trigger mode	Auto
POSITION knob	Trigger offset

RUN/STOP:

Run or Stop waveform acquiring.

NOTE:

In **STOP** status, the volts/div and horizontal time base can be adjusted in a fixed limit. That is, to zoom in/out the signal in vertical and horizontal directions.

Chapter 3 : Application & Examples

Example 1: Taking Simple Measurements

The function is used to observe an unknown signal; to display, measure frequency, and peak-to-peak amplitude.

To quickly display a signal, please do the steps as follows:

1. Set the probe and the channel attenuations to 10X
2. Connect signal to CH1 with the probe
3. Press the AUTO button

The oscilloscope sets the vertical, horizontal, and trigger controls at the best status automatically. To optimize the waveform display, adjust these controls manually to meet the requirements.

Selecting Automatic Measurements

The oscilloscope takes automatic measurements on most signals. To measure the frequency and the peak-to-peak amplitude, do these steps as follows:

1. Measure peak-to-peak amplitude

   Press Measure→**Source**→**CH1** to set the measurement source

   Press **Voltage**→**Peak-Peak** to select the peak-to-peak measurements and the result will be displayed on the screen.

2. Measure frequency

   Press Measure→**Source**→**CH1** to set the measurement source

   Press **Time**→**Freq** to select the frequency measurements and the result will be displayed on the screen.

NOTE: The frequency, period, and peak-to-peak measurements are shown on the screen and are updated periodically.

Example 2: View a Signal Delay Caused by a Circuit

This example is to test the input and output signals of a circuit and observe the signal delay. First, set the probe and the channel attenuation to 10X and connect CH1 probe to the input, CH2 to the output of the circuit.

Do these steps as follow:

1. Display the signals (CH1 and CH2):

1) Press the AUTO button
2) Adjust the vertical and the horizontal scale by turning the SCALE knobs to set appropriate ranges for display.
3) Press the CH1 button to select Channel 1, and turn the vertical POSITION knob to adjust the vertical position of Channel 1 waveform.
4) Press the CH2 button to select Channel 2, and turn the vertical POSITION knob to adjust the vertical position of Channel 2 waveform.

2. Measure the delay time when a signal going through the circuit.

Auto-measuring the delay:

Press Measure→**Source**→**CH1** to set the measurement source.

Press **Time** to select the measurement Type.

Press **Delay A→B** to display the result on the screen.

You can see the change of the waveform in the following figure:

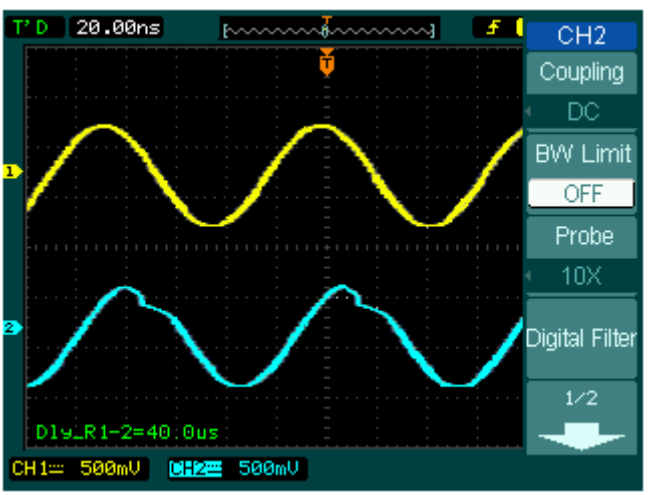


Figure 3-1 Delay of the signals

Example 3: Capture a Single-Shot Signal

To capture a single event, it needs to gather some pre-test knowledge of the signal in order to set up the trigger level and slope correctly. For example, if the event is derived from TTL logic, a trigger level of 2 volts should work on a rising edge.

The following steps show how to use the oscilloscope to capture a single event.

1. Set the probe and the channel attenuations to 10X.

2. Set up the trigger.

1) Press the MENU button in the Trigger control area to display the menu.
2) Press **Edge** to select the trigger mode.
3) Press **Slope** to select .
4) Press **Source** to select **CH1**.
5) Press **Sweep** to select **Single.**
6) Press **Set Up**→**Coupling** to select **DC**.

3. Turn the vertical and horizontal SCALE knobs to adjust the Volts/Div and the Time base in a proper range for the signal.

4. Turn the LEVEL knob to adjust trigger level.

5. Press RUN/STOP button to start capturing. When the trigger conditions are met, data appears on the display representing the data points that the oscilloscope obtained with one acquisition.

