



## MO2000 Modular Oscilloscope User Manual



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Saluki Technology Inc.

### The document applies to the Modular Oscilloscopes of the following models:

- MO2052 Modular Oscilloscope
- MO2082 Modular Oscilloscope
- MO2102 Modular Oscilloscope
- MO2202 Modular Oscilloscope
- MO2074 Modular Oscilloscope
- MO2104 Modular Oscilloscope
- MO2204 Modular Oscilloscope
- MO2254 Modular Oscilloscope
- MO2074A Modular Oscilloscope
- MO2104A Modular Oscilloscope
- MO2204A Modular Oscilloscope
- MO2254A Modular Oscilloscope

### MO2000 Modular Oscilloscope standard accessories:

- Main machine
- X1, X10 two passive probe x2
- SMA-SMA connection cable
- USB cable
- CD

## Preface

Thank you for choosing MO2000 Modular Oscilloscope produced by Saluki Technology Inc.

We devote ourselves to meeting your demands, providing you high-quality measuring instrument and the best after-sales service. We persist with “superior quality and considerate service”, and are committed to offering satisfactory products and service for our clients.

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Saluki Technology

## Document Authorization

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## Product Quality Assurance

The warranty period of the product is 36 months from the date of delivery. The instrument manufacturer will repair or replace damaged parts according to the actual situation within the warranty period.

## Product Quality Certificate

The product meets the indicator requirements of the document at the time of delivery. Calibration and measurement are completed by the measuring organization with qualifications specified by the state, and relevant data are provided for reference.

## Quality/Settings Management

Research, development, manufacturing and testing of the product comply with the requirements of the quality and environmental management system.

## Contacts

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## 1 General Safety Summary

Review the following safety precautions carefully before operate the device to avoid any personal injuries or damages to the device and any products connected to it. To avoid potential hazards, use the device as specified by this user's guide only.

- **To Avoid Fire or Personal Injury.**
- **Connect and Disconnect Properly.**

Do not connect or disconnect probes or test leads while they are connected to a voltage source.

- **Connect and Disconnect Properly.**

Connect the probe output to the measurement device before connecting the probe to the circuit under test. Disconnect the probe input and the probe reference lead from the circuit under test before disconnecting the probe from the measurement device.

- **Observe All Terminal Ratings.**

To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

- **Use Proper Probe.**

To avoid shock hazard, use a properly rated probe for your measurement.

- **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 device, have it inspected by qualified service personnel before further operations.

- **Provide Proper Ventilation.**

Refer to the installation instructions for proper ventilation of the device.

- **Do not operate in Wet/Damp Conditions.**
- **Do not operate in an Explosive Atmosphere.**
- **Keep Product Surfaces Clean and Dry.**

### Safety Information

In order to ensure the correct using and the best efficient service, please carefully read the user's manual.

### System Symbols

These symbols may appear in this manual or on the instrument.



**Warning:** "Waring" identifies conditions and actions that pose hazards to the users.

 **Caution:** "Caution" identifies conditions and actions that may damage the product or other properties.



**DANGER:**  
High Voltage



Refer to  
the manual



Protective  
Conductor Terminal



Chassis ground



Earth(ground) Terminal

## System Terms

The following terms may appear on the instrument:

**Danger:** The term "Danger" is used in the manual to indicate that when you read this mark, personal injury may be caused to immediately.

**Warning:** The term "Warning" is used in the manual to indicate that when you read this mark, personal injury may not be caused to you immediately, but you need to be cautious.

**Notice:** The term "Notice" is used in this manual to indicate that damages may be caused on this product or other properties.



## 2 Brief Introduction

The oscilloscope is small, lightweight, no external power required, portable oscilloscopes! The oscilloscopes is ideal for production test, research and design and all of the applications involving analog circuits test and troubleshooting, as well as education and training.

In addition to the list of general features on the next page, this chapter describes how to do the following tasks:

- System Requirements
- Install Software
- Install Driver
- General Features
- General Check
- Function Check
- Self Calibration
- Accessories

## 2.1 System Requirement

To run the oscilloscope software, the needs of computer configuration are as follows:

### Minimum System Requirements

#### Operating System

Vista/Win7/Win8/Win10

#### Processor

Upwards of 1.00G processor

#### Memory

256M byte

#### Disk Space

500M disk free space

#### Screen resolution

800 x 600

### Recommended Configuration

#### Operating System

SP3 System

#### Processor

2.4G Processor

#### Memory

1G Byte Memory

#### Disk Space

80G Disk Space

#### Screen resolution

1024 x 768 or 1280 x 1024 resolution

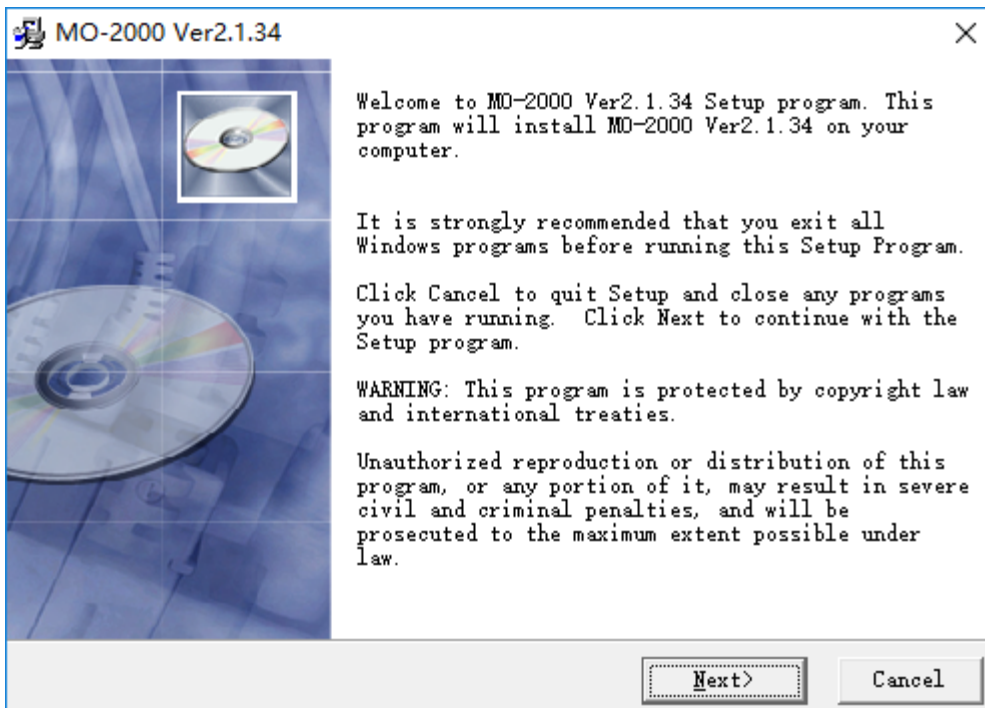
#### DPI Setting

Normal Size (96DPI)

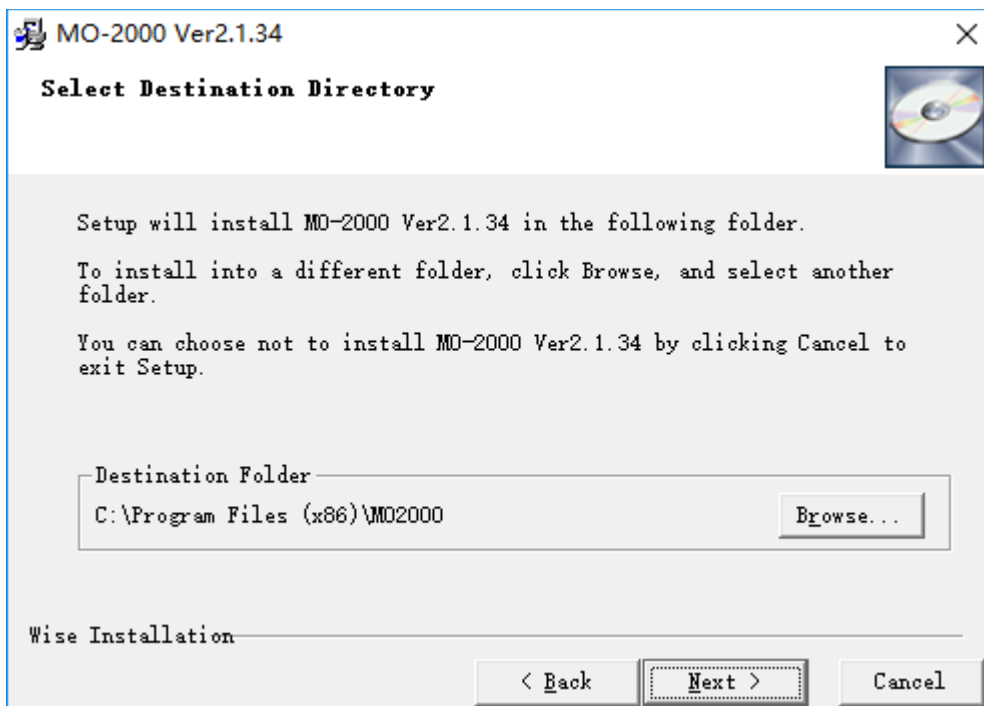
## 2.2 Install Software

**Caution:** You must install the software before using the oscilloscope.

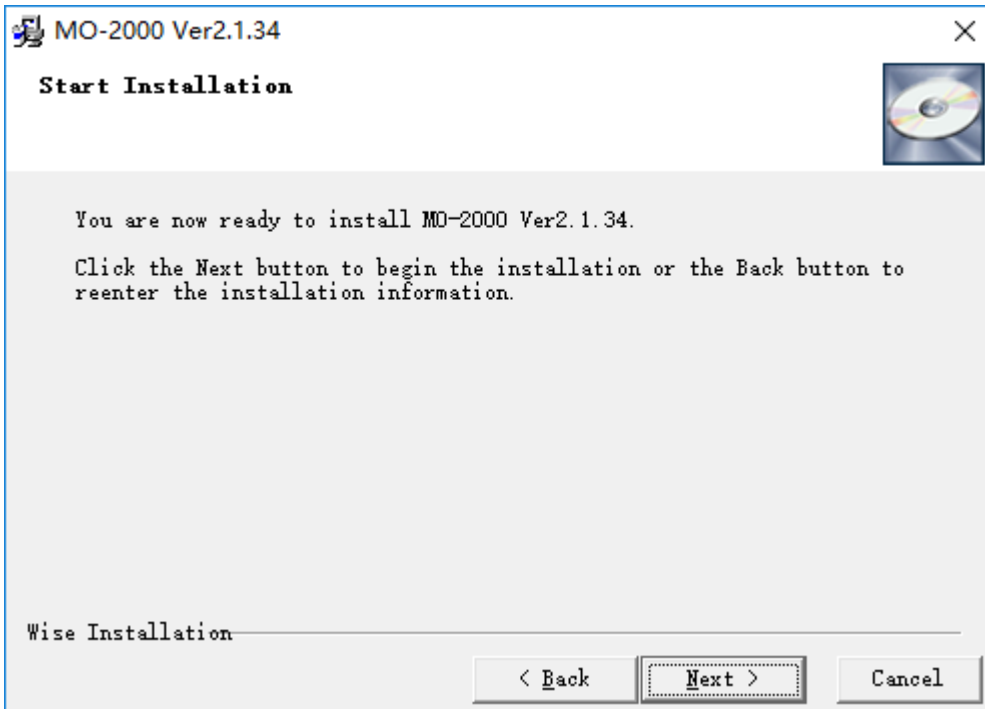
1. While in Windows, insert the installation CD into the CD-ROM drive.
2. The installation should start up automatically. Otherwise in Windows Explorer, switch to the CD-ROM drive and run Setup.exe.
3. The software Installation is started. Click 'Next' to continue.



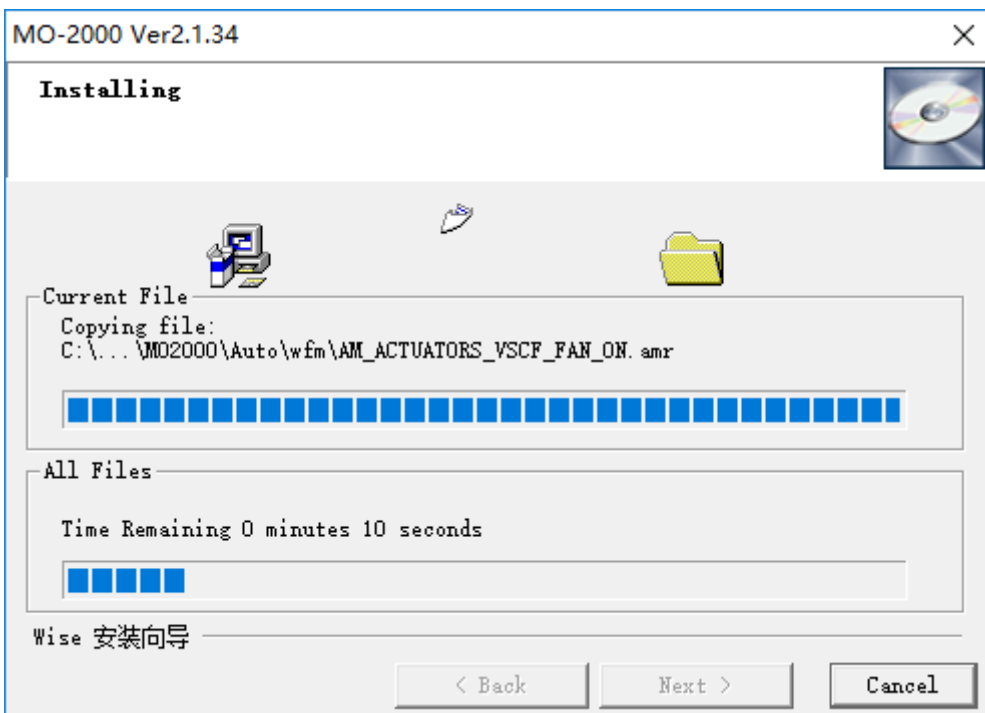
4. Choose a destination directory. Click 'Next' to continue.



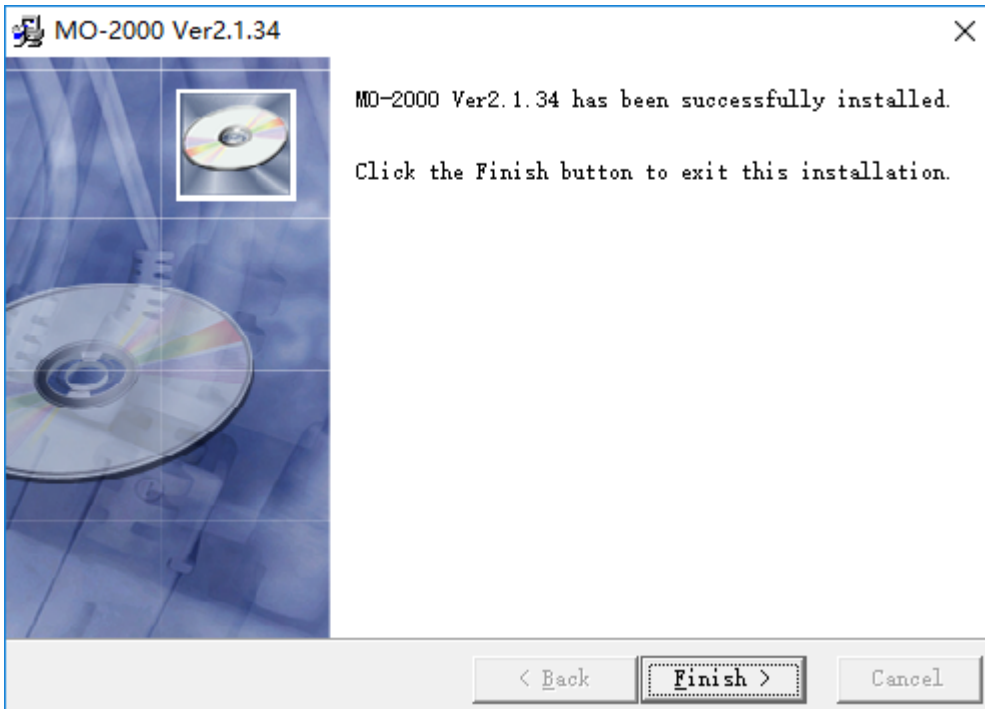
5. Check the setup information. Click Next to start copying of files.



6. This Status dialog is displayed during copying of files.



7. The installation is complete.



## 2.3 Install Driver

Example:

1. Connect the A-Type Plug of USB cable to your PC'S USB port.



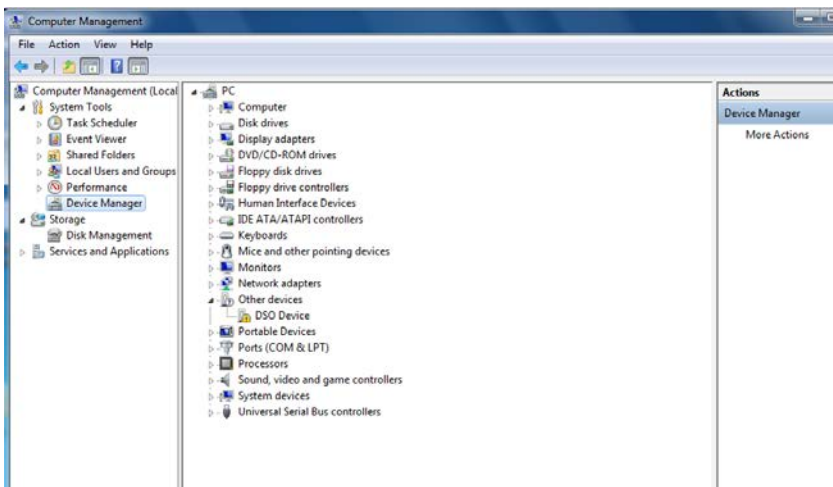
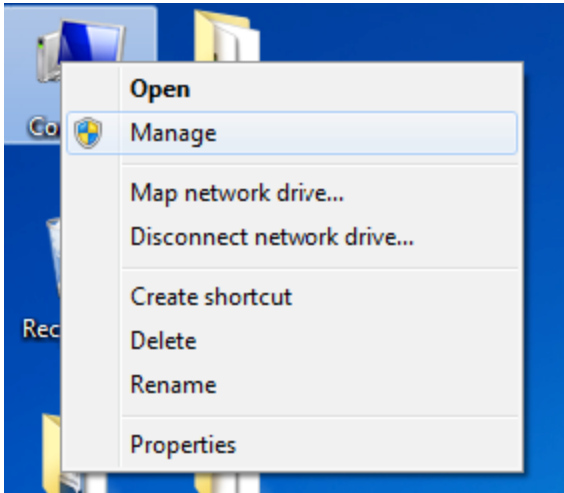
2. Connect the other A -Type Plug of USB cable to the device's USB port.



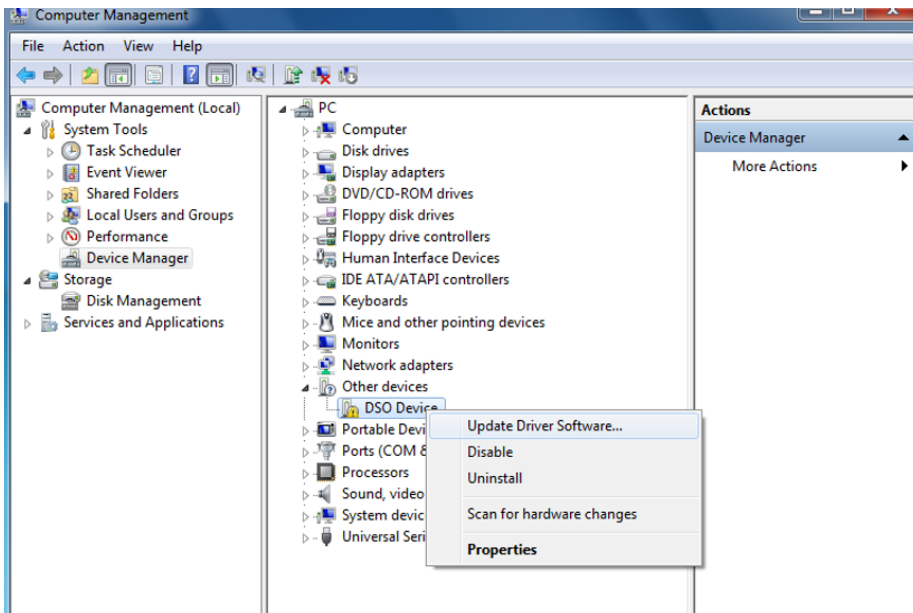
3. New hardware is found.



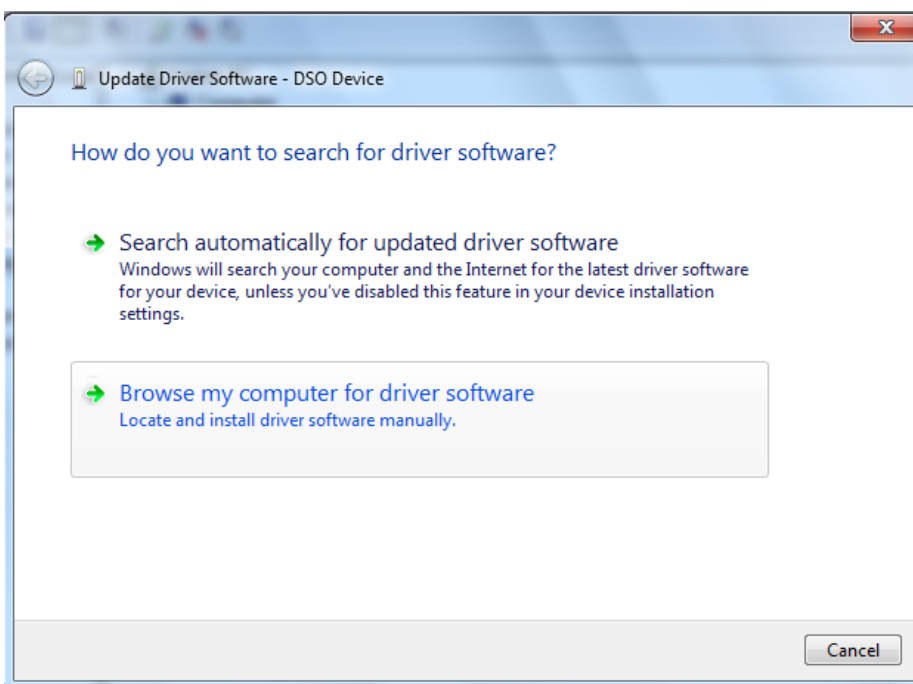
4. Click right mouse and select "Manage".



