



**PDS Series**  
**Portable Mixed Signal Digital Storage Oscilloscope**  
**User Manual**

■ **PDS8102T**

■ **PDS8202T**

**[WWW.OWON.COM.CN](http://WWW.OWON.COM.CN)**

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# 1.General Safety Requirements

**Before any operations, please read the following safety precautions to avoid any possible bodily injury and prevent this product or any other products connected from damage. In order to avoid any contingent danger, this product is only used within the range specified.**

Only the qualified technicians can implement the maintenance.

**Prevent the Fire or Bodily Injury.**

**Connect the probe correctly. The grounding end of the probe corresponds to the grounding phase. Please don't connect the grounding end to the positive phase.**

**Use the proper power line.** Only use the power cord specially provided for this product or that has been approved to be used in this user state.

**Connect or Disconnect Correctly.** When the probe or testing wire is connected to the power lead, please do not connect and disconnect the probe or testing wire at random.

**Product Grounded.** This product is grounded through the power lead grounding conductor. In order to prevent any electric shocking, the grounding conductor must be connected to the ground. It requires guarantee that this product has been already grounded correctly before any connection with its input or output terminal.

**Pay attention to the nominal values of all terminals.** In order to prevent any fire or electric shock risks, please pay attention to all the nominal values and marks of this product. Before implement any connections for this product, please read the user's manual of this product to understand the information about the rated values further.

**Do not make any operations without the instrument cover installed.** If the cover or panel has already been removed, please don't operate this product.

**Use the proper fuse.** Only the fuse complying with the specified type and nominal value for this product can be used.

**Avoid touching any exposed circuit.** When the product is on power, please don't touch the uncovered contacts and parts.

**Please don't make any operations while there is an uncertain fault emerged.** If suspecting damage to this product, please contact the qualified maintenance personnel for check.

**Keep a good ventilation condition.** Please consult the detailed installation instruction in the user's manual so that this product can be erected correctly, keeping it under a good ventilation condition.

**Please do not make any operations in a moist environment.**

**Please do not make any operates in an explosive environment.**

**Keep the products surface clean and dry.**

## 2.Safety Terms and Symbols

**Terms in this manual.** The following terms may appear in this manual:



**Warning.** A warning statement indicates the conditions and actions which may endanger the life safety.



**Note.** A note statement indicates the conditions and actions which may cause damage to this product or other property.

**Terms on the product.** The following terms may appear on this product:

**Danger:** It indicates that there may be an immediate injury to you when you encounter this mark.

**Warning:** It indicates that there may not be an immediate injury to you when you encounter this mark.

**Note:** It indicates that there may be damage to this product or other property.

**Symbols on the product.** The following symbol may appear on the products:



High Voltage



Please Consult the Manual.



Protective Ground End



Earth End on the Shell



Grounding End for Measurement

To avoid body damage and prevent product and connected equipment dam. This product can only be used in the specified applications. Carefully read the following safety information before using the test tool.

 **Warning:**

**When use BC(battery charge) as power supply, to avoid fire or electrical shock if a test tool input is connected to more 42V peak (30Vrms) or on circuits of more than 4800VA:**

- **Only use accessory insulated voltage probes, test lead**
- **Before use, inspect oscilloscope probes, accessories for mechanical damage and replace when damage.**
- **Remove all probes, test leads and accessories that are not in use.**
- **Remove computer data line**
- **Do not apply input voltages above the rating of the instrument Use caution when using 1:1 test leads because the probe tip voltage will be directly transmitted to the oscilloscope.**
- **Do not use exposed metal BNC or banana plug connectors**
- **Do not insert metal objects into connectors.**



## 3.General Characteristics of the PDS Series Oscilloscope

### Digital Storage Oscilloscope

- | Model    | Bandwidth | Sample Rate                               |
|----------|-----------|---|
| PDS8102T | 100MHz    | 1GS/s half channel*, 500MS/s each channel |
| PDS8202T | 200MHz    | 2GS/s half channel*, 1G S/s each channel  |
- Dual channel, 2.5M points on each channel for the Record length;
  - Reading-out with the cursor;
  - Twenty automatic measurement functions;
  - Autoscale function;
  - Color liquid crystal display of high resolution and high contrast with adjustable back light;
  - Storage and call-out of waveforms;
  - Automatic setting function provided capable of fast setting;
  - Multiple-waveform calculation function;
  - Built-in FFT function;
  - Implementation of detecting the average and peak values of the waveform;
  - Digital real-time oscilloscope;
  - Edge, video,pulse,slope and alternate triggering function;
  - RS232 or USB communication ports;
  - Different continuous displaying time;
  - Multiple Language User Interface.

**\*Half channel is when only one channel is turned on.**

## **4.Junior User Guidebook**

**This chapter deals with the following topics mainly:**

### **Digital Storage Oscilloscope**

- Introduction to the front panel and the user's interface of the PDS series oscilloscope
- How to implement the general inspection
- How to implement the function inspection
- How to make a probe compensation
- How to set the probe attenuation coefficient
- How to use the probe safely
- How to implement an auto-calibration
- Introduction to the vertical system
- Introduction to the horizontal system
- Introduction to the trigger system

## Introduction to the Front Panel and the User's Interface of the PDS series Oscilloscope

When you get a new-type oscilloscope, you should get acquainted with its front panel at first and the PDS series mixed digital storage oscilloscope is no exception. This chapter makes a simple description of the operation and function of the front panel of the PDS series mixed oscilloscope, enabling you to be familiar with the use of the PDS series mixed oscilloscope in the shortest time. The PDS series mixed oscilloscope offers a simple front panel with distinct functions to users for their completing some basic operations, in which the knobs and function pushbuttons are included. The knobs have the functions similar to other oscilloscopes. The 5 buttons in the column on the right side of the display screen are menu selection buttons (defined as F1 to F5 from top to bottom respectively), through which, you can set the different options for the current menu. The other pushbuttons are function buttons, through which, you can enter different function menus or obtain a specific function application directly.

### Front panel

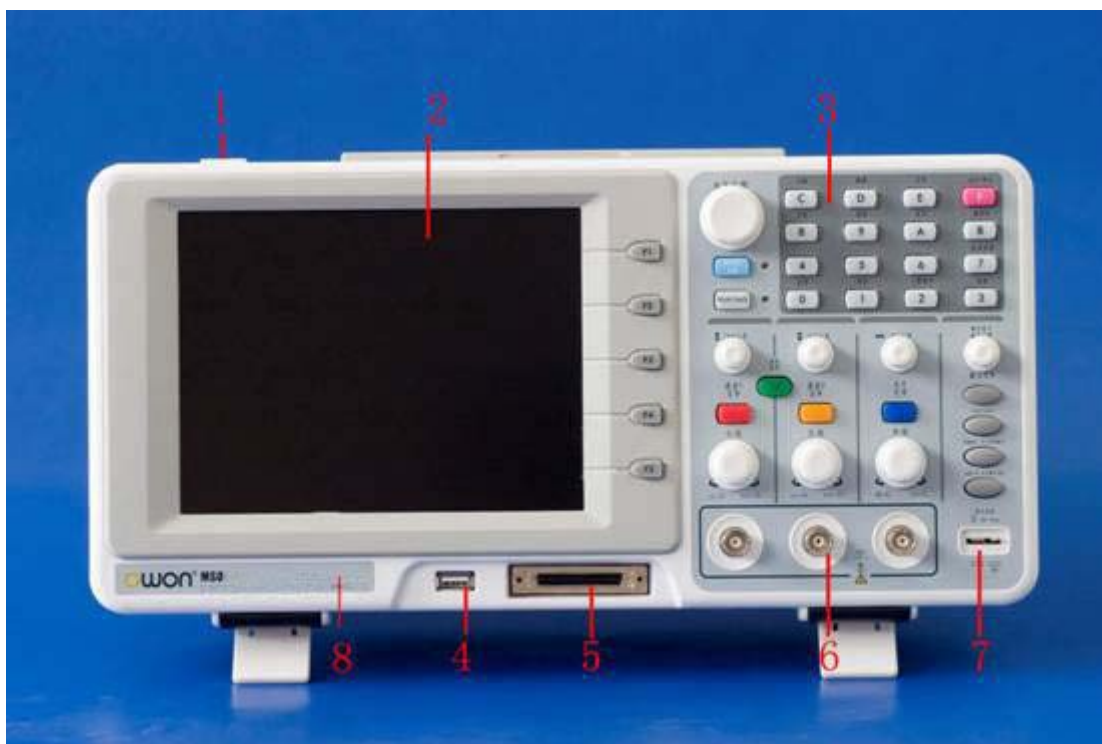


Fig. 4-1 Front panel overview

- 1、 Power on/off
- 2、 Display area
- 3、 Control (key and knob) area
- 4、 U slot
- 5、 LA signal input
- 6、 DSO signal input
- 7、 Measurement signal output

8、 Power and charging indication: Green light indicate AC supply and battery full charged; yellow light indicate under charging.

## Contrlo(key and knob) area

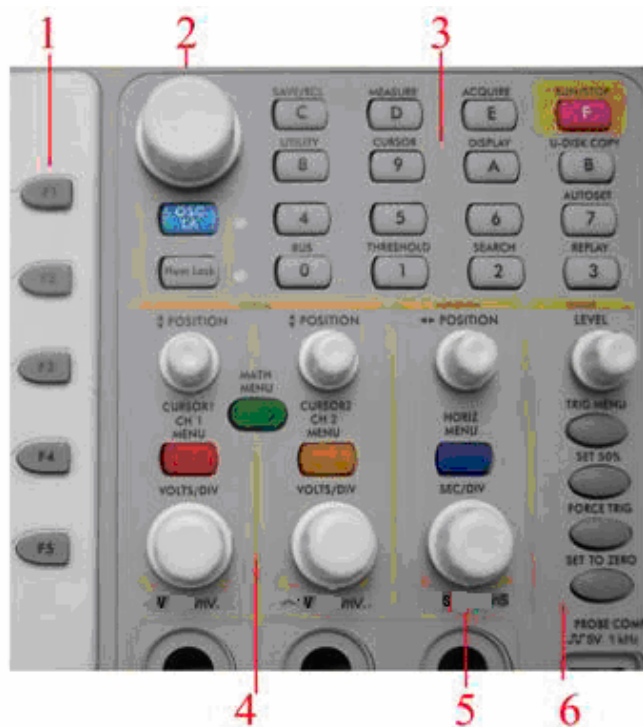


Fig. 4-2 Keys Overview

1、 1、 Menu option setting: F1~F5

2、 Switch

Switch includes two keys and one knob. The function for keys of "OSC/LA" and "Info" is reserved.

For DSO “cursor” knob is idle. But it takes effect in magnifying or minificating the waveform after FFT operation when the mode is FFT.

3、 Function key area

For DSO 0~5 keys are idle and 6~F refer to different DSO function menu.

4、 Vertical control area

It's including 3 keys and 4 knobs.

For DSO: “CH1 menu” and “CH2 menu” correspond to setting menu in CH1 and CH2, “Wave Math” key refer to math menu, the math menu consists of six kinds of operations, including CH1-CH2、 CH2-CH1、 CH1+CH2 、 CH1\*CH2、 CH1/CH2 and FFT. Two “Vertical position” knob control the vertical position of CH1. CH2, and two “Volts/Div” knob control voltage scale of CH1, CH2.

5、 Horizontal control area with 2 knob and 1 key.

For DSO, “Horizontal position” knob control trigger position, “Volts/Div” control time base, “Horizontal menu” key refer to horizontal system setting menu.

6、 Trigger control area with 4 keys and 1 knob.

For DSO, “Trig adjust” knob is to adjust trigger voltage. Other four keys refer to trigger system setting.

## User interface introduction

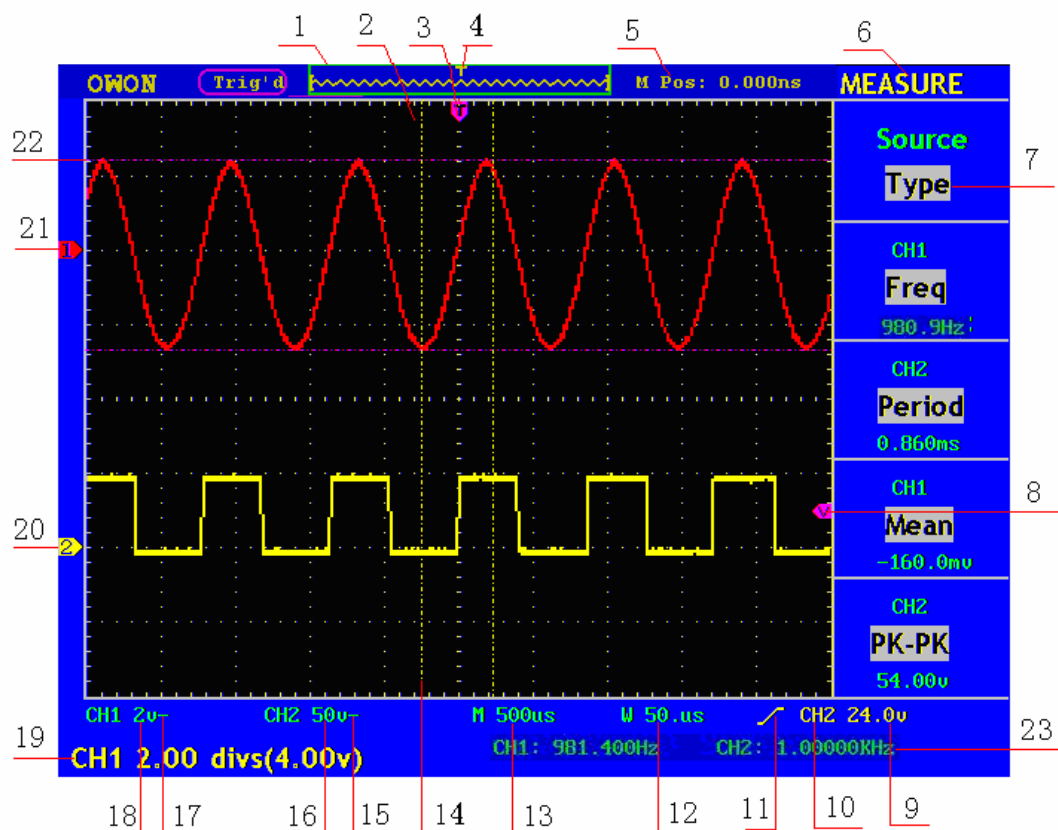






Fig. 4-3 Illustrative Drawing of Display Interfaces

1. The Trigger State indicates the following information:
  - Auto: The oscilloscope is under the Automatic mode and is collecting the waveform under the non-trigger state.
  - Trig' d: The oscilloscope has already detected a trigger signal and is collecting the after-triggering information.
  - Ready: All pre-triggered data have been captured and the oscilloscope has been already ready for accepting a trigger.
  - Scan: The oscilloscope captures and displays the waveform data continuously in the scan mode.
  - Stop: The oscilloscope has already stopped the waveform data acquisition.
2. Waveform Viewing Area.
3. The purple pointer indicates the horizontal trigger position, which can be adjusted by the horizontal position control knob.
4. The pointer indicates the trigger position in the internal memory.
5. This reading shows the time deviation between the horizontal trigger position and the window centre line, which is regarded as 0 in the window center.

6. It indicates the current function menu.
7. It indicates the operation options for the current function menu, which changes with the function menus.
8. The purple pointer shows the trigger level position.
9. The reading shows the trigger level value.
10. The reading shows the trigger source.
11. It shows the selected trigger type:

-  Rising edge triggering
-  Falling edge triggering
-  Video line synchronous triggering
-  Video field synchronous triggering

12. The reading shows the window time base set value.
13. The reading shows the main time base set value.
14. The two yellow dotted lines indicate the size of the viewing expanded window.
15. The icon shows the coupling mode of the CH2 channel.

“—” indicates the direct current coupling


“ ~ ” indicates the AC coupling

“  ” indicates GND coupling.

16. The reading shows the vertical scale factor (the Voltage Division) of the CH2 channel.
17. The icon indicates the coupling mode of the CH1 channel:

The icon "—" indicates the direct current coupling

The icon "~" indicates the AC coupling

The icon "  ” indicates GND coupling.

18. The reading indicates the vertical scale factor (the Voltage Division) of the CH1 channel.
19. The information shows the zero point positions of CH1 or CH2 channel.
20. The yellow pointer shows the grounding datum point (zero point position) of the waveform of the CH2 channel. If the pointer is not displayed, it shows that this channel is not opened.
21. The red pointer indicates the grounding datum point (zero point position) of the waveform of the CH1 channel. If the pointer is not displayed, it shows that the channel is not opened.

22. The positions of two purple dotted line cursors measurements.
23. The reading shows the frequency of the two channels. It is a 6 digits cymometer. Its measurement range of frequency is 2Hz to full bandwidth. when the triggering mode is edge triggering, it is a one channel cymometer and it can only measure the frequency of the tiggering channel. When the triggering mode is alternating triggering, it is a two channel cymometer and it can measure the frequency of two channels.

## How to implement the General Inspection

After you get a new PDS series oscilloscope, it is recommended that you should make a check on the instrument according to the following steps:

### 1. Check whether there is any damage caused by transportation.

If it is found that the packaging carton or the foamed plastic protection cushion has suffered serious damage, do not throw it away first till the complete device and its accessories succeed in the electrical and mechanical property tests.

### 2. Check the Accessories

The supplied accessories have been already described in the **Appendix B** “Accessories” of this Manual. You can check whether there is any loss of accessories with reference to this description. If it is found that there is any accessory lost or damaged, please get in touch with the distributor of LILLIPUT responsible for this service or the LILLIPUT’s local offices.

### 3. Check the Complete Instrument

If it is found that there is damage to the appearance of the instrument, or the instrument can not work normally, or fails in the performance test, please get in touch with the LILLIPUT’s distributor responsible for this business or the LILLIPUT’s local offices. If there is damage to the instrument caused by the transportation, please keep the package. With the transportation department or the LILLIPUT’s distributor responsible for this business informed about it, a repairing or replacement of the instrument will be arranged by the LILLIPUT.

## How to implement the Function Inspection

Make a fast function check to verify the normal operation of the instrument, according to the following steps:

### 1. Connect the Instrument to the Power and Push down the Power Switch Button.

The instrument carries out all self-check items and shows the prompt “**Press any Key Enter system**”. Press the “**8 (UTILITY)**” button to get access to the “FUNCTION” menu and push down F2 the menu selection button to call out the function “Recall Factory”. The default attenuation coefficient set value of the probe in the menu is

10X,

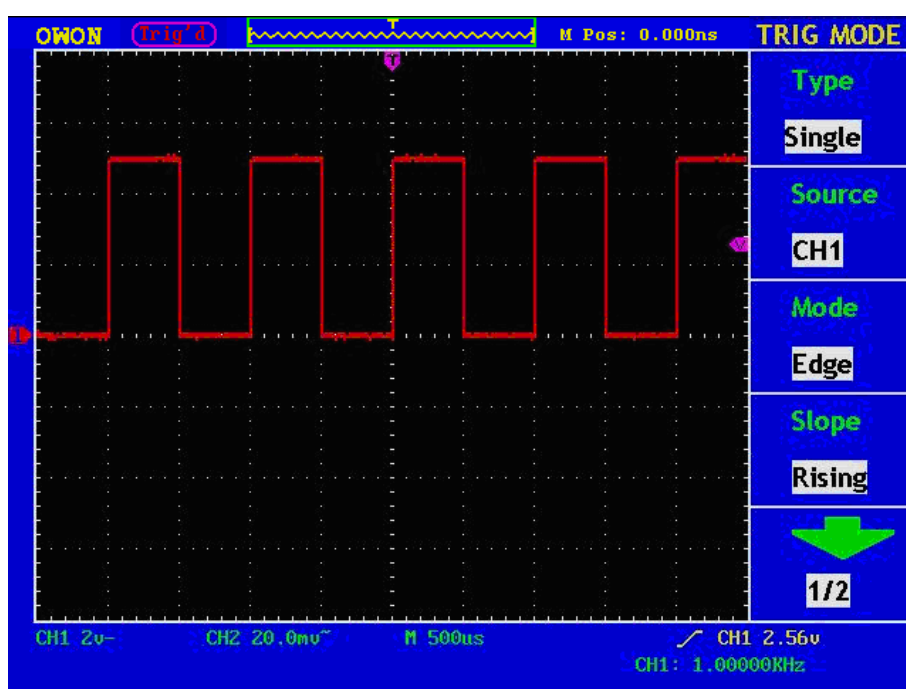
2. **Set the Switch in the Oscilloscope Probe as 10X and Connect the Oscilloscope with CH1 Channel.**

Align the slot in the probe with the plug in the CH1 connector BNC, and then tighten the probe with rotating it to the right side.

Connect the probe tip and the ground clamp to the connector of the probe compensator.

3. **Press the “7(AUTOSET)” Button.**

The square wave of 1 KHz frequency and 5V peak-peak value will be displayed in several seconds (see Fig. 4-4).



**Fig.4-4** Auto set

Check CH2 by repeating Step 2 and Step 3.

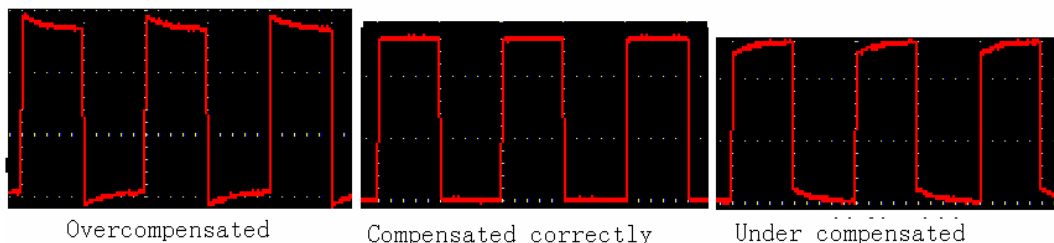
## How to Implement the Probe Compensation

When connect the probe with any input channel for the first time, make this adjustment to match the probe with the input channel. The probe which is not compensated or presents a compensation deviation will result in the measuring error or mistake. For adjusting the probe compensation, please carry out the following steps:

1. Set the attenuation coefficient of the probe in the menu as 10X and that of the switch in the probe as 10X, and connect the oscilloscope probe with the CH1 channel. If a probe hook tip is used, ensure that it keeps in close touch with the probe. Connect the probe tip with the signal connector of the probe compensator

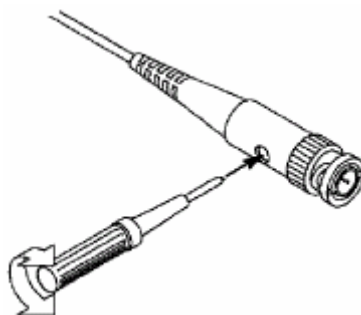


- and connect the reference wire clamp with the ground wire connector of the probe connector, and then press the button “7(AUTOSET)”.
2. Check the displayed wave forms and regulate the probe till a correct compensation is achieved (see Fig.4-5 and Fig.4-6).