This function helps to capture the occurrence easily, such as the noise with large amplitude; and set the trigger level higher a little above the normal level and press RUN/STOP and wait. When noise occurs, the instrument will record the waveform before and after the trigger. Adjust the POSITION knob in the horizontal control area and change the level of the trigger position, will get the inverted delay trigger. It is useful to observe the waveform before the occurrence of the noise.

Example 4: To Reduce the Random Noise on a Signal

If the signal is noisy (Figure 3-2), set up the oscilloscope to reduce the noise on the waveform and avoid its interference to the signal.

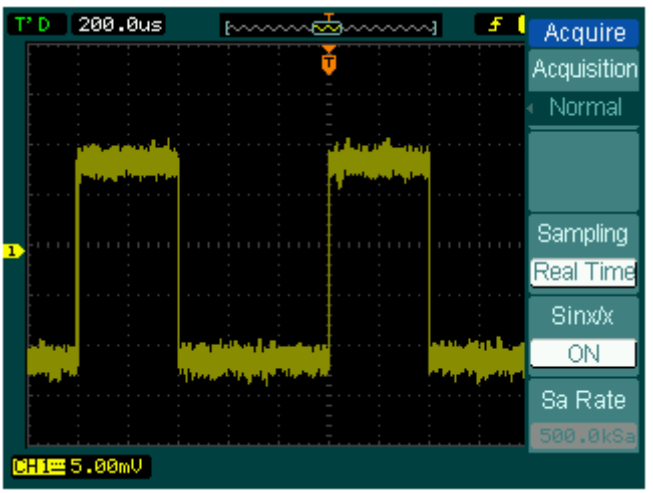


Figure 3-2
Waveform display

1. Set the probe and the channel attenuations to 10X.
2. Connect a signal to the oscilloscope and obtain a stable display.
3. Improve the trigger by setting the Coupling

1) Press the MENU in the Trigger control area.
2) Press **Set Up**→**Coupling**→**LF Reject** or Press **Set Up**→**HF Reject**→**ON**.

HF Reject (High frequency rejects) adds a low pass filter with the -3 dB cut-off point at 150 kHz. Use HF rejects to remove high frequency noise such as AM or FM broadcast stations from the trigger path.

LF Reject (Low frequency rejects) adds a high pass filter with the -3 dB cut-off point at 8 kHz. Use LF Reject to remove low frequency signals such as power line noise from the trigger path.

4. To reduce the noise by setting the acquisition type and adjust the waveform intensity

1) If there is noise within the signal and the waveform looks too wide, in this case, choose average acquisition. In this mode the waveform will be thin and easy to observe and measure.

To use average acquisition follows these steps.

- Press soft button as Acquire→**Acquisition**→**Average**
- Toggle the **Averages** soft button to select the number of averages that best eliminates the noise from the displayed waveform. It can be adjusted from 2-256. (See Figure 3-3)

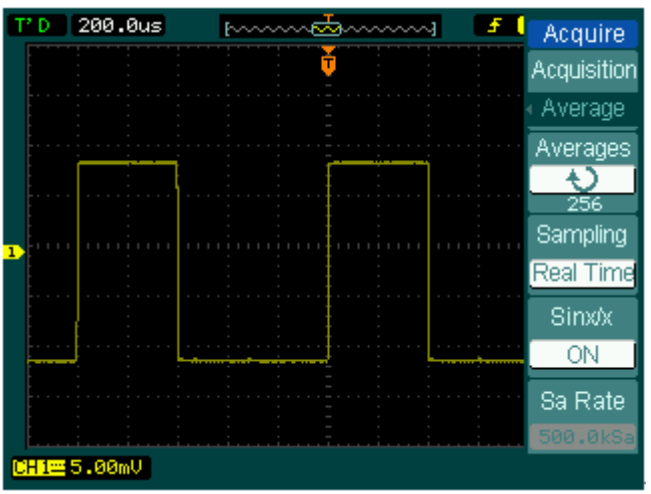


Figure 3-3
Waveform display

2) To reduce the noise it can also be achieved by reducing the intensity of the display.

NOTE:
It is normal that the refresh rate will slow down when the average acquisition mode is ON.

Example 5: Making Cursor Measurements

There are 22 build-in automatic measurements. They can also be conducted using cursors to make time and voltage measurements of a waveform quickly.