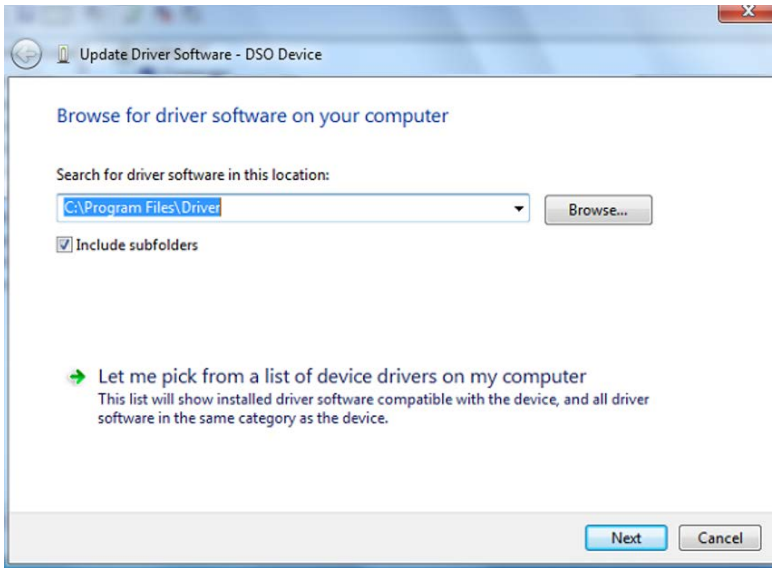
5. Click right mouse and select "Update Driver Software".



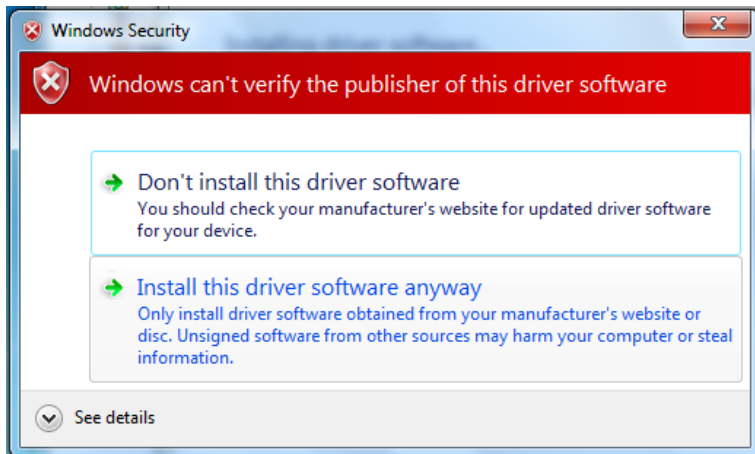
6. Select "Browse my computer for driver software".



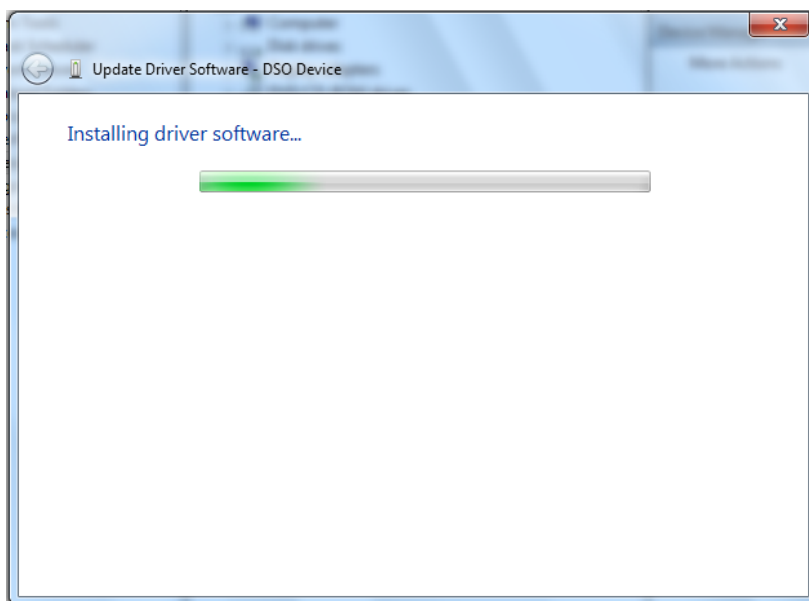
7. Select the right driver path, click "Next".



8. Click "Install this driver software anyway".

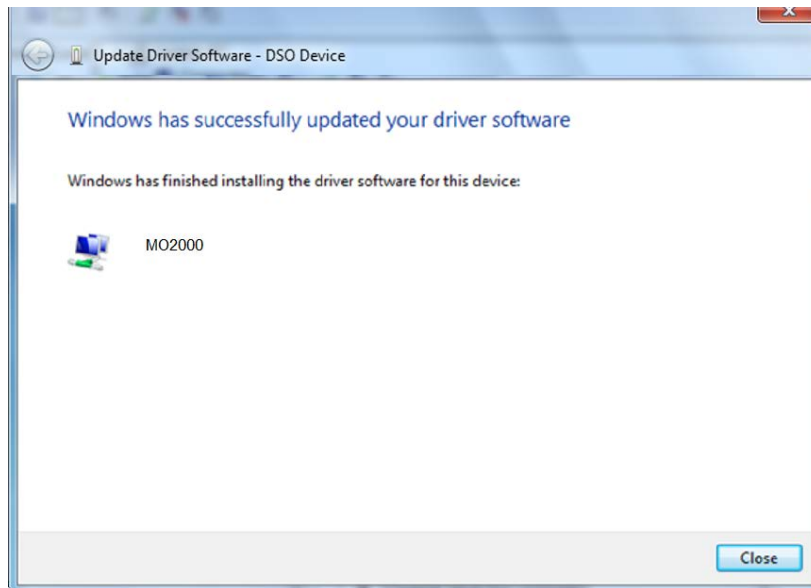


9. Installing driver software...



10. Software has been successfully installed.





## 2.4 General Features

### Product Features:

- Four Channels, Max Bandwidth:

250MHz/200MHz/100MHz/70MHz

- Maximum real-time sample rate:

1GSa/s

- Memory depth:

64K /CH

- Automatic setup for ease of use (AUTOSET);
- Built-in Fast Fourier Transform function(FFT);
- 20 Automatic measurements;
- Automatic cursor tracking measurements;
- Waveform storage, record and replay dynamic waveforms;
- User selectable fast offset calibration;
- Add, Subtract and Multiply Mathematic Functions;
- Selectable 20 MHz bandwidth limit;
- Waveform average;
- Adjustable waveform intensity, more effective waveform view;
- User interface in several user-selectable languages;

## 2.5 General Check

Please check the instrument as following steps after receiving an oscilloscope:

### Check 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.

### Check the accessories:

Accessories supplied with the instrument are listed in "Accessories" in this guide. If the contents are incomplete or damaged, please notify the franchiser.

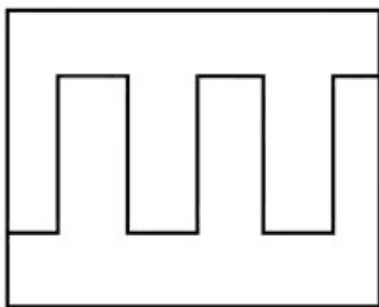
### Check the instrument:

In case there is any mechanical damage or defect, or the instrument does not operate properly or fails performance tests, please notify the franchiser.

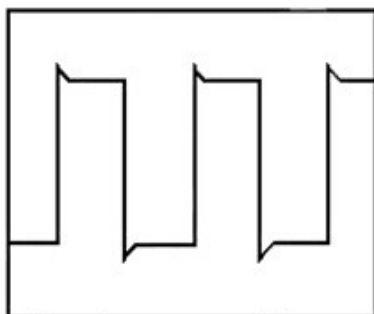
### Probe Compensation

Perform this function 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.

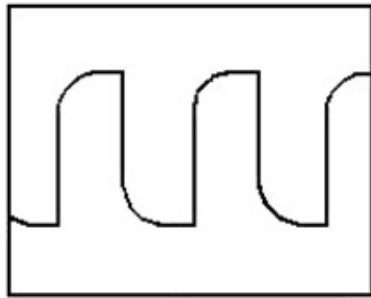
- 1) From the "Probe" menu, select attenuation to 1:10. Set the switch to "X10" on the probe and connect it to CH1 of the oscilloscope. When using the probe hook-tip, insert the tip onto the probe firmly to ensure a proper connection.
- 2) Connect the probe tip with a 1 KHz, 2 Vp-p square, select CH1, and then press the "AUTOSET" button into the menu or the toolbar.
- 3) Check the shape of the displayed waveform.



Correctly Compensated

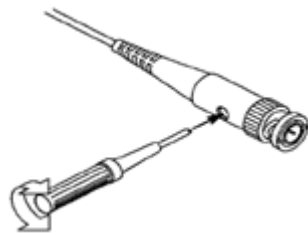


Over compensated



Under Compensated

- 4) If necessary, use a non-metallic tool to adjust the trimmer capacitor of the probe for the fattest square wave being displayed on the oscilloscope.



- 5) Repeat if necessary.

**WARNING:** 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.

## 2.6 Function Check

Perform this functional check to verify that your oscilloscope is operating correctly.

- **Connect the oscilloscope**

You should connect the A-Type Plug of USB cable to your PC USB port and connect the other A-Type Plug of USB cable to oscilloscope USB port.



- **Input a signal to a channel of the oscilloscope**

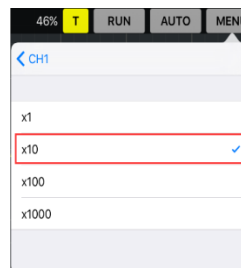
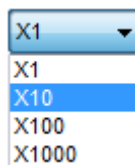
The oscilloscope is equipped with two channels plus external trigger.

Please input signal in the following steps:

1. Set the attenuation switch on the probe as 10X and connect the probe on the oscilloscope with CH1. Aim the slot in the probe connector at the faucet on BNC of CH1 and insert, then, turn right to lock the probe. Finally, attach the tip of probe and ground nip to the Connector of Probe compensator.



2. Set the CH1 probe attenuation of the oscilloscope to X10. (The default is X1).



3. Attach the tip of probe and ground nip to the Connector of Probe compensator. Click the AUTO button. A square wave will be displayed within a several seconds. (Approximately 1 KHz, 2V, peak- to- peak).
4. Inspect CH2 with the same method. Repeat steps 2 and 3.

## 2.7 Self Calibration

The self calibration routine lets you optimize the oscilloscope signal path for maximum measurement accuracy. You can run the routine at any time but you should always run the routine if the ambient temperature changes by 5°C or more. For accurate calibration, power on the oscilloscope and wait twenty minutes to ensure it is warmed up. To compensate the signal path, disconnect any probes or cables from the input connectors. Then, access the “Utility -> Calibrate/Self Calibration” option and follow the directions on the screen. The self calibration routine takes about several minutes.

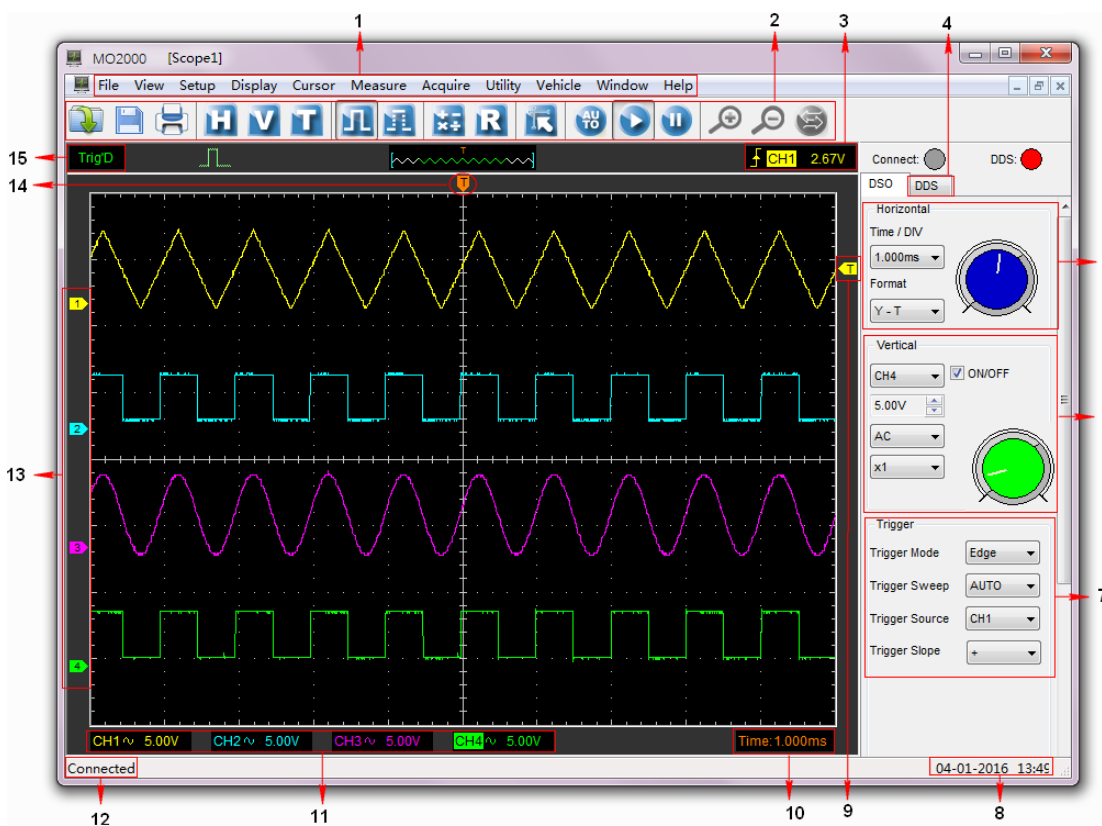
## 3 Operating Basics

- **The User’s Interface**

- The Menu System
- The Vertical System
- The Horizontal System
- The Trigger System
- Input Connectors

### 3.1 The User' s Interface

Click the software icon on the desk after you finished the software setting and equipment connecting. Then a user interface will be showed as follows:



In addition to displaying waveforms, the display area is filled with many details about the waveform and the oscilloscope control settings.

1. **The Main Menu:** All settings can be found in the main menu.
2. **The Toolbar**
3. **Displays the trigger information:** Displays the edge trigger slope, source and level.
4. **The DDS Panel (MO2000A)**
5. **The Horizontal Panel:** The user can change Time/Div, format in the panel.
6. **The Vertical Panel:** The user can turn on/off the CH1/CH2/CH3/CH4. Also the user can change the CH1/CH2/CH3/CH4 volt/div, coupling and probe attenuation.
7. **The Trigger Panel:** In this panel, the user can change the trigger mode, sweep, source and slope.
8. **Displays the system time.**

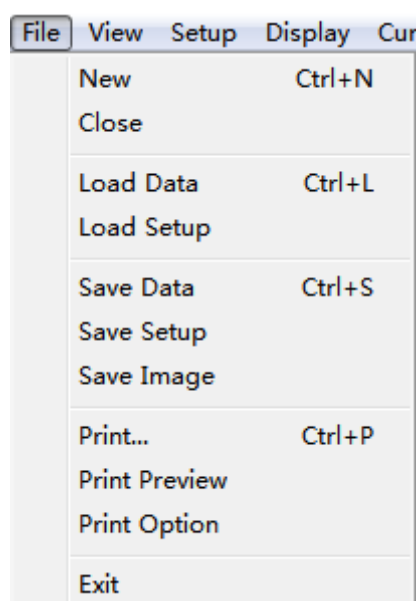
9. Marker shows Edge trigger level
10. Displays the main time base setting.
11. Displays the CH1/CH2/CH3/CH4 information:
  - Readouts show the coupling of the channels.
  - Readouts show the vertical scale factors of the channels.
  - A "B" icon indicates that the channel is bandwidth limited
12. Connect
13. The markers show the CH1/CH2/CH3/CH4 reference points of the displayed waveforms. If there is no marker, the channel is not displayed.
14. Marker shows horizontal trigger position
15. Trigger status indicates the following:
  - AUTO: The oscilloscope is in auto mode and is acquiring waveforms in the absence of triggers.
  - Trig'D: The oscilloscope has seen a trigger and is acquiring the post trigger data.
  - STOP: The oscilloscope has stopped acquiring waveform data.
  - RUN: The oscilloscope is running.

## 3.2 The Menu System

The Main Menu:

File View Setup Display Cursor Measure Acquire Utility Vehicle Window Help

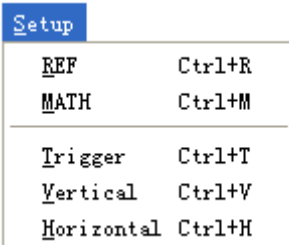
1. **File:** Load or Save data, setup



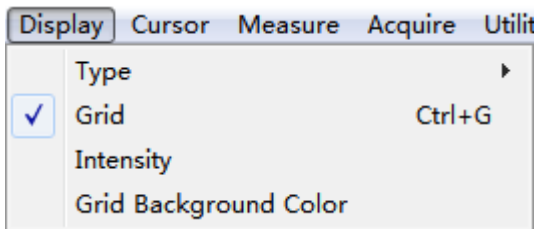
2. **View:** Change the user interface



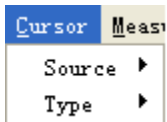
3. **Setup:** Setup setting



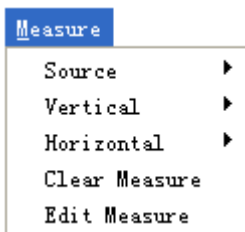
4. **Display:** Change wave display type



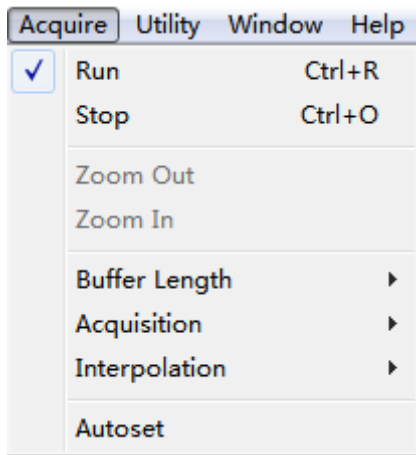
5. **Cursor:** Set Cursor measure type



6. **Measure:** Set measurement parameters



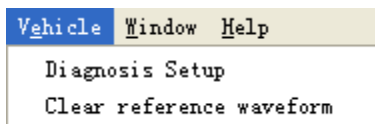
7. **Acquire:** Run ,Stop or other operation setting



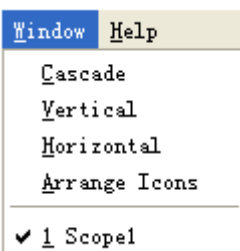
8. **Utility:** Utility setting



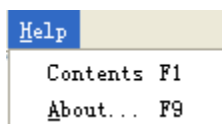
9. **Vehicle:**



10. **Window:** Window setting



11. **Help:** Turn on help file

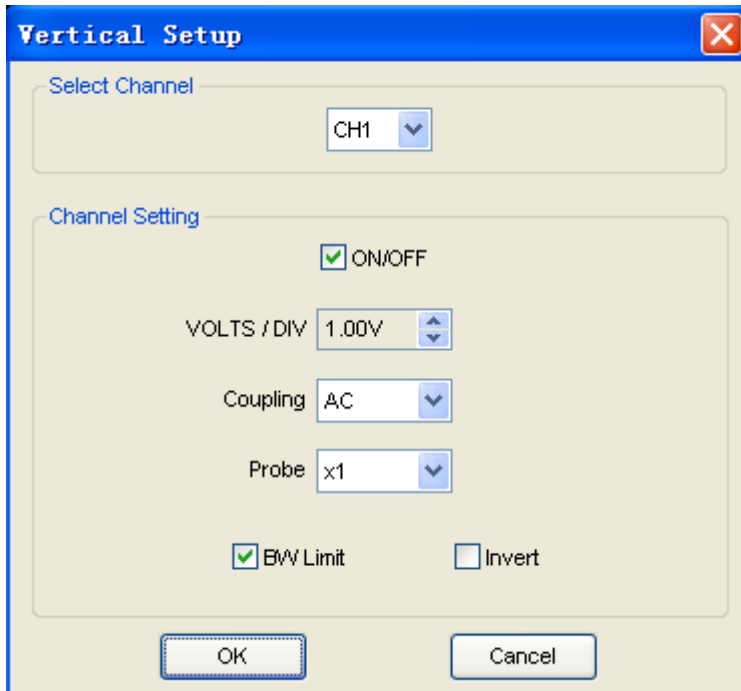


### 3.3 The Vertical System

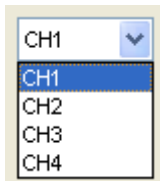
Click "Setup->Vertical"

The following figure shows the vertical Setup window. It shows the vertical parameters setting.





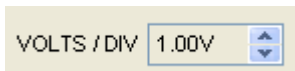
1. Select channel: User can select the channel by clicking the Combo box.



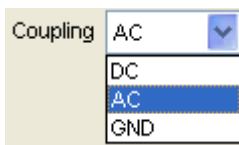
2. Select channel: User can select the channel by clicking the Combo box.



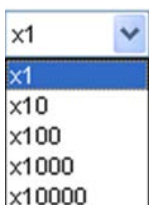
3. VOLTS/DIV: Set the selected channel voltage range.



4. Coupling: Set the selected channel to DC/AC.



5. Probe: Set the Select one according to the probe attenuation factor to ensure correct vertical scale reading



6. BW Limit: Reject the frequency component higher than 20MHz.



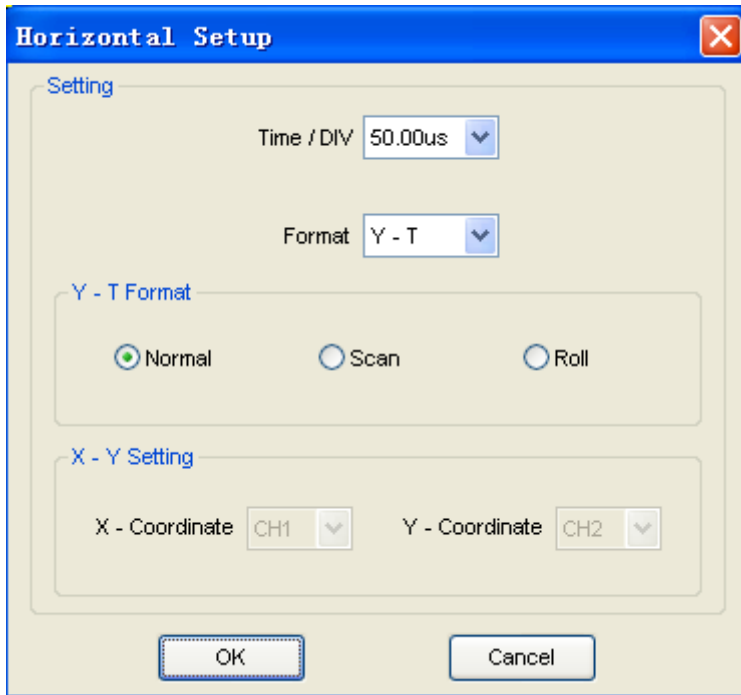
7. Invert: Invert the selected wave.