**Fig. 4-5** Displayed Wave Forms of the Probe Compensation

3. Repeat the steps mentioned if necessary.



**Fig. 4-6** Adjust Probe

## How to Set the Probe Attenuation Coefficient

The probe has several attenuation coefficients, which will influence the vertical scale factor of the oscilloscope.

If it is required to change (check) the set value of the probe attenuation coefficient, press the function menu button of the channels used, then push down the selection button corresponding to the probe till the correct set value is shown.

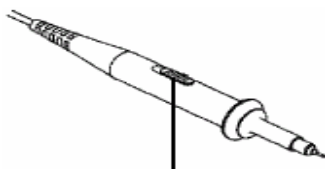
This setting will be valid all the time before it is changed again.



**Note:** The attenuation coefficient of the probe in the menu is preset to 10X when the oscilloscope is delivered from the factory.

Make sure that the set value of the attenuation switch in the probe is the same as the menu selection of the probe in the oscilloscope.

The set values of the probe switch are 1X and 10X (see Fig. 4-7).



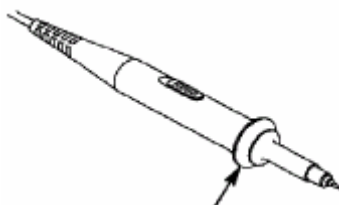
**Fig.4-7** Attenuation Switch



**Note:** When the attenuation switch is set to 1X, the probe will limit the bandwidth of the oscilloscope in 5MHz. If it is needed to use the whole bandwidth of the oscilloscope, the switch must be set to 10X.

## How to Use the Probe Safely

The safety guard ring around the probe body protects your finger against the electric shock, shown as Fig. 4-8.



**Fig. 4-8** Finger Guard



**Warning:** In order to avoid suffering from the electric shock, please keep your finger behind the safety guard ring of the probe body during the operation.

In order to protect you from suffering from the electric shock during your using the probe, do not touch the metal part of the probe tip when the probe is connected to the power supply.

Before making any measurements, please connect the probe to the instrument and connect the ground terminal to the earth.

## How to Implement Auto-calibration

The auto-calibration application can make the oscilloscope reach the optimum condition rapidly to obtain the most accurate measurement value. You can carry out this application program at any time, but when the range of variation of the ambient temperature is up to or over 5°C, this program must be executed.

For the performing of the self-calibration, all probes or wires should be disconnected with the input connector first. Then, press the “**8(UTILITY)**” button to call out the **FUNCTION** menu; push down the F3 menu selection button to choose the option “Do Self Cal”; finally, run the program after confirming that everything is ready now.

## Introduction to the Vertical System

Shown as Fig.4-9, there are a series of buttons and knobs in **VERTICAL CONTROLS**. The following practices will gradually direct you to be familiar with the using of the vertical setting.



**Fig. 4-9** Vertical Control Zone

1. Use the button “**VERTICAL POSITION**” knob to show the signal in the center of the waveform window. The “**VERTICAL POSITION**” knob functions the regulating of the vertical display position of the signal. Thus, when the “**VERTICAL POSITION**” knob is rotated, the pointer of the earth datum point of the channel is directed to move up and down following the wave form.

### Measuring Skill

If the channel is under the DC coupling mode, you can rapidly measure the DC component of the signal through the observation of the difference between the wave form and the signal ground.

If the channel is under the AC mode, the DC component will be removed by filtration. This mode helps you display the AC component of the signal with a higher sensitivity.

2. Change the Vertical Setting and Observe the Consequent State Information Change.

With the information displayed in the status bar at the bottom of the waveform window, you can determine any changes in the channel vertical scale factor.

- Rotate the vertical “**VOLTS/DIV**” knob and change the “Vertical Scale Factor (Voltage Division)”, it can be found that the scale factor of the channel corresponding to the status bar has been changed accordingly.
- Press buttons of “**CH1 MENU**”, “**CH2 MENU**” and “**MATH MENU**”, the

operation menu, symbols, wave forms and scale factor status information of the corresponding channel will be displayed in the screen.

## Introduction to the Horizontal System

Shown as Fig.4-10, there are a button and two knobs in the “**HORIZONTAL CONTROLS**”. The following practices will gradually direct you to be familiar with the setting of horizontal time base.



**Fig. 4-10** Horizontal Control Zone

1. Use the horizontal “**SEC/DIV**” knob to change the horizontal time base setting and observe the consequent status information change. Rotate the horizontal “**SEC/DIV**” knob to change the horizontal time base, and it can be found that the “**Horizontal Time Base**” display in the status bar changes accordingly. The horizontal scanning speed steps from  
2 ns up to 100s in the sequence of 1-2-5 -----PDS8102T;  
1 ns up to 100s in the sequence of 1-2-5 -----PDS8202T.
2. Use the “**HORIZONTAL POSITION**” knob to adjust the horizontal position of the signal in the waveform window. The “**HORIZONTAL POSITION**” knob is used to control the triggering displacement of the signal or for other special applications. If it is applied to triggering the displacement, it can be observed that the wave form moves horizontally with the knob when you rotate the “**Horizontal Position**” knob.
3. With the “**HORIZONTAL MENU**” button pushed down, you can set and initiate the Window Expansion.

## Introduction to the Trigger System

Shown as Fig.4-11, there are a knob and four buttons in the “**TRIGGER CONTROLS**”. The following practices will direct you to be familiar with the setting of the trigger system gradually.



**Fig.4-11** Trigger Control Zone

1. Press the “**TRIG MENU**” button and call out the trigger menu. With the operations of the 5 menu selection buttons, the trigger setting can be changed.
2. Use the “**LEVEL**” knob to change the trigger level setting.  
With the rotation of the “**LEVEL**” knob, it can be found that the trigger indicator in the screen will move up and down with the rotation of the knob. With the movement of the trigger indicator, it can be observed that the trigger level value displayed in the screen changes.
3. Press the button “**SET 50%**” to set the trigger level as the vertical mid point values of the amplitude of the trigger signal.
4. Press the “**FORCE TRIG**” button to force a trigger signal, which is mainly applied to the “Normal” and “Single” trigger modes.
5. The “**SET TO ZERO**” button is used to reset the trigger horizontal position.

## 5. Advanced User Guidebook

Up till now, you have already been familiar with the initial operations of the functions of the function areas, buttons and knobs in the front panel of the PDS series oscilloscope. Based the introduction of the previous Chapter, the user should have an intimate knowledge of the determination of the change of the oscilloscope setting through observing the status bar. If you have not been familiar with the above-mentioned operations and methods yet, we advise you to read the section of “Chapter One Junior Users' Guidebook”.

This chapter will deal with the following topics mainly:

- **How to Set the Vertical System**
- **How to Set the Horizontal System**
- **How to Set the Trigger System**
- **How to Implement the Sampling Setup**
- **How to Set the Display System**
- **How to Save and Recall Wave Form**
- **How to Implement the Auxiliary System Function Setting**
- **How to Implement the Automatic Measurement**
- **How to Implement the Cursor Measurement**
- **How to Use Autoscale function**
- **How to Use Executive Buttons**
- **How to set Utility**

It is recommended that you read this chapter carefully to get acquainted the various measurement functions and other operation methods of the PDS series oscilloscope.

## How to Set the Vertical System

The **VERTICAL CONTROLS** includes three menu buttons such as **CH1 MENU**, **CH2 MENU** and **MATH MENU**, and four knobs such as **VERTICAL POSITION**, **VOLTS/DIV** (one group for each of the two channels).

### Setting of CH1 and CH2

Every channel has an independent vertical menu and each item is set respectively based on the channel.

With the “**CH1 MENU**” or “**CH2 MENU**” menu button pushed down, the system shows the operation menu of the corresponding channel (see Fig. 5-1).



**Fig. 5-1** Channel Setting Menu

The description of the Channel Menu is shown as the following list:

| Function Menu | Setting    | Description   |
|---------------|------------|---|
| Coupling      | AC         | Block the DC component in the input signal.   |
|               | DC         | Unblock the AC and DC components in the input signal.   |
|               | GROUND     | The Input signal is interrupted.  |
| Band Limit    | OFF 100MHz | Get full bandwidth.   |
|               | ON 20MHz   | Limits the channel bandwidth to 20MHz to reduce display noise.                                    |
| Channel       | OFF        | Close the measurement channel.  |
|               | ON         | Open the measuring channel.   |
| Probe         | 1X         | Choose one according to the probe attenuation factor to make the vertical scale reading accurate. |
|               | 10X        |   |
|               | 100X       |   |
|               | 1000X      |   |
| Inverted      | OFF        | The wave form is displayed normally.  |
|               | ON         | Initiate the wave form inverted function.   |

### 1. Setting Channel Coupling

Taking the Channel 1 for example, the measured signal is a square wave signal containing the direct current bias. The operation steps are shown as below:

- (1). Press the **CH1 MENU** button and call out the **CH1 SETUP** menu.
- (2). Press the **F1** menu selection button and select the Coupling item as “AC” to set the channel coupling as ac mode, under which the direct current component in the signal will be blocked.

Then, press the **F1** menu selection button again and select the Coupling item as “DC”, setting the channel coupling as dc mode, under which both dc and ac components in the signal will be unblocked.

The wave forms are shown as Fig.5-2 and Fig.5-3.



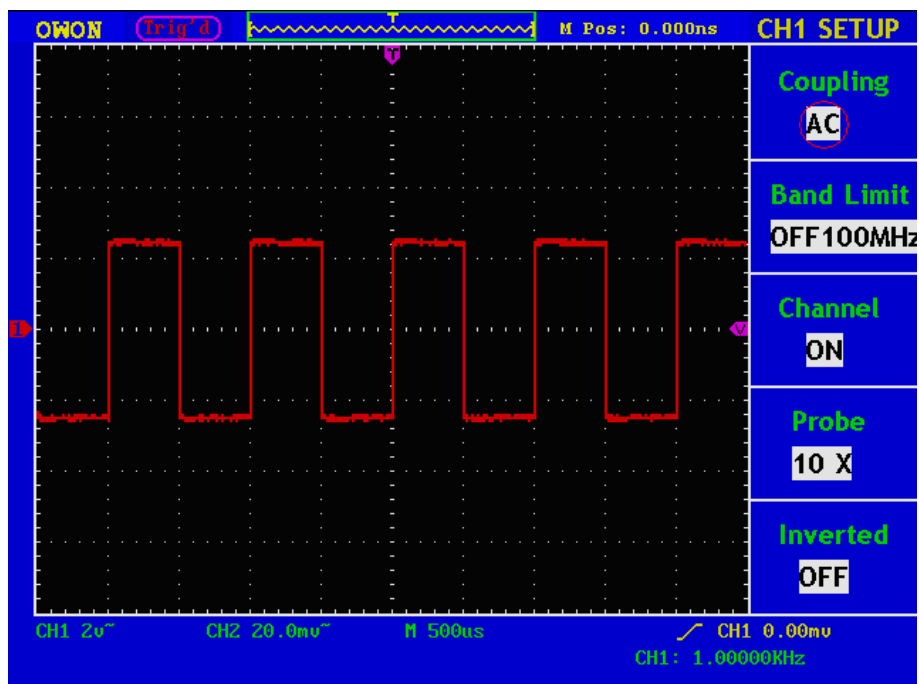


Fig. 5-2 AC Coupling Oscillogram

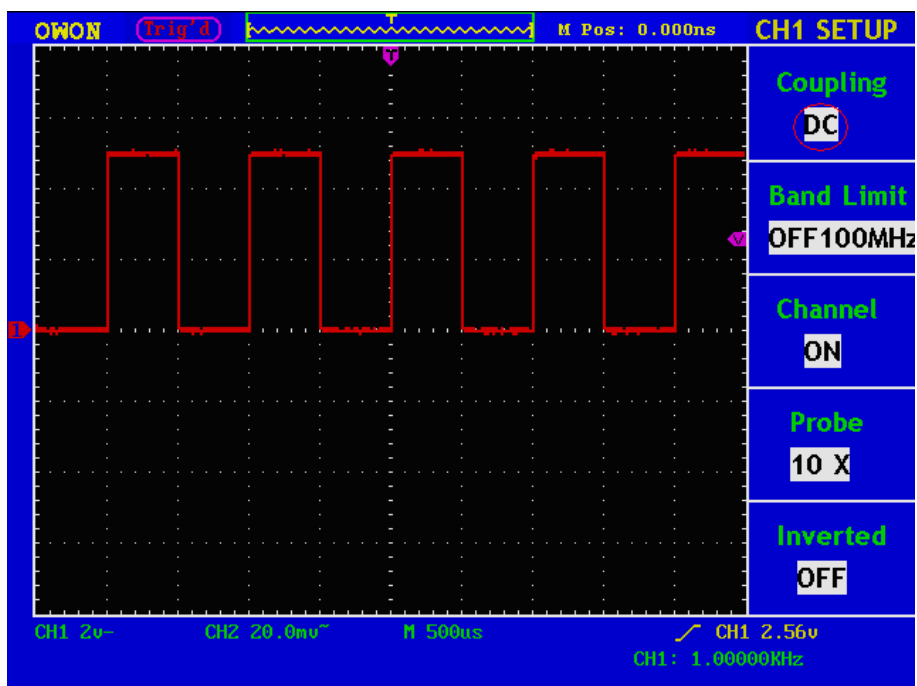


Fig. 5-3 DC Coupling Oscillogram

## 2. Setting the“Band Limit”

Taking the Channel 1 for example, the operation steps are shown as below:

- (1). Press the **CH1 MENU** button and call out the **CH1 SETUP** menu.
- (2). Press the **F2** menu selection button and select the Band Limit as **OFF 100MHz**, with Channel 1 Band Limit switched off.
- (3). Press **F2** menu selection button again, select the Band Limit as **ON 20MHz**, with Channel 1 Band Limit is switched on.

### 3. Setting the Channel “ON/OFF”

Taking the Channel 1 for example, the operation steps are shown as below:

- (1). Press the **CH1 MENU** button and call out the **CH1 SETUP** menu.
- (2). Press the **F3** menu selection button and select the Channel as **OFF**, with Channel 1 switched off.
- (3). Press **F3** menu selection button again, select the channel as **ON**, with Channel 1 is switched on.

**Note:**In FFT mode, both CH1 and CH2 are not allowed to be ON when F3 is pressed. See Fig.5-4.

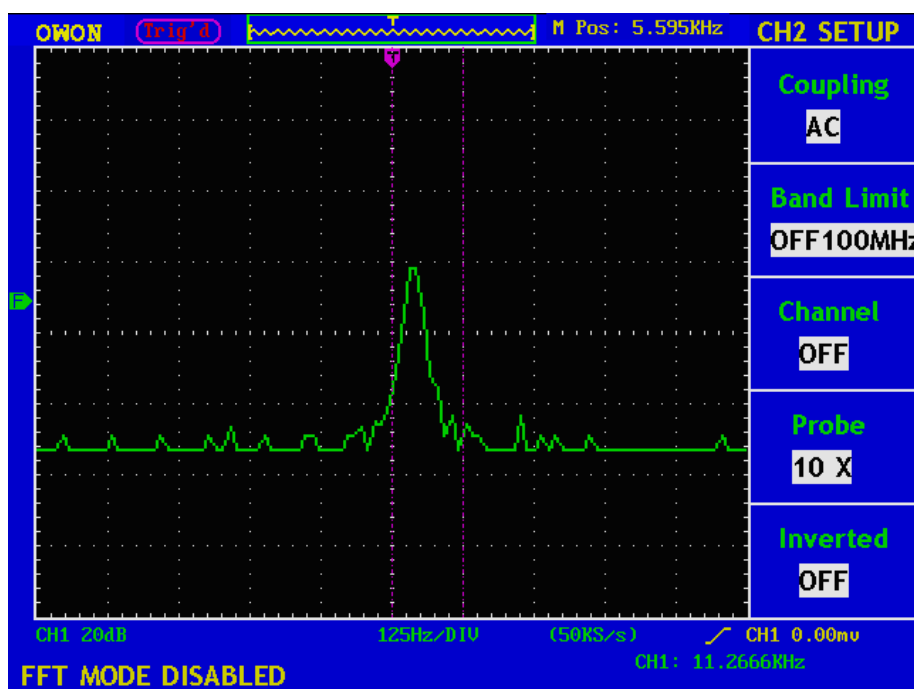


Fig. 5-4 Channel CH1 is disable under FFT mode

### 4. Regulate the Attenuation Ratio of the Probe

In order to match the attenuation coefficient of the probe, it is required to adjust the attenuation ration coefficient of the probe through the operating menu of the Channel accordingly. If the attenuation coefficient of the probe is 1:1, that of the oscilloscope input channel should also be set to 1X to avoid any errors presented in the displayed scale factor information and the measured data.

Take the Channel 1 as an example, the attenuation coefficient of the probe is 10:1, the operation steps is shown as follows:

- (1). Press the **CH1 MENU** button, access CH1 SETUP menu.
- (2). Press the **F4** menu selection button and select 10X for the probe.

The Fig.24 illustrates the setting and the vertical scale factor when the probe of the attenuation coefficient of 10:1.is used.

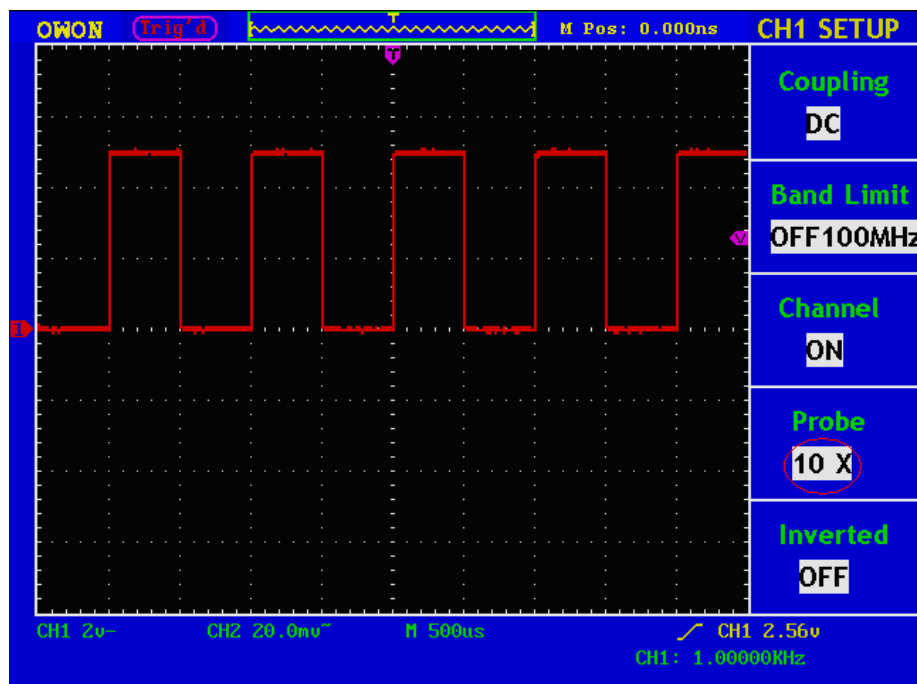


Fig. 5-5 Regulation of the Attenuation Ratio of the Probe

A List of the Attenuation Coefficient of Probes and the Corresponding Menu Settings.

| Attenuation Coefficient of the Probe | Corresponding Menu Setting |
|--------------------------------------|----------------------------|
| 1:1                                  | 1X                         |
| 10:1                                 | 10X                        |
| 100:1                                | 100X                       |
| 1000:1                               | 1000X                      |

## 5. Setting of Wave Form Inverted

Wave form inverted: the displayed signal is turned 180 degrees against the phase of the earth potential.

Taking the Channel 1 for example, the operation steps are shown as follows:

- (1). Press the **CH1 MENU** button and get access to the **CH1 SETUP** menu.
- (2). Press the **F5** menu selection button and select **ON** in the **Inverted**. The wave form inverted function is initiated.
- (3). Press the **F5** menu selection button again and select **OFF** for **Inverted** item. The function of wave form inverted is closed off.

For the screen display, see Fig. 5-6 and Fig. 5-7

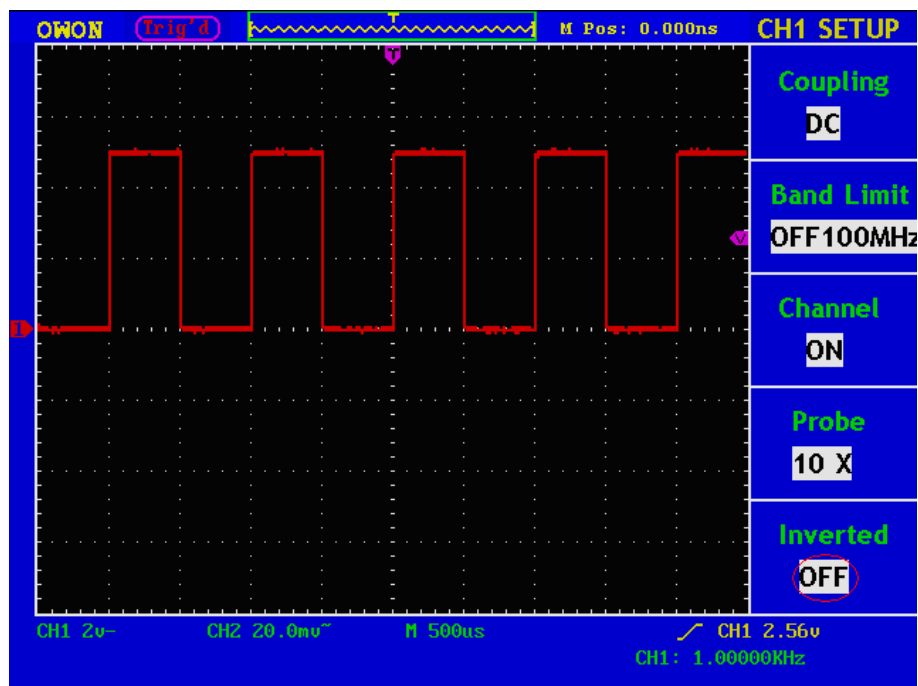


Fig. 5-6 Wave Form not inverted

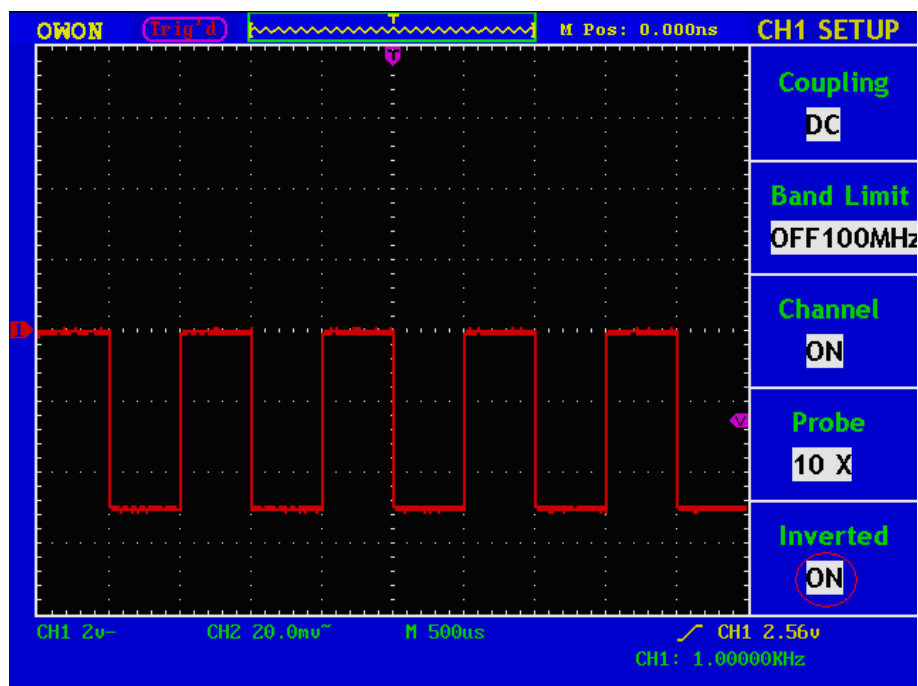


Fig. 5-7 Wave Form Inverted

## Implementation of Mathematical Manipulation Function

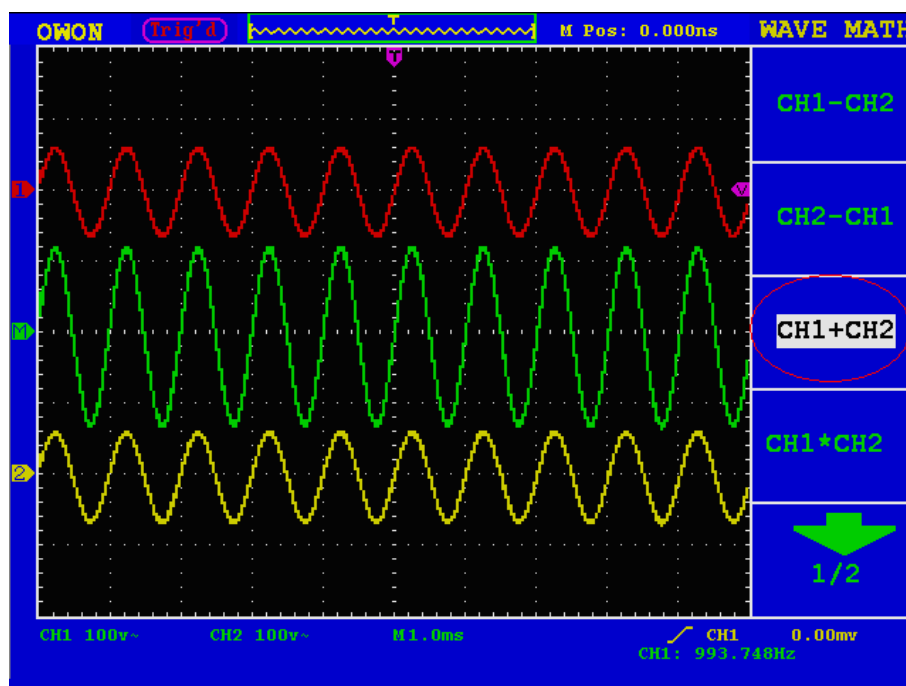
The **Mathematical Manipulation** function is used to show the results of the additive, multiplication, division and subtraction operations between Channel 1 and Channel 2, and the FFT operation of CH1 or CH2 .