Measure the Peak Frequency of the First Sinc Waveform

To measure the rising frequency at the rising edge of a signal, do these steps:

1. Press Cursor key to see the Cursor menu.
2. Press **Mode** to set **Manual** mode.
3. Press **Type** to select **X**.
4. Turn (↻) knob to place cursor A on the first peak of the wave.
5. Turn (↻) knob to place cursor B on the second peak of the wave.

Observe the data in time and frequency displayed on the screen.

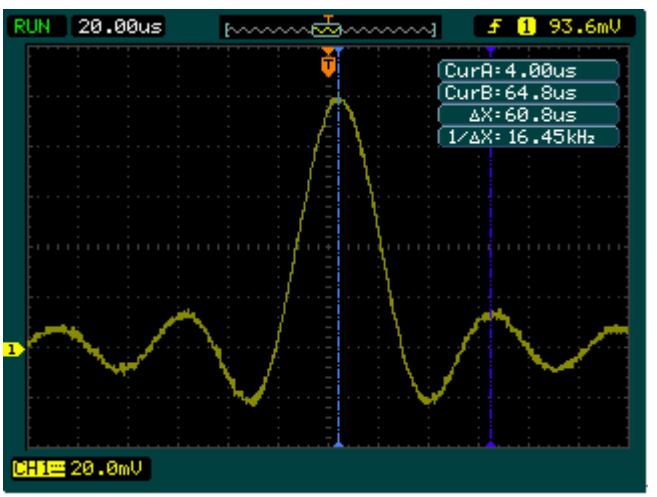


Figure 3-4
Waveform display

Measure the Amplitude of the First Waveform Peak of the Sinc.

Please follow these steps:

1. Press Cursor key to see the Cursor menu.
2. Press **Mode** to set **Manual** mode
3. Press **Type** to select **Y**.
4. Turn (↻) knob to place cursor A on the first peak of the wave.
5. Turn (↻) knob to place cursor B on the second peak of the wave.

Observe the following measurements in the cursor menu: (See Figure 3-5)

- The delta voltage (peak-to-peak voltage of the waveform)
- The voltage at Cursor 1
- The voltage at Cursor 2

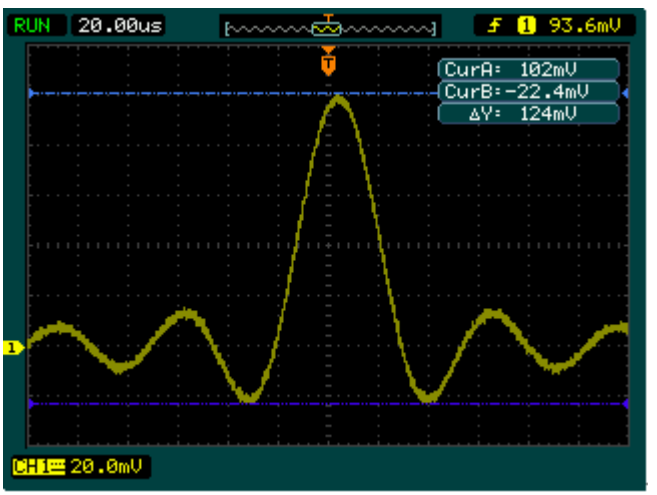


Figure 3-5
Waveform display

Example 6: The Application of the X-Y operation

Viewing Phase Changes through a Network

Theme: Connect the oscilloscope to monitor the input and output of the circuit and capture the phase changes.

To view the input and output of the circuit in an X-Y display, do these steps:

1. From the probe menu set the attenuation to 10X. Set the switch to 10X on the probes.
2. Connect the CH 1 probe to the input of the network, and connect the CH 2 probe to the output.
3. If the channels are not displayed, press the CH1 and CH2 buttons.
4. Press the AUTO button
5. Adjust the vertical SCALE knob to display approximately the same amplitude signals on each channel
6. Press the MENU in horizontal control area to display the menu
7. Press the **Time Base** soft button to select **X-Y**

   The oscilloscope displays a Lissajous pattern representing the input and output characteristics of the circuit
8. Adjust the vertical SCALE and POSITION knobs to a desirable waveform display.
9. Apply the Ellipse method to observe the phase difference between the two channels.