### 3.4 The Horizontal System

Click "Setup->Horizontal"

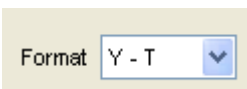
The following figure shows the Horizontal System window. It shows the horizontal parameters settings.



1. **Time/DIV:** leads the setting of the time base parameters



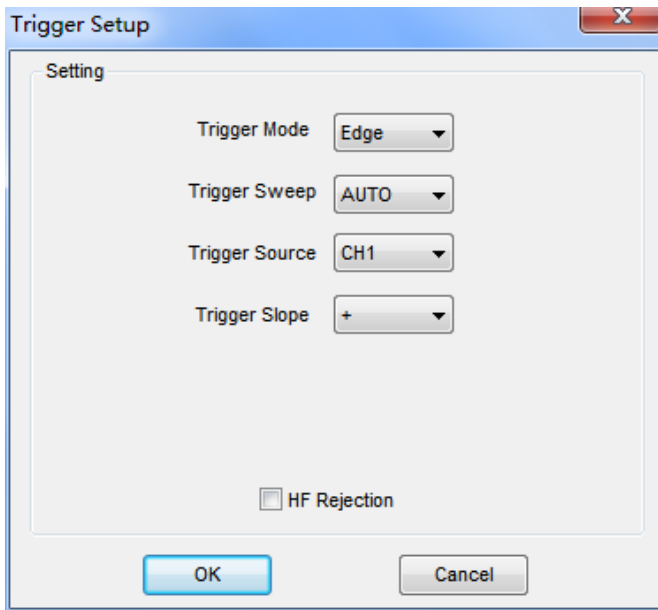
2. **Format:** leads the setting of the horizontal format parameters



### 3.5 The Trigger System

Click "Setup-> Trigger "

The following figure shows the trigger system control.



Trigger:

1. **Trigger Mode:** Sets the trigger mode
2. **Trigger Sweep:** Selects the trigger sweep mode to AUTO, NORMAL or SINGLE
3. **Trigger Source:** Selects the trigger source to CH1, CH2, CH3, CH4
4. **Trigger Slope:** Selects the edge trigger slope to Positive or Negative slope

### 3.6 Input Connector



CH1/CH2/CH3/CH4: Input connectors for waveform display.

Other Connector:



GND.: A ground terminal

**USB PORT:** Connect the USB cable to this port.

**CAL.:** Probe compensation output.

## 4 Oscilloscope Functions

- Set Oscilloscope
- Set Vertical System
- Set Horizontal System
- Set Trigger System
- Save/Load
- Utility Function
- Measure Signal
- Zoom In/Out Waveforms
- Acquire Signal
- Print

### 4.1 Setup the Oscilloscope

Using “**AUTOSET**” to display a signal automatically.

Auto setup functions one time each time you push the “**AUTOSET**” button. The function obtains a stable waveform display for you. It automatically adjusts the vertical scale, horizontal scale and trigger settings. Auto setup also displays several automatic measurements in the graticule area, depending on the signal type.

Connect a signal to the CH1 input:

1. Connect a signal to the oscilloscope as described above.
2. Click the “**Acquire -> AutoSet**” button.

The oscilloscope will change the current settings to display this signal.

#### Save Setup

The oscilloscope software saves the current setup before you close the oscilloscope software. The oscilloscope recalls this setup the next time you run the software. You can use the “**Save Setup**” menu to permanently save up to several different setups.

#### Load Setup

The oscilloscope can recall the last setup before the oscilloscope software was running, any saved setups, or the factory setup. You can use the “**Load Setup**” menu to permanently recall a setup.

#### Factory Setup

The oscilloscope software is set up for normal operation when it is shipped from the factory. This is the factory setup. To recall this setup, push the “**Factory Setup**” menu.

### 4.2 Set Vertical System

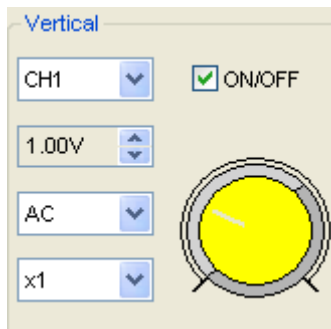
#### Set Channel

Click “**Vertical**” in “**Setup**” menu.

## The Channel Selection



The Channel Control Panel in sidebar



**The Vertical function:**

**Turn ON/Off:** Turn on/off the channel

**Volt/DIV:** Select the channel voltage/div

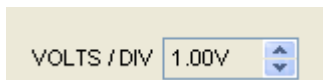
**Coupling:** Select the channel coupling

**Probe:** Select the channel probe attenuation

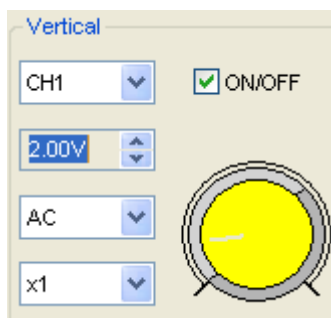
**Invert:** Turn on/off the invert function.

**Change Volt/DIV**

You can click "volt/Div" in "vertical Setup" window to select the voltage



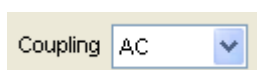
You can also change the selected channel voltage in sidebar



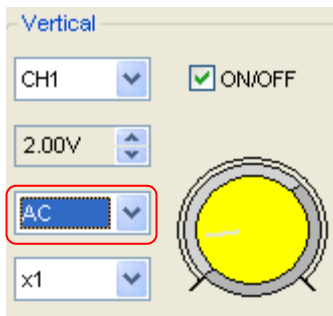
You can left click and drag the mouse on the knob to change the voltage.

**Set Channel Coupling**

Click "Coupling" in "Vertical Setup" window



In the sidebar, you can change the channel coupling too.



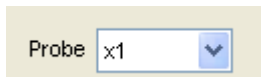
You can set the coupling to **DC**, **AC** or **GND**. If you set the coupling to **DC**, it blocks the **AC** component of the input signal.

### Probe Attenuation Setting

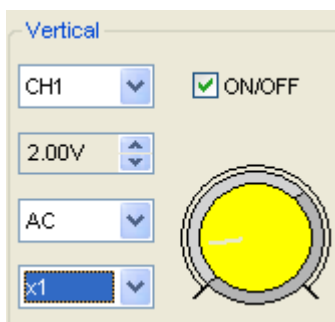
Select the attenuation factor for the probe. To check the probe attenuation setting, toggle the probe menu to match the attenuation factor of the probe.

This setting remains in effect before you changed again.

Click "**Probe**" in Vertical Setup window to select the probe attenuation



The probe setting window in the sidebar

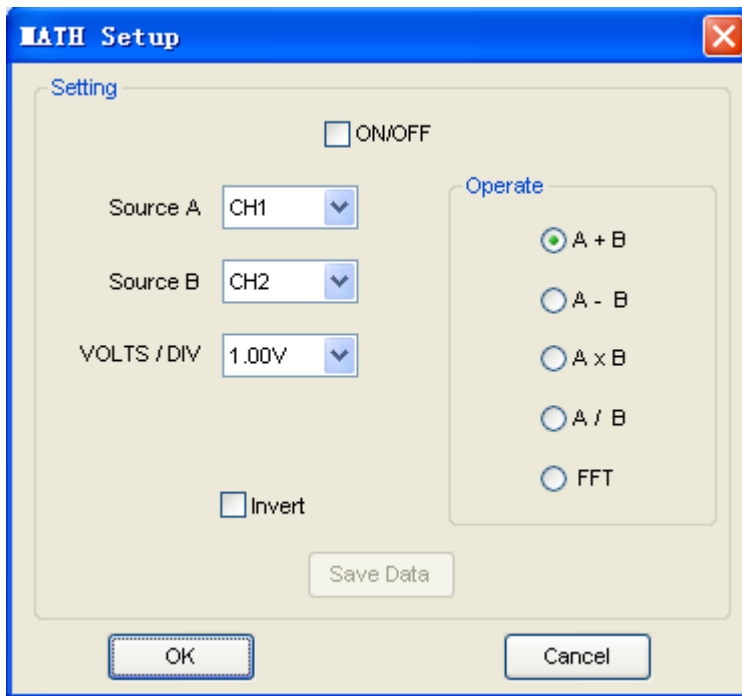


**Note:** The attenuation factor changes the vertical scale of the oscilloscope so that the measurement results reflect the actual voltage levels at the probe tip.

### Set Math

Click "**MATH**" in **Channel** menu to set **MATH** channel.

The **MATH Setup** window:



**ON/OFF:** Turn On/Off the MATH Channel.

**Source A/B:** Set the sources of the math channel.

**Operate:** Set operates type of the math channel.

**Volt/DIV :** Set the resolution of the math channel.

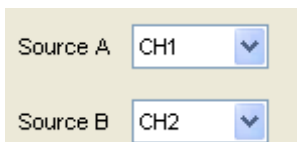
**Probe:** Set the math channel probe attenuation.

**Invert:** Turn on/off the invert function

The mathematic functions include addition, subtract, multiply and FFT for CH2.

### Source A/B

Source A and Source B Menu



### Operate

Four Types:

A + B                      Add source A and source B

A - B                      Subtract source B from source A

A x B                      Multiply source A by source B

A / B                      Divide source A by source B

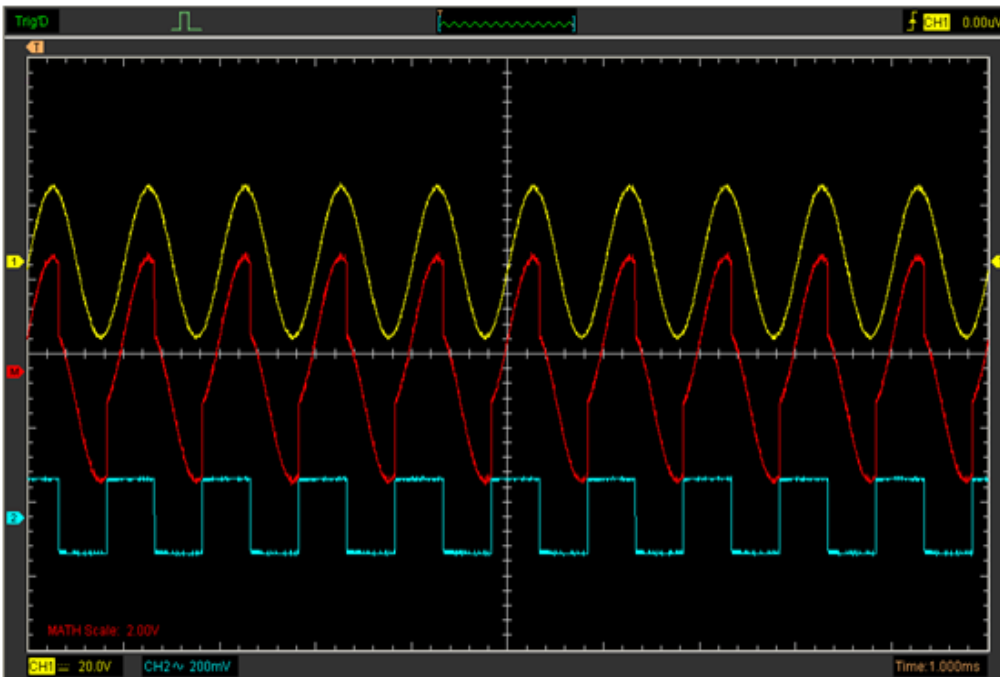
FFT                        Convert a time-domain signal into its frequency components (spectrum).

In this function, use the addition, subtraction, multiplication and FFT function to operate and analyze the waveform.

Select the operate type in the **Operate** menu. Select source A and B. Then adjust the vertical scale and offset to view the math channel clearly. The mathematic result can be measured by the measure and the cursor.

### The Math Function Display

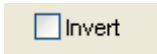




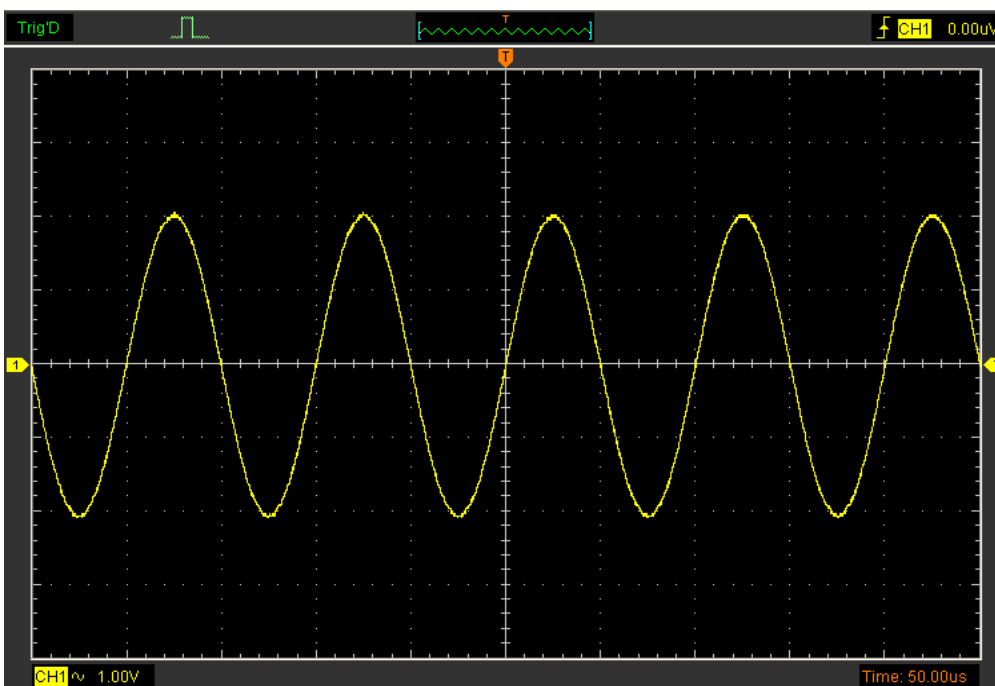
### Invert

The invert function 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.

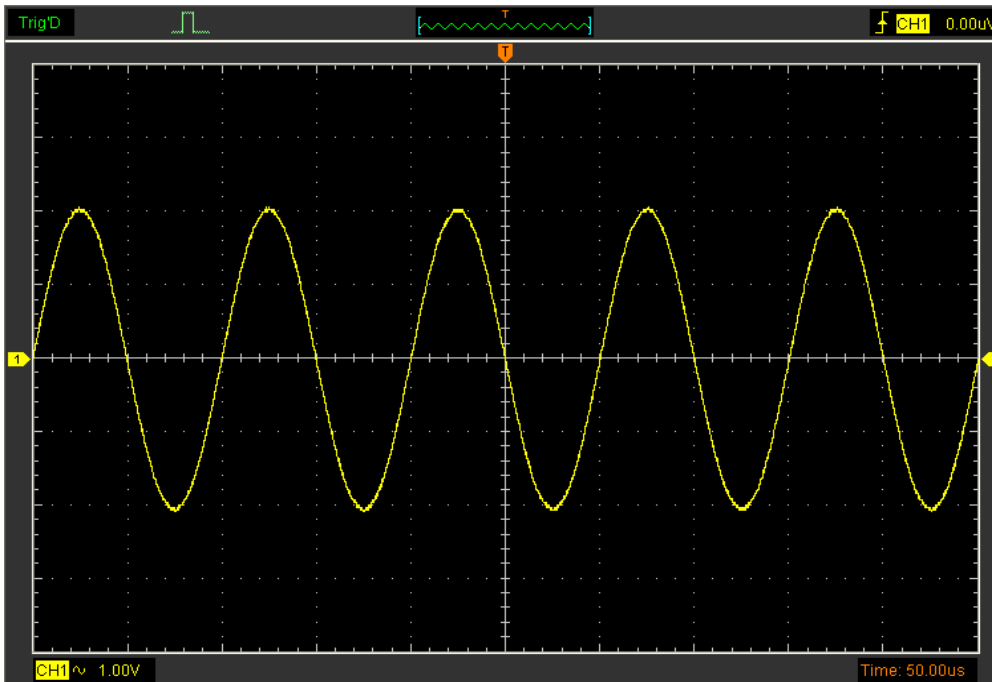
Click "Invert" in MATH.



The following picture shows the waveform before inversion:

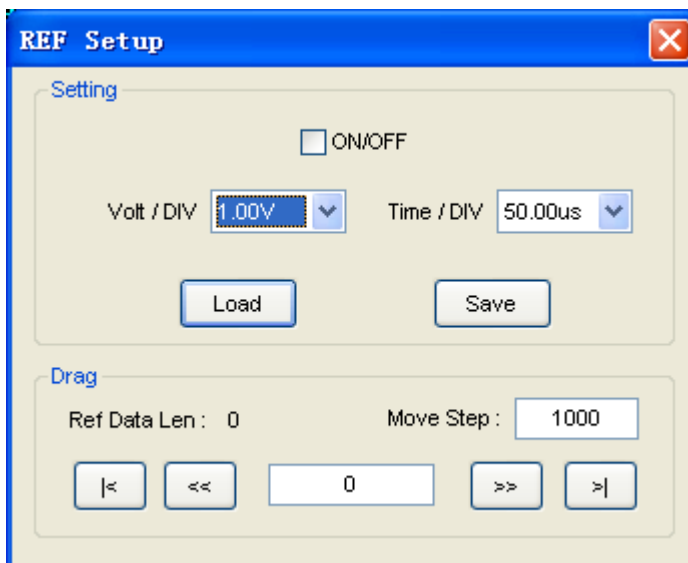


The following picture shows the waveform of inversion:



### Set Reference

Click "REF" in "Setup" menu to set REF channel.



The Reference Channel Function:

**On/Off:** Turn on/off the reference channel.

**Volt/DIV:** Channel the resolution of the reference channel.

**Load:** Load the reference waveform from the ".rfc" file from your computer.

**Save:** Save the current reference waveform to your computer as ".rfc" format.

**Save Reference:** Save the current reference waveform to your computer as "rfc" format.

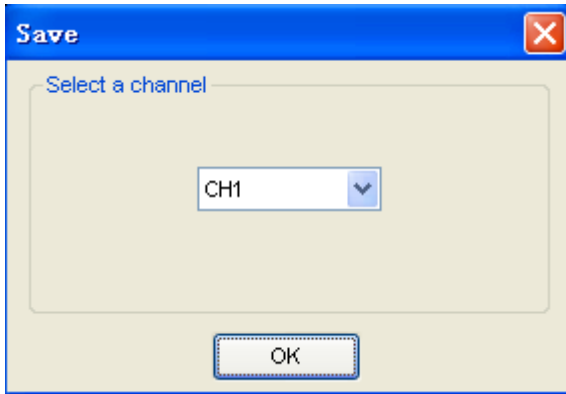
You can change the vertical scale of a waveform. The waveform display will contract or expand relative to the reference level.

### Load

Click “Load” to load the “\*.rfc” file that was selected. The load file window will appear.

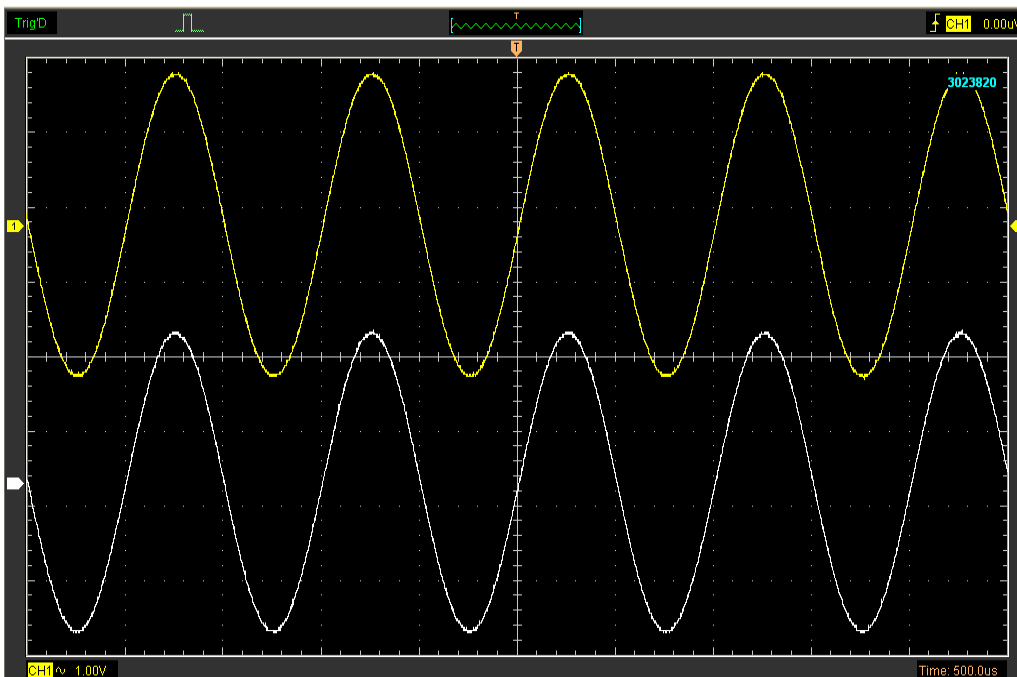
### Save

Click “Save” to save the waveform to \*.rfc file. The saved source window appears.



The save file window will appear after you selected the saved source.

### The Reference Waveform Display Window:

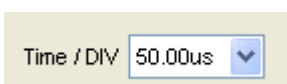


Note: If you turn on the “Reference” channel, the load file window will appear.

## 4.3 Setup Horizontal System

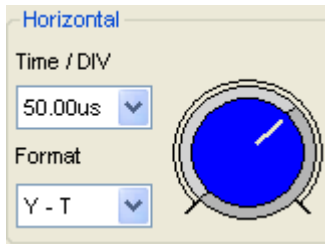
### Change Time/Div

The “Time/Div”



Selects the horizontal Time/DIV (scale factor) for the main or the window time base

## The Horizontal Panel



Click the blue knob can change **Time/Div**.

If the waveform acquisition is stopped, **Time/Div** control expands or compresses the waveform.

### Change Format

Click "**Time/Div**" you can set the Time base in Horizontal Setup window.



In the "**Format**" item, set the waveform display format (**Y-T**, **X-Y**).

**Y-T**: Show the relative relation between vertical voltage and horizontal time

**X-Y**: Show CH1 value at X axis; CH2 value at Y axis

### Change Horizontal Position

Double click the channel button to set the trigger point to the horizontal center of the screen.