## The corresponding FCL (Functional Capabilities List) of the **Wave Form Calculation**

| Setting | Description  |
|---------|--|
| CH1-CH2 | Subtract the Channel 2 wave form from the Channel 1 wave form. |
| CH2-CH1 | Subtract the Channel 1 wave form from the Channel 2 wave form. |
| CH1+CH2 | Add the Channel 1 wave form to the Channel 2.                  |
| CH1*CH2 | Multiply Channel 1 wave form by Channel 2 wave form.           |
| CH1/CH2 | Channel 1 wave form is divided by the Channel 2 wave form.     |
| FFT     | Waveform of Corresponding FFT operation.                       |

Taking the additive operation between Channel 1 and Channels 2 for example, the operation steps are as follows:

1. Press the **MATH MENU** button and call out the **WAVE MATH** menu.
2. Press the **F3** menu selection button and choose **CH1+CH2**. The green calculated wave form M is displayed in the screen; press the **F3** menu selection button again, the wave form M is closed off (see Fig.5-8).



**Fig. 5-8** Wave Form resulted from CH1 +CH2 Mathematical Manipulation

## Using FFT function

An FFT breaks down signals into component frequencies, which the oscilloscope uses to display a graph of the frequency domain of a signal, as opposed to the oscilloscope's standard time domain graph. You can match these frequencies with known system frequencies, such as system clocks, oscillators, or power supplies.

FFT in this oscilloscope can transform 2048 points of the time-domain signal into its frequency components and the final frequency contains 1024 points ranging from 0Hz to Nyquist frequency .

The following table describes the FFT menu:

| Function Menu | Setting   | Instruction               |
|---------------|-----------|---------------------------|
| FFT           | ON        | Turn on FFT function.     |
|               | OFF       | Turn off FFT function.    |
| Source        | CH1       | Select CH1 as FFT source. |
|               | CH2       | Select CH2 as FFT source. |
| Window        | Rectangle | Select window for FFT.    |
|               | Blackman  |                           |
|               | Hanning   |                           |
|               | Hamming   |                           |
| Format        | dB        | Select dB for Format.     |
|               | Vrms      | Select Vrms for Format.   |
| Zoom          | *1        | Set multiple *1.          |
|               | *2        | Set multiple *2.          |
|               | *5        | Set multiple *5.          |
|               | *10       | Set multiple *10.         |

Taking the FFT operation for example, the operation steps are as follows:

1. Press the **MATH MENU** button and call out the WAVE MATH menu.
2. Press the **F5** selection button to turn to Page2 , Press **F3** to choose FFT.
3. Press F1 to turn on/off FFT after entering FFT menu, and please note that FFT is prohibited in Window setting mode. The green waveform F is shown in the screen after calculation.
4. Press **F2** selection button to switch over source channel CH1 and CH2.
5. Press **F3** button to select WINDOW,including Rectangle、Hamming、Hanning and Blackman.
6. Press **F4** to choose the Format as dB or Vrms.
7. Press F5 to zoom in or out the wave of the multiple including \*1, \*2, \*5, \*10.
8. Adjust the “Horizontal” knob in horizontal control zone to move the waveform and the shown frequency of M Pos is the exact frequency of the cursor point in the middle of spectrum.
9. Turn off FFT and then press **math menu** button to go back to the second page of wave math.

### Selecting an FFT Window

■ The FFT feature provides four windows. Each one is a trade-off between frequency resolution and magnitude accuracy. What you want to measure and your source signal characteristics help you to determine which window to use. Use the following guidelines to select the best window.





| Type             | Description   | Window  |
|------------------|---|---|
| <p>Rectangle</p> | <p>This is the best type of window for resolving frequencies that are very close to the same value but worst for accurately measuring the amplitude of those frequencies. It is the best type for measuring the frequency spectrum of nonrepetitive signals and measuring frequency components near DC.</p> <p>Use rectangle for measuring transients or bursts where the signal level before and after the event are nearly equal. Also, use this window for equal-amplitude sine waves with frequencies that are very close and for broadband random noise with a relatively slow varying spectrum.</p> |    |
| <p>Hamming</p>   | <p>This is a very good window for resolving frequencies that are very close to the same value with somewhat improved amplitude accuracy over the rectangle window. It has a slightly better frequency resolution than the Hanning.</p> <p>Use Hamming for measuring sine, periodic and narrow band random noise. This window works on transients or bursts where the signal levels before and after the event are significantly different.</p>  |  |
| <p>Hanning</p>   | <p>This is a very good window for measuring amplitude accuracy but less so for resolving frequencies.</p> <p>Use Hanning for measuring sine, periodic, and narrow band random noise. This window works on transients or bursts where the signal levels before and after the event are significantly different.</p>  |  |
| <p>Blackman</p>  | <p>This is the best window for measuring the amplitude of frequencies but worst at resolving frequencies.</p> <p>Use Blackman-Harris for measuring predominantly single frequency waveforms to look for higher order harmonics.</p>   |  |

Fig.5-9,5-10,5-11,5-12 show four kinds of window function referring to sine wave of

1KHz.

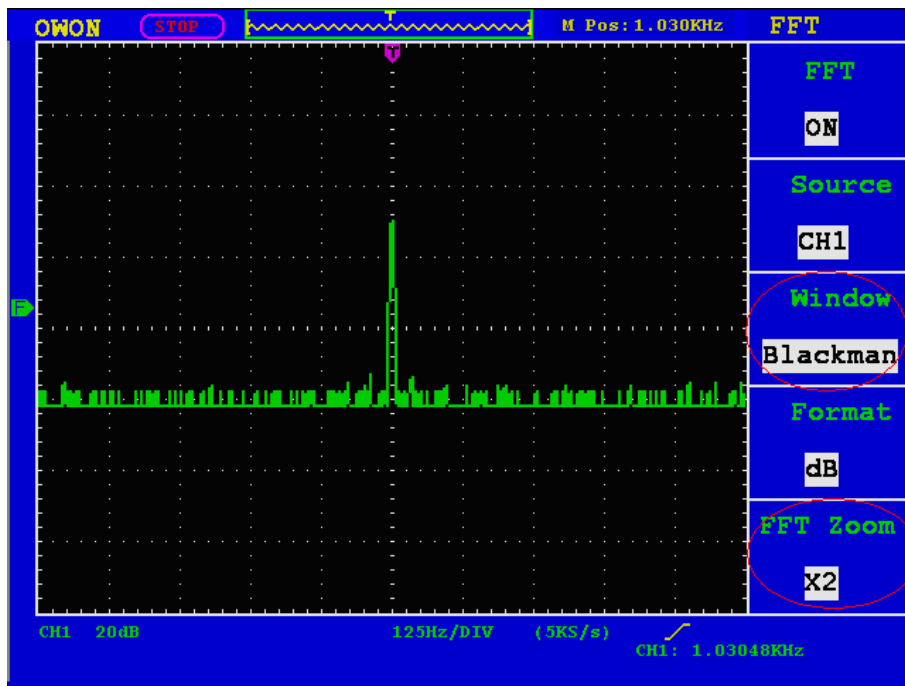


Fig.5-9. Blackman window

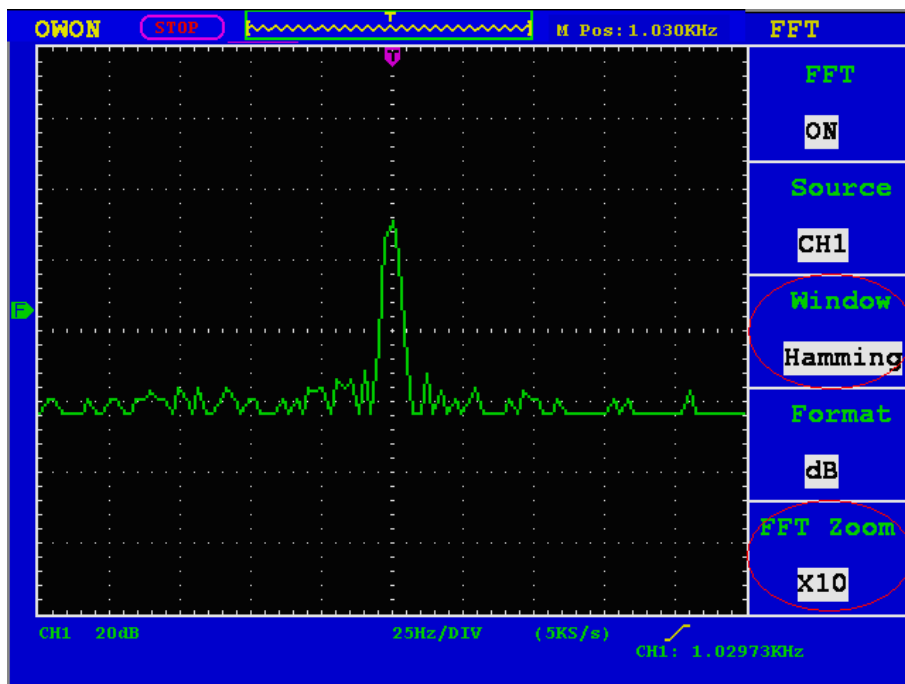


Fig.5-10 . Hamming window



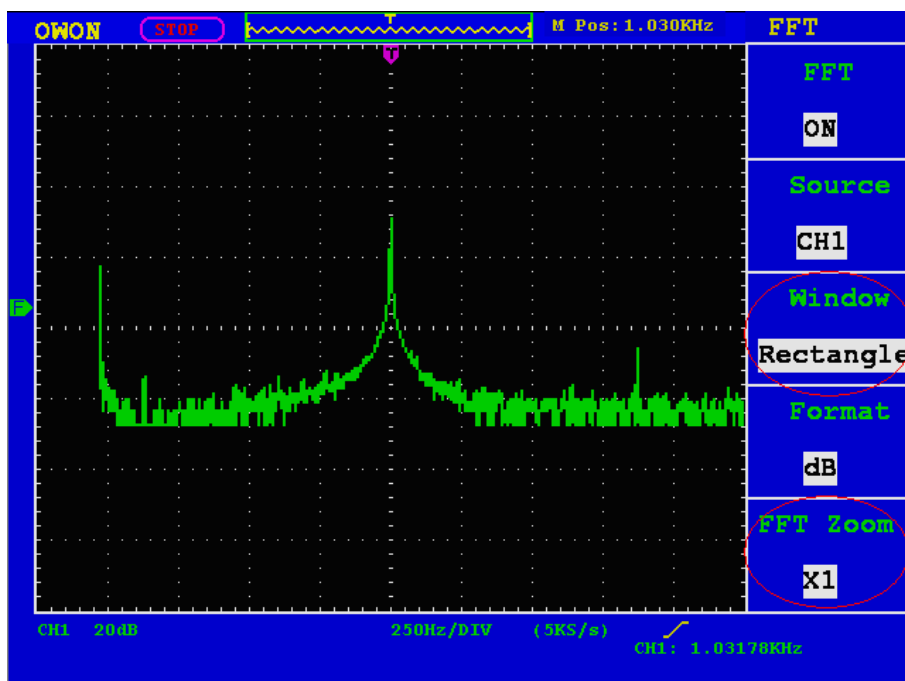


Fig.5-11. Rectangle window

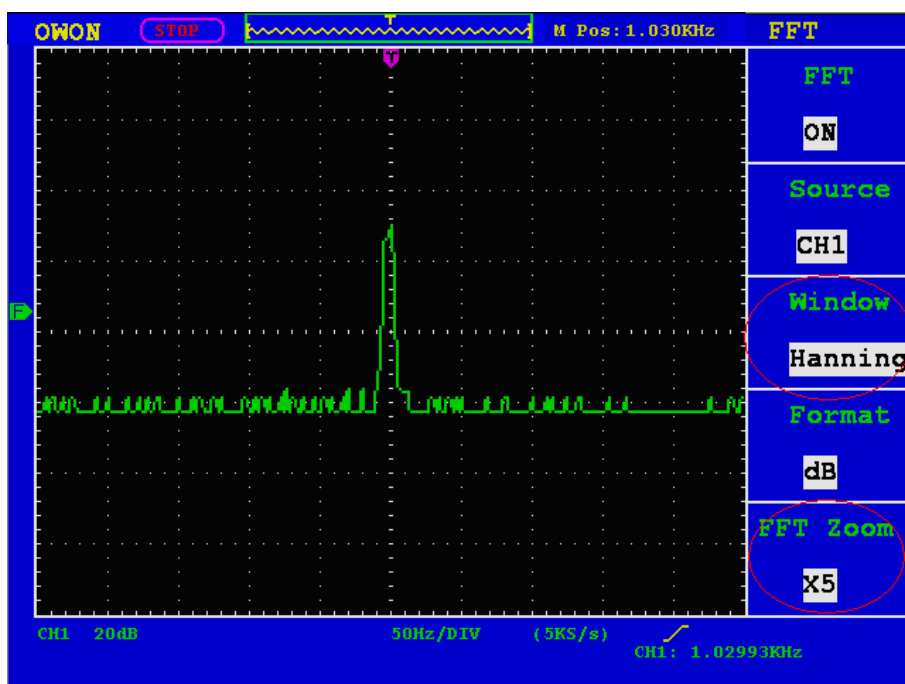


Fig..5-12 . Hanning window

### Quick Tips

- If desired, use the zoom feature to magnify the FFT waveform.
- Use the default dBV RMS scale to see a detailed view of multiple frequencies, even if they have very different amplitudes. Use the linear RMS scale to see an overall view of how all frequencies compare to each other.
- 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.

- To reduce random noise and aliased components in repetitive or single-shot events, set the oscilloscope acquisition mode to average.

### **Term interpretation**

**Nyquist frequency:** The highest frequency that any Real Time Digital Oscilloscope can measure is exactly half of the sampling rate under the condition of no mistakes, which is called Nyquist frequency. If under-sampling occurs when the frequency sampled is higher than Nyquist frequency, “False Wave” phenomenon will appear. So pay more attention to the relation between the frequency being sampled and measured.

### **NOTE:**

In FFT mode, the following settings are prohibited:

- 1) Window set;
- 2) change source channel (in CH1 Setup or CH2 Setup menu);
- 3) XY Format in DISPLAY SET;
- 4) “SET 50%” (the triggering level at the vertical point of signal amplitude) in Trigger setting;
- 5) Autoscale;
- 6) Measure 1 and Measure 2.

## **Application of VERTICAL POSITION and VOLTS/DIV Knobs**

1. The **.VERTIVAL POSITION** knob is used to adjust the vertical positions of the wave forms of all Channels (including those resulted from the mathematical operation).  
The analytic resolution of this control knob changes with the vertical division.
2. The **VOLTS/DIV** knob is used to regulate the vertical resolution of the wave forms of all channels (including those obtained from the mathematical manipulation), which can determine the sensitivity of the vertical division with the sequence of 1-2-5. The vertical sensitivity goes up when the knob is rotated clockwise and goes down when the knob is rotated anticlockwise.
3. When the vertical position of the channel wave form is adjusted, the screen shows the information concerning the vertical position at the lower left corner (see Fig.5-13).

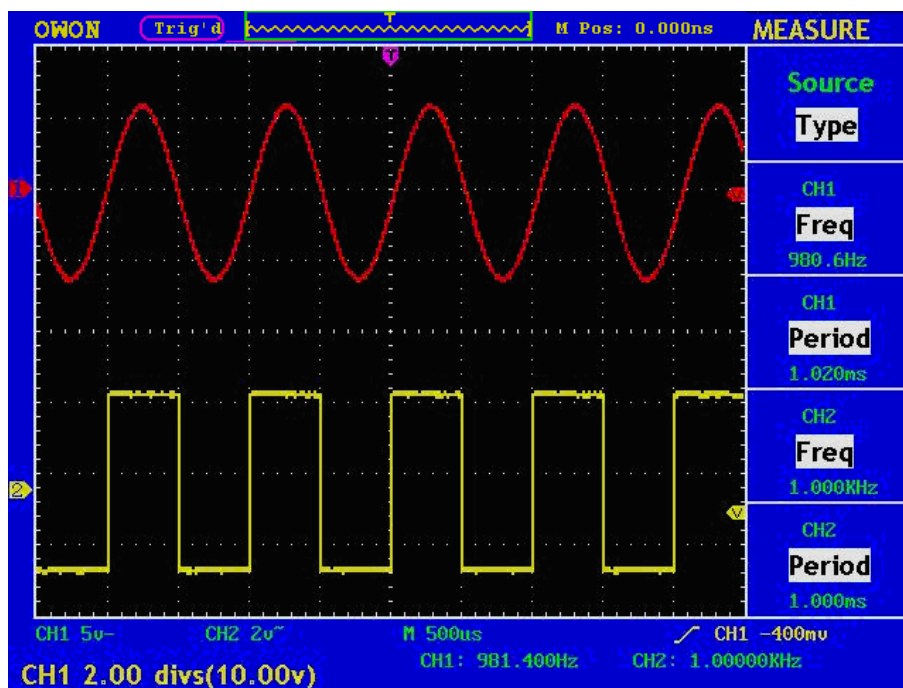


Fig. 5-13 Information about Vertical Position

## How to Set the Horizontal system

The **HORIZONTAL CONTROLS** includes the **HORIZONTAL MENU** button and such knobs as **HORIZONTAL POSITION** and **SEC/DIV**.

1. **HORIZONTAL POSITION** knob: this knob is used to adjust the horizontal positions of all channels (include those obtained from the mathematical manipulation), the analytic resolution of which changes with the time base.
2. **SEC/DIV** knob: it is used to set the horizontal scale factor for setting the main time base or the window.
3. **HORIZONTAL MENU** button: with this button pushed down, the screen shows the operating menu (see Fig. 5-14).