   (See Figure 3-6)

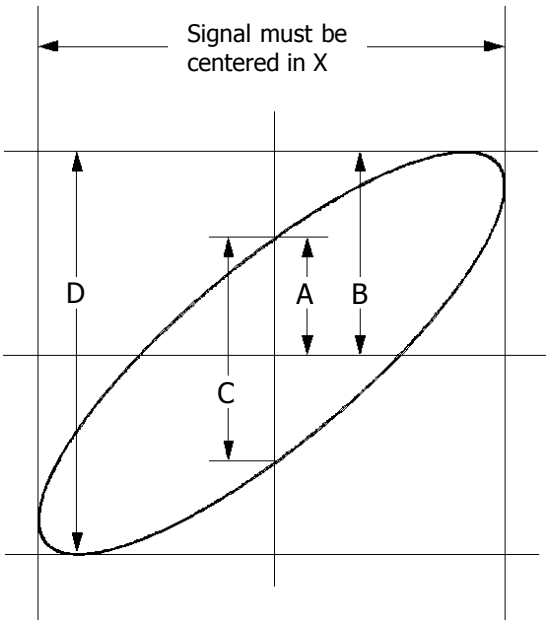


Figure 3-6
Ellipse method to observe the phase difference

Sinθ = A/B or C/D, where θ = phase shift (in degrees) between the two signals. From the formula above, you could get:

θ = ±arcsine (A/B) or ±arcsine (C/D)

If the main axis of the ellipse is at I and III quadrant, θ must be in the range of (0~π/2) or (3π/2~2π). If the main axis is at II and IV quadrant, θ must be in the range of (π/2~π) or (π~3π/2).

Example 7: Triggering on a Video Signal

Test a video circuit in the DVD set. Use video trigger to obtain a stable display.

Triggering on Video Fields

To trigger on the video fields, please do as the following steps:

1 Press the MENU key in the Trigger control area to see the Trigger menu.

2 Press **Mode** to select **Video**.

3 Press **Source** to select **CH1** as trigger source.

4 Press **Polarity** to select ⊔.

5 Press **Sync** as **Odd Field** or **Even Field**.

6 Adjust the LEVEL knob to set trigger level at the video sync pulse to get stable trigger.

7 Turn the horizontal SCALE knob to see a complete waveform on the screen.

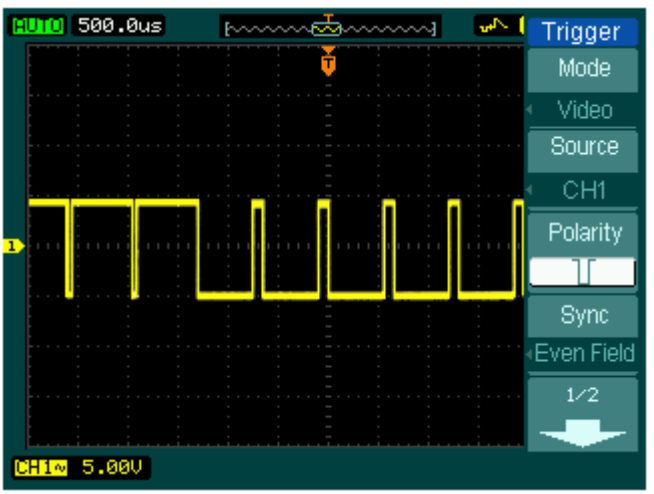


Figure 3-7
Waveform display

DS1000B series triggers on the Odd field or Even field. To avoid confusion when Odd field and Even field trigger simultaneously, choose Odd field or Even field as step 5 above.

Triggering on the Video Lines

1. Press the MENU key in the Trigger control area to see the trigger menu.
2. Press **Mode** to select **Video**.
3. Press **Source** to select **CH1** as trigger source.
4. Press **Polarity** to select .
5. Press **Sync** to select **Line Num**.
6. Turn ( ) knob to trigger on a specified line number.
7. Adjust the LEVEL to set trigger level at the video sync pulse to get a stable trigger.
8. Turn the horizontal SCALE knob to observe a complete waveform on the screen.

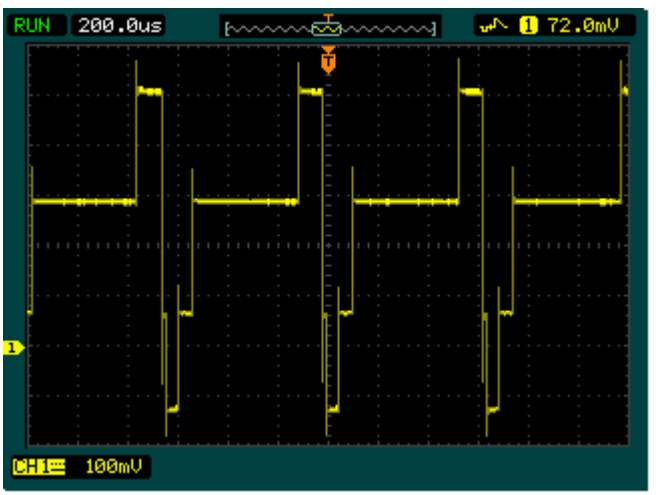


Figure 3-8
Waveform display

Example 8: FFT Cursor Measurement

FFT measurements include: Amplitude measurement (Vrms or dBVrms) and Frequency measurement (Hz).