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

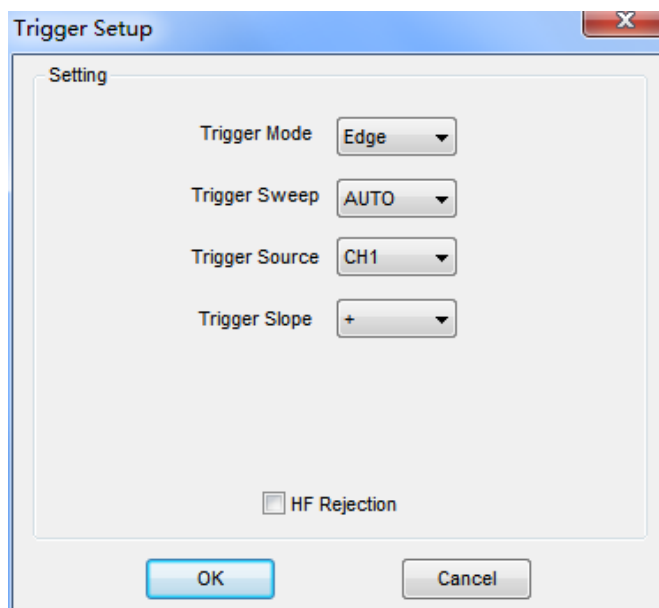
The user can drag  on screen to change the horizontal position.

## 4.4 Set Trigger System

Click "**Setup->Trigger**", you can configure the trigger.

The user can also click  in the toolbar to set Trigger.

### 1. Set Trigger

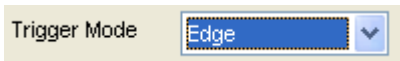


## Edge Trigger

The trigger determines when the oscilloscope starts to acquire data and display a wave- form. When a trigger is set up properly, it can convert unstable displays or blank screens into meaningful waveforms. If the oscilloscope wants 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. The oscilloscope continues to acquire enough data so that it can draw the waveform to the right of the trigger point after it detects a trigger.

The **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 or **Falling** edge.

**Mode:** Select the trigger mode.



**Sweep:** Set the sweep mode to **Auto**, **Normal** or **Single**.



**Auto:** Acquire waveform even no trigger occurred

**Normal:** Acquire waveform when trigger occurred.

**Single:** Acquire waveform when trigger occurred then stop

**Source:** You can use the trigger source options to select the signal that the oscilloscope uses as a trigger. The source can be any signal connected to a channel BNC.



**CH1:** Select CH1 as trigger signal

**CH2:** Select CH2 as trigger signal

**CH3:** Select CH2 as trigger signal

**CH4:** Select CH2 as trigger signal

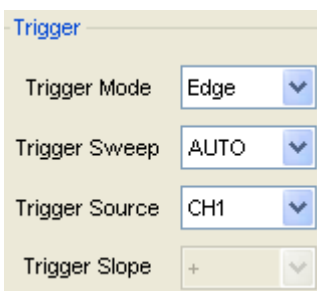
**Slope:** Set the slope to **Rising (+)** or **Falling (-)**.



**Rising:** Trigger on rising edge

**Falling:** Trigger on falling edge

The user can also change the trigger setting on trigger panel in sidebar.



## Set Pulse Trigger

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

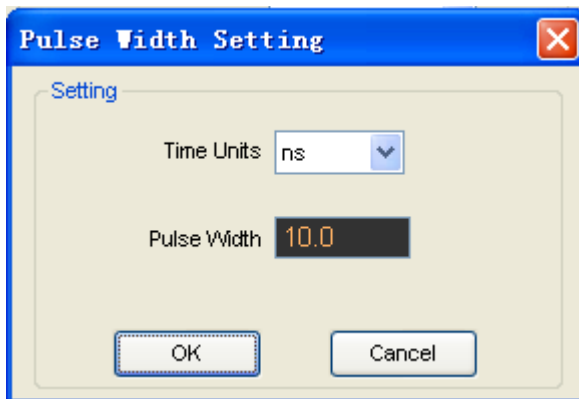
Mode: Trigger Mode

Sweep: Trigger Sweep

Source: Trigger Source

PW Condition: PW Condition

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



The user can also change the trigger setting on trigger panel in sidebar.

Trigger

Trigger Mode

Trigger Sweep

Trigger Source

PW Condition

Pulse Width

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 four vertical channels.

Options	Settings	Comments
Pulse		With Pulse highlighted, the trigger occurs on pulses that meet the trigger condition (defined by the Source, When and Set Pulse Width options).
Sweep	Auto, Normal,	Auto: Acquire waveform even no trigger occurred Normal: Acquire waveform when trigger occurred

Options	Settings	Comments
	Single	Single: Acquire waveform when trigger occurred then stop.
Source	CH1 CH2 CH3 CH4	Select the input source as the trigger signal.
PW Condition	+Less, +Equal, +More -Less -Equal -More	+Less: +Pulse width less than selecting pulse condition. +Equal: +Pulse width equal than selecting pulse condition. +More: +Pulse width more than selecting pulse condition. -Less: -Pulse width less than selecting pulse condition. -Equal: -Pulse width equal than selecting pulse condition. -More: -Pulse width more than selecting pulse condition.
Pulse Width		Set Pulse Width highlighted, including Time Unit and Pulse Width

### Video Trigger:

**Mode:** Select the trigger mode.

Trigger Mode

### Sweep:

Trigger Sweep

**Source:** Set the Trigger Channel to CH1,CH2,CH3,CH4.

Trigger Channel

### Trigger Sync:

Trigger Sync

### Trigger Standard:

Standard

Options	Settings	Comments
Video		With Video highlighted, an NTSC, PAL or SECAM standard video signal will be triggered. The trigger coupling is preset to AC.
Sweep	Auto, Normal Single	Auto: Acquire waveform even no trigger occurred Normal: Acquire waveform when trigger occurred Single: Acquire waveform when trigger occurred then stop.
Source	CH1	Select the input source as the trigger signal.

Options	Settings	Comments
	CH2 CH3 CH4	
Sync	All Lines Line Number Odd Field Even Field All Fields	Choose a proper video sync. When selecting Line Number for the Sync option, you may use the User Select knob to specify a line number.
Standard	NTSC PAL/SECAM	Choose a video standard for sync and line number count.

### Set ALT System

**Mode:** Select the trigger mode.

Trigger Mode

**Trigger Channel:** Set the Trigger Channel to CH1,CH2,CH3,CH4.

Trigger Channel

**Trigger Type:** Set the Trigger Type to Edge or Pulse.

Trigger Type

**PW Condition:** Set the PW Condition to the following condition.

**+More:** +Pulse width more than selecting pulse condition.

**+Less:** +Pulse width less than selecting pulse condition.

**+Equal:** +Pulse width equal to selecting pulse condition.

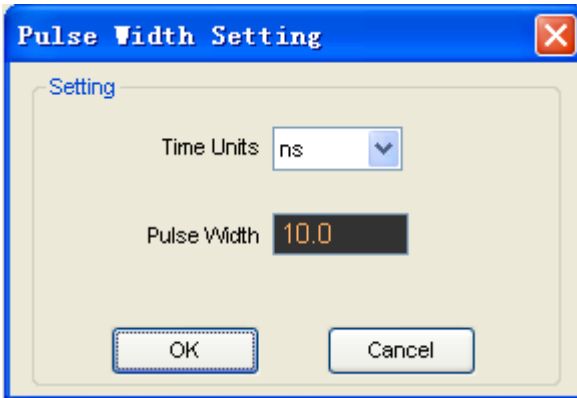
**-More:** -Pulse width more than selecting pulse condition.

**-Less:** -Pulse width less than selecting pulse condition.

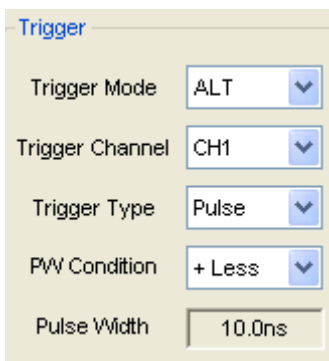
**-Equal:** -Pulse width equal to selecting pulse condition.

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



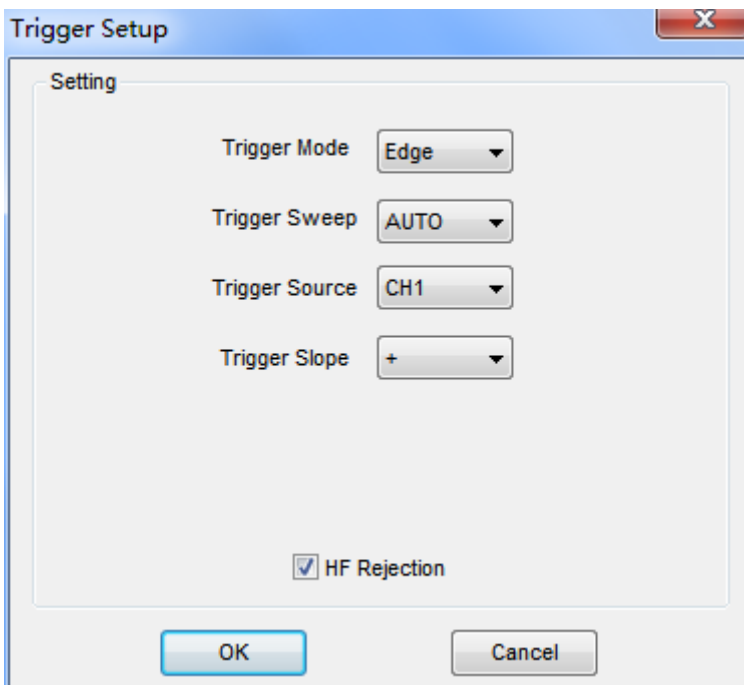


The user can also change the trigger setting on trigger panel in sidebar.



### High Frequency Rejection

Select "HF Rejection" in "Trigger Setup" window

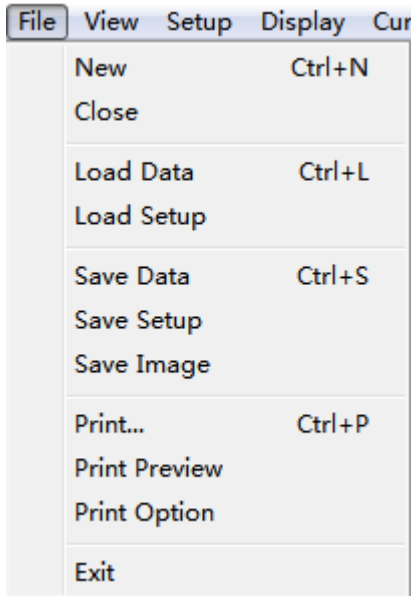


The user can turn on "HF Rejection" to eliminate trigger higher-frequency (20M above)

### 4.5 Save/Load

#### Save

Click "File" in main menu to save waveform, setups and screen.



### 1. Save Data

Save waveform data as a type file

### 2. Save Setup

Save the current oscilloscope setup to file

### 3. Save Image

Save the software display window as a .bmp or .jpg file

## Load

Click "File" in main menu to recall saved waveform, setup

### 1. Load Data

Load the waveform that had saved as a type file

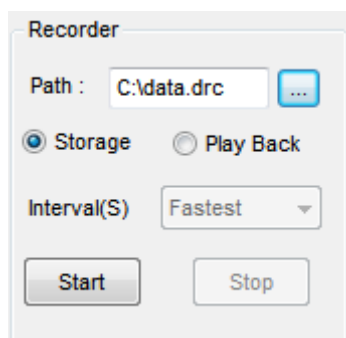
### 2. Load Setup

Load the instrument that had saved

## 4.6 Utility Function

### 4.6.1 Record

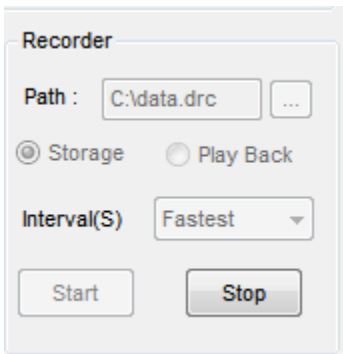
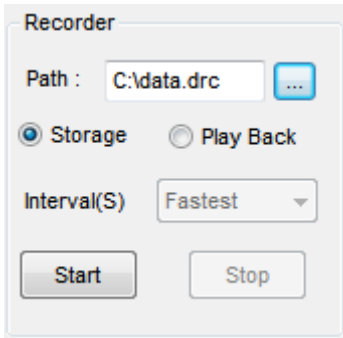
The following picture shows the Record Interface. The dialog box of record is shown on the lower right corner of the screen.



This function can record input waveform form CH1, CH2, CH3, CH4.

**Storage:** Record waveform and save it as ".drf" file. **"Play Back"** button: Click this button to start playing back waveform.

**"Start"** button: Start to record waveforms. After you start to record waveforms, this window will disappear. Please click "Utility->Record" to open the window again. Click **"Stop"** to stop recording waveforms.



### File Information:

Writing: Recording data.

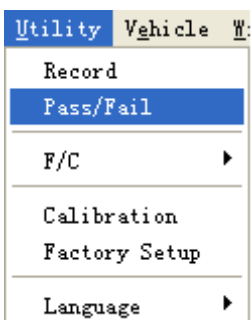
Reading: Playing back data.

data.0.drf: the name of the recorded file. The Max. length of this file is about 1GB. When recording data length is more than 1GB, it will create next file named data.1.drf, and so on.

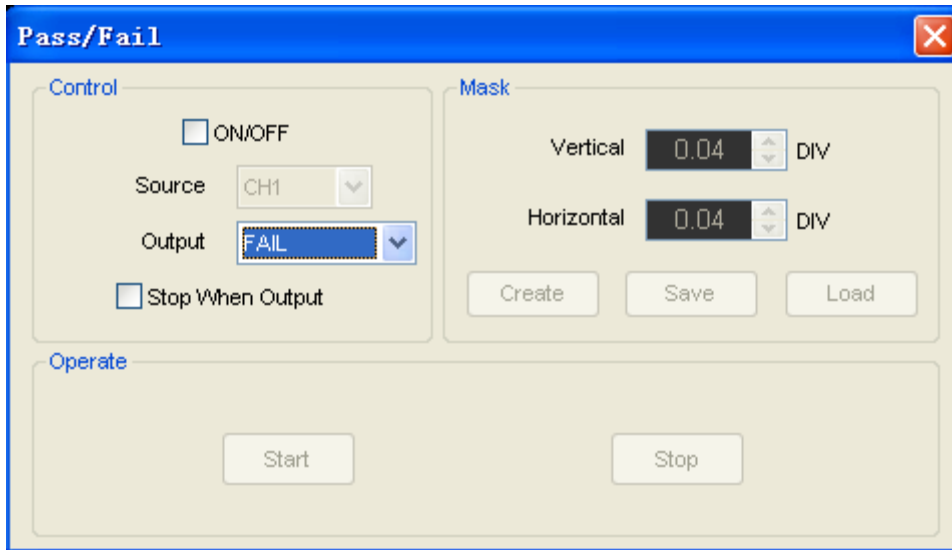
When click **play back** button, it will play back data from the first file (data.0.drf) to the last file. If you want to read an arbitrary file, please delete the data.drf, and then play back.

## 4.6.2 Pass/Fail

Click "Pass/Fail" in "Utility" menu.

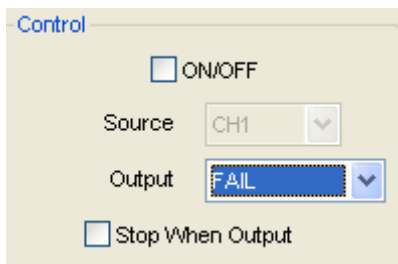


The Pass/Fail window appears:

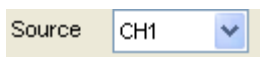


The Pass/Fail function monitors changes of signals and outputs pass or fail signals by comparing the input signal with the pre-created mask.

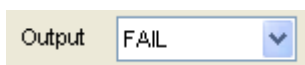
### Control Setting



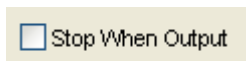
**Source:** Select the Pass/Fail channel



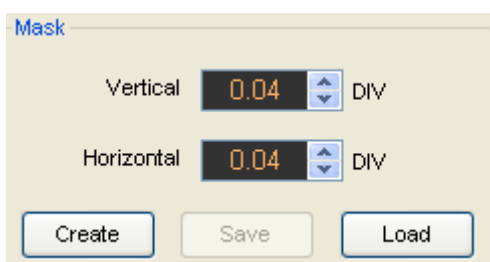
**Output:** Select the Pass/Fail output condition.



**Stop When Output:** If it was checked, the Pass/Fail will stop when output.



### Mask Setting



**Vertical:** Set the vertical limit range

Vertical  DIV

Horizontal: Set the horizontal limit range

Horizontal  DIV

“Create” button: Click this button to create Pass/Fail area according to the mask

“Save” button: Click this button to save the setups to file

“Load” button: Click this button to load the saved setups file

### Information Display

```
Pass: 81 wfs
Fail: 1 wfs
Total: 82 wfs
```

Fail: It shows the fail waveform number

Pass: It shows the pass waveform number

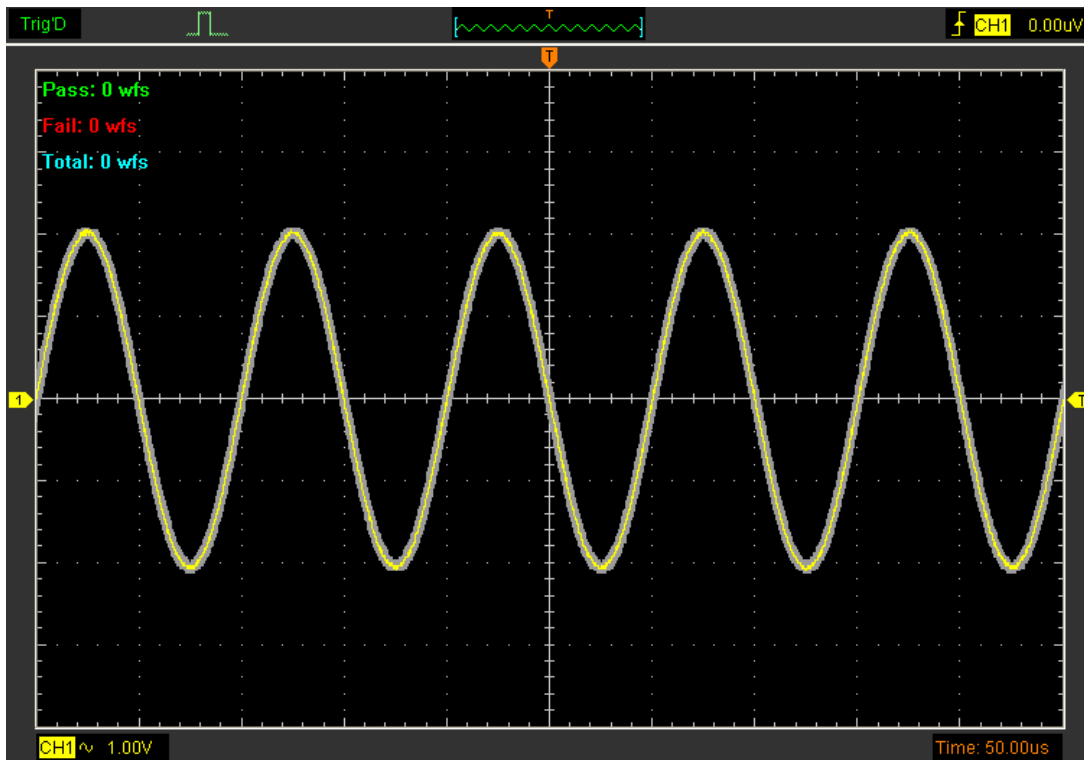
Total: It shows the total Pass/Fail waveform number

### Operation

Click “Start” button to start the Pass/Fail test.

Click “Stop” button to stop the Pass/Fail test.

The Pass/Fail function display



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

### 4.6.3 Factory Setup

Click "Factory Setup" in "Utility" menu to load default setups



When you click the **Factory Setup** in **Utility** menu, the oscilloscope displays the CH1 and CH2 waveforms and removes all other waveforms.

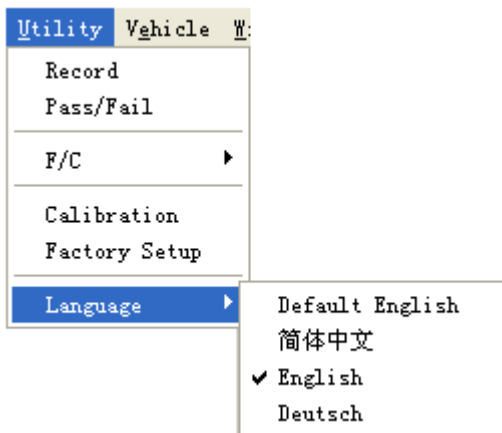
The oscilloscope set up for normal operation when it is shipped from the factory and can be recalled at anytime by user.

The Factory Setup function does not reset the following settings:

- Language option
- Date and time

### 4.6.4 Language

Click "Language" in "Utility" menu

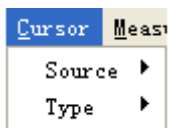


There are four languages in “Language” menu. The default language is English.

## 4.7 Measure Signal

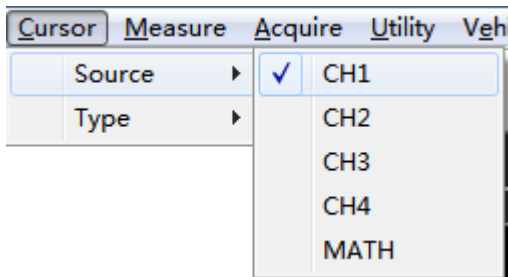
### 4.7.1 Cursor Menu

Click “Cursor” in main menu.



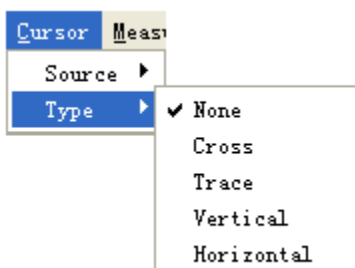
This method allows you to take measurements by moving the cursors

#### 1. Source



The user can set the source to CH1, CH2, CH3, CH4 and MATH. When you use cursors, be sure to set the **Source** to the waveform on the display that you want to measure.