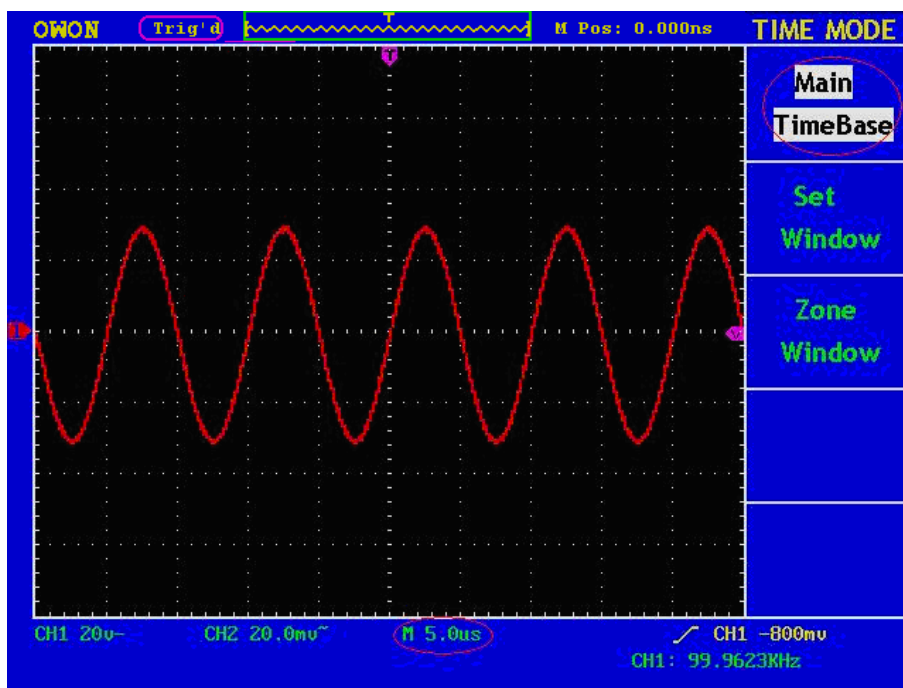
**Fig. 5-14** Time Base Mode Menu

The description of the **Horizontal Menu** is as follows:

| Function Menu  | Setting | Description   |
|----------------|---------|---|
| Main Time Base |         | The setting of the horizontal main time base is used to display the wave form.              |
| Set Window     |         | A window area is defined by two cursors. This function is forbidden at the FFT mode disable |
| Zone Window    |         | The defined window area for display is expanded to the full screen.                         |

### Main Time Base

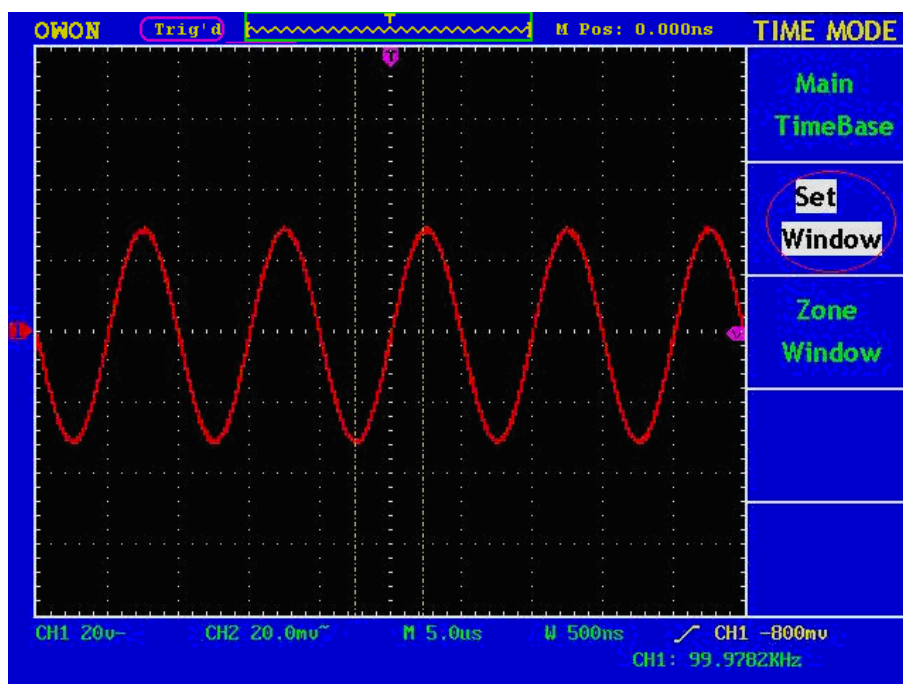
Press the **F1** menu selection button and choose the **Main Time Base**. In this case, the **HORIZONTAL POSITION** and **SEC/DIV** knobs are used to adjust the main window. The display in the screen is shown as Fig.5-15



**Fig. 5-15** Main Time Base

### Set Window

Press the F2 menu selection button and choose **Set Window**. The screen will show a window area defined by two cursors. In this case, the **HORIZONTAL POSITION** and **SEC/DIV** knobs can be used to adjust the horizontal position and size of this window area. Press F2 menu button under the FFT mode ,it will notice “FFT mode disable”.see Fig.5-16.



**Fig. 5-16** Window Setting

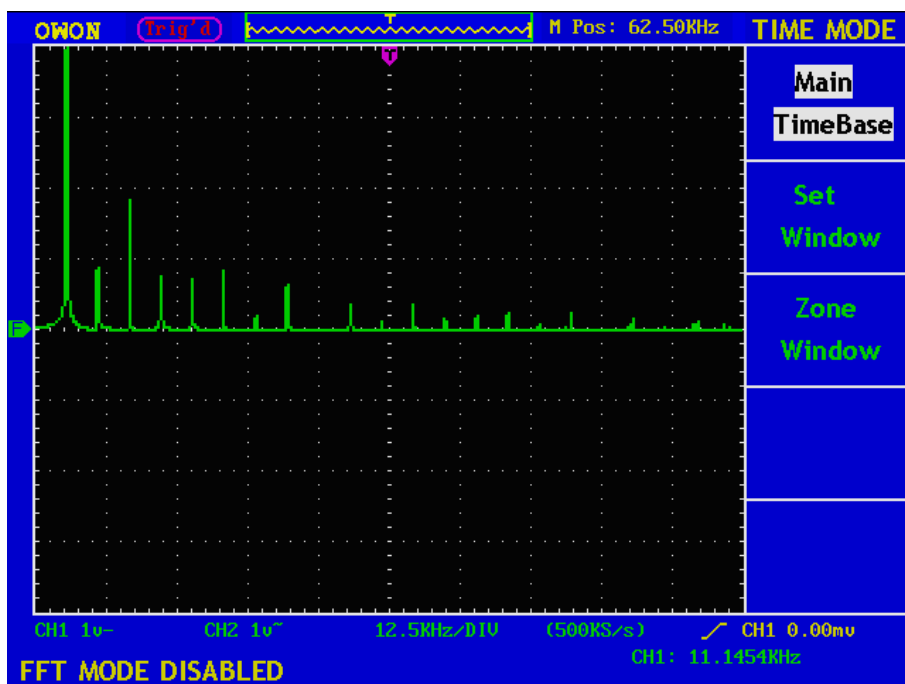


Fig.5-17 Set Window isable under FFT mode

### Window Expansion

Press the **F3** menu selection button and choose **Zone Window**. As a result, the window area defined by two cursors will be expanded to the full screen size (see Fig. 5-18).



Fig. 5-18 Zone Window

## How to set trigger system

Trigger is to determine when DSO starts to acquire data and waveform display. Once trigger to be set correctly then it will convert the unstable display to meaning waveform.

When DSO start to acquire data it will acquire enough data to form waveform on left of trigger point. DSO continues to acquire data when it waits for trigger condition happen. Once it detect out the trigger it will acquire enough data continuously to form the waveform on right of trigger point.

Trigger control area include 1 knob and 4 menu keys.

**Trigger level:** trigger level knob to set signal voltage correspond to trigger point.

**SET 50%:** set trigger level in middle vertical point of trigger signal voltage range, this setting is disable at the FFT mode.

**FORCE TRIG:** Force to a trigger signal and mainly to use in “Normal” and “Single” mode.

**SET TO ZERO:** Trigger horizontal position set to Zero.

**Trig MENU:** Press this key and panel display menu.

### Trigger Control

The oscilloscope provides two trigger types: single trigger and alternate trigger. Press F1 to choose.

**Single trigger:** Use a trigger level to capture stable waveforms in two channels simultaneously

**Alternate trigger:** Trigger on non-synchronized signals.

The **Single Trigger** and **Alternate Trigger** menus are described respectively as follows:

### Single trigger

Single trigger has four modes: edge trigger, video trigger, pulse trigger and slope trigger .

**Edge Trigger:** It happens when a specified voltage level passes through the trigger input in the specified slope direction.

**Video Trigger:** Carry out field or line video trigger on the standard video signal.

**Pulse Trigger :** Use this trigger type to catch pulses with certain pulse width..

**Slope Trigger :** The oscilloscope begins to trigger according to the signal rising or falling speed.

The four trigger modes in Single Trigger are described respectively as follows:

### Edge Trigger

An edge trigger occurs on trigger threshold value of input signal . Select Edge trigger Mode to trigger on Rising edge, falling edge or rising & falling edge

The **Edge Trigger Menu** is shown as Fig.5-19

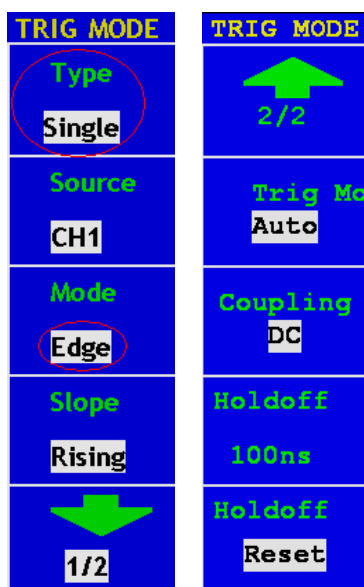


Fig. 5-19 Edge trigger menu

Edge menu list:

| MENU             | SETTING       | INSTRUCTION   |
|------------------|---------------|---|
| Source           | CH1           | Select CH1 as the trigger source.   |
|                  | CH2           | Select CH2 as the trigger source.   |
|                  | EXT           | Ext-trigger   |
|                  | EXT/5         | Ext-trigger divide to 5 and extend trigger level range.                       |
|                  | AC LINE       | AC Line as resource trigger signal.   |
| Mode             | Edge          | Set vertical channel trigger type for edge trigger.                           |
| Slope            | Rising        | Trigger in signal rising edge   |
|                  | Falling       | Trigger in signal falling edge  |
| Trigger mode     | Auto          | Acquire waveform whatever detect trigger condition or not                     |
|                  | Normal        | Only acquire waveform when match trigger condition                            |
|                  | Single        | Only acquire waveform for single time when detect trigger condition then stop |
| Coupling         | AC            | Not allow DC portion to pass.   |
|                  | DC            | Allow all portion pass.   |
|                  | HF            | Not allow high frequency of signal pass and only low frequency portion pass.  |
|                  | LF            | Not allow low frequency of signal pass and only high frequency portion pass   |
| Holdoff          | 100ns~<br>10s | Turn “TRIG LEVEL” knob to set time slot before another trigger event.         |
| Holdoff<br>Reset |               | Reset hold time to 100ns  |

## Video Trigger

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

Trig menu refer to Fig.5-20



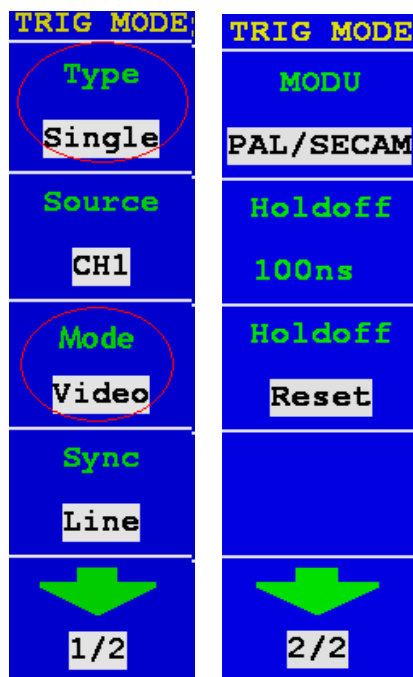


Fig. 5-20 Video trigger menu

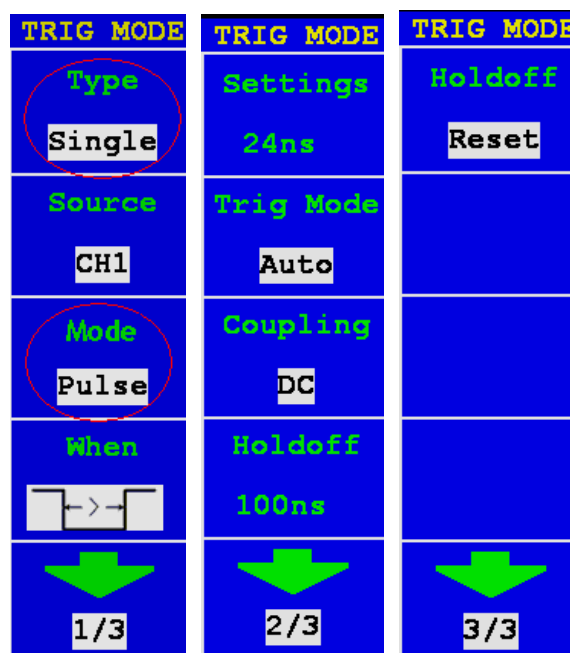
Video menu list

| MENU             | SETTING  | INSTRUCTION   |
|------------------|--|---|
| Source           | CH1<br>CH2<br>EXT<br>EXT/5                               | Select CH1 as the trigger source.<br>Select CH2 as the trigger source.<br>Ext-trigger<br>Ext-trigger divide to 5 to extend trigger level range  |
| Mode             | Video  |   |
| Sync             | Line<br>Field<br>Odd Field<br>EvenField<br>Designed Line | Synchronic trigger in video line.<br>Synchronic trigger in video field.<br>Synchronic trigger in video odd filed<br>Synchronic trigger in video even field<br>Synchronic trigger in designed video line |
| Modulation       | NTSC<br>PAL/SECAM  | Video modulation setting  |
| Holdoff          | 100ns~10s  | Turn “TRIG LEVEL” knob to set time slot before another trigger event  |
| Holdoff<br>Reset |  | Reset hold time to 100ns  |

**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.

The **Pulse Width Trigger Menu** is shown as **Fig. 5-21**.



**Fig. 5-21** Pulse Width Trigger menu

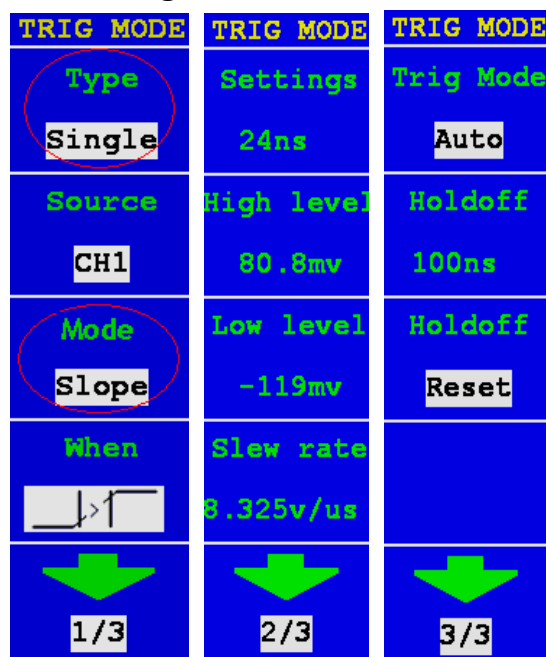
Pulse Width Trigger menu list

| MENU          | SETTING  | INSTRUCTION   |
|---------------|--|---|
| Source        | CH1<br>CH2   | Select CH1 as the trigger source.<br>Select CH2 as the trigger source.  |
| Mode          | Pulse  |   |
| when          |  (+pulse width less than )<br> (+pulse width more than )<br> (+Pulse width equal to )<br> (-Pulse width less than)<br> (-Pulse width more than)<br> (-Pulse width equal to ) | To select pulse width condition   |
| Time setting  | 24ns~10s   | Turn “TRIG LEVEL” knob to set time  |
| Trigger mode  | Auto<br>Normal<br>Single   | Acquire waveform whatever detect trigger condition or not<br>Only acquire waveform when match trigger condition<br>Only acquire waveform for single time when detect trigger condition then stop                        |
| Coupling      | AC<br>DC<br>HF<br>LF   | Not allow DC portion to pass.<br>Allow all portion pass.<br>Not allow high frequency of signal pass and only low frequency portion pass.<br>Not allow low frequency of signal pass and only high frequency portion pass |
| Holdoff       | 100ns~10s  | Turn “TRIG LEVEL” knob to set time slot before another trigger event  |
| Holdoff Reset |  | Reset hold time to 100ns  |

## Slope Trigger

Slope trigger sets the oscilloscope as the positive/negative slope trigger within the specified time.

The **Slope Trigger Menu** is shown as **Fig. 5-22**.



**Fig. 5-22** Slope Trigge menu

Slope Trigger menu list

| MENU          | SETTING                  | INSTRUCTION  |
|---------------|--------------------------|--|
| Source        | CH1<br>CH2               | Select CH1 as the trigger source.<br>Select CH2 as the trigger source.   |
| Mode          | Slope                    |  |
| When          |                          | Set slope condition  |
| Settings      | 24ns~10s                 | Turn “TRIG LEVEL” knob to set slope time   |
| High level    |                          | Turn “TRIG LEVEL” knob to set the High level   |
| Low level     |                          | Turn “TRIG LEVEL” knob to set Low level  |
| Slew rate     |                          | Slew rate=( High level- Low level)/ Settings   |
| Trigger mode  | Auto<br>Normal<br>Single | Acquire waveform whatever detect trigger condition or not<br>Only acquire waveform when match trigger condition<br>Only acquire waveform for single time when detect trigger condition then stop |
| Holdoff       | 100ns~<br>10s            | Turn “TRIG LEVEL” knob to set time slot before another trigger event   |
| Holdoff Reset |                          | Reset hold time to 100ns   |

## Alternate trigger

Trigger signal comes from two vertical channels when alternate trigger is on. This mode is used to observe two unrelated signals. You can choose different trigger modes for different channels. The options are as follows: edge, video, pulse or slope.

### Alternate trigger(Trigger mode: Edge)

Alternate trigger(Trigger Type: Edge) Menu is shown as Fig.5-23.

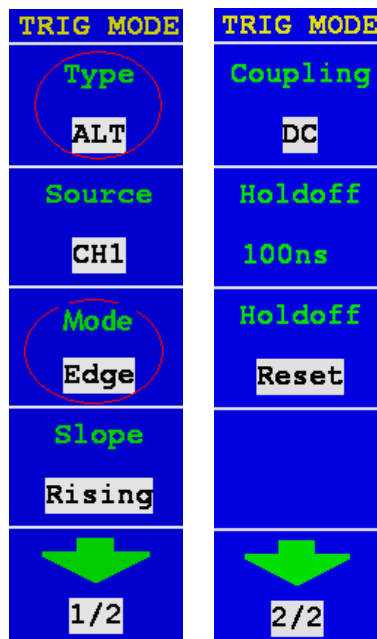


Fig.5-23 Alternate trigger(Trigger Type: Edge) Menu

Alternate trigger(Trigger Type: Edge) Menu list:

| MENU             | SETTING   | INSTRUCTION  |
|------------------|-----------|--|
| Source           | CH1       | Select CH1 as the trigger source.  |
|                  | CH2       | Select CH2 as the trigger source.  |
| Mode             | Edge      | Set vertical channel trigger type for edge trigger.                          |
| Slope            | Rising    | Trigger in signal rising edge  |
|                  | Falling   | Trigger in signal falling edge   |
| Coupling         | AC        | Not allow DC portion to pass.  |
|                  | DC        | Allow all portion pass.  |
|                  | HF        | Not allow high frequency of signal pass and only low frequency portion pass. |
|                  | LF        | Not allow low frequency of signal pass and only high frequency portion pass  |
| Holdoff          | 100ns~10s | Turn “TRIG LEVEL” knob to set time slot before another trigger event.        |
| Holdoff<br>Reset |           | Reset hold time to 100ns   |

## Alternate trigger(Trigger Mode:video)

Alternate trigger(Trigger Type:video) Menu is shown as Fig.5-24.

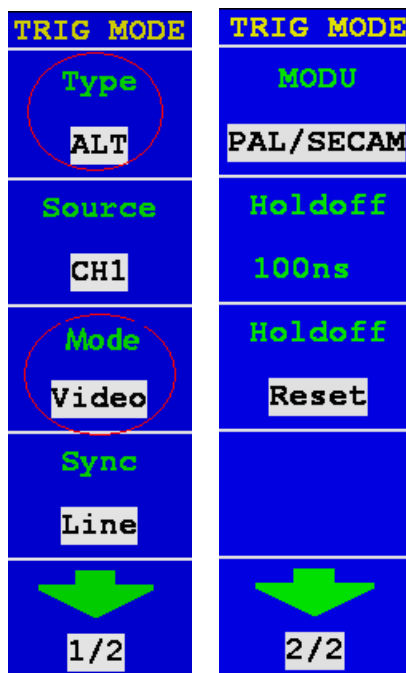


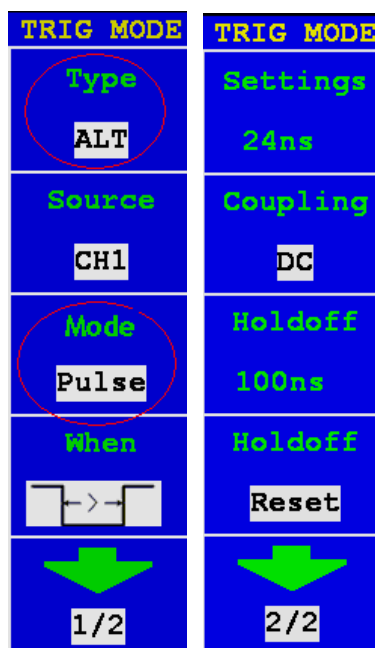
Fig.5-24 Alternate trigger(Trigger Type:video) Menu

Alternate trigger(Trigger Type: video) Menu list:

| MENU             | SETTING  | INSTRUCTION   |
|------------------|--|---|
| Source           | CH1<br>CH2<br>EXT<br>EXT/5                               | Select CH1 as the trigger source.<br>Select CH2 as the trigger source.<br>Ext-trigger<br>Ext-trigger divide to 5 to extend trigger level range  |
| Mode             | Video  |   |
| Sync             | Line<br>Field<br>Odd Field<br>EvenField<br>Designed Line | Synchronic trigger in video line.<br>Synchronic trigger in video field.<br>Synchronic trigger in video odd filed<br>Synchronic trigger in video even field<br>Synchronic trigger in designed video line |
| Modulation       | NTSC<br>PAL/SECAM  | Video modulation setting  |
| Holdoff          | 100ns~10s  | Turn “TRIG LEVEL” knob to set time slot before another trigger event  |
| Holdoff<br>Reset |  | Reset hold time to 100ns  |







## Alternate trigger(Trigger Mode: Pulse)

Alternate trigger(Trigger Type: Pulse) Menu is shown as Fig.5-25.



**Fig.5-25 Alternate trigger(Trigger Type: Pulse) Menu**

Alternate trigger(Trigger Type: Pulse) menu list

| MENU          | SETTING  | INSTRUCTION   |
|---------------|--|---|
| Source        | CH1<br>CH2   | Select CH1 as the trigger source.<br>Select CH2 as the trigger source.  |
| Mode          | Pulse  |   |
| when          |  (+pulse width less than )<br> (+pulse width more than )<br> (+Pulse width equal to)<br> (-Pulse width less than)<br> (-Pulse width more than)<br> (-Pulse width equal to) | To select pulse width condition   |
| settings      | 24ns~10s   | Turn “TRIG LEVEL” knob to set time  |
| Coupling      | AC<br>DC<br>HF<br>LF   | Not allow DC portion to pass.<br>Allow all portion pass.<br>Not allow high frequency of signal pass and only low frequency portion pass.<br>Not allow low frequency of signal pass and only high frequency portion pass |
| Holdoff       | 100ns~10s  | Turn “TRIG LEVEL” knob to set time slot before another trigger event  |
| Holdoff Reset |  | Reset hold time to 100ns  |

## Alternate trigger(Trigger Mode: Slope )

Alternate trigger(Trigger Type: Slope )Menu is shown as Fig.5-26.