Do these steps as follows:

1. Press Cursor→Press No.1 button to set cursor **mode** to **Manual**.
2. Press No.2 button associated with **Type** to select **X** or **Y**.
3. Press button MATH→set operate mode as **FFT**.
4. Press Cursor →press No.3 button to specify source as **MATH**.
5. Turn (↻) knob to move the cursor A and cursor B to a point of interest.

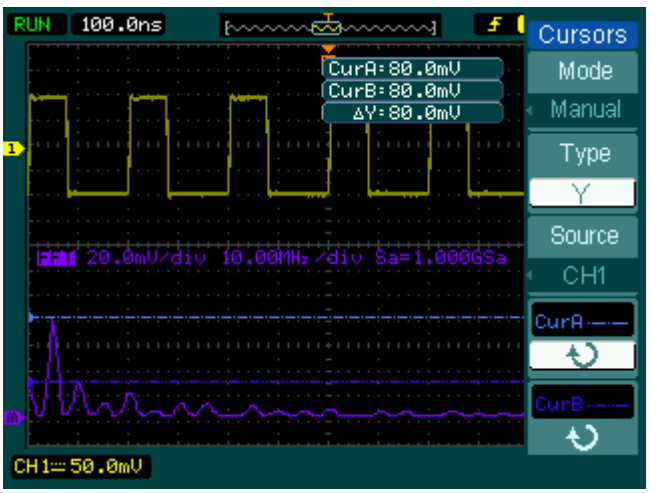


Figure 3-9
Cursor Measurement (Type Y)

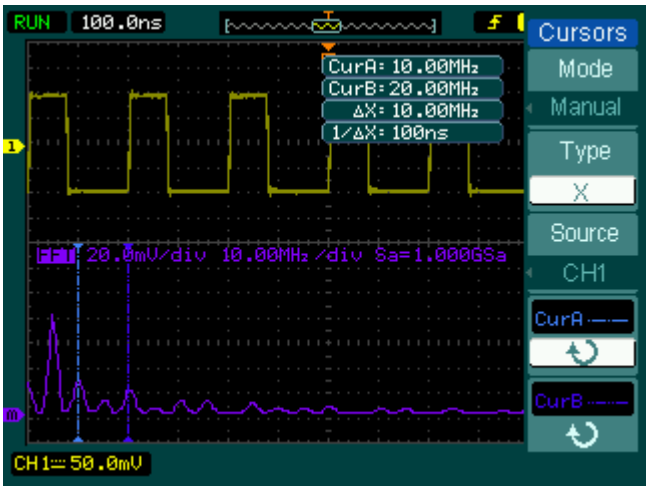


Figure 3-10
Cursor Measurement (Type X)

Example 9: Pass/Fail Test

The Pass/Fail Test is one of enhanced special functions based on DS1000B series. In this test function the oscilloscope compares the input signal to the established waveform mask. If the waveform "touches" the mask, a "Fail" signal occurs, otherwise the test passes. When needed, a programmable output can be used for external automatic control applications. The output is built in as a standard feature, and is photo electricity isolated.

Execute the steps as following:

1. Press Utility→**Pass/Fail.**
2. Press **Enable Test** and select **ON**.
3. Press **Mask Setting**→**Load**.
4. Press **Load** to recall the saved mask or press **X Mask** and **Y Mask** to adjust the horizontal limit and vertical limit with the multifunctional knob then press **Create Mask** to create a new mask.
5. Press **Output** to select the expected outputting waveforms.
6. Press **Operate** to start the test.