#### 2. Type

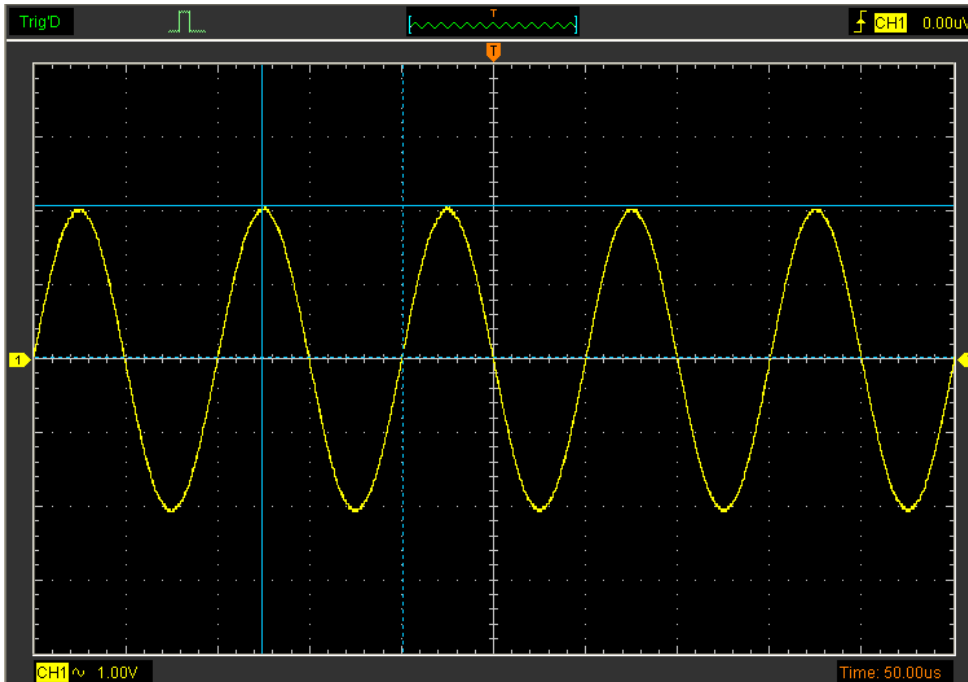


There are four types of cursors: **Cross**, **Trace**, **Vertical** and **Horizontal**

1) Cross

The **Cross** cursors appear as cross lines on the display and measure the vertical and horizontal parameters.

The **Cross** cursor display window:



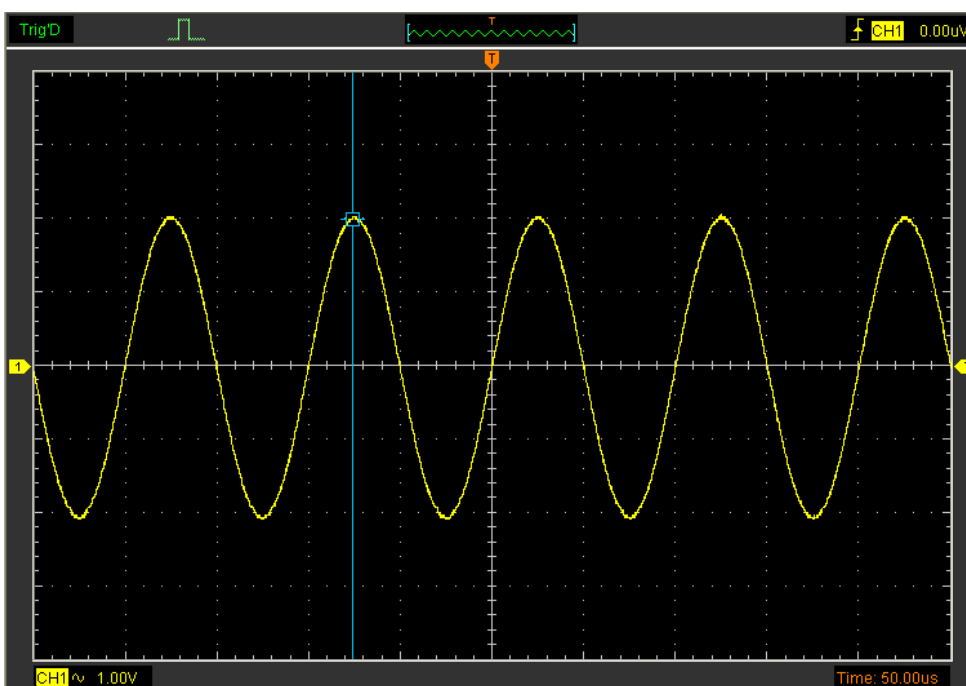
The **Cross** measure result displays on status bar

Freq: 1.032KHz      Time: 969uS      Volt: 508mV

2) Trace

The **Trace** cursors appear as vertical lines on the display and measure the waveform amplitude at the point the waveform crosses the cursor.

The **Trace** cursor display window





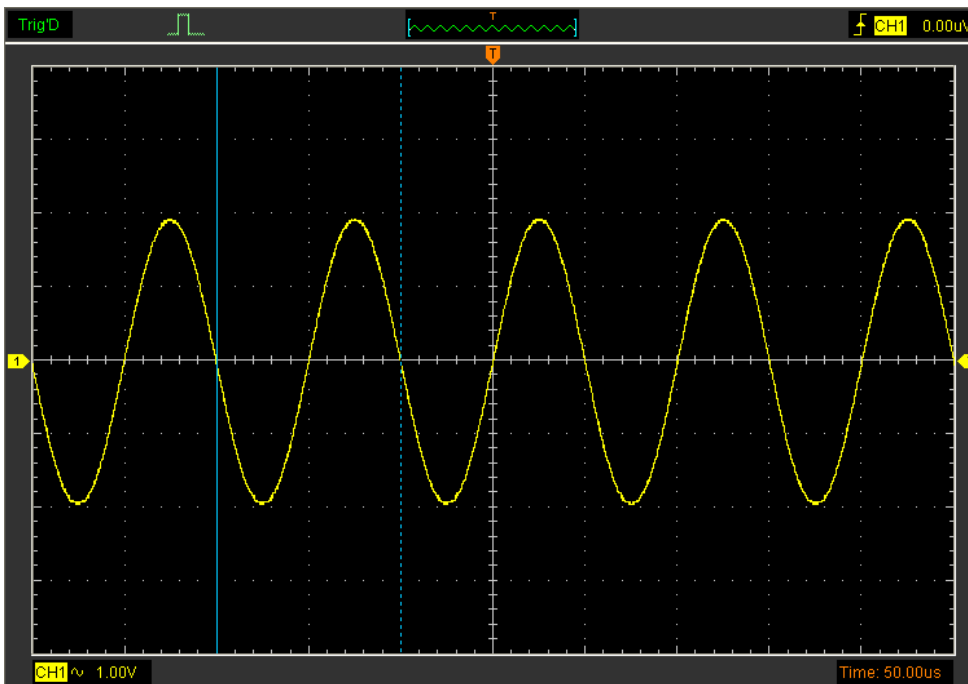
The Trace cursor measure result display on status bar

Volt: -1.95V

3) Vertical

The **Vertical** cursors appear as vertical lines on the display and measure the vertical parameters.

The **Vertical** cursor display window:



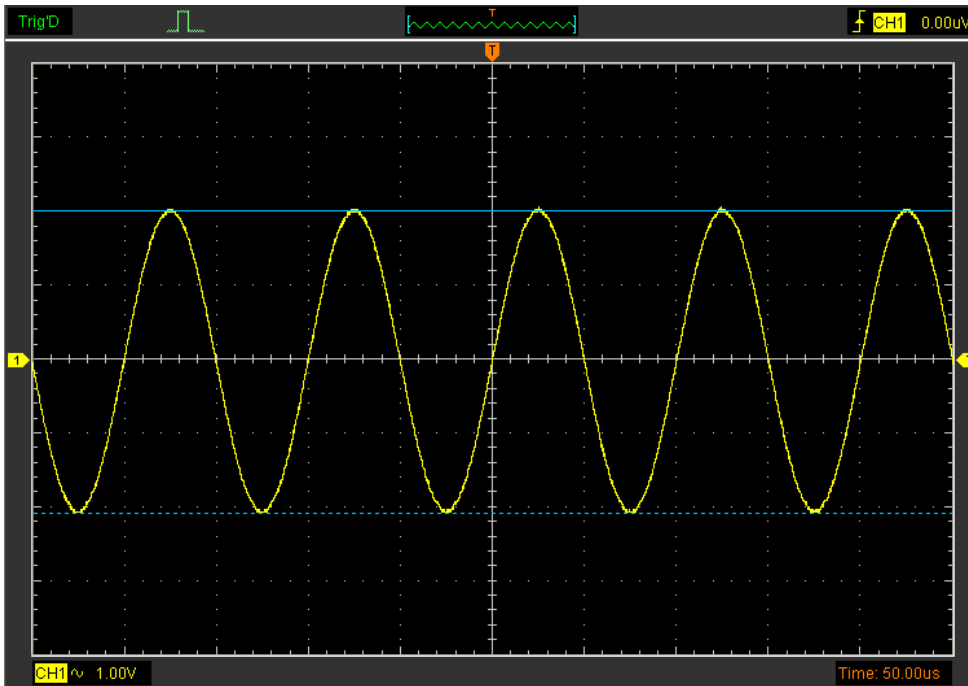
The **Vertical** cursor measure result display on status bar

Freq: 820.1Hz      Time: 1.22mS

4) Horizontal

The **Horizontal** cursors appear as horizontal lines on the display and measure the horizontal parameters.

The **Horizontal** cursor display window:



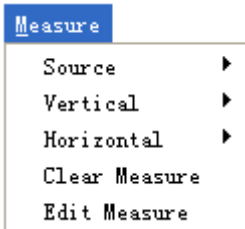
The Horizontal cursor measure result display on status bar

Volt: -3.01V

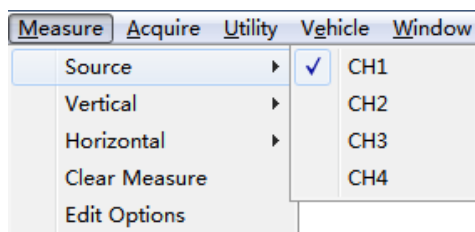
### 4.7.2 Measure Menu

Click "Measure" in main menu.

The oscilloscope provides 20 parametric auto measurements (12 voltage and 8 time measurements).

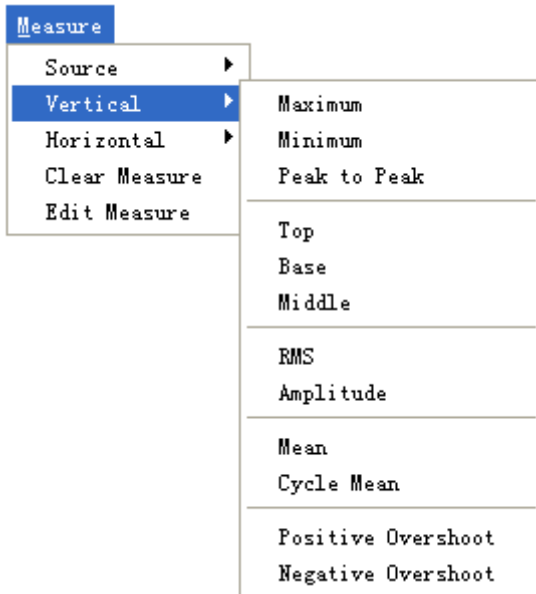


#### 1. Source



The user can use the "Source" menu to select a measure source.

#### 2. Vertical



**Maximum:** Voltage of the absolute maximum level, Measured over the entire waveform

**Minimum:** Voltage of the absolute minimum level, Measured over the entire waveform

**Peak To Peak** : Peak-to-peak = Max –Min, Measured over the entire waveform

**Top** : Voltage of the statistical maximum level, Measured over the entire waveform

**Base:** Voltage of the statistical minimum level, Measured over the entire waveform

**Middle:** Voltage of the 50% level from base to top

**RMS:** The Root Mean Square voltage over the entire waveform

**Amplitude:** Amp = Base - Top, Measured over the entire waveform

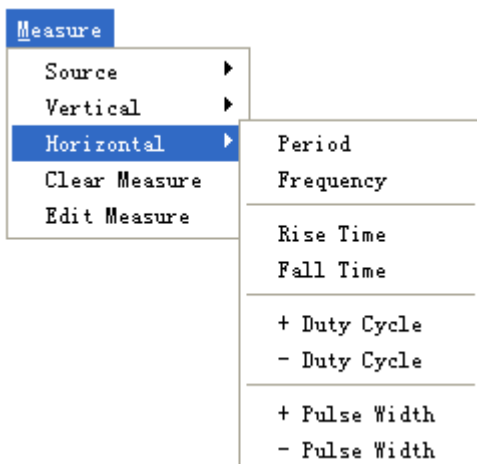
**Mean:** The arithmetic mean over the entire waveform

**Cycle Mean:** The arithmetic mean over the first cycle in the waveform

**Preshoot:** Positive Overshoot = (Max - Top)/Amp x 100 %, Measured over the entire waveform

**Overshoot:** Negative Overshoot = (Base - Min)/Amp x 100 %, Measured over the entire waveform.

### 3. Horizontal



**Period:** Time to take for the first signal cycle to complete in the waveform

**Frequency:** Reciprocal of the period of the first cycle to complete in the waveform

**Rise Time:** Time taken from lower threshold to upper threshold

**Fall Time:** Time taken from upper threshold to lower threshold

**+Duty Cycle:** Positive Duty Cycle = (Positive Pulse Width)/Period x 100%, Measured of the first cycle in waveform.

**-Duty Cycle:** Negative Duty Cycle = (Negative Pulse Width)/Period x 100%, Measured of the first waveform.

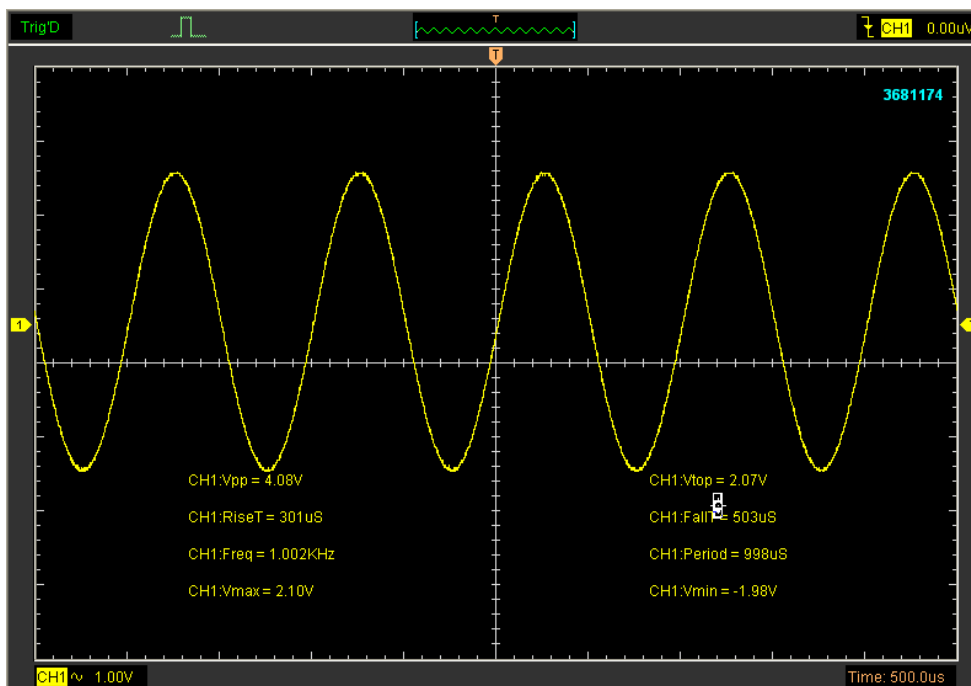
**+Pulse Width:** Measured of the first positive pulse in the waveform. The time between the 50% amplitude points

**-Pulse Width:** Measured of the first negative pulse in the waveform. The time between the 50% amplitude points

#### 4. Clear Measure

Clear all measure items on display screen.

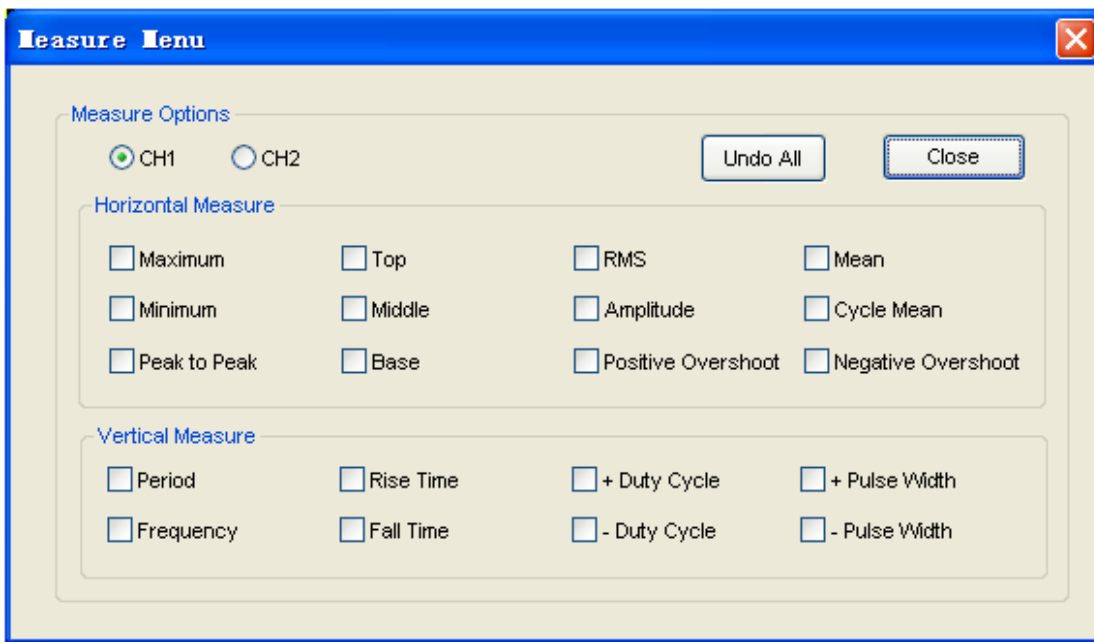
The Measure Display Window:



**Note:** The results of the automatic measurements will be displayed on the bottom of the screen. Maximum 8 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.

#### 5. Edit Measure

Click "Measure->Edit Measure".



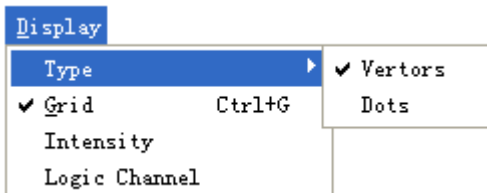
User can select Maximum 8 measure options to measure.

## 4.8 The Display System

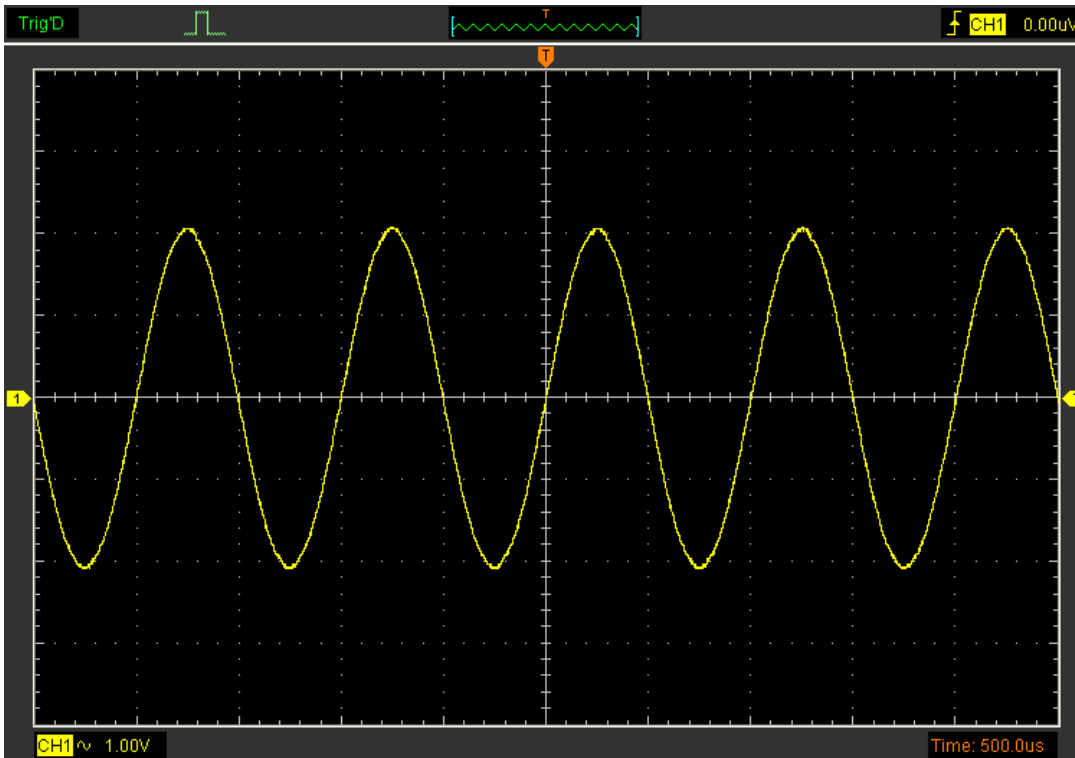
### 4.8.1 Display Type

Click "Type" in "Display" menu.

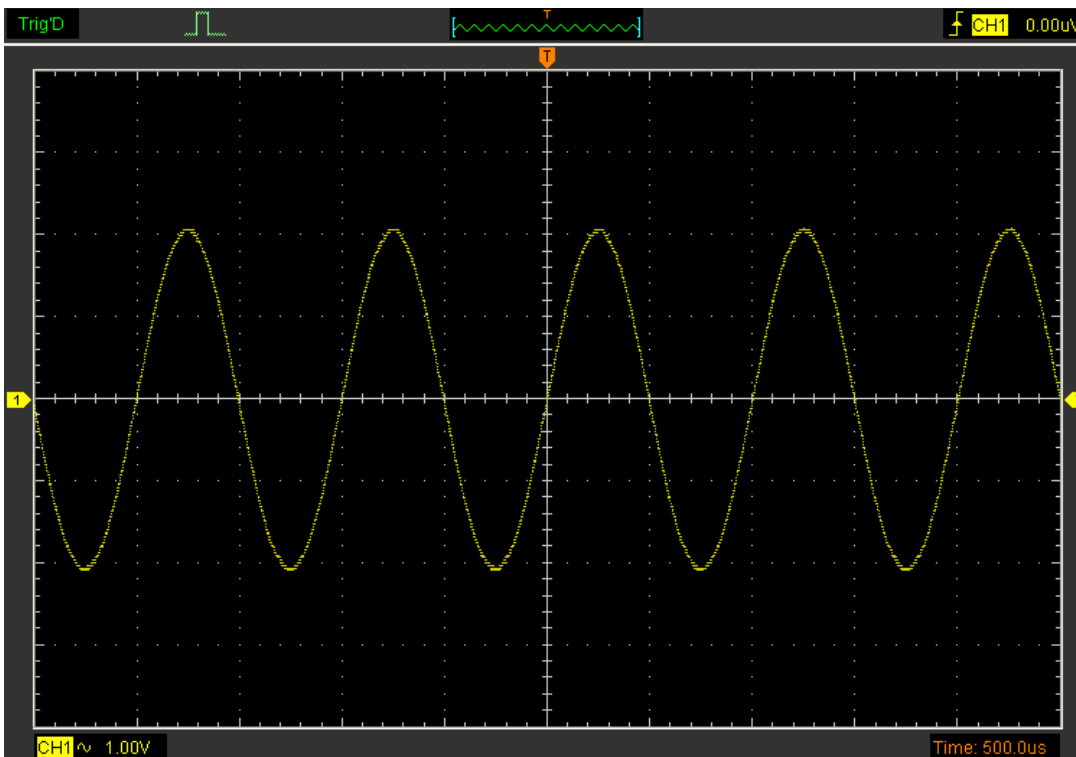
The following figure shows the type parameters setting.