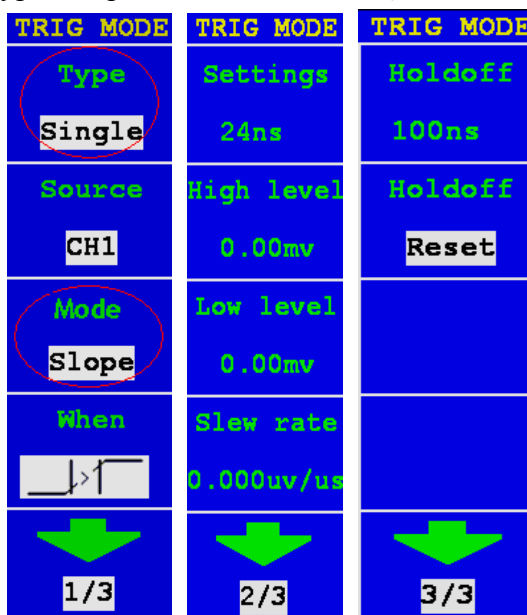


Fig.5-26 Alternate trigger(Trigger Type: Slope )Menu

Alternate trigger(Trigger Type: Slope) menu list:

| MENU            | SETTING              | INSTRUCTION   |
|-----------------|----------------------|---|
| Source          | CH1<br>CH2           | Select CH1 as the trigger source.<br>Select CH2 as the trigger source.  |
| Mode            | Slope                |   |
| Slope Condition | <br><br><br><br><br> | Rising Edge and more than.<br>Rising Edge and less than.<br>Rising Edge and equal to .<br>Falling Edge and more than<br>Negative pulse and less than<br>Negative pulse and equal to                                     |
| settings        | 24ns~10s             | Turn “TRIG LEVEL”knob to set slope time   |
| High level      |                      | Turn“TRIG LEVEL”knob to set the High level  |
| Low level       |                      | Turn “TRIG LEVEL”knob to set Low level  |
| Slew rate       |                      | Slew rate=( High level- Low level)/ Settings  |
| Coupling        | AC<br>DC<br>HF<br>LF | Not allow DC portion to pass.<br>Allow all portion pass.<br>Not allow high frequency of signal pass and only low frequency portion pass.<br>Not allow low frequency of signal pass and only high frequency portion pass |
| Holdoff         | 100ns~<br>10s        | Turn “TRIG LEVEL” knob to set time slot before another trigger event  |
| Holdoff Reset   |                      | Reset hold time to 100ns  |

## Term interpretation

**1. Source:** Trigger can occur from several sources: Input channels (CH1, CH2), AC Line, Ext, Ext/5.

- **Input :** It is the most commonly used trigger source. The channel will work when selected as a trigger source whatever displayed or not.
- **Ext Trig:** The instrument can trigger from a third source while acquiring data from CH1 and CH2. For example, you might want to trigger from an external clock or with a signal from another part of the test circuit. The Ext, Ext/ 5 trigger sources use the external trigger signal connected to the EXT TRIG connector. Ext uses the signal directly; it has a trigger level range of +1.6 V to -1.6 V. The EXT/ 5 trigger source attenuates the signal by 5X, which extends the trigger level range to +8 V to -8 V. This allows 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 power cord, so you do not have to input an AC trigger signal. When AC Line is selected as trigger source, the oscilloscope automatically set coupling to DC, set trigger level to 0V.

## 2. Trigger Mode:

The trigger 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.
- **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, if any, 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.
- **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 what part of the signal passes to the trigger circuit. Coupling types include AC, DC, LF Reject and HF Reject.

- **AC:** AC coupling blocks DC components.
- **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 8 kHz.
- **HF Reject:** HF Reject coupling attenuates all signals with a frequency higher than 150 kHz.

**4. Holdoff:** A time interval before the oscilloscope responds 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 “TRIG LEVEL” knob, then turn it to adjust Holdoff time.

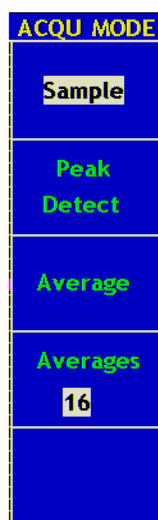


## How to Operate the Function Menu

The function menu control zone includes 7 function menu buttons and 3 immediate-execution buttons: **SAVE/RCL**, **MEASURE**, **ACQUIRE**, **UTILITY**, **CURSOR**, **DISPLAY**, **AUTOSCALE**, **AUTOSET**, **RUN/STOP** and **U-DISK COPY**.

### How to Implement Sampling Setup

Press the **ACQUIRE** button and the menu is displayed in the screen, shown as **Fig.5-27**.



**Fig.5-27** ACQU MODE Menu

The description of the **Sampling Setup Menu** is shown as follows:

| Function Menu | Setting        | Description   |
|---------------|----------------|---|
| Sample        |                | General sampling mode.  |
| Peak Detect   |                | It is used for the detection of the jamming burr and the possibility of reducing the confusion. |
| Average       |                | It is used to reduce the random and don't-care noises, with the optional number of averages.    |
| Averages      | 4, 16, 64, 128 | Choose the number of averages.  |

Change the **ACQU Mode** settings and observe the consequent variation of the wave form displayed.

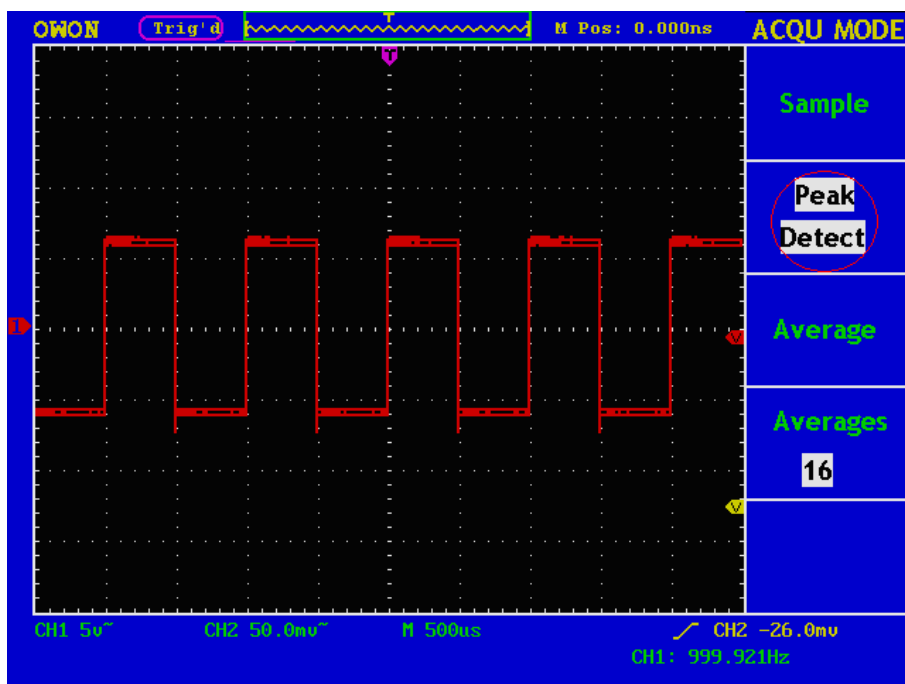


Fig.5-28 Peak Detect mode, under which the burrs on the falling edge of the square wave, can be detected and the noise is heavy.

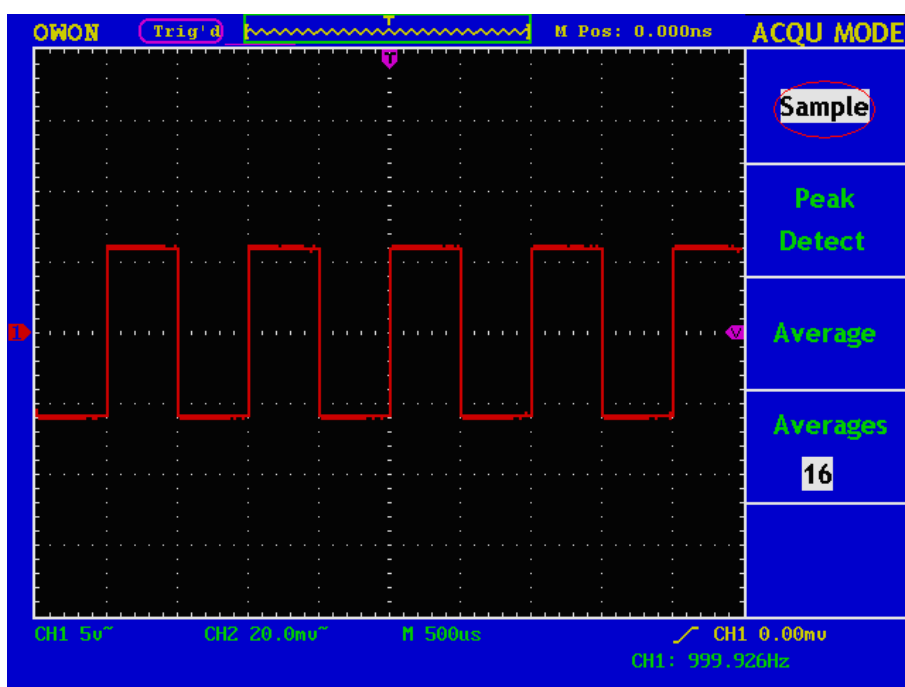
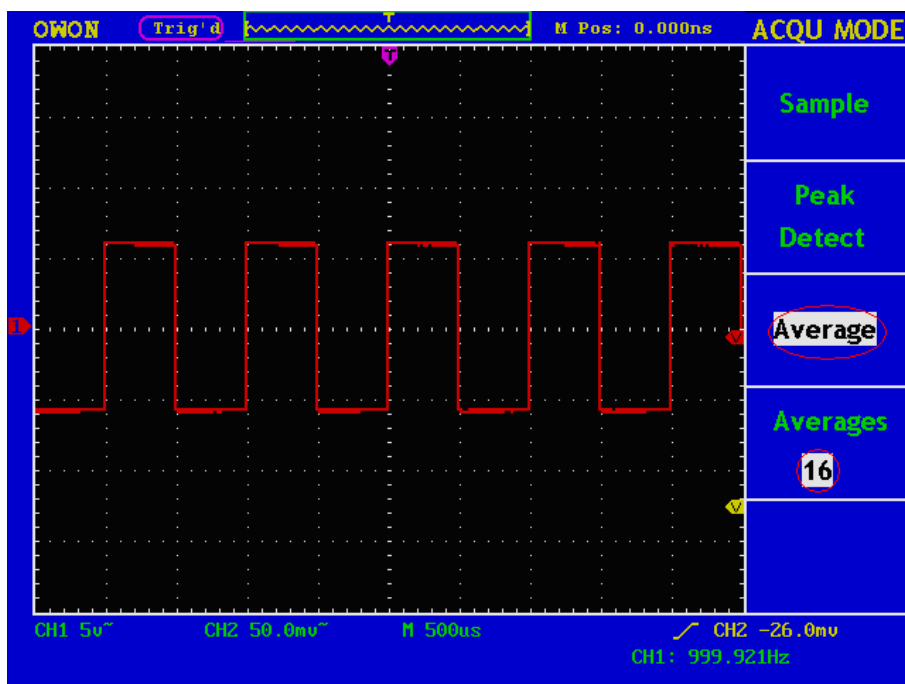


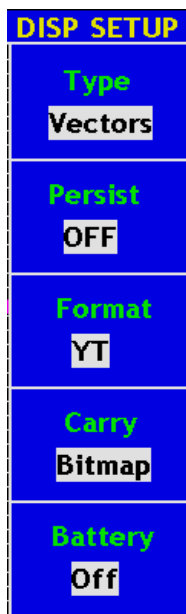
Fig.5-29 Common ACQU Mode display, in which no burr can be detected.



**Fig.5-30** The displayed wave form after the noise is removed under the Average Mode, in which the average number of 16 is set.

### How to Set the Display System

Push down the **DISPLAY** button and the menu displayed in the screen is shown as Fig.5-31.

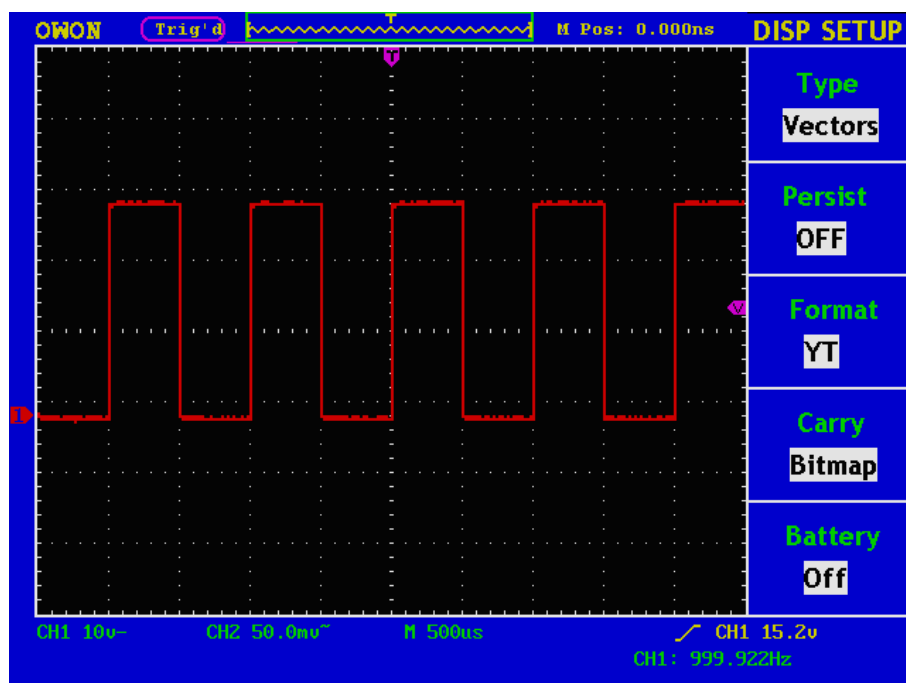


**Fig.5-31** Display Set Menu

The description of the **Display Set Menu** is shown as follows:

| Function Menu | Setting  | Description   |
|---------------|----------|---|
| Type          | Vectors  | The space between the adjacent sampling points in the display is filled with the vector form.       |
|               | Dots     | Only the sampling points are displayed.   |
| Persist       | OFF      | Set the persistence time for each sampling point.   |
|               | 1sec     |   |
|               | 2sec     |   |
|               | 5sec     |   |
|               | Infinite |   |
| Format        | YT       | Show the relative relation between the vertical voltage and the horizontal time.                    |
|               | XY       | Channel 1 is displayed on the horizontal axis and Channel 2 on the vertical axis. FFT mode disable. |
| Carry         | Bitmap   | The data transmitted in communication are in the bitmap form.                                       |
|               | Vectors  | The data transmitted in communication are in the vector form.                                       |
| Battery       | On       | Battery power content symbol on   |
|               | Off      | Battery power content symbol off  |

**Display Type:** With the **F1** menu selection button pushed down, you can shift between **Vectors** and **Dots** types. The differences between the two display types can be observed through the comparison between **Fig.5-32** and **Fig.5-33**.



**Fig.5-32** Display in the Vector Form

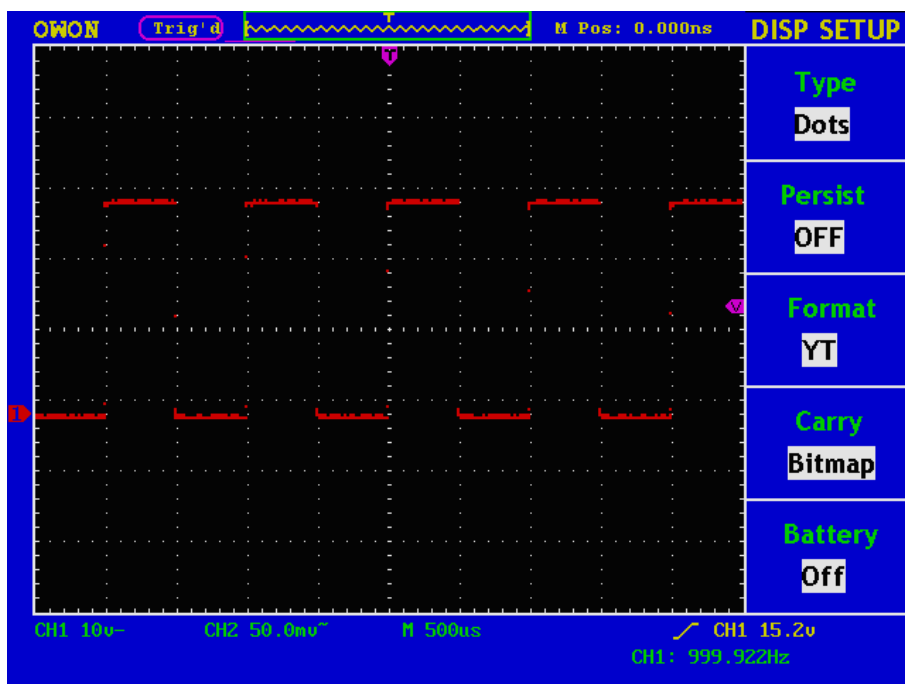


Fig.5-33 Display in Dots form

## Persist

When the **Persist** function is used, the persistence display effect of the picture tube oscilloscope can be simulated: the reserved original data is displayed in fade color and the new data is in bright color. With the **F2** menu selection button, different persistence time can be chosen: **1sec**, **2sec**, **5sec**, **Infinite** and **Closed**. When the “**Infinite**” option is set for **Persist** time, the measuring points will be stored till the controlling value is changed (see Fig.5-34).

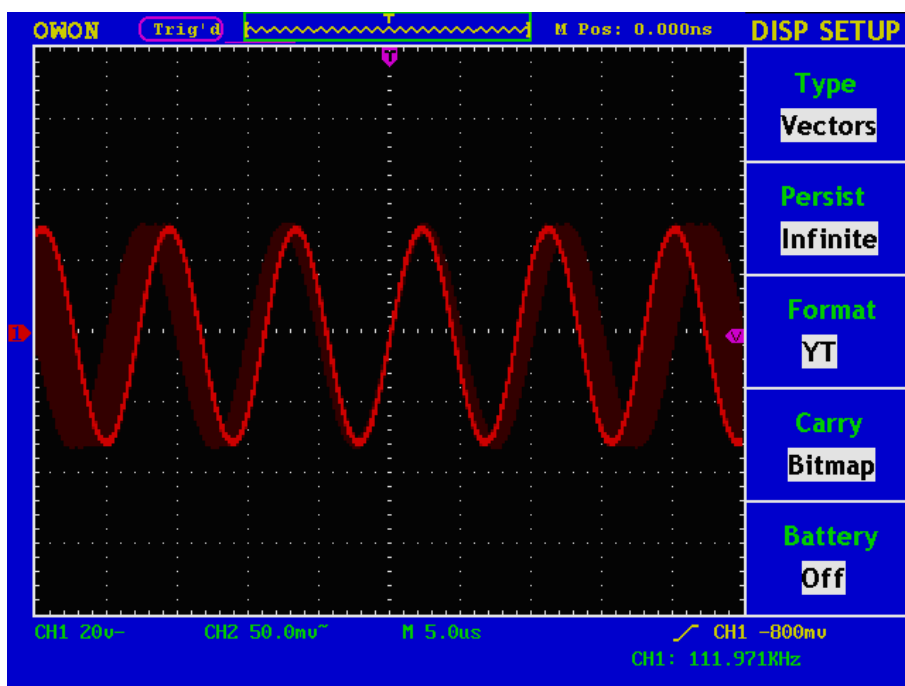


Fig.5-34 Infinite Persistence Display

## XY Format

This format is only applicable to Channel 1 and Channel 2. After the XY display format is selected, Channel 1 is displayed in the horizontal axis and Channel 2 in the vertical axis; the oscilloscope is set in the un-triggered sample mode: the data are displayed as bright spots and the sampling rate is 1MS/s and can not be changed.

**The operations of all control knobs are as follows:**

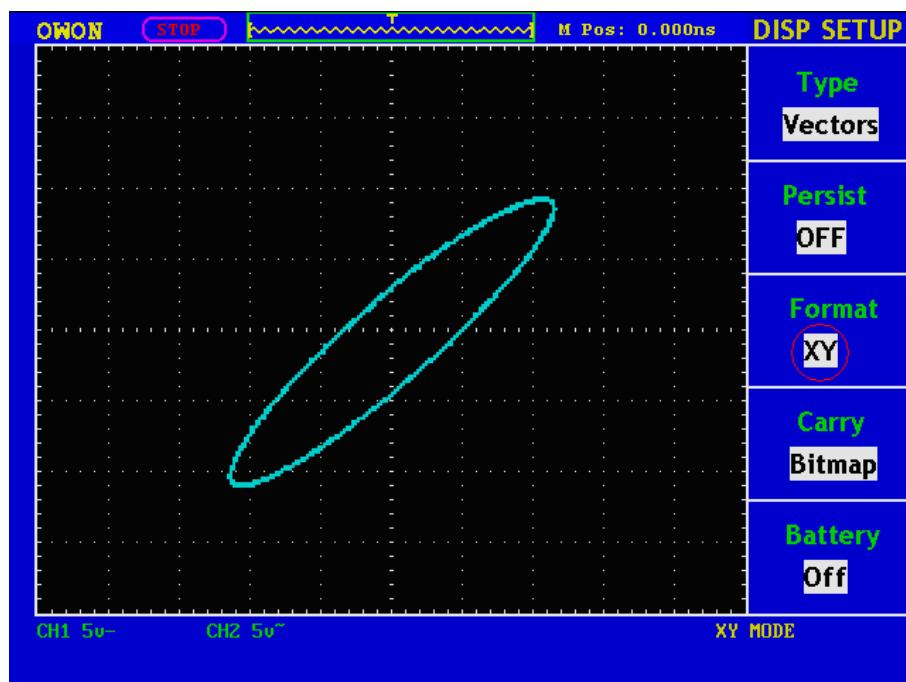
- The **Vertical VOLTS/DIV** and the **Vertical POSITION** knobs of Channel 1 are used to set the horizontal scale and position.
- The **Vertical VOLTS/DIV** and the **Vertical POSITION** knobs of Channel 2 are used to set the vertical scale and position continuously.

**The following functions can not work in the XY Format:**

- Reference or digital wave form
- Cursor
- Time base control
- Trigger control

Operation steps:

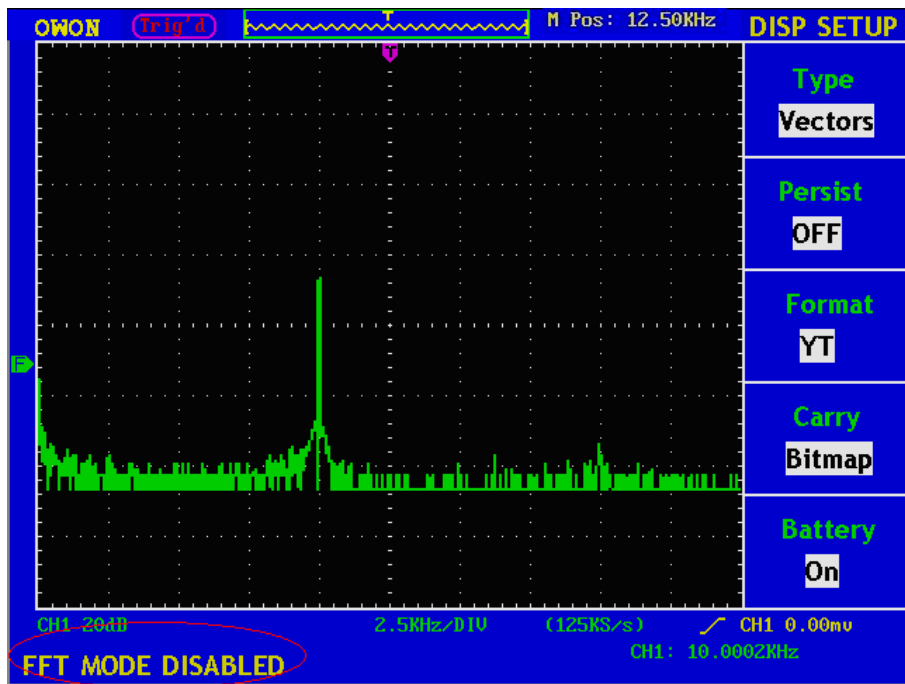
1. Press the **DISPLAY** button and call out the **Display Set Menu**.
2. Press the **F3** menu selection button and choose the form as XY. The display format is changed to be XY mode (see **Fig.5-35**).