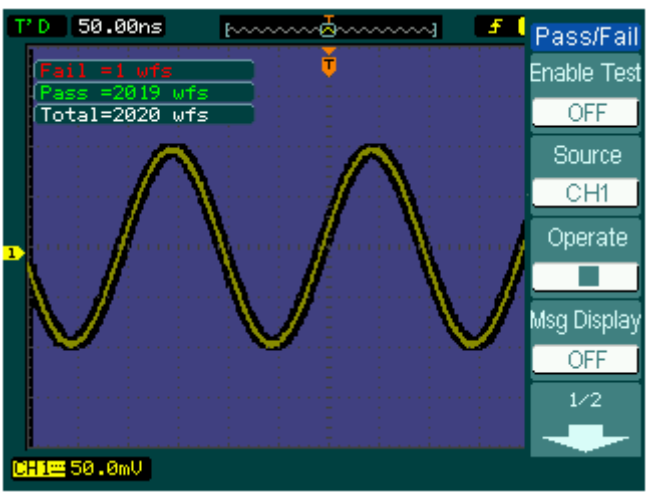


Figure 3-11
Waveform display

Chapter 4 : Troubleshooting

1. After the oscilloscopes is powered on, the screen remains dark (no display):

(1) Check the power cord connection.
(2) Ensure the power switch is turned on.
(3) After the above inspection, restart the oscilloscope.
(4) If the problem still remains, please contact **RIGOL** for help.

2. After the signal acquisition the waveform does not appear:

(1) Check the probes connected with the signals.
(2) Check the probes connected to the channels firmly.
(3) Check the probes connected with the object being tested.
(4) Check the circuit generates signal at the test point.
(5) Repeat the acquisition.

3. The measurement result is 10 times higher or lower than the value expected.

Check if the probe attenuation is the same as the channel attenuation.

4. If the oscilloscope does not get a stable waveform display:

(1) Check the **Trigger Source** and notice if it is set to the channel in use.
(2) Check the **Trigger Type**. Use "Edge" for normal signals, and use "Video" for VIDEO signals.
(3) Switch the **coupling** into **HF Rejection** or **LF Rejection** in order to filter the noise which disturbs trigger.
(4) Adjust the trigger **Sensitivity** and the **hold off** time.

5. After pressing the RUN/STOP **button, the oscilloscope does not display any waveform on screen.**

Check whether the **Trigger Mode** is set to "Normal" or "Single" and see whether the trigger level is out of the signal range. If yes, set the trigger level in proper range by turning the LEVEL knob or pressing the 50% button. Or set the Trigger Mode as "AUTO". Moreover, push AUTO button to display the waveform on screen.

6. After the Acquisition is set to "Averages" or Display Persistence is set ON, the waveform refreshes slowly.

It is normal in these settings.

7. The signal is displayed as ladder like waveform.

(1) The time base setting maybe is too slow. Turn the horizontal SCALE knob to increase horizontal resolution to improve the display.

(2) Maybe the display **Type** is set to "Vectors", and set it to "Dots" mode to improve the display.

8. Unable to connect to PC or the PictBridge printer by USB:

(1) When connected to PC, if the message "Unknown device" appears or prompting scanner or camera was found. Press Utility to choose the I/O Setting menu, you may see the USB Device menu has been set to be "PictBridge", you should switch it to "Auto Detect" or "Computer". If necessary, restart the oscilloscope.

(2) If connecting to a PictBridge printer or the printing is unsuccessful, maybe the USB Device menu has been set to "Computer". You should switch it to be "Auto Detect" or "PictBridge". If necessary, restart the oscilloscope.

Chapter 5 : Specifications

All specifications apply to the DS1000B Series Oscilloscopes and a probe with the Attenuation switch set to 10X unless noted otherwise. To meet these specifications, two conditions must first be met:

- The instrument must have been operating continuously for thirty minutes within the specified operating temperature.
- Must perform the Self Calibration operation, accessible through the Utility menu, if the operating temperature changes by more than 5℃.
- All specifications are guaranteed unless noted "typical".

Specifications

Acquisition		
Sampling Modes	Real-Time	Equivalent-time
Sampling Rate	2 GSa/s (half channel [1]) 1 GSa/s (each channel)	50 GSa/s[2]
Averages	N time acquisitions, all channels simultaneously, N is selectable from 2, 4, 8, 16, 32, 64, 128 and 256	

Inputs	
Input Coupling	DC, AC, GND
Input Impedance	1MΩ±2%, in parallel with 18pF±3pF
Probe Attenuation Factors	0.001X, 0.01X, 0.1X, 1X, 2X, 5X, 10X, 20X, 50X, 100X, 200X, 500X, 1000X
Maximum Input Voltage	Maximum Input Voltage of the analog channel: CAT I 300Vrms, 1000Vpk; transient overvoltage 1000Vpk CAT II 100Vrms, 1000Vpk RP2200 10:1, CAT II 300Vrms RP3200 10:1, CAT II 300Vrms RP3300 10:1, CAT II 300Vrms
Time delay between channel (typical)	500ps