If the Vectors type mode is selected, the waveform will be displayed as following figure.

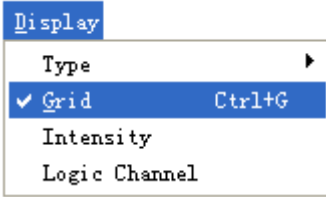


If the **Dots** type mode is selected, the waveform will be displayed as following figure.

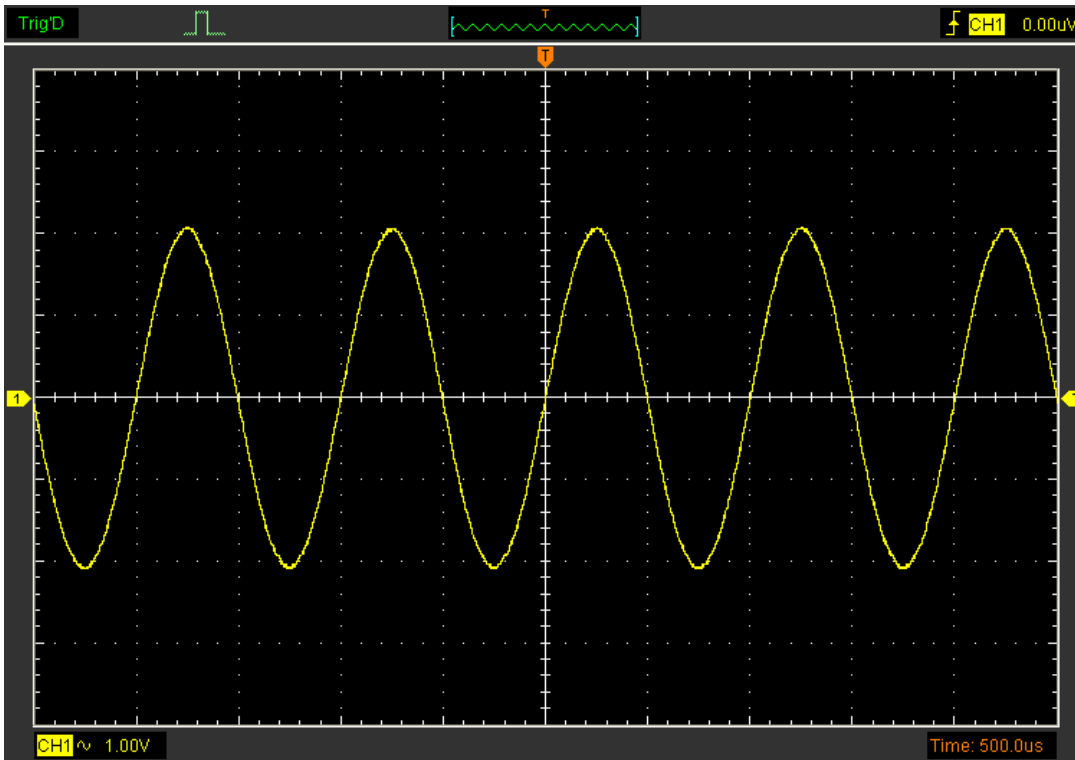


### 4.8.2 Display Grid

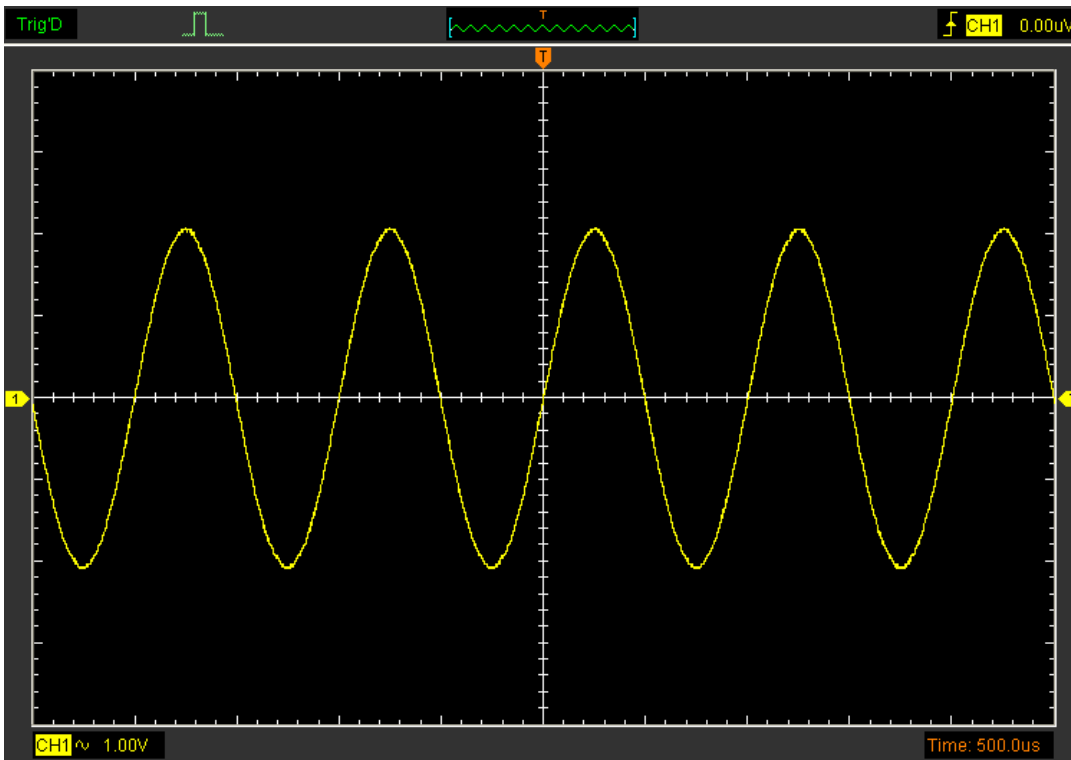
Click "Display" in main menu



The grid shows:



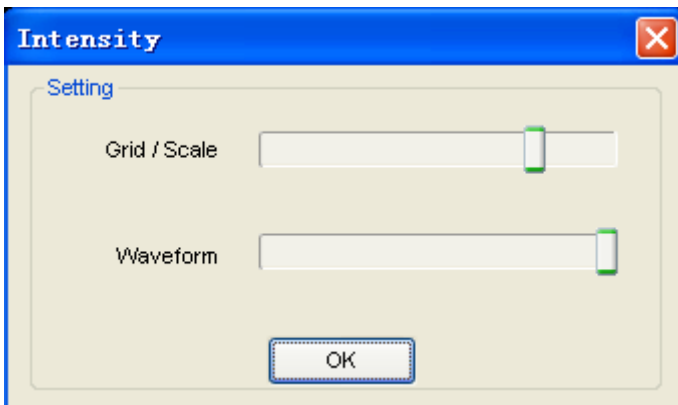
The grid not shows:



### 4.8.3 Intensity

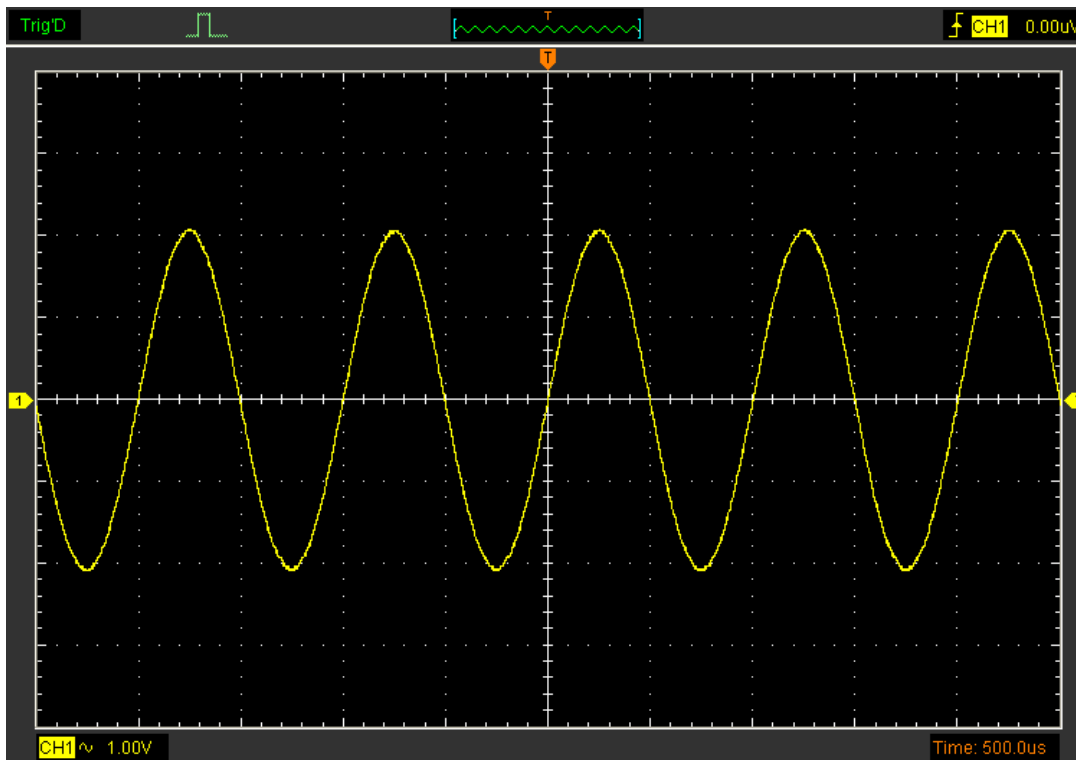
Click "Display->Intensity" in main menu.

The following figure shows the intensity dialog. It shows the display parameters setting.



You can change the grid and waveform color intensity in this dialog.



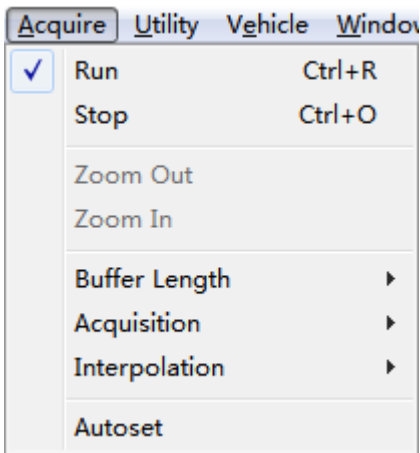


#### 4.9 Zoom In/Out and Drag Waveforms

The software will stop updating waveform after the user clicked “Stop” button.

The user can change the waveform display by adjusting the scale and position. When you change the scale, the waveform display will increase or decrease in size. When you change the position, the waveform will move up, down, right, or left.

The channel reference indicator identifies each waveform on the display. The indicator points to the reference level of the waveform record.

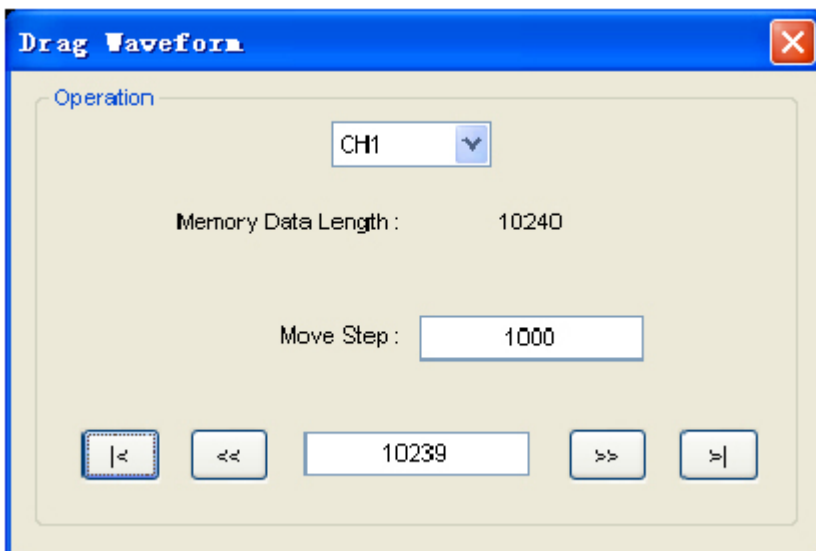


### Zoom In/Out

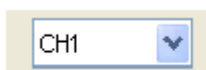
The user can click "Zoom In/Out" in "Acquire" menu, then left or right click the mouse button on display screen to zoom in/out the waveform. Also the user can change Time/Div in Horizontal menu or in Horizontal panel to zoom in/out the waveform.

### Drag

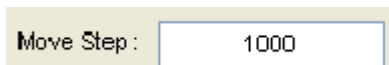
The user can modify the waveform position after clicked "Drag" in "Acquire" menu following the following steps.



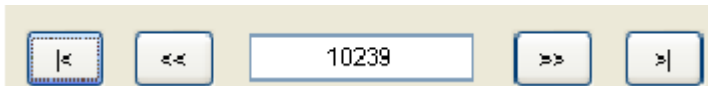
1. Select Channel:



2. Set the Move Step:



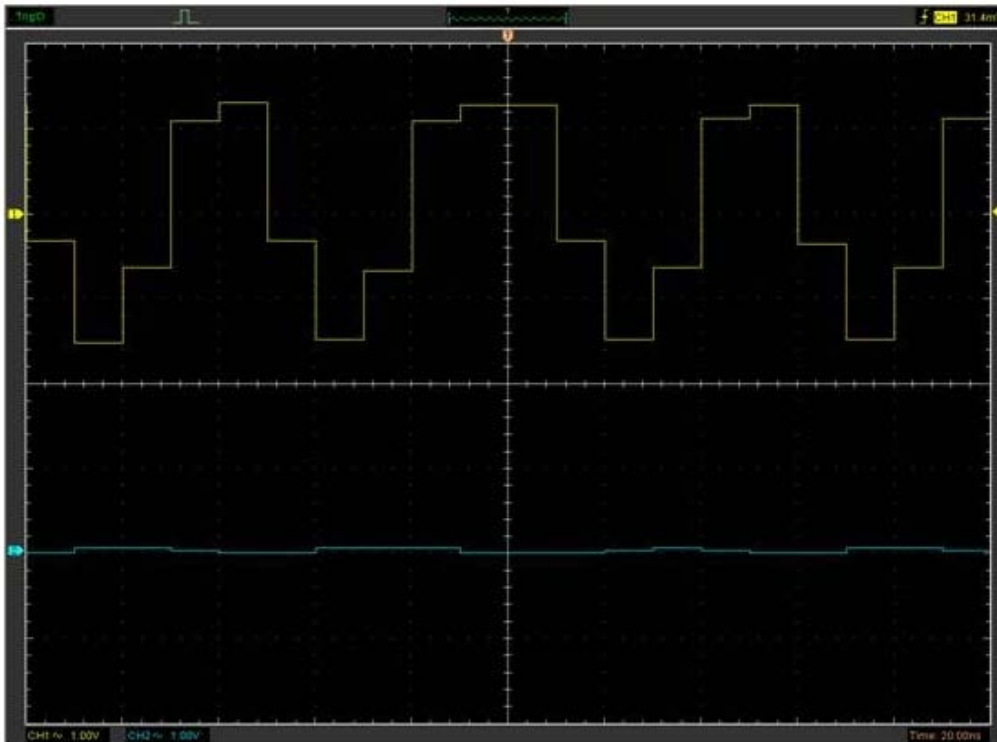
3. Change the waveform position:



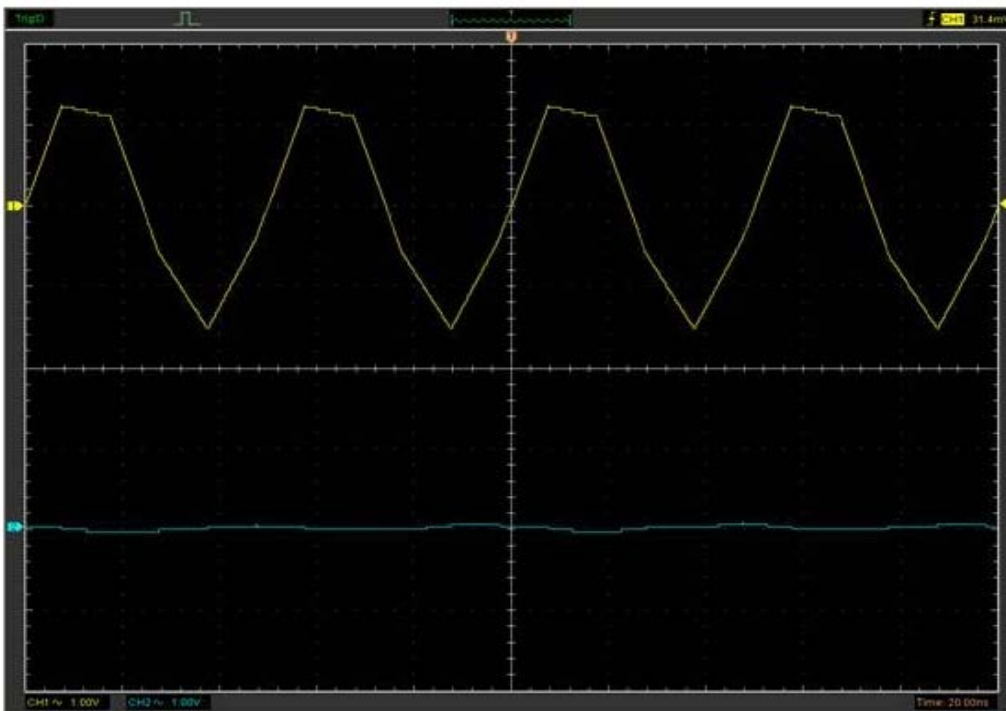
## 4.10 Interpolation

At the time base 40ns/div or faster, user can use the 3 different interpolation mode to get waveforms of different smoothness.

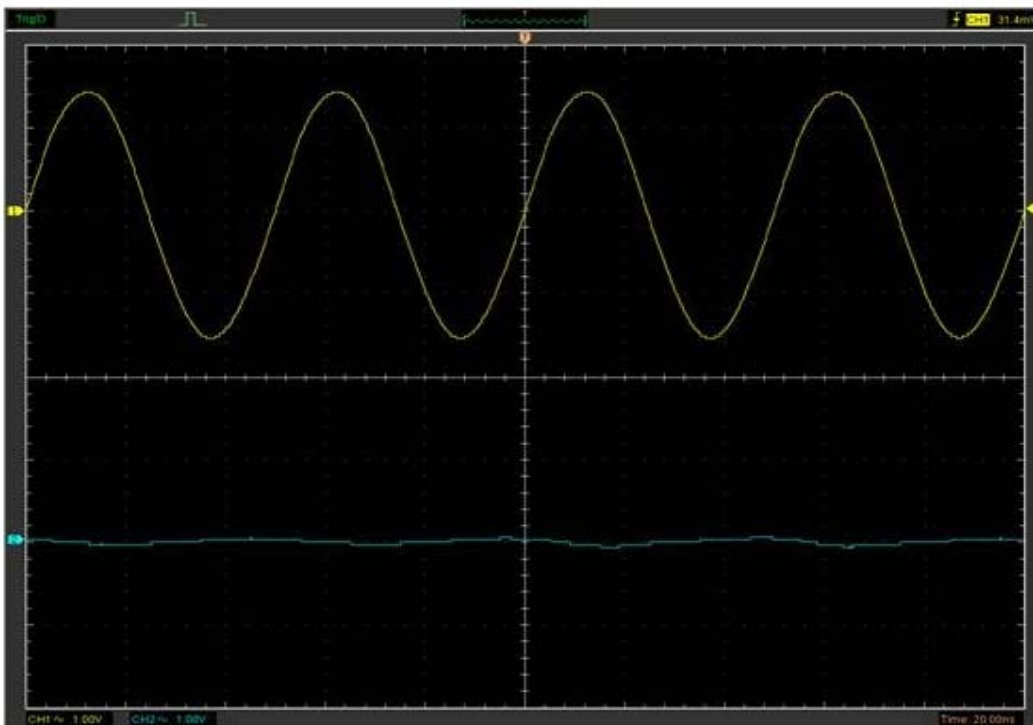
The **Step** Interpolation:



The **Linear** Interpolation:



The  $\text{Sin}(x)/x$  Interpolation:



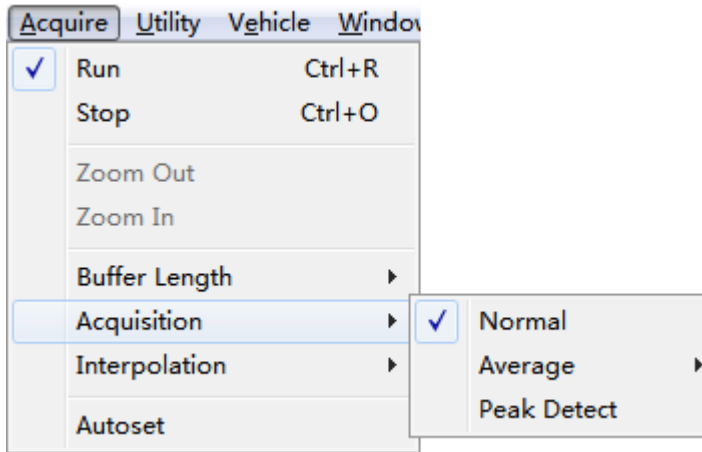
**Note:** The default interpolation mode is  $\text{Sin}(x)/x$ .

### Acquisition

When you acquire a signal, the oscilloscope converts it into a digital form and displays a waveform. The acquisition mode defines how the signal is digitized and the time base setting affects the time span and level of detail in the acquisition.

## 4.11 Acquisition Modes

There are two acquisition modes: Normal, Average and Peak Detect.



**Normal:** In this acquisition mode, the oscilloscope samples the signal in evenly spaced intervals to construct the waveform.

**Average:** In this acquisition mode, the oscilloscope acquires several waveforms, averages them, and displays the resulting waveform. You can use this mode to reduce random noise.

**Peak Detect:** In this acquisition mode, the oscilloscope finds the maximum and the minimum in every sampling interval, and use these values to show waveform.