**Fig.5-35** XY Display Mode

At the mode of FFT,if switching YT to XY, “FFT MODE is unavailable” prompts as

**Fig.5-36**



**Fig.5-36** FFT mode XY Format Disable

## How to Save and Recall a Wave Form

Press the **SAVE/RCL** button, you can save and call out the waveforms in the instrument. The menu displayed in the screen is shown as **Fig.5-37**.



**Fig.5-37** Wave Form Save Menu

The description of the **Wave Form Save Menu** is shown as the following table:

| Function Menu | Setting                | Description  |
|---------------|------------------------|--|
| Source        | CH1<br>CH2<br>MATH OFF | Choose the wave form to be saved.  |
| WAVE          | A , B<br>C , D         | Choose the address in or from which the waveform is saved or can be get access to. |
| Save          |                        | Save the wave form of the source in the selected address.                          |
| CHA           | OFF<br>ON              | Switch on or off the display of the stored waveform.                               |

### Save and Recall the Wave Form

The PDS series oscilloscope can store four waveforms, which can be displayed with the current waveform at the same time. The stored waveform called out can not be adjusted.

In order to save the waveform of the channel CH1 into the address A, the operation steps should be followed:

1. Press the **F1** menu selection button and choose CH1 for Source.
2. Press the **F2** menu selection button and choose A as save address.
3. Press the **F3** menu selection button and save the waveform.



4. Press the **F4** menu selection button and choose **ON** for CH A. The stored waveform A will be displayed in the screen. The voltage level and time base level will also be shown at the upper left corner of the display area at the same time (see Fig.5-38).

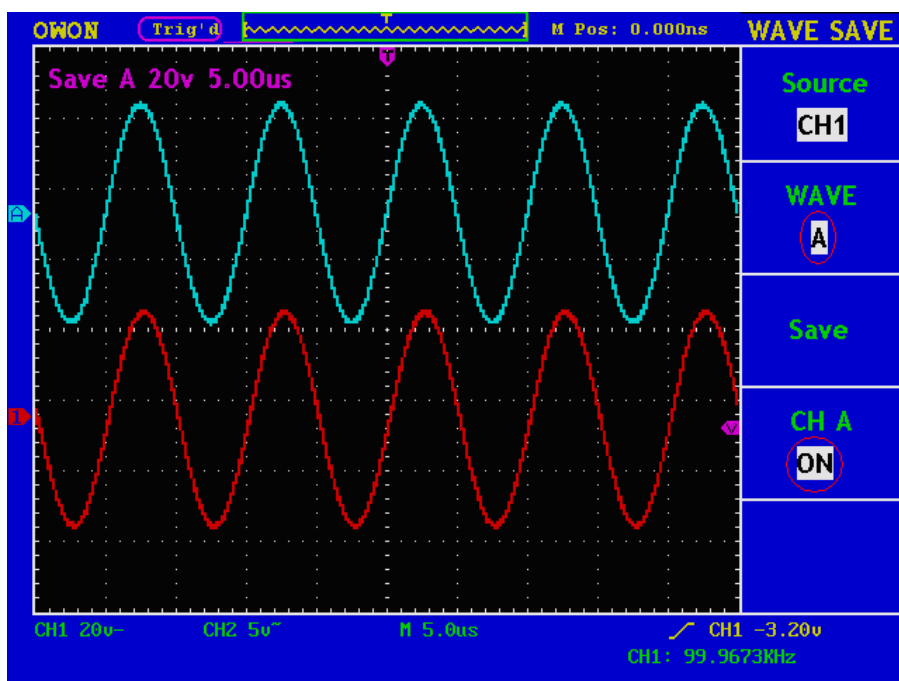


Fig.5-38 Wave Saving

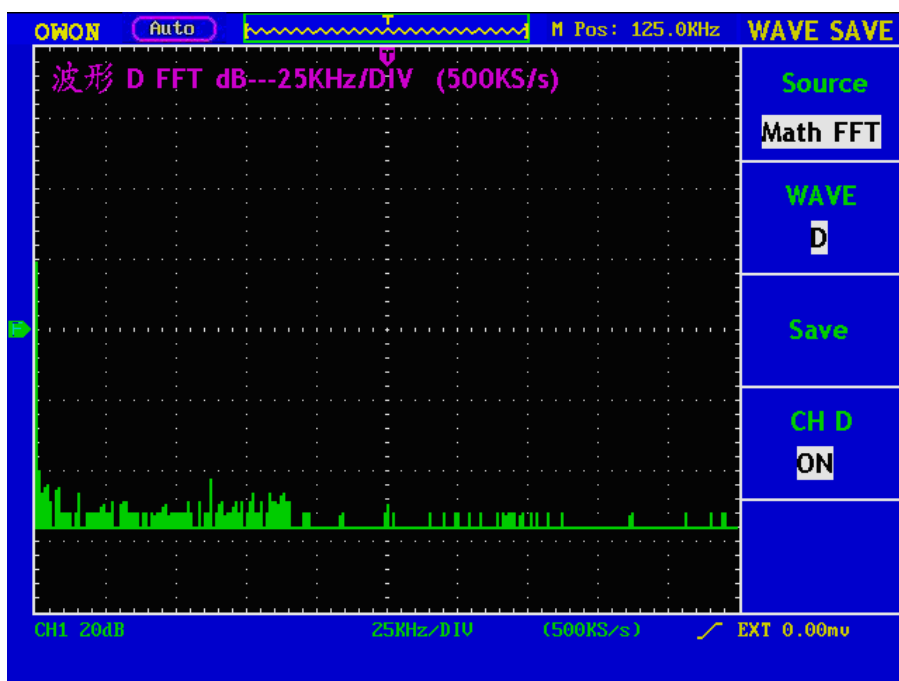


Fig.5-39 FFT wave Saving

## How to Implement the Auxiliary System Function Setting

Press the **UTILITY** button and the menu is displayed in the screen as **Fig.5-40**.



**Fig.5-40** Function Menu

The description of the **Auxiliary Function Menu** is shown as the following table.

| Function Menu  | Setting            | Description  |
|----------------|--------------------|--|
| System Status  |                    | Display the system function menu.                    |
| Recall Factory |                    | Call out the factory settings.                       |
| Do Self Cal    |                    | Carry out the self-calibration procedure.            |
| Language       | Chinese<br>English | Choose the display language of the operating system. |

### Do Self Cal (Self-Calibration)

The self-calibration procedure can improve the accuracy of the oscilloscope under the ambient temperature to the greatest extent. If the change of the ambient temperature is up to or exceeds 5°C, the self-calibration procedure should be executed to obtain the highest level of accuracy.

Before executing the self-calibration procedure, disconnect the probe or wire and the input connector. Then, press the **F3** menu selection button and choose “**Do Self Cal**”. After confirming it is all set, push down **F3** button and choose “**Do Self Cal**”, entering the self-calibration procedure of the instrument.

### SYS STAT (System State)

Press the **F1** menu selection button and choose “**SYS STAT**” item. The menu pops up in the screen as **Fig.5-41**.

**Fig.5-41** SYS STAT Menu

The “**SYS STAT**” menu is described as the following table:

| <b>Function Menu</b> | <b>Setting</b> | <b>Description</b>                            |
|----------------------|----------------|---|
| Horizontal           |                | Show the horizontal parameter of the channel. |
| Vertical             |                | Show the vertical parameter of the channel.   |
| Trigger              |                | Show the parameters of the trigger system.    |
| Misc                 |                | Show the serial number and edition number.    |

After entering into the SYS STAT menu, choose the corresponding function, with the corresponding parameters shown in the screen. If press the **F1** menu selection button and choose the function item “**Horizontal**”, the Horizontal System State will be displayed in the screen. Press any other function button and exit from the SYS STAT menu (see **Fig.5-42**).

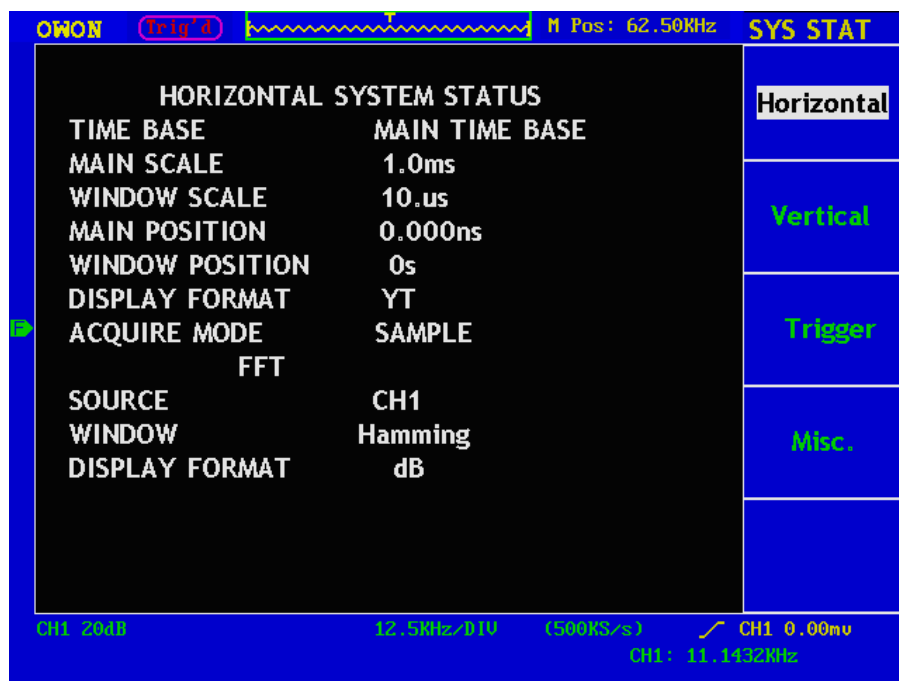


Fig.5-42 Horizontal System State

## How to Implement the Automatic Measurement

With the **Measure** button pressed down, an automatic measurement can be implemented. There are 20 types of measurements and 4 measurement results can be displayed simultaneously.

### Term interpretation:

**V<sub>pp</sub>**: Peak-to-Peak Voltage.

**V<sub>max</sub>**: The maximum amplitude. The most positive peak voltage measured over the entire waveform.

**V<sub>min</sub>**: The minimum amplitude. The most negative peak voltage measured over the entire waveform.

**V<sub>amp</sub>**: Voltage between V<sub>top</sub> and V<sub>base</sub> of a waveform

**V<sub>top</sub>**: Voltage of the waveform's flat top, useful for square/pulse waveforms.

**V<sub>base</sub>**: Voltage of the waveform's flat base, useful for square/pulse waveforms.

**Overshoot**: Defined as  $(V_{max} - V_{top}) / V_{amp}$ , useful for square and pulse waveforms.

**Preshoot**: Defined as  $(V_{min} - V_{base}) / V_{amp}$ , useful for square and pulse waveforms.

**Average**: The arithmetic mean over the entire waveform.

**V<sub>rms</sub>**: The true Root Mean Square voltage over the entire waveform.

**Rise Time**: Time that the leading 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.

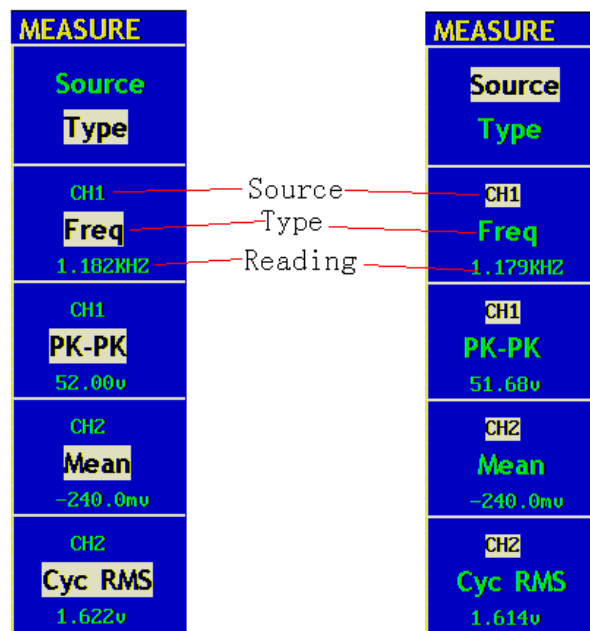
**Delay 1→2**: The delay between the two channels at the rising edge.

**Delay 1→2**: The delay between the two channels at the falling edge.

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

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

Press the **F1** menu selection button to choose **Source** or **Type** menu. You can choose the channel to be measured from the **Source** menu and choose the measurement **Type** (Freq, Period, Mean, PK-PK, and Cyc RMS). The menu is displayed as **Fig.5-43**.



**Fig.5-43** Measure Menu

## Measure

Four automatic measured values can be detected on each channel simultaneously. Only if the waveform channel is in the ON state can the measurement be carried out. No automatic measurement can be made in the following situation: 1) on the saved waveform. 2) on the mathematical waveform. 3) on the XY format. 4) on the Scan format.

Measure the frequency, the peak-to-peak value of the Channel CH1 and the mean, the RMS of the Channel CH2, following below steps:

1. Press the **F1** menu selection button and choose **Source**.
2. Press the **F2** menu selection button and choose **CH1**.
3. Press the **F3** menu selection button and choose **CH1**.
4. Press the **F4** menu selection button and choose **CH2**.
5. Press the **F5** menu selection button and choose **CH2**.
6. Press the **F1** menu selection button and choose **Type**.
7. Press the **F2** menu selection button and choose **Freq**.
8. Press the **F3** menu selection button and choose **Pk-Pk**.

9. Press the **F4** menu selection button and choose **Mean**.
10. Press the **F5** menu selection button and choose **Cyc RMS**.

The measured value will be displayed in the reading window automatically (see Fig.5-44).

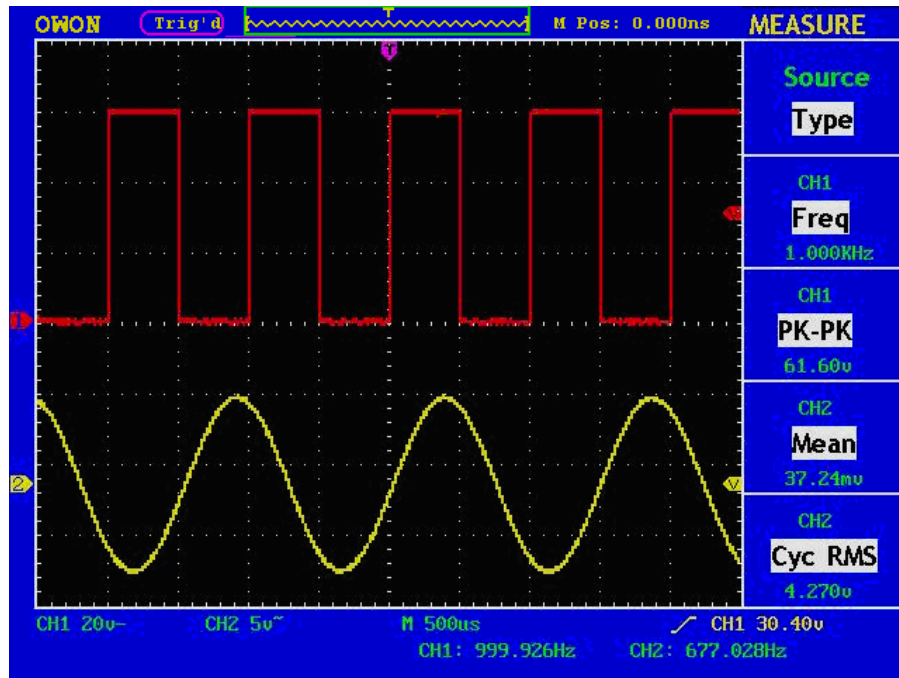


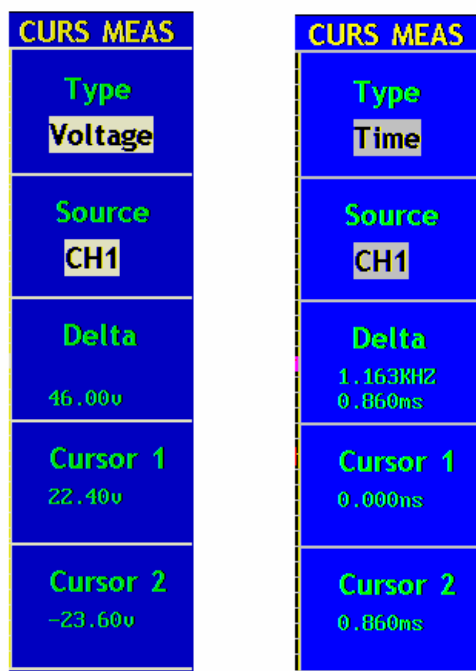
Fig.5-44 Automatic Measurement

## How to Implement the Cursor Measurement

Press the **CURSOR** button to display the cursor measurement function menu (**CURS MEAS**) in the screen.

the Cursor Measurement for normal model:

The cursor measurement includes **Voltage Measurement** and **Time Measurement** at normal model, shown as Fig.5-45.



**Fig.5-45** CURS MEAS Menu

The description of the **cursor measurement menu** is shown as the following table:

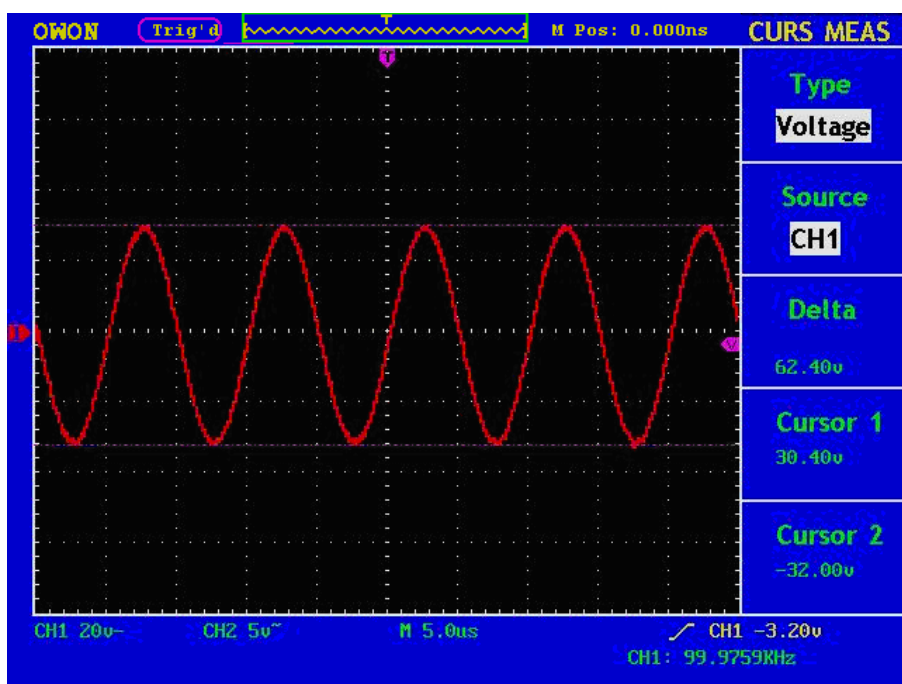
| Function Menu | Setting    | Description   |
|---------------|------------|---|
| Type          | OFF        | Switch off the cursor measurement.  |
|               | Voltage    | Display the voltage measurement cursor and menu.  |
|               | Time       | Display the time measurement cursor and menu.   |
| Source        | CH1<br>CH2 | Display the channel generating the waveform to which the cursor measurement will be applied.  |
| Delta         |            | Read the difference between cursors.  |
| Cursor 1      |            | Read the position of Cursor 1 (the Freq is read with reference to the horizontal trigger position and the Vamp is to the ground point). |
| Cursor 2      |            | Read the position of Cursor 2 (the Freq is read with reference to the horizontal trigger position and the Vamp is to the ground point). |

When carrying out the cursor measurement, the position of Cursor 1 can be adjusted with the **CURSOR1 (VERTICAL POSITION)** knob of Channel 1, and that of Cursor 2 can be adjusted with the **CURSOR2 (VERTICAL POSITION)** knob of Channel 2.

Perform the following operation steps for the voltage cursor measurement of the channel CH1:

1. Press **CURSOR** and recall the **CURS MEAS** menu.
2. Press the **F1** menu selection button to choose **Voltage** for Type, with two purple dotted lines displayed along the horizontal direction of the screen, which

- indicating **CURSOR1** and **CURSOR2**.
- Press the **F2** menu selection button and choose **CH1** for **Source**.
  - Adjust the positions of **CURSOR1** and **CURSOR2** according to the measured waveform, with the absolute value of the voltage amplitude difference between Cursor 1 and Cursor 2 displayed in the increment window. The current position of Cursor1 is displayed in the Cursor1 window and that of Cursor2 is displayed in the Cursor2 window (see **Fig.5-46**).



**Fig.5-46** Waveform of Voltage Cursor Measurement

Carry out the following operation steps for the time cursor measurement of the channel CH1:

- Press “**CURSOR**” and recall the **CURS MEAS** menu.
- Press the **F1** menu selection button and choose **Time** for **Type**, with two purple dotted lines displayed along the vertical direction of the screen, which indicating Cursor 1 and Cursor 2.
- Press the **F2** menu selection button and choose **CH1** for **Source**.
- Adjust the positions of **CURSOR1** and **CURSOR2** according to the measured waveform, with the period and frequency of Cursor1 and Cursor 2 displayed in the increment window. The current position of Cursor1 is displayed in the Cursor1 window and that of Cursor2 is displayed in the Cursor2 window (see **Fig.5-43**).