Horizontal	
Sample Rate Range	3.65Sa/s-2GSa/s (Real-Time), 3.65Sa/s-50GSa/s (Equivalent-time)
Waveform interpolation	Sin(x)/x
Record Length	16k samples for half channel[1] 8k samples for each channel
Scan speed Range (Sec/div)	1ns/div~50s/div, DS1202/4B 2ns/div~50s/div, DS1102/4B 5ns/div~50s/div, DS1062/4B 1-2-5 Sequence
Sample Rate and Delay Time Accuracy	±50ppm (over any≥1ms time interval)

Delta Time Measurement Accuracy (Full Bandwidth)	Single-shot: ±(1 sample interval + 50ppm × reading + 0.6 ns) >16 averages: ±(1sample interval + 50ppm × reading + 0.4 ns)

Vertical	
A/D converter	8-bit resolution, each channel samples simultaneously
Volts/div Range	2mV/div-10V/div at input BNC
Offset Range	±40V(500mV~10V) ±2V(2mV~200mV)
Analog Bandwidth	60MHz(DS1062/4B) 100MHz(DS1102/4B) 200MHz(DS1202/4B)
Single-shot Bandwidth	60MHz(DS1062/4B) 100MHz(DS1102/4B) 200MHz(DS1202/4B)
Selectable Analog Bandwidth Limit (typical)	20MHz
Lower Frequency Limit (AC -3dB)	≤5Hz (at input BNC)
Rise Time at BNC, typical	<1.75ns, <3.5ns, <5.8ns, On 200MHz, 100MHz, 60MHz respectively
DC Gain Accuracy	2mV/div~5mV/div: ±4% (Sample or Average acquisition mode) 10mV/div~10V/div: ±3% (Sample or Average acquisition mode)
DC Measurement Accuracy, Average Acquisition Mode	Average of ≥16 Waveforms with vertical position at zero: ±(DC Gain Accuracy×reading+0.1div+1mV) Average of ≥16 Waveforms with vertical position not at zero: ±[DC Gain Accuracy×(reading+ vertical position)+(1% of vertical position)+0.2div] Add 2mV for settings from 1mV/div to 200 mV/div Add 50mV for settings from >200mV/div to 10V/div
Delta Volts Measurement Accuracy (Average Acquisition Mode)	Delta Volts between any two averages of 16 waveforms acquired under same setup and ambient conditions: ±(DC Gain Accuracy×reading + 0.05 div)

Trigger		
Trigger Sensitivity	0.1div-1.0div (adjustable)	
Trigger Level Range	Internal	±6 divisions from center of screen
	EXT	±0.6V
	EXT/5	±3V
Trigger Level Accuracy (typical) applicable for the signal of rising and falling time ≥20ns	Internal	±(0.3div × V/div)(±4 divisions from center of screen)
	EXT	±(6% of setting + 40 mV)
	EXT/5	±(6% of setting + 200 mV)
Trigger Offset	Normal mode: pre-trigger(storage depth/(2×sampling) rate), delayed trigger 1s	
	Slow Scan mode: pre-trigger 6div, delayed trigger 6div	
Trigger Holdoff range	100ns~1.5s	
HF Rejection	100kHz ±20%	
LF Rejection	10kHz ±20%	
Set Level to 50% (typical)	Input signal frequency ≥50Hz	
Edge Trigger		
Edge trigger slope	Rising, Falling, Rising + Falling	
Pulse Trigger		
Trigger condition	(>, <, =) Positive pulse, (>, <, =) negative pulse	
Pulse Width range	20ns ~10s	
Video Trigger		
Video standard & line frequency	Support standard NTSC, PAL and SECAM broadcast systems. Line number range: 1~525 (NTSC) and 1~625 (PAL/SECAM)	
Pattern Trigger		
Pattern setup	H, L, X,  , 	
Alternate Trigger		
Trigger on CH1, CH2, CH3, CH4	Edge, Pulse, Video	

Measurements		
Cursor	Manual	Voltage difference between cursors (ΔV) Time difference between cursors (ΔT)

		Reciprocal of ΔT in Hertz (1/ΔT)
	Track	Voltage value for Y-axis waveform Time value for X-axis waveform
	Auto	Cursors are visible for Automatic Measurement
Auto Measure	Vpp, Vamp, Vmax, Vmin, Vtop, Vbase, Vavg, Vrms, Overshoot, Preshoot, Freq, Period, Rise Time, Fall Time, +Width, -Width, +Duty, -Duty, Delay A→B↓, Delay A→B↑, Phase A→B↓,Phase A→B↑	

[1] Half channel indicates selecting one of the channels in CH1 and CH2, or in CH3 and CH4.