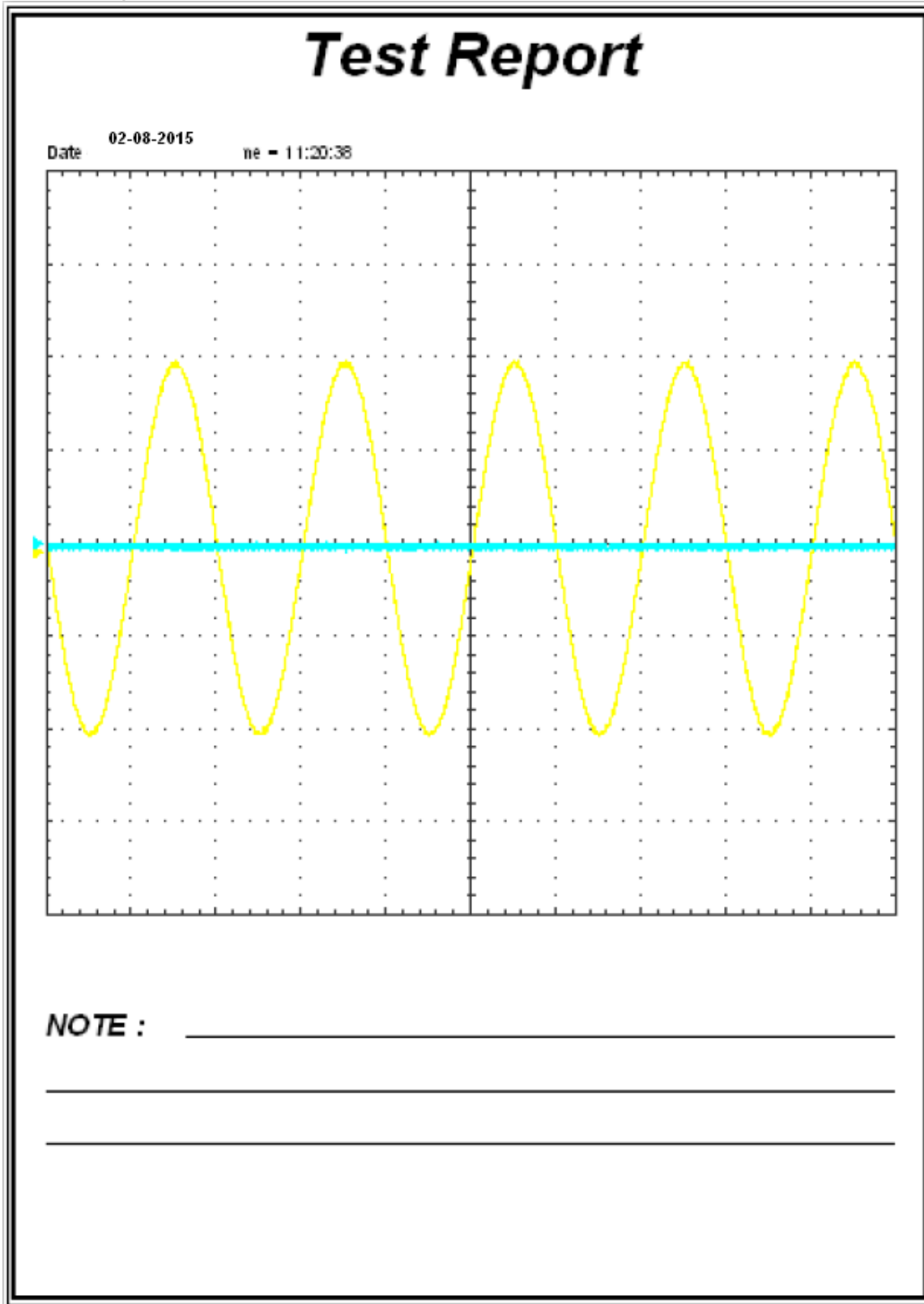
## 4.12 Print And Print Preview

New	Ctrl+N
Close	
Load Data	Ctrl+L
Load Setup	
Save Data	Ctrl+S
Save Setup	
Save Image	
Print...	Ctrl+P
Print Preview	
Print Option	
Exit	

1. Click "Print" in "File" menu to set the printer to print the current waveform
2. Click the "PrintPreview" in "File" menu to get into the Preview window.

In "PrintPreview" window, use the "Zoom In" button and the "Zoom Out" button to change the size of the waveform graph. Click the "Close" button to turn this window off and click the "Print" button to print the report.

The Print report:



## 5 Application Example

- Simple Measurement
- Capturing a Single-Shot Signal
- The Application of the X-Y
- Taking Cursor Measurement
- Arbitrary Waveform Generator

## 5.1 Simple Measurement

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

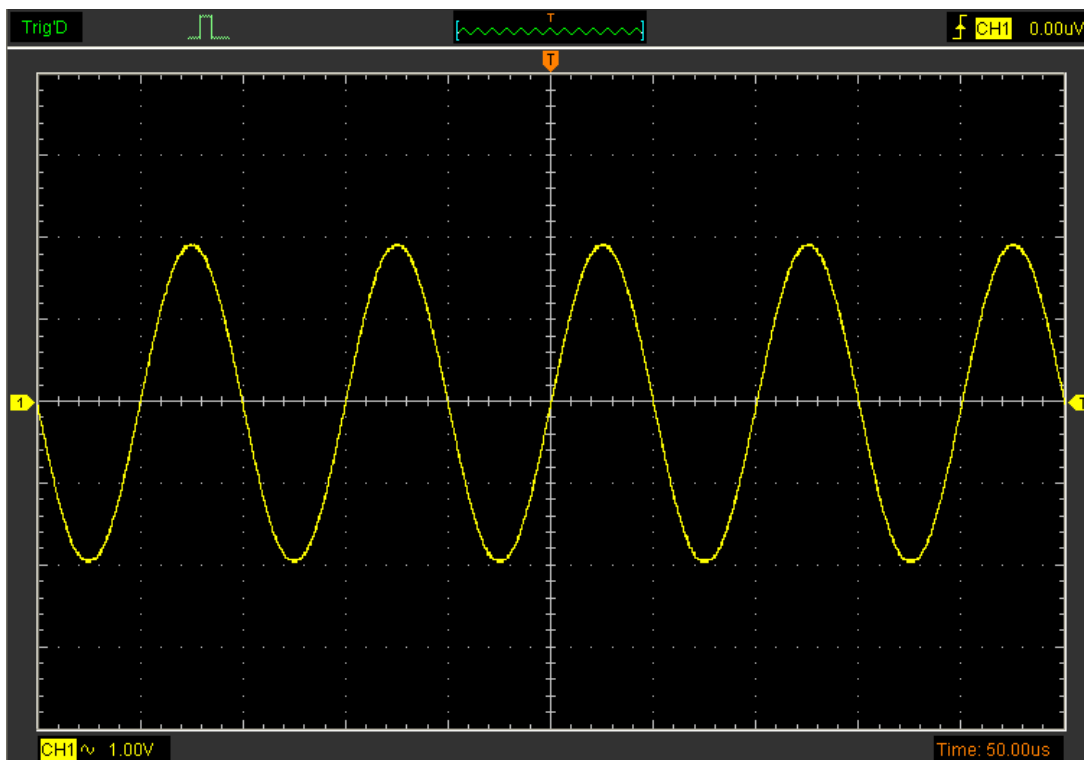
1. Connect signal to **CH1** by using probe
2. Click the button on toolbar or **"Acquire -> Auto Setup"** on menu.

The MO set the vertical, horizontal, and triggers controls at the best status automatically. Also, you can adjust the controls to meet your measurement to optimize the waveform display.

To measure the frequency and **"Vpp"**, you can do these steps as follows:

1. Click the **"Measure->Horizontal->Frequency"** button, the frequency of the signal display on the bottom of the waveform interface.
2. Click the **"Measure->Vertical->Peak-to-Peak"** button, the **"Vpp"** of the signal will also display on the bottom of the waveform interface.

To clear the measurement on the waveform interface, click the **"Measure->Clear Measure"** button.



## 5.2 Capturing 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 3.3V COMS logic, a trigger level of 1.2 or higher Volts should work on a rising edge. Do these steps as follows:

1. Set the probe and the channel attenuations to X 10.
2. Set up the trigger in the Trigger Menu, or in the Trigger Setting window.
  - 1) Adjust the Trigger Mode to Edge.




- 2) Set the Trigger Sweep to Single.
- 3) Set the Trigger Source to CH1.
- 4) Set the Trigger Slope to "+" which means you select the rising edge.
- 5) Adjust the Volts/Div and the time base in a proper range for the signal.
- 6) Drag the trigger level sign on the waveform display screen to proper position. It ally higher a little above the normal level.
- 7) Click **START** 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 signal occurrence easily, such as the noise with large amplitude; set the trigger level higher a little above the normal level and press and wait. When noise occurs, the instrument will record the waveform before and after the trigger.

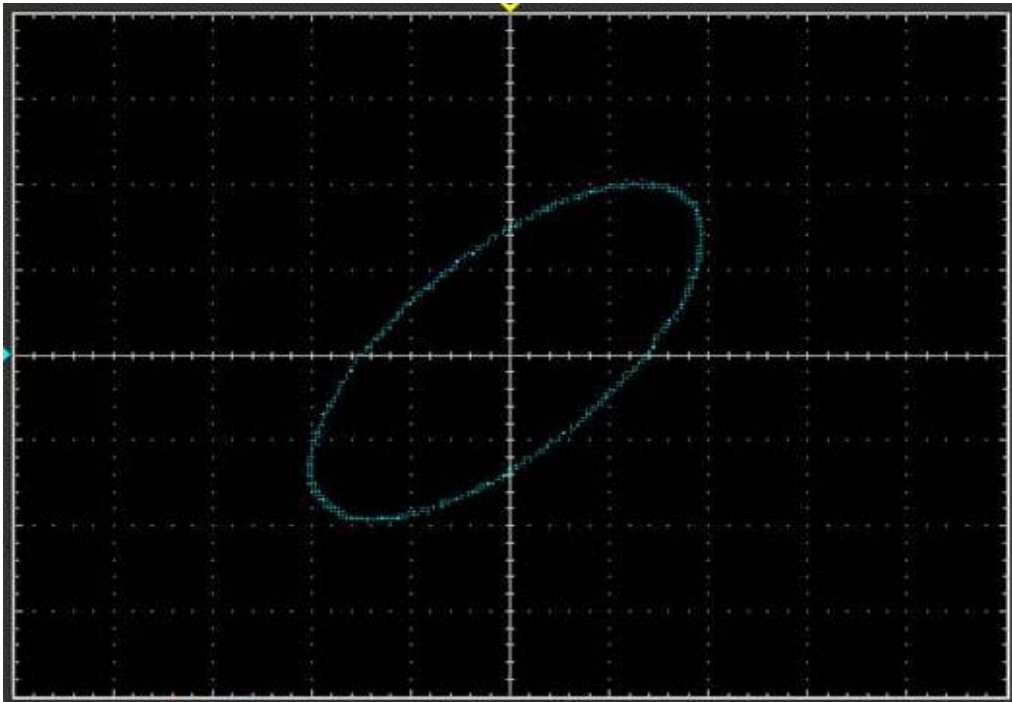
### 5.3 The Application of the X-Y Operation

**X-Y** Plot acts to analyze correlation of data of two channels. Lissajous diagram is displayed in the screen when you use X-Y Plot, which enables to compare frequencies, amplitudes and phases of counterpart waveform against the reference waveform. This makes it possible to compare and analyze frequency, amplitude and phase between input and output.

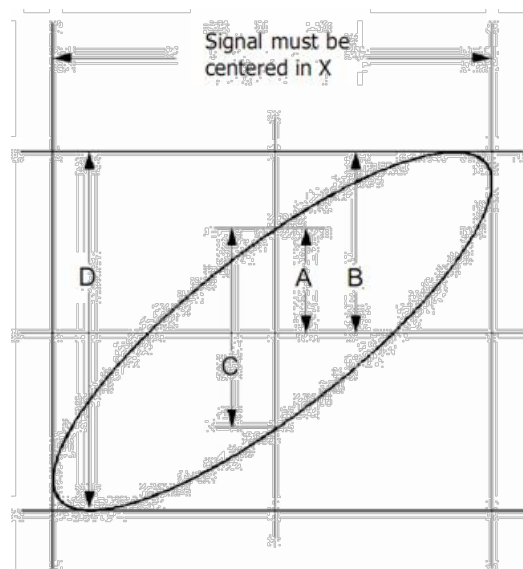
Do these steps as follows:

1. Set the probe attenuation to "x10" Set the switch to "x10" on the probes.
2. Connect the CH1 probe to the input of the circuit, and connect the CH2 probe to the output of the circuit.
3. Click  button.
4. Adjust the vertical scale and offset to display approximately the same amplitude signals on each channel.
5. Select X-Y format at Horizontal window. The oscilloscope will displays a Lissajous pattern representing the input and the output characteristics of the circuit.
6. Adjust the scale and offset of the horizontal and vertical to a desirable waveform display. The following picture shows a typical example.
7. Apply the Ellipse Method to observe the phase difference between the two channels.

**Signal in X-Y Format:**



Instruction of the Ellipse Method



$\sin\theta = A/B$  or  $C/D$ , where  $\theta$  = phase shift (in degrees) between the two signals.

From the formula above:

$$\theta = \arcsin(A/B) \text{ or } \arcsin(C/D)$$

must be in the range of  $(0 \sim \pi/2)$  or  $(3\pi/2 \sim 2\pi)$  if the main axis of the ellipse is between I and III quadrant, . If the main axis is at II and IV quadrant,  $\theta$  must be in the range of  $(\pi/2 \sim \pi)$  or  $(\pi \sim 3\pi/2)$ .

## 5.4 Taking Cursor Measurements

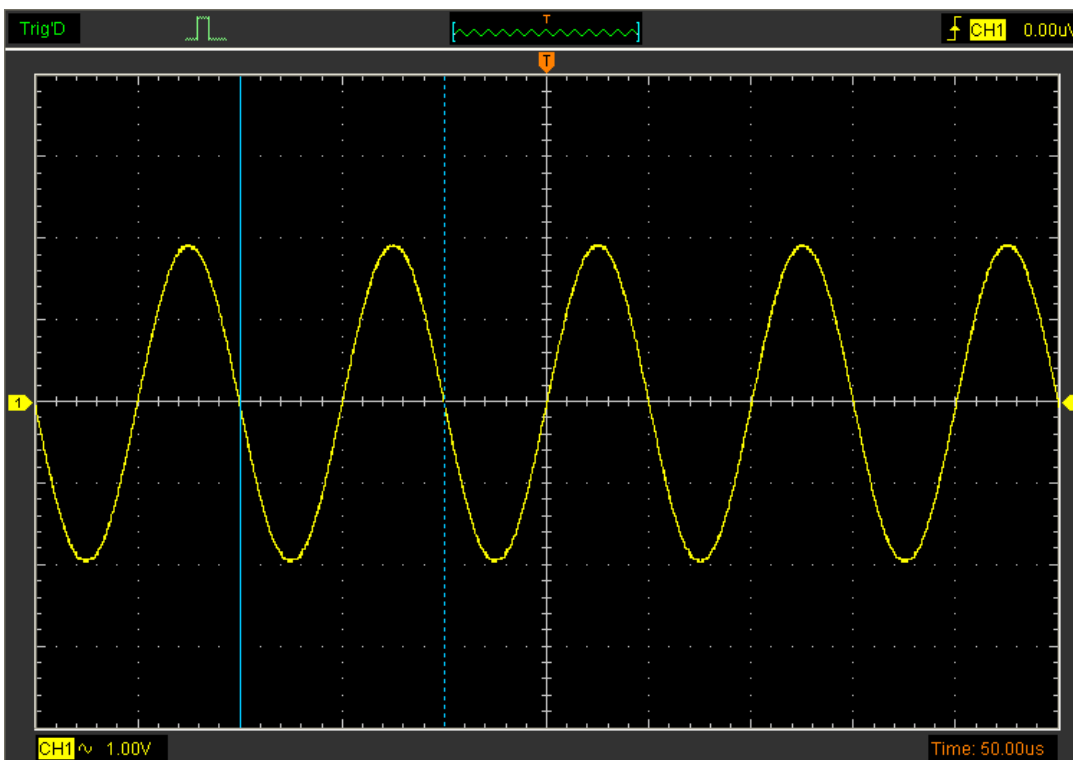
Use cursors to make time and amplitude measurements on a waveform quickly.

### Measure the Peak Frequency or Time of the First Sine Waveform

Do these steps:

1. Click "Cursor->Source", select CH1 (select CH2 if you want measure CH2).
2. Click "Cursor->Type", select Vertical.
3. Push left mouse button, and the vertical lines appear.
4. Drag the mouse button to the point you want to measure.
5. Release the left mouse button, the frequency difference and time difference will be shown at the status bar.

### Measure the Frequency and Time:



Read the details showing in the status bar.

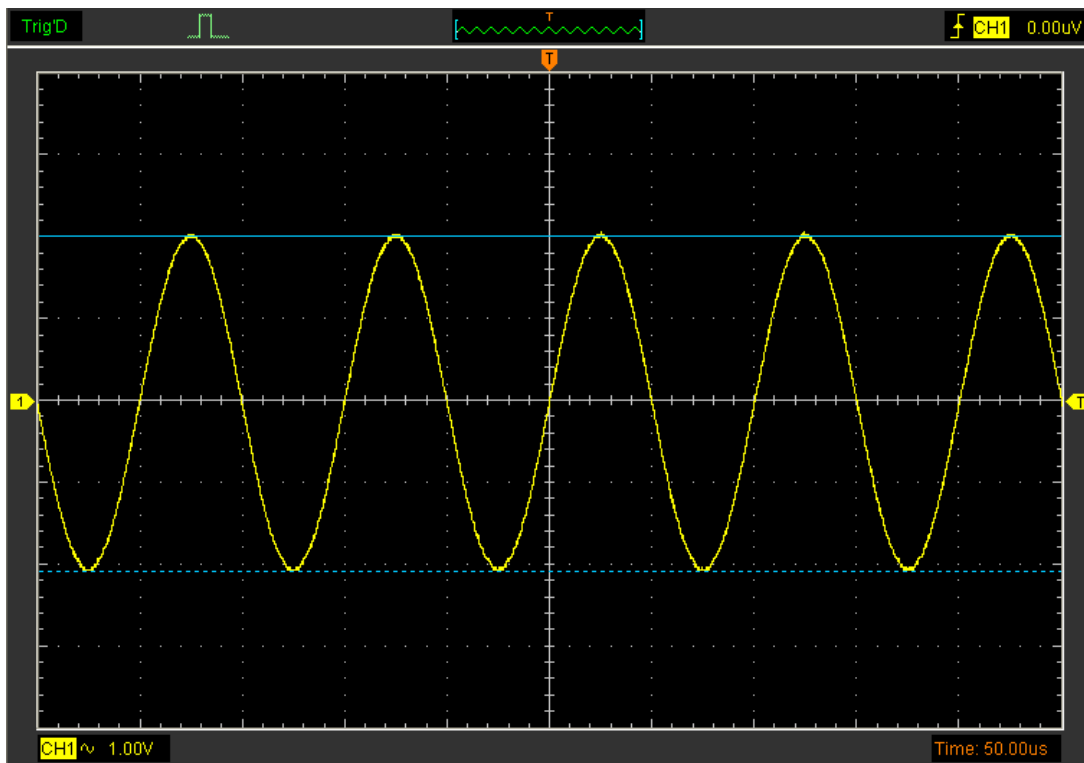
Freq: 1.361KHz      Time: 735uS

### Measure the Amplitude of the First Waveform Peak of the Waveform

Do these steps:

1. Click "Cursor->Source", select CH1 (select CH2 if you want measure CH2).
2. Click "Cursor->Type", select Horizontal.
3. Push left mouse button, and the Horizontal lines appear.
4. Drag the mouse button to the point you want to measure.
5. Release the left mouse button, the voltage difference will be shown at the status bar.

### Measure the Amplitude:



Read the details showing in the status bar.

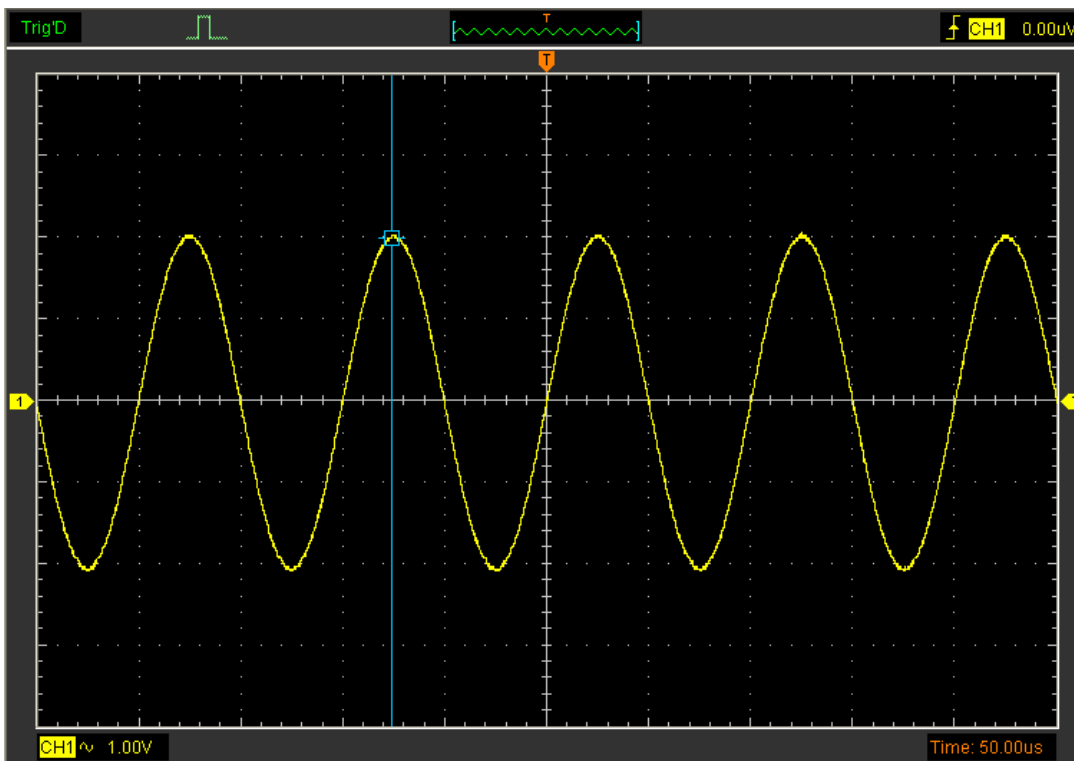
Vol: 18.6V

### Trace the Amplitude of a fixed position on X-axis in a Waveform

Do these steps:

1. Click "Cursor->Source", select CH1 (select CH2 if you want trace CH2).
2. Click "Cursor->Type", select Trace.
3. Click the cursor at the position that you want traced of the wave in the waveform window.

Trace the Amplitude :



Read the details showing in the status bar.