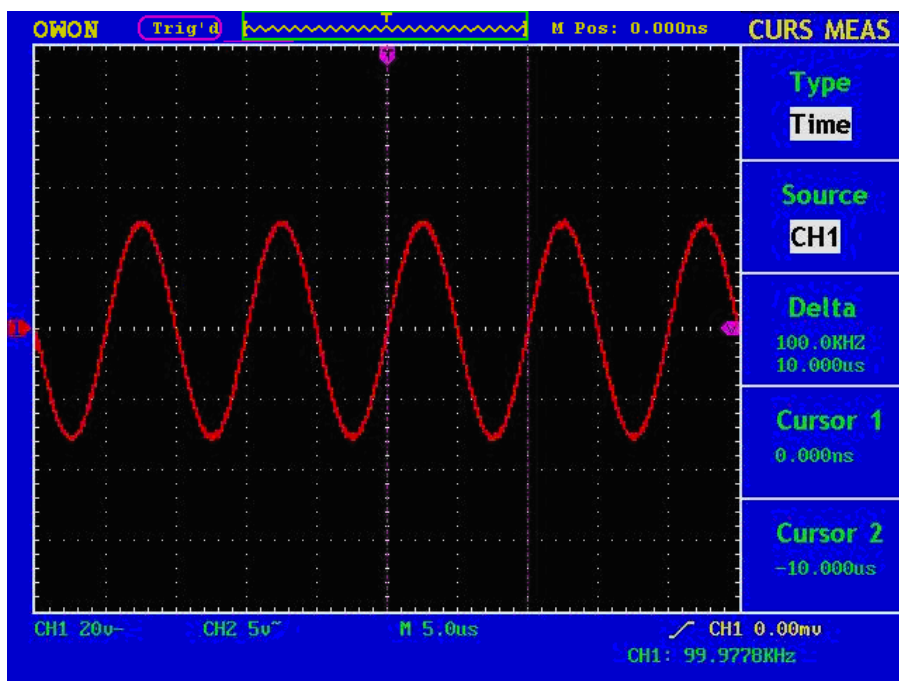


Fig.5-47 Wave Form of Cursor Measurement

the Cursor Measurement for FFT model:

Press the CURSOR button to display the cursor measurement function menu (CURS MEAS) in the screen, which includes Vamp Measurement and Freq Measurement at the mode of FFT, shown as Fig.5-48.

| CURS MEAS                 | CURS MEAS                 |
|---------------------------|---------------------------|
| Type<br><b>Vamp</b>       | Type<br><b>Freq</b>       |
| Source<br><b>MATH FFT</b> | Source<br><b>MATH FFT</b> |
| Delta<br>51.2dB           | Delta<br>125.0HZ          |
| Cursor 1<br>0.0dB         | Cursor 1<br>30.00HZ       |
| Cursor 2<br>-43.2dB       | Cursor 2<br>95.00HZ       |

Fig.5-48 CURS MEAS Menu

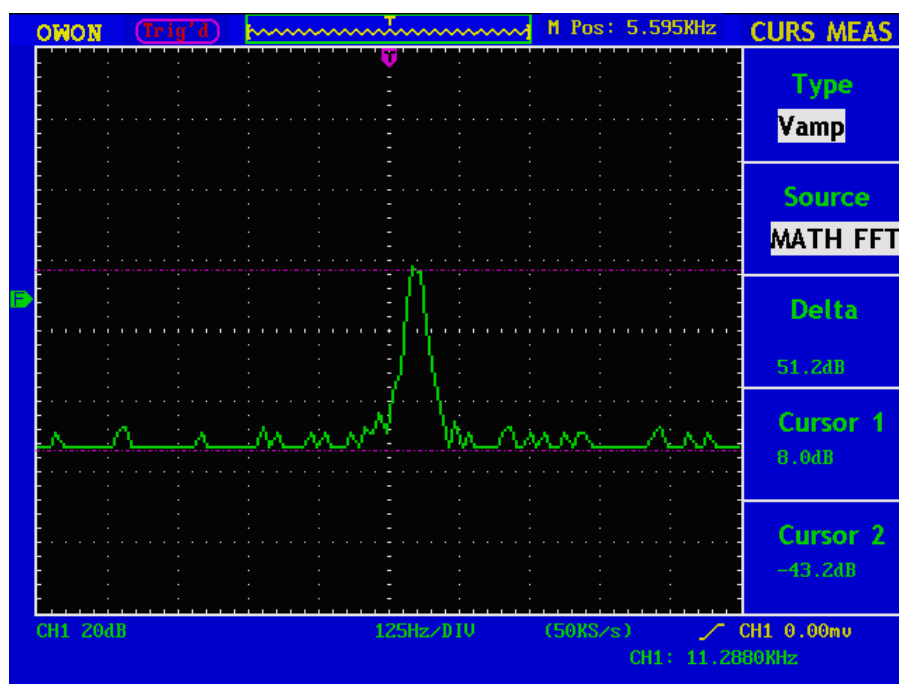
The description of the **cursor measurement menu** is shown as the following table:

| Function Menu | Setting  | Description  |
|---------------|----------|--|
| Type          | OFF      | Switch off the cursor measurement.   |
|               | Vamp     | Display the Vamp measurement cursor and menu.  |
|               | Freq     | Display the Freq measurement cursor and menu.  |
| Source        | MATH FFT | Display the channel for the cursor measure.  |
| Delta         |          | Read the difference between cursors.   |
| Cursor 1      |          | Read the position of Cursor 1 (the Freq is read with reference to the start point of freq spectrum and the Vamp is to the cursor F). |
| Cursor 2      |          | Read the position of Cursor 2 (the Freq is read with reference to the start point of freq spectrum and the Vamp is to the cursor F). |

When carrying out the cursor measurement, the position of Cursor 1 can be adjusted with the CURSOR1 (VERTICAL POSITION) knob of Channel 1, and that of Cursor 2 can be adjusted with the CURSOR2 (VERTICAL POSITION) knob of Channel 2.

Perform the following operation steps for the Vamp cursor measurement :

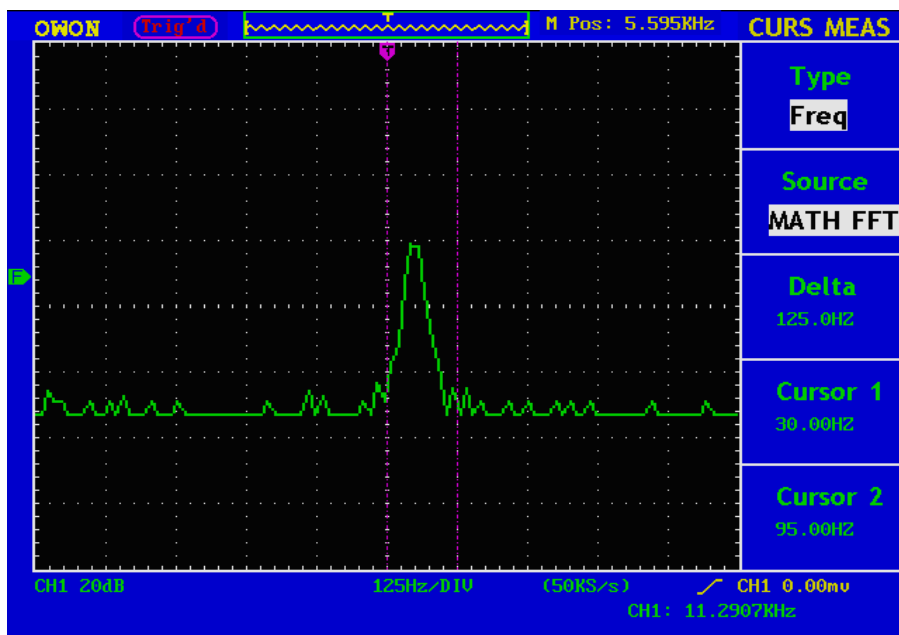
1. Press **CURSOR** and recall the CURS MEAS menu.
2. Press **F1** and choose Vamp for Type, with two purple dotted lines displayed along the horizontal direction of the screen indicating CURSOR1 and CURSOR2.
3. Adjust the positions of CURSOR1 and CURSOR2 according to the measured waveform, with the absolute value of the Vamp amplitude difference between Cursor 1 and Cursor 2 displayed in the increment window. The current position of Cursor1 is displayed in the Cursor1 window and that of Cursor2 is displayed in the Cursor2 window (see **Fig.5-49**).



**Fig.5-49** wave of Vamp cursor measurement

Carry out the following operation steps for the Freq cursor measurement :

1. Press **CURSOR** and recall the CURS MEAS menu.
2. Press **F1** and choose Freq for Type, with two purple dotted lines displayed along the vertical direction of the screen indicating the corresponding Cursor 1 and Cursor 2
3. Adjust the positions of CURSOR1 and CURSOR2 according to the measured waveform, with the period and frequency of Cursor1 and Cursor 2 displayed in the increment window. The current position of Cursor1 is displayed in the Cursor1 window and that of Cursor2 is displayed in the Cursor2 window (see **Fig.5-50**).





**Fig.5-50** wave of Freq cursor measurement

## How to use Autoscale


The function is applied to follow-up signals automatically even if the signals change at any time. Autoscale enables the instrument to set up trigger mode, voltage division and time scale automatically according to the type, amplitude and frequency of the signals.

The menu is as follows:

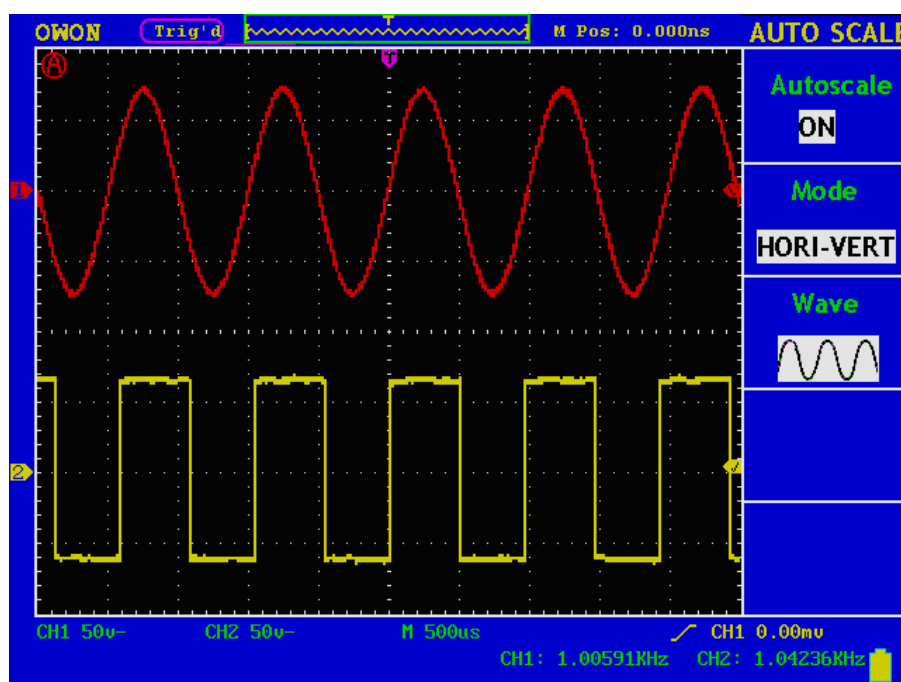
| Function Menu | Setting    | Instruction  |
|---------------|------------|--|
| Autoscale     | OFF        | Turn off Autoscale.  |
|               | ON         | Turn on Autoscale.   |
| Mode          | Vertical   | Follow-up and adjust vertical scale without changing horizontal setting. |
|               | Horizontal | Follow-up and adjust horizontal scale without changing vertical setting. |
|               | HORI—VERT  | Follow-up and adjust the vertical and horizontal settings.               |

|      |   |                               |
|------|---|-------------------------------|
| Wave |  | Only show one or two periods. |
|      |  | Show Multi-period waveforms.  |

If you want to measure the two-channel signal, you can do as the follows:


1. Press **Autoscale**, the function menu will appear on the right of the screen.
2. Press **F1** and choose **ON**.
3. Press **F2** and choose Horizontal- Vertical for **Mode** item.
4. Press **F3** and choose  for **Wave** item.

Then the wave is displayed in the screen, shown as **Fig.5-51**.



**Fig.5-51:** Autoscale Horizontal- Vertical multi-period waveforms

Note:

1. Entering into Autoscale function and  flicker will be on the top left corner. (flicker every 0.5 second)
2. At the mode of Autoscale, the oscilloscope can self-estimate “Trigger Type” (Edge, Video, and Alternate) and “mode” (Edge, Video). If now, you press “Trigger mode” or “Type”, the forbidden information will display on the screen.
3. At the mode of XY and STOP status, pressing **AUTO SET** to enter into Autoscale, DSO switches to YT mode and AUTO status.
4. At the mode of Autoscale, DSO is always in the state of DC coupling and AUTO triggering. In this case, the forbidden information will be showing when making Triggering or Coupling settings.
5. At the mode of Autoscale, if adjust the vertical position, voltage division, trigger level or time scale of CH1 or CH2, the oscilloscope will turn off Autoscale function and if press **AUTOSET** again, the oscilloscope will enter into Autoscale.

6. Turn off the submenu at the Autoscale menu, the Autoscale is off and turn on the submenu still enters into the function.
7. When video triggering, the horizontal time scale is 50us. If one channel is showing edge signal, the other channel is showing video one, the time scale refers to 50us as video one as standard.
8. While the Autoscale is working, below settings will be made forcibly:
  - (1) The unit will switch from non-main time base to main time base status.
  - (2) The unit will switch to Peak detection menu while in the state of Average sampling mode.

## How to Use Executive Buttons

### AUTOSET

This button is used for the automatic setting of all control values of the instrument to generate the waveform suitable for observation. Press the **AUTOSET** button and the oscilloscope will perform the fast automatic measurement of the signal.

The function items of **AUTOSET** are shown as the following table:

| Function Items    | Setting                              |
|-------------------|--------------------------------------|
| Acquisition Mode  | Current                              |
| Vertical Coupling | DC                                   |
| Vertical Scale    | Adjust to the proper division.       |
| Bandwidth         | Full                                 |
| Horizontal Level  | Middle                               |
| Horizontal Sale   | Adjust to the proper division        |
| Trigger Type      | Current                              |
| Trigger Source    | Show the minimum number of channels. |
| Trigger Coupling  | Current                              |
| Trigger Slope     | Current                              |
| Trigger Level     | Mid-point Setting                    |
| Trigger Mode      | Auto                                 |
| Display Format    | YT                                   |

### RUN/STOP

Enable or disable the waveform sampling.

**Notice:** Under the **Stop** state, the vertical division and the horizontal time base of the waveform can be adjusted within a certain range, in other words, the signal can be expanded in the horizontal or vertical direction.

When the horizontal time base equal to or is less than 50ms, the horizontal time base can be expanded for 4 divisions downwards.

### U-DISK COPY

Insert U disk into USB port, then press "COPY" key and you can save the waveform data into the U disk. There is two formats available for choice: Vector format and Bitmap which the

corresponding name will be WAVE1.BIN、 WAVE2.BIN、 WAVE3.BIN.....or WAVE1.BMP、 WAVE2.BMP、 WAVE3.BMP..... Then you can open the files in computer by connecting USB disk to computer.

Noted: During the U disk saving procedure, some notes such as “Waveform saving” 、 “Waveform saved” 、 “USB already connected” 、 “USB connection interrupt ” etc will be prompted.

## 6. Demonstration

### Example 1: Measurement of Simple Signals

Observe an unknown signal in the circuit, and display and measure rapidly the frequency and peak-to-peak value of the signal.

**1. Carry out the following operation steps for the rapid display of this signal:**

1. Set the probe menu attenuation coefficient as **10X** and that of the switch in the probe switch as **10X**.
2. Connect the probe of **Channel 1** to the measured point of the circuit.
3. Push down the **AUTOSET** button.

The oscilloscope will implement the **AUTOSET** to make the wave form optimized, based on which, you can further regulate the vertical and horizontal divisions till the waveform meets your requirement.

**2. Perform Automatic Measurement**

The oscilloscope can measure most displayed signals automatically. Complete the following operations for the measurement of frequency, cycle, mean and peak-to-peak value:

1. Press the **MEASURE** button to show the automatic measurement function menu.
2. Press the **F1** menu selection button and choose **Source**, with the **Source** menu displayed.
3. Press the **F2, F3, F4** and **F5** menu selection buttons and choose **CH1**.
4. Press the **F1** menu selection button again and choose **Type**, with the **Type** menu displayed.
5. Press the **F2** menu selection button and choose **Freq**.
6. Press the **F3** menu selection button and choose **Period**.
7. Press the **F4** menu selection button and choose **Mean**.
8. Press the **F5** menu selection button and choose **Pk-Pk**.

Then, the frequency, cycle, mean and peak-to-peak value will present in the menu and change periodically (see **Fig.6-1**).

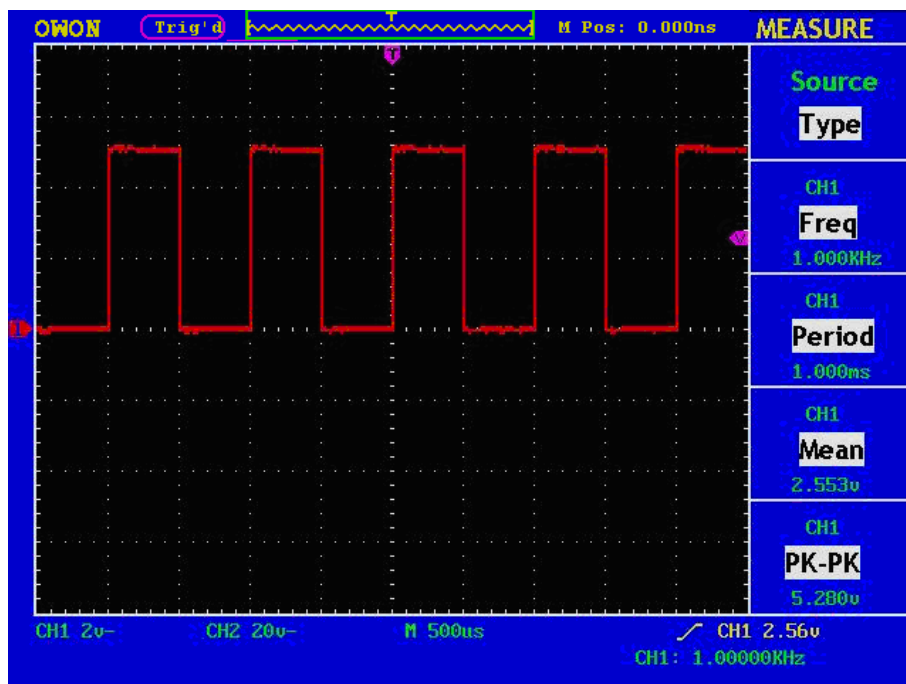


Fig.6-1 Waveform of Automation Measurement

## Example 2: Gain of the Amplifier in the Metering Circuit

Set the probe menu attenuation coefficient as **10X** and that of the switch in the probe as **10X**.

Connect the oscilloscope CH1 channel with the circuit signal input end and the CH2 channel to the output end.

### Operation Steps

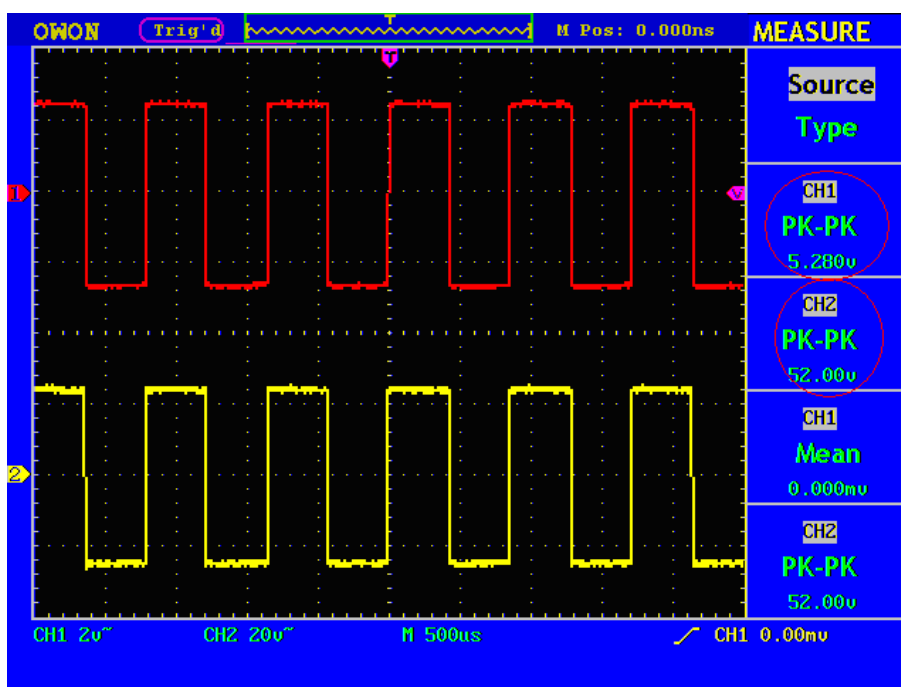
1. Push down the **AUTOSET** button and the oscilloscope will automatically adjust the waveforms of the two channels into the proper display state.
2. Push down the **MEASURE** button to show the MEASURE menu.
3. Press the **F1** menu selection button and choose **Source**.
4. Press the **F2** menu selection button and choose **CH1**.
5. Press the **F3** menu selection button and choose **CH2**.
6. Press the **F1** menu selection button again and choose **Type**.
7. Press the **F2** menu selection button and choose **Pk-Pk**.
8. Press the **F3** menu selection button and choose **Pk-Pk**.
10. Read the peak-to-peak values of Channel 1 and Channel 2 from the displayed menu (see Fig.6-2).



- Calculate the amplifier gain with the following formulas.

$$\text{Gain} = \text{Output Signal} / \text{Input signal}$$

$$\text{Gain (db)} = 20 \times \log (\text{gain})$$



**Fig.6-2** Wave Form of Gain Measurement

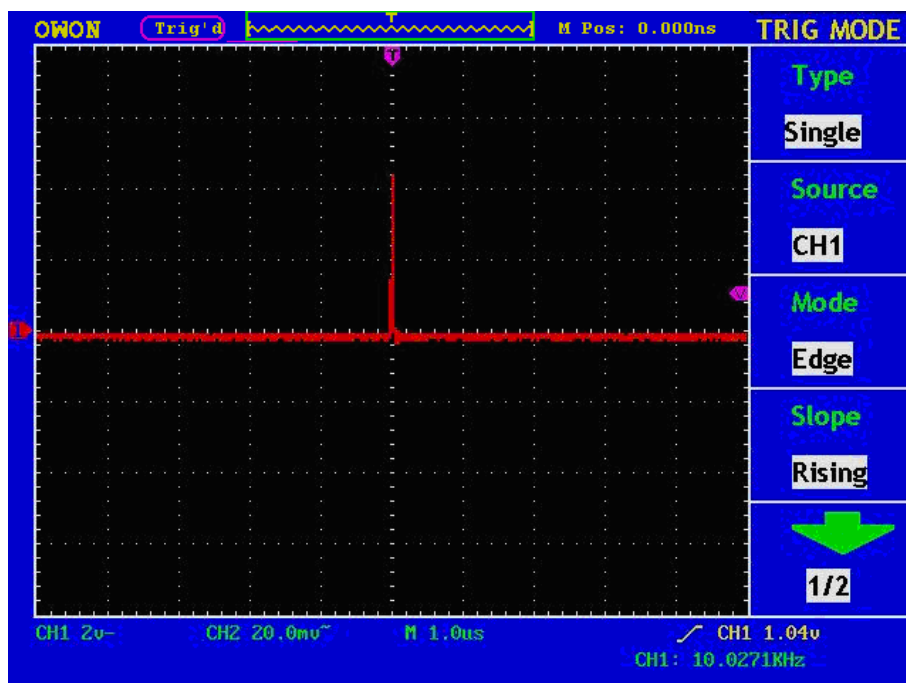
### Example 3: Capture the Single Signal

The digital storage oscilloscope takes the lead in providing the convenience capturing of such non-periodic signals as pulse and burr, etc. If you intent to capture a single signal, you can not set the trigger level and the trigger edge unless you have particular priori knowledge of this signal. For example, if the pulse is the logic signal of a TTL level, the trigger level should be set to 2 volts and the trigger edge be set as the rising edge trigger. If it is uncertain as to the signal, you can make an observation of it in advance under the automatic or ordinary mode to determine the trigger level and the trigger edge.