[2] This is the highest specification, the specific specifications are as follows:
DS1202/4B: 50GSa/s
DS1102/4B: 25GSa/s
DS1062/4B: 10GSa/s

General Specifications

Display	
Display Type	5.7 inch. (145 mm) diagonal TFT Liquid Crystal Display
Display Resolution	320 horizontal ×RGB×240 vertical pixels
Display Color	64k color
Display Contrast (typical)	150:1
Backlight Brightness (typical)	300 nit

Probe Compensator Output	
Output Voltage (typical)	Amplitude, ~3Vpp
Frequency (typical)	1kHz

Power	
Supply Voltage	AC，100~240 V, 45~440Hz, CAT II
Power Consumption	Less than 50VA
Fuse	2A, T rating, 250 V

Environmental	
Ambient Temperature	Operating 10℃~ 40℃
	Non-operating -20℃~ +60℃
Cooling Method	Fan force air flow
Humidity	+35℃ or below: ≤90% relative humidity
	+35℃~ +40℃: ≤60% relative humidity
Altitude	Operating 3,000 m or below
	Non-operating 15,000 m or below

Mechanical		
Size	Width	325mm
	Height	159mm
	Depth	133 mm
Heavy	Without package	3kg
	Packaged	4.3 kg

IP Degree
IP2X

Calibration Interval
The recommended calibration interval is one year

Chapter 6 : Appendixes

Appendix A: Accessories

- Probe×4 (1.5m), 1:1, (10:1) Passive Probes

  When the switch of probe is toggled to 1X attenuation setting, the probe has 6MHz bandwidth, according with 150V CAT II.

  When the switch of probe is set to 10X attenuation setting ,the probe's bandwidth equals to the upper limit of the oscilloscope, according with 300V CAT II.

- A Power Cord that fits the standard of destination country.
- A USB Cable
- A Quick Guide
- A CD-ROM (including《User's Guide》an application software)
- A Warranty Card

Optional accessories:

- BNC Cable
- RS232 Cable
- DS1000B special convenient soft bag

All accessories (standard and optional) are available by contacting your local RIGOL office.

Appendix B: Warranty

RIGOL Technologies, Inc. warrants its products' mainframe and accessories in materials and techniques within the warranty period. During the period concerned, **RIGOL** guarantees the free replacement or repair of products which are approved defective.

To get repair service or obtain a copy of the whole warranty statement, please contact with your nearest **RIGOL** sales and service office.

RIGOL does not provide any other warranty items except the one being provided by this summary and the warranty statement. The warranty items include but not being subjected to the hinted guarantee items related to tradable characteristic and any particular purpose.

RIGOL will not take any responsibility in cases regarding to indirect, particular and ensuing damage.

Appendix C: Maintenance

General Care

Do not store or leave the instrument in which the LCD display will be exposed to direct sunlight for long periods of time.

CAUTION: To avoid damage to the instrument or probes, do not expose them to sprays, liquids, or solvents.

Cleaning

If this instrument requires cleaning, disconnect it from all power sources and clean it with a mild detergent and water. Make sure the instrument is completely dry before reconnecting it to a power source.

To clean the exterior surface, perform the following steps:

- Remove loose dust on the outside of the instrument and probes with a lint- free cloth. Take care to avoid scratching the clear plastic display filter.
- Use a soft cloth dampened with water to clean the instrument.

NOTE: To avoid damage to the surface of the instrument or probes, do not use any abrasive or chemical cleaning agents.

Appendix D: Contact RIGOL

If you have any problem or requirement during using our products, please contact **RIGOL** Technologies, Inc. or the local distributors.

Domestic: Please call

Tel: (86-10) 8070 6688
Fax: (86-10) 8070 5070
Service & Support Hotline: 800 810 0002
9:00 am –5: 00 pm from Monday to Friday

Or by e-mail:
service@rigol.com

Or mail to:
RIGOL Technologies, Inc.
156# CaiHe Village, ShaHe Town, ChangPing District, Beijing, China
Post Code: 102206

Overseas: Contact the local **RIGOL** distributors or sales office.

For the latest product information and service, visit our website: www.rigolna.com

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