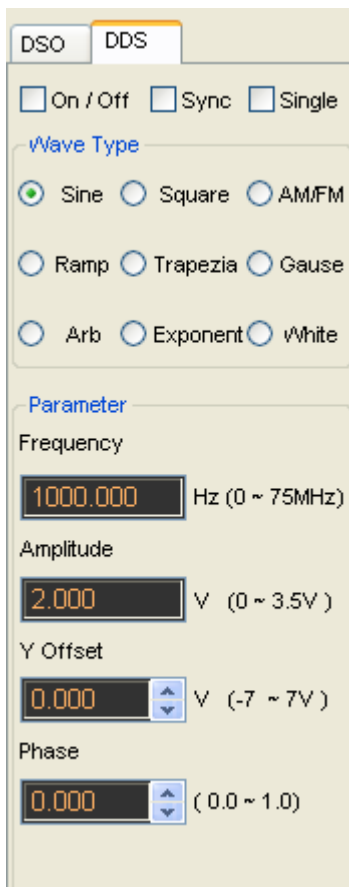
**Volt: -9.45V**

**Note:** Click "Cursor->Type", select "Cross", you can measure time and amplitude at one time.

## 5.5 Waveform Generator

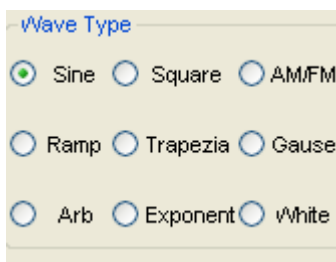
**Caution:** This part is only used for MO2000A.

Select the DDS control panel in the sidebar.



Click any button of certain waveform to switch to the output of such kinds of waveform.

The user can select wave type as below:



### Waveform Parameter Setup

Select a wave type, and you can set the "Parameters" in the sidebar.

#### Generate the Sine waveform

To output a Sine Wave, please do the following steps:

1. Press the check box "On/Off" to open the wave output function.
2. Select the Wave Type "Sine Wave".
3. Set the Wave Parameter:

Frequency: Set the output wave frequency.

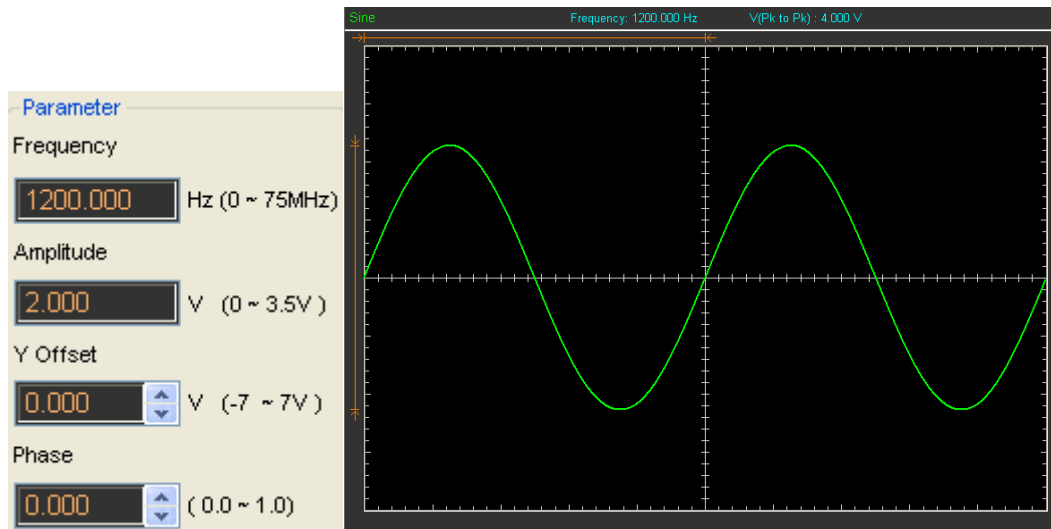
Sweep: Set the output wave to sweep.

Amplitude: Set the output wave amplitude.

Y Offset: Set the output wave vertical level offset.

Phase: Set the output wave phase.

The Sine waveform window as the following:

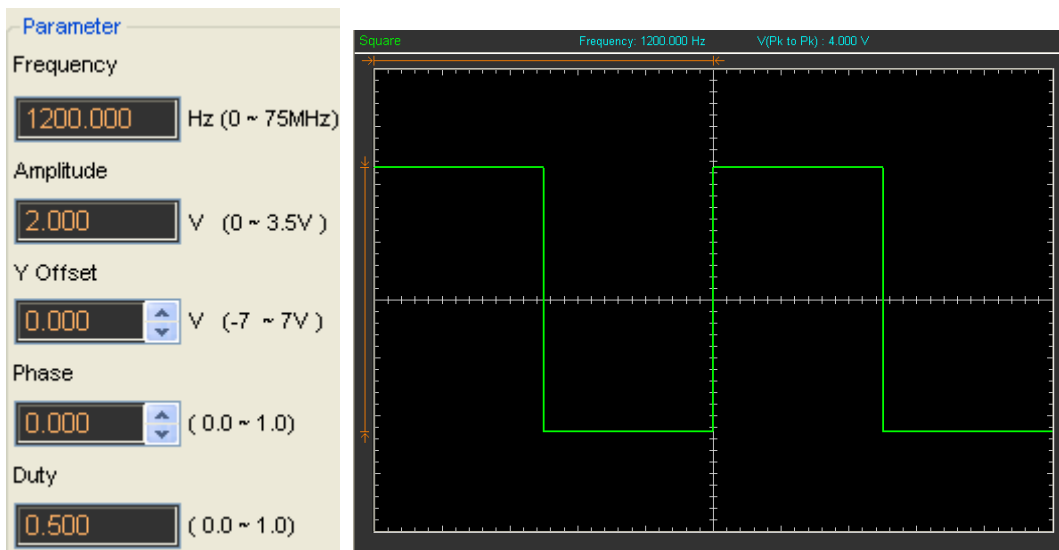


### Generate the Square waveform

To output a Square Wave, please do the following Step:

1. Press the check box "On/Off" to open the wave output function.
2. Select the Wave Type "Square".
3. Set the Wave Parameters:
  - Frequency: Set the output wave frequency.
  - Amplitude: Set the output wave amplitude.
  - Y Offset: Set the output wave vertical level offset.
  - Phase: Set the output wave phase.
  - Duty: Set the duty of the output wave.

The Square waveform window as the following:



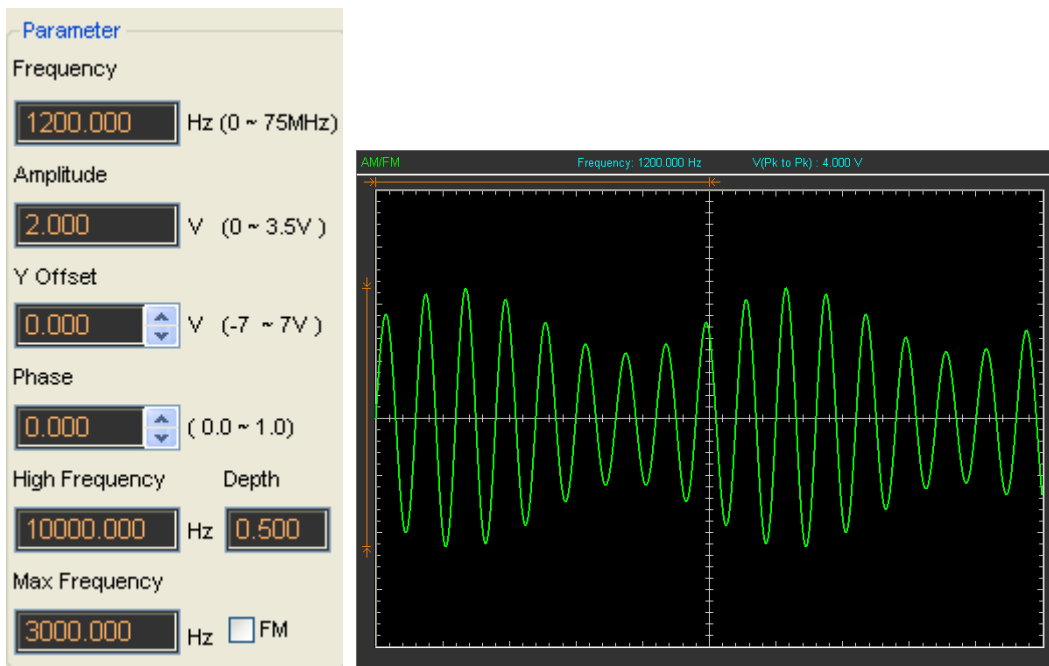
### Generate the AM/FM waveform

To output an AM/FM Wave, please do the following Steps:

1. Press the check box "On/Off" to open the wave output function.
2. Select the Wave Type "AM/FM".
3. Set the Wave Parameters:
  - Frequency: Set the output wave frequency.
  - Amplitude: Set the output wave amplitude.
  - Y Offset: Set the output wave vertical level offset.
  - Phase: Set the output wave phase.
  - High Frequency: Set the output wave High Frequency.
  - Depth: Set the output wave Depth.
  - Max Frequency: Set the output wave Max Frequency.
  - FM: Change the output wave "AM" into "FM".

The AM/FM waveform window as following:



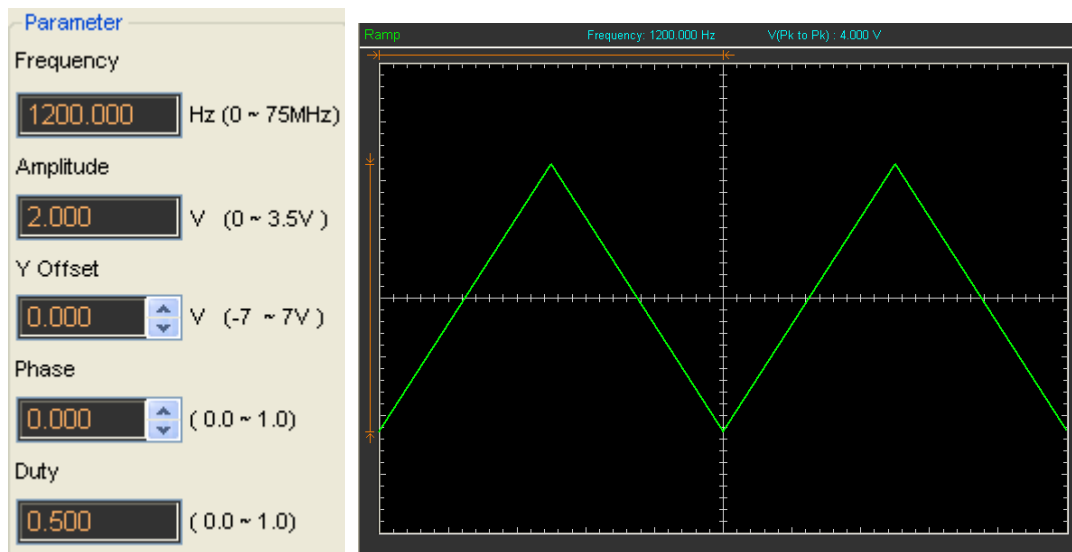


### Generate the Ramp waveform

To output a Ramp Wave, please do the following steps:

1. Press the check box "On/Off" to open the wave output function.
2. Select the Wave Type "Ramp".
3. Set the Wave Parameters:
  - Frequency: Set the output wave frequency.
  - Amplitude: Set the output wave amplitude.
  - Y Offset: Set the output wave vertical level offset.
  - Phase: Set the output wave phase.
  - Duty: The duty of the output wave.

The Ramp waveform window as the following:



### Generate the Trapezia waveform

To output a Trapezia wave, please do the following steps:

1. Press the check box "On/Off" to open the wave output function.
2. Select the Wave Type "Trapezia".

Frequency: Set the output wave frequency.

Amplitude: Set the output wave amplitude.

Y Offset: Set output wave vertical level offset.

Phase: Set the output wave phase.

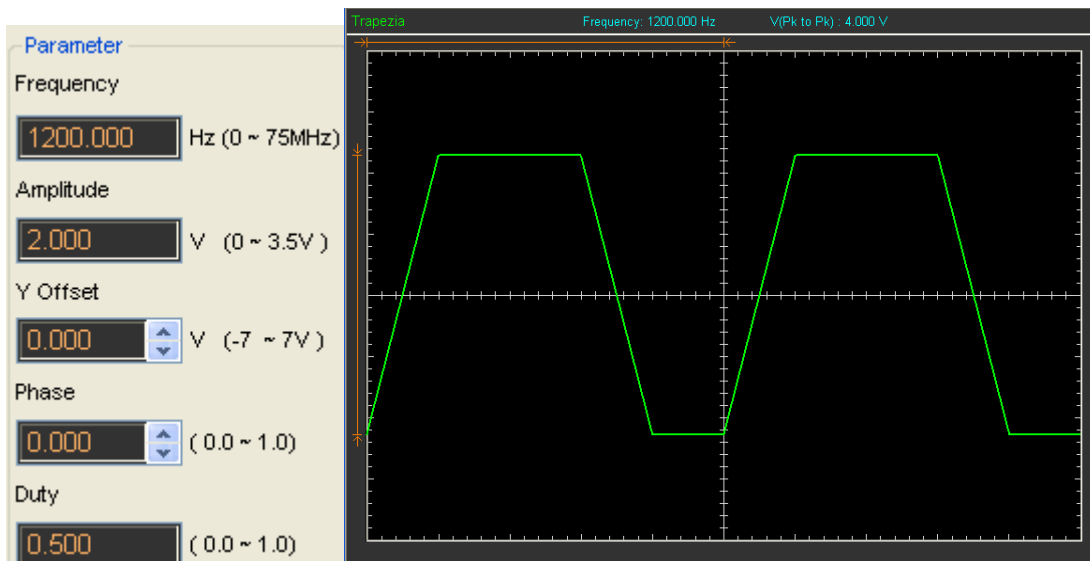
Duty: Set the output wave duty.

Rise Duty: Set the output wave rise duty.

High Duty: Set the output wave high duty.

Fall Duty: Set the output wave fall duty.

The Trapezia waveform window as the following:



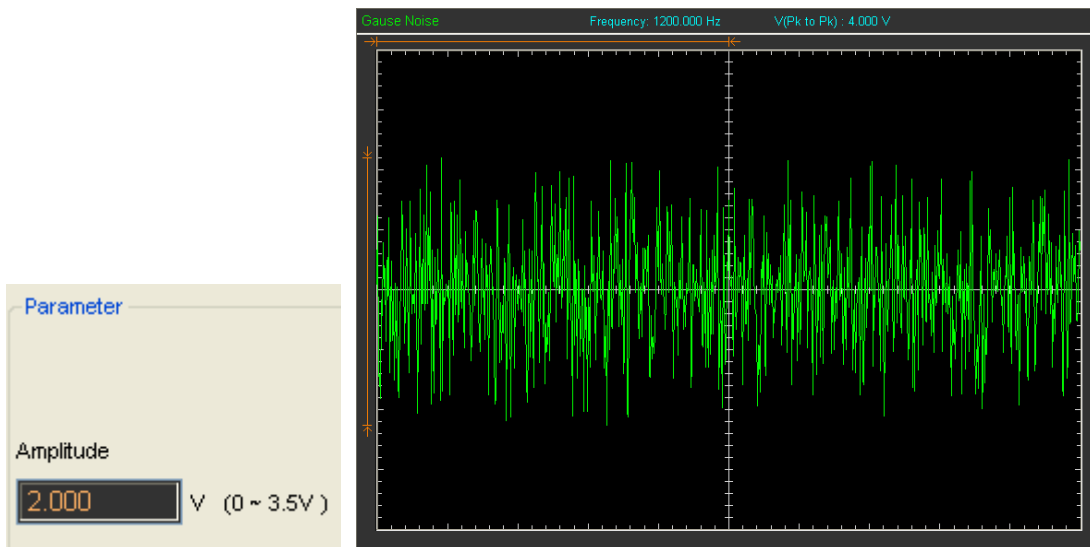
### Generate the Gause waveform

To output a Gause Wave, please do the following steps:

1. Press the check box "On/Off" to open the wave output function.
2. Select the Wave Type "Gause".
3. Set the Wave Paramters:

Amplitude: Set the output wave amplitude.

The Gause waveform window as the following:



### Generate the Arb. waveform

To output an Arbitrary Waveform, please do the following steps:

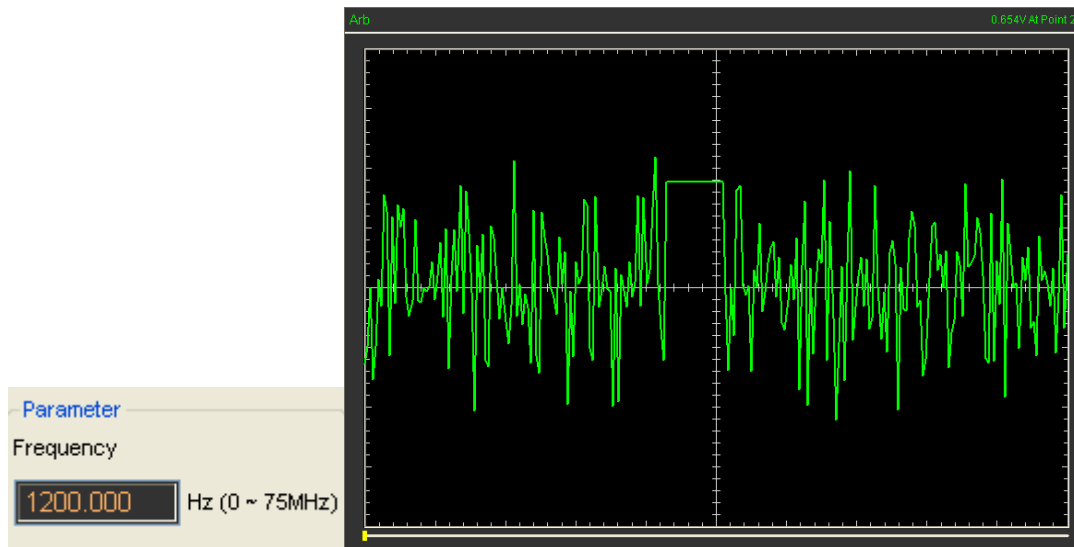
1. Press the check box "On/Off" to open the wave output function.
2. Select the Wave Type "Arb.".

3. Set the Wave Parameters:

Frequency: Set the output wave frequency.

4. Set the output wave.

The Arb. waveform window as the following:

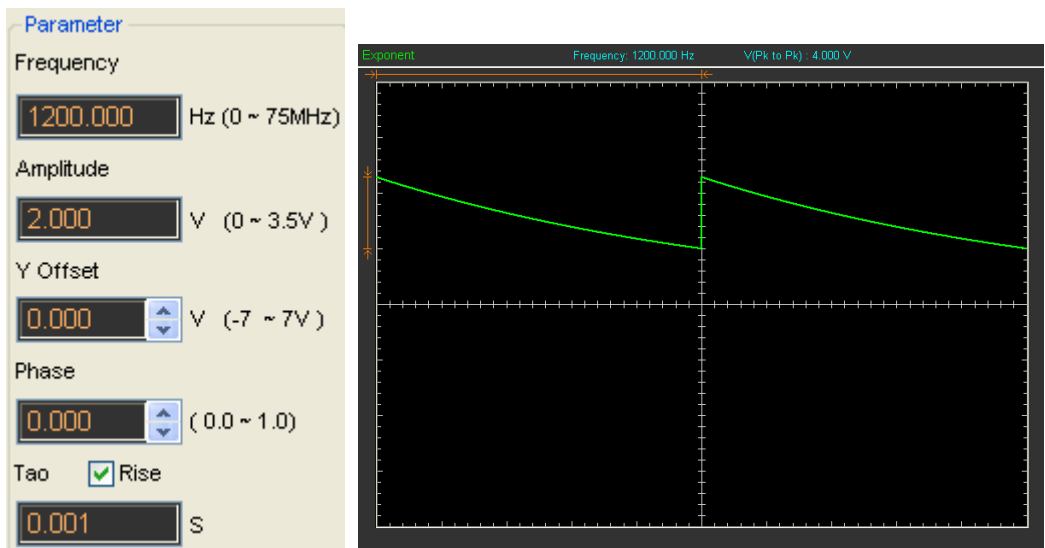


### Generate the Exponent waveform

To output an Exponent Waveform, please do the following steps:

1. Press the check box "On/Off" to open the wave output function.
2. Select the Wave Type "Exponent".
3. Set the Wave Parameters:
  - Frequency: Set the output wave frequency.
  - Amplitude: Set the output wave amplitude.
  - Y Offset: Set the output wave vertical level offset.
  - Phase: Set the output wave phase.
  - Tao: Set the output wave Tao param.
  - Rise: Set the output wave slope.

The Exponent waveform window as the following



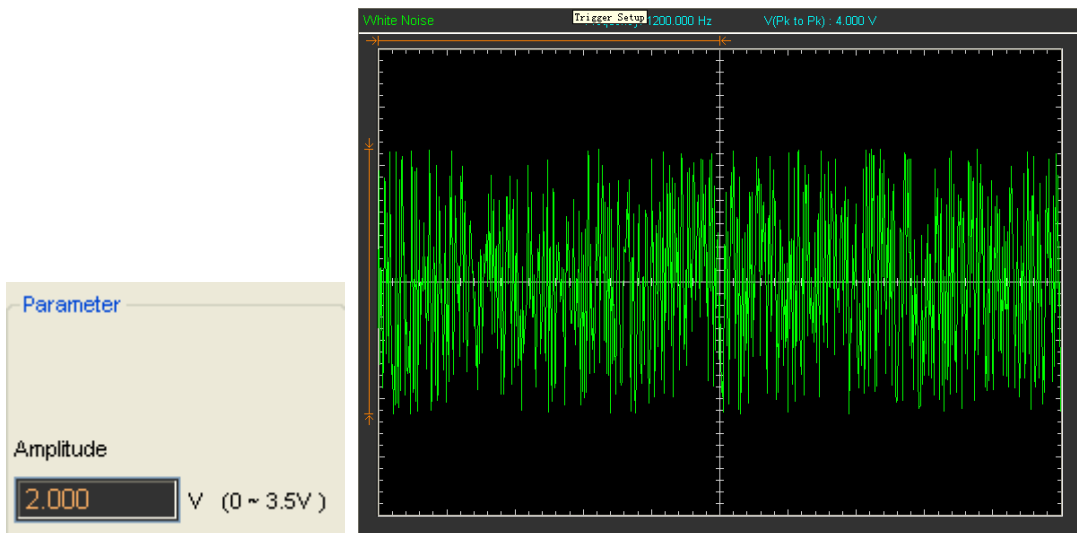
### Generate the White noise waveform

To Generate a White noise Wave, please do the following steps:

1. Press the check box "On/Off" to open the wave output function.
2. Select the Wave Type "White".
3. Set the Wave Parameters:

Amplitude: Set the output wave amplitude.

The White noise waveform window as the following:



## 6 General Maintenance

### General Care

Do not store or leave the oscilloscope where the device will be exposed to direct sunlight for long periods of time.

### Caution

To avoid damages to the device or probes, do not expose them to sprays, liquids or solvents.

To avoid damages to the surface of the device or probes not use any abrasive or chemical cleaning agents.

### Cleaning

Inspect the device and probes as often as operating conditions require. Make sure the device disconnect form all power sources.

To clean the exterior surface, perform the following steps:

1. Remove loose dust on the outside of the oscilloscope and probes with a lint-free cloth. Use care to avoid scratching the clear glass display filter.
2. Use a soft cloth dampened with water to clean the device.

**-END OF DOCUMENT-**