**The operation steps are as follows:**

- Set the probe menu attenuation coefficient to 10X and that of the switch in the probe to 10X.
- Adjust the **VOLTS/DIV** and **SEC/DIV** knobs to set up a proper vertical and horizontal ranges for the signal to be observed.
- Press the button **ACQUIRE** to display the **ACQUIRE Mode** menu.
- Press the **F2** menu selection button and choose **Peak Detect**.
- Press the **TRIG MENU** button to display the **Trigger Mode** menu.

6. Press the **F1** menu selection button and choose **Single** as the type.
7. Press the **F3** menu selection button and choose **Edge** as the mode.
8. Press the **F4** menu selection button and choose **Rising** as the slope.
9. Press the **F5** menu selection button to next menu.
10. Press the **F2** menu selection button and choose **Single** as the trigger mode.
11. Rotate the **LEVEL** knob and adjust the trigger level to the mid-value of the signal to be measured.
12. If the **Trigger State Indicator** at the top of the screen does not indicate **Ready**, push down the **RUN/STOP** button and start **Acquire**, waiting the emergence of the signal in conformity with the trigger conditions. If a signal reaches to the set trigger level, one sampling will be made and then displayed in the screen. With this function, any random occurrence can be captured easily. Taking the burst burr of larger amplitude for example, set the trigger level to the value just greater than the normal signal level, and then presses the **RUN/STOP** button and waits. When there is a burr occurring, the instrument will trigger automatically and record the wave form generated during the period around the trigger time. With the **HORIZONTAL POSITION** knob in the horizontal control area in the panel rotated, you can change the horizontal position of the trigger position to obtain the negative delay, making an easy observation of the waveform before the burr occurs (see **Fig.6-3**).



**Fig.6-3** Capture the Single Signal

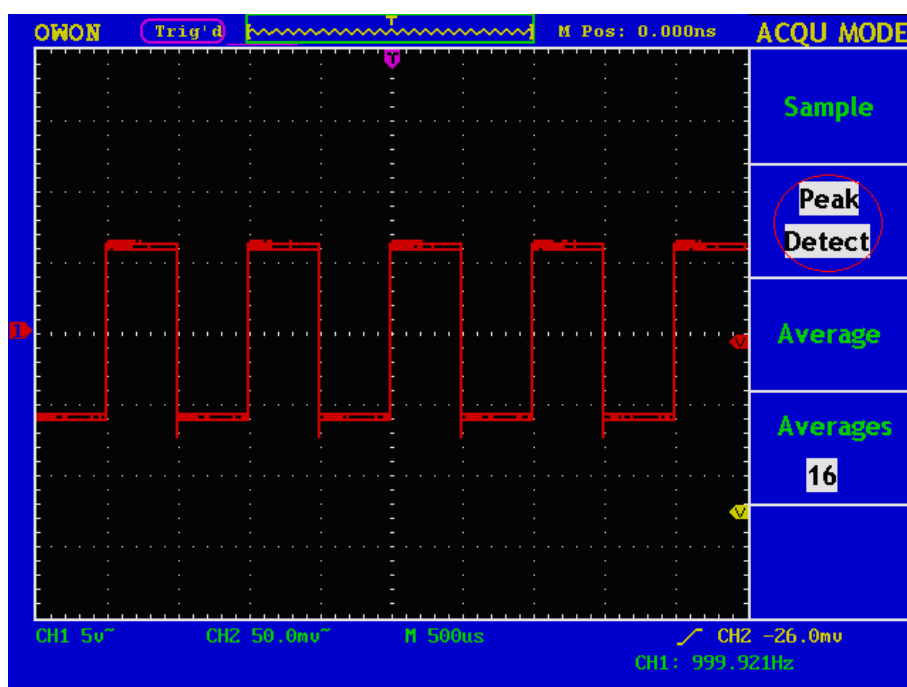
## Example 4: Analyze the Details of a Signal

### Observe the Signal Containing Noises

If the signal is interfered by the noise, the noise may cause a failure in the circuit. For the analyzing of the noise in detail, please operate the instrument according to the following steps:

1. Press the **ACQUIRE** button to display the **ACQU MODE** menu.
2. Press the **F2** menu selection button and choose **Peak Detect**.

In this case, the screen display contains the wave form of a random noise. Especially when the time base is set as Low Speed, then noise peak and burr contained in the signal can be observed with the peak detection (See **Fig.6-4**).



**Fig.6-4** Wave Form of the Signal Containing Noises

### Separate Noises from the Signal

When analyze the wave form of a signal, you should remove the noise contained in it. For the reduction of the random noise in the oscilloscope display, please operate the instrument according to the following step:

1. Press the **ACQUIRE** button to show the **ACQU MODE** menu.
2. Press the **F3** menu selection button and choose **Average**.
3. Press the **F4** menu selection button and observe the wave form obtained from averaging the wave forms of different average number.

After the averaging, the random noise is reduced and the detail of the signal is easier to be observed. Shown as follows, after the noise is removed, the burrs on the rising and falling edges appear (see **Fig.6-5**).

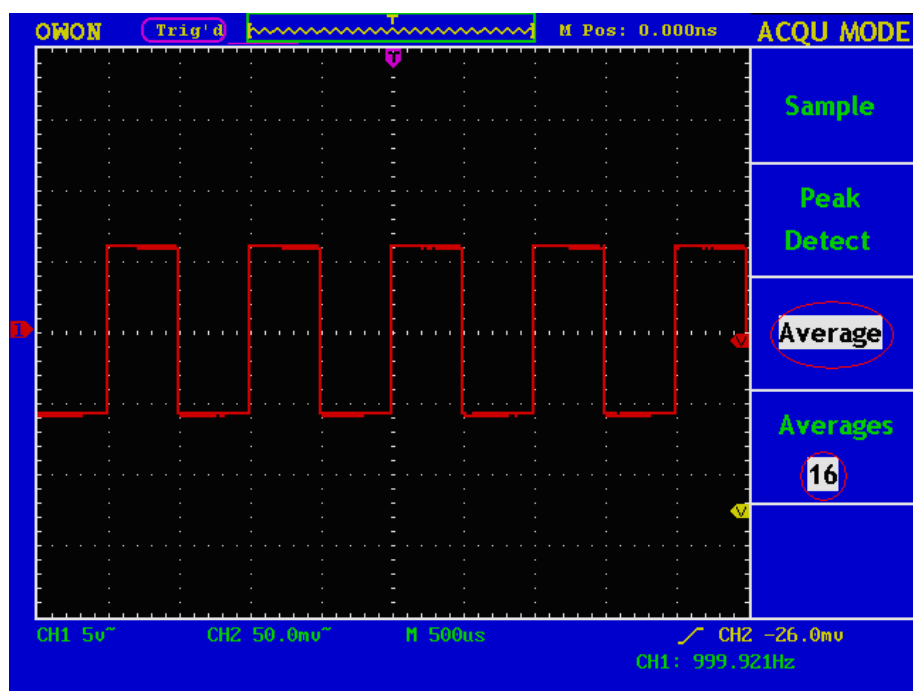


Fig.6-5 Wave Form of the Noise-Removed Signal

## Example 5: Application of X-Y Function

### Examine the Phase Difference between Signals of two Channels

Example: Test the phase change of the signal after it passes through a circuit network.

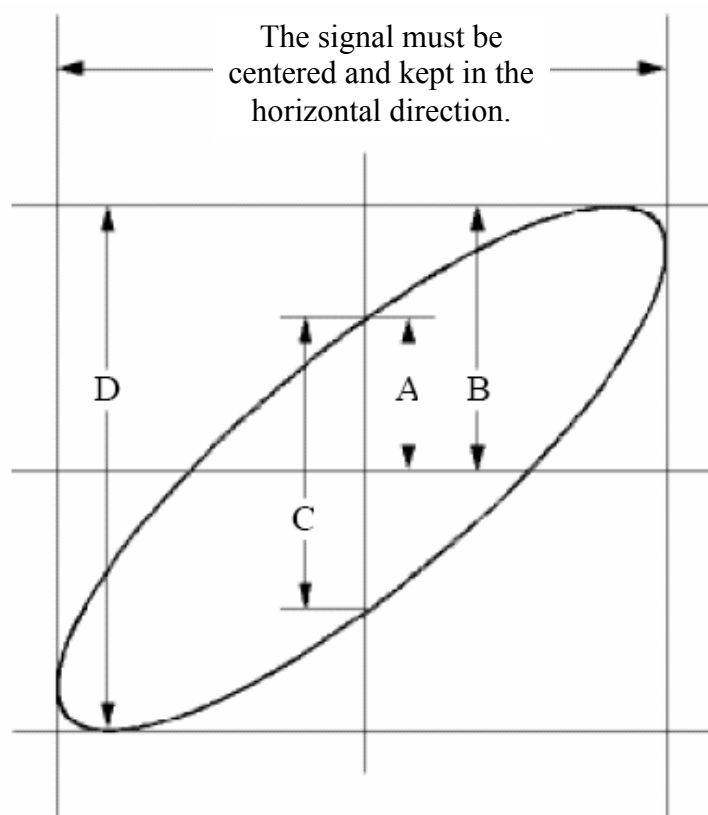
Connect the oscilloscope with the circuit and monitor the input and output signals of the circuit.

For the examination of the input and output of the circuit in the form of X-Y coordinate graph, please operate according to the following steps:

1. Set the probe menu attenuation coefficient for **10X** and that of the switch in the probe for **10X**.
2. Connect the probe of channel 1 to the input of the network and that of Channel 2 to the output of the network.
3. Push down the **AUTOSET** button, with the oscilloscope turning on the signals of the two channels and displaying them in the screen.
5. Adjust the **VOLTS/DIV** knob, making the amplitudes of two signals equal in the rough.
6. Push down the **DISPLAY** button and recall the **DISP SET** menu.
7. Press the F3 menu selection button and choose XY for Format.  
The oscilloscope will display the input and terminal characteristics of the network in the **Lissajous** graph form.
8. Adjust the **VOLTS/DIV** and **VERTICAL POSITION** knobs, optimizing the

wave form.

9. With the elliptical oscillogram method adopted, observe and calculate the phase difference (see Fig.6-6).



**Fig.6-6** Lissajous Graph

Based on the expression  $\sin q = A/B$  or  $C/D$ , where,  $q$  is the phase difference angle, and the definitions of A, B, C, and D are shown as the graph above. As a result, the phase difference angle can be obtained, namely,  $q = \pm \arcsin (A/B)$  or  $\pm \arcsin (C/D)$ . If the principal axis of the ellipse is in the I and III quadrants, the determined phase difference angle should be in the I and IV quadrants, that is, in the range of  $(0 - \pi/2)$  or  $(3\pi/2 - 2\pi)$ . If the principal axis of the ellipse is in the II and IV quadrants, the determined phase difference angle is in the II and III quadrants, that is, within the range of  $(\pi/2 - \pi)$  or  $(\pi - 3\pi/2)$ .

## Example 6: Video Signal Trigger

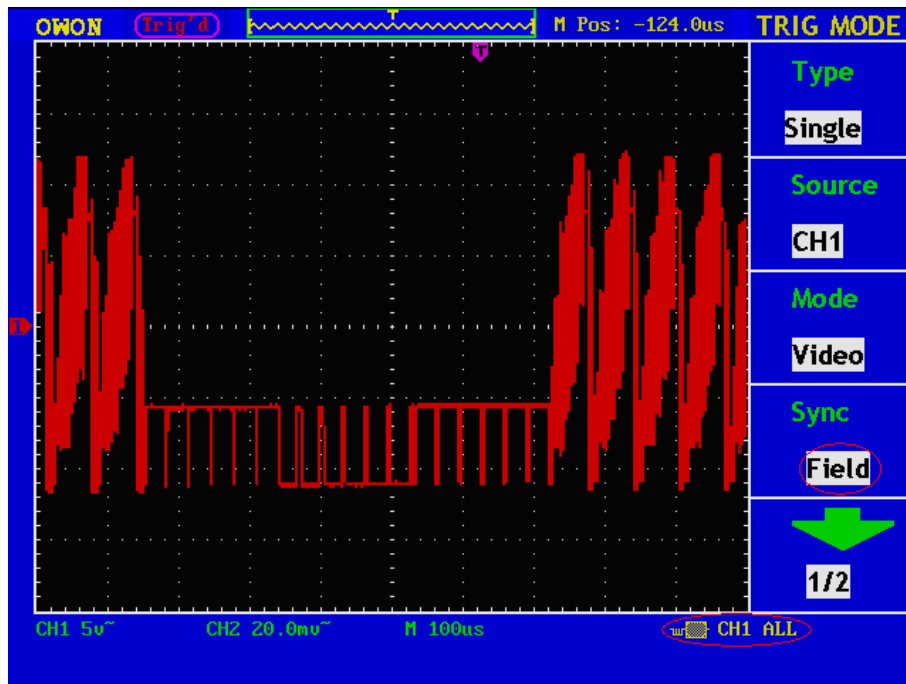
Observe the video circuit of a television, apply the video trigger and obtain the stable video output signal display.

### Video Field Trigger

For the trigger in the video field, carry out operations according to the following steps:

1. Press the **TRIG MENU** button to display the trigger menu.

2. Press the **F1** menu selection button and choose **Single** for Type.
3. Press the **F2** menu selection button and choose **CH1** for Source.
4. Press the **F3** menu selection button and choose **Video** for type.
5. Press the **F4** menu selection button and choose **Field** for Sync.
6. Adjust the **VOLTS/DIV**, **VERTICAL POSITION** and **SEC/DIV** knobs to obtain a proper wave form display (see **Fig.6-7**).



**Fig.6-7** Wave Form Obtained from Video Field Trigger

## 7.F.A.Q

1. **In the case of that the oscilloscope is still in the black-screen state without any display after the power is switch on, implement the following fault treatment procedure.**

- Check whether the power connection is connected properly.
- Check whether the power switch is pushed down to the designated position.
- Restart the instrument after complete the checks above.
- If this product still can not work normally, please get in touch with Lilliput and we will be under your service.

2. **After acquiring the signal, carry out the following operations if the wave form of the signal is not displayed in the screen.**

- Check whether the probe is properly connected to the signal connecting wire.
- Check whether the signal connecting wire is correctly connected to the BNC (namely, the channel connector).
- Check whether the probe is properly connected with the object to be measured.
- Check whether there is any signal generated from the object to be measured (the trouble can be shot by the connection of the channel from which there is a signal generated with the channel in fault).
- Make the signal acquisition operation again.

3. **The measured voltage amplitude value is 10 times greater or smaller than the actual value.**

Check whether the channel attenuation coefficient and the attenuation ration of the probe used in practical application is match.

4. **There is wave form displayed, but it is not stable.**

- Check whether the **Source** item in the **TRIG MODE** menu is in conformity with the signal channel used in the practical application.
- Check on the trigger **Type** item: The common signal chooses the **Edge** trigger mode for **Type** and the video signal the **Video**. Only if a proper trigger mode is applied, the wave form can be displayed steadily.
- Try to change the trigger coupling into the high frequency suppress and the low frequency suppress to smooth the high frequency or low frequency noise triggered by the interference.

5. **No Display Responses to the Push-down of RUN/STOP.**

Check whether Normal or Signal is chosen for Polarity in the TRIG MODE menu and the trigger level exceeds the wave form range.

If it is, make the trigger level is centered in the screen or set the trigger mode as Auto. In addition, with the **AUTOSET** button pressed, the setting above can be completed automatically.

6. **After the AVERAGE value sampling is set in the ACQU MODE or the longer duration is set in the DISP MODE, the display rate is slowed down.**

It is a normal phenomenon.

## 8. Technical Specifications

Unless otherwise specified, the technical specifications applied are applicable to the probe with the attenuation switch setting 10X and the PDS series digital oscilloscope. Only if the oscilloscope fulfill the following two conditions at first, can these specification standards be reached.

- This instrument should run for more than 30 minutes continuously under the specified operating temperature.
- If the change range of the operating temperature is up to or exceeds 5°C, open the system function menu and execute the “Auto-calibration” procedure.

All specification standards can be fulfilled, except one(s) marked with the word “Typical”.

| Performance Characteristics |                                     | Instruction  |
|-----------------------------|-------------------------------------|--|
| Bandwidth                   |                                     | <ul style="list-style-type: none"> <li>● 100MHz----PDS8102T</li> <li>● 200MHz----PDS8202T</li> </ul>   |
| Channel                     |                                     | 2 + 1 (External)   |
| <b>Acquisition:</b>         | Mode                                | Normal, Peak detect, Averaging   |
|                             | Sample rate (real time)             | <ul style="list-style-type: none"> <li>● 1GS/s half channel*, 500MS/s each channel---- PDS8102T</li> <li>● 2GS/s half channel*, 1GS/s each channel---- PDS8202T</li> </ul>                                       |
| <b>Input:</b>               | Input coupling                      | DC, AC, Ground   |
|                             | Input impedance                     | 1MΩ±2%, in parallel with 15pF±5pF  |
|                             | Probe attenuation factor            | 1X, 10X, 100X, 1000X   |
|                             | Max. input voltage                  | 400V (PK-PK) (DC + AC PK-PK)   |
|                             | Bandwidth limit                     | 20MHz、100MHz   |
|                             | Channel isolation                   | 50Hz: 100 : 1<br>10MHz: 40 : 1   |
|                             | Time delay between channel(typical) | 150ps  |
| <b>Horizontal System</b>    | Sampling rate range                 | <ul style="list-style-type: none"> <li>● 1S/s~1GS/s half channel*,<br/>1S/s~500MS/s each channel<br/>---- PDS8102T</li> <li>● 1S/s~2GS/s half channel*,<br/>1S/s~1G S/s each channel<br/>----PDS8202T</li> </ul> |



|                        |  |  |
|------------------------|--|--|
|                        | Interpolation                                | $(\sin x) / x$   |
|                        | Record length                                | 2.5M points on each channel  |
|                        | Scanning speed (S/div)                       | <ul style="list-style-type: none"> <li>● 2ns/div~100s/div, step by 1~2~5<br/>----- PDS8102T</li> <li>● 1ns/div~100s/div, step by 1~2~5<br/>----- PDS8202T</li> </ul> |
|                        | Sampling rate / relay time accuracy          | ±100ppm  |
|                        | Interval ( $\Delta T$ ) accuracy (DC~100MHz) | Single : ±(1 interval time+100ppm×reading+0.6ns);<br>Average>16 : ±(1 interval time +100ppm×reading+0.4ns)   |
| <b>Vertical system</b> | A/D converter                                | 8 bits resolution (2 Channels simultaneously)  |
|                        | Sensitivity                                  | 2mV/div~10V/div (at BNC)   |
|                        | Displacement                                 | ±1V(2mV ~ 50mV), ±10V(100mV ~ 1V), ±100V(2V~10V)   |
|                        | Analog bandwidth                             | <ul style="list-style-type: none"> <li>● 100MHz-----PDS8102T</li> <li>● 200MHz-----PDS8202T</li> </ul>   |
|                        | Single bandwidth                             | Full bandwidth   |
|                        | Low Frequency                                | ≥5Hz (at input, AC coupling, -3dB)   |
|                        | Rise time                                    | <ul style="list-style-type: none"> <li>● ≤3.5 ns (at input, Typical)<br/>----- PDS8102T</li> <li>● ≤1.75 ns (at input, Typical)<br/>-----PDS8202T</li> </ul>         |
|                        | DC accuracy                                  | ±3%  |
|                        | DC accuracy (average)                        | Average > 16: ±(3% rdg + 0.05 div) for $\Delta V$  |
| <b>Measurement</b>     | Cursor                                       | $\Delta V$ and $\Delta T$ between cursors  |

|                           |  |   |                |
|---------------------------|--|---|----------------|
|                           | Automatic                              | Vpp, Vmax, Vmin, Vtop, Vbase, Vamp, Vavg, Vrms, Overshoot, Preshoot, Freq, Period, Rise Time, Fall Time, DelayA→B $\frac{1}{f}$ , DelayA→B $\frac{1}{T}$ , +Width, -Width, +Duty, -Duty |                |
|                           | Waveform Math                          | +, -, *, /, FFT   |                |
|                           | Waveform storage                       | 4 waveforms   |                |
|                           | Lissajou's figure                      | Bandwidth   | Full bandwidth |
|                           |  | Phase difference  | ±3 degrees     |
| Frequency ( typical)      | 1KHz square wave                       |   |                |
| <b>Communication port</b> | USB1.1 or RS-232, USB for file storage |   |                |

\* Half channel is when only one input channel is available.

#### Trigger:

|                                  |   |  |
|----------------------------------|---|--|
| Trigger level range              | Internal                                  | ±6 div from the screen center                          |
|                                  | EXT                                       | ±600mV   |
|                                  | EXT/5                                     | ±3V  |
| Trigger level Accuracy (typical) | Internal                                  | ±0.3div  |
|                                  | EXT                                       | ±(40mV + 6% of Set Value)                              |
|                                  | EXT/5                                     | ±(200mV + 6% of Set Value)                             |
| Trigger displacement             | Pre-trigger: 655 div, Post-trigger: 4 div |  |
| Trigger Holdoff range            | 100ns~10s                                 |  |
| 50% level setting (typical)      | Input signal frequency ≥50Hz              |  |
| Edge trigger                     | slope                                     | Rising, Falling  |
|                                  | Sensitivity                               | 0.3div   |
| Pulse trigger                    | Trigger condition                         | Positive pulse: >, <, =<br>negative pulse: >, <, =     |
|                                  | Pulse Width range                         | 24ns~10s   |
| Video Trigger                    | Modulation                                | Support standard NTSC, PAL and SECAM broadcast systems |

|                   |                   |  |
|-------------------|-------------------|--|
|                   | Line number range | 1-525 (NTSC) and 1-625 (PAL/SECAM)             |
| Slope Trigger     | Trigger condition | Positive pulse: >、<、=<br>negative pulse: >、<、= |
|                   | Time setting      | 24ns~10s                                       |
| Alternate Trigger | Trigger on CH1    | Edge, Pulse, Video, Slope                      |
|                   | Trigger on CH2    | Edge, Pulse, Video, Slope                      |

## General Technical Specifications

### Display

|                    |  |
|--------------------|--|
| Display Type       | 8" Colored LCD (Liquid Crystal Display)  |
| Display Resolution | 640 (Horizontal) × 480 (Vertical) Pixels |
| Display Colors     | 65536 colors, TFT screen                 |

### Output of the Probe Compensator

|                           |   |
|---------------------------|---|
| Output Voltage (Typical ) | About 5V, with the Peak-to-Peak value equal to or greater than 1MΩ of load. |
| Frequency (Typical )      | Square wave of 1KHz   |

### Power

|                   |                                  |
|-------------------|----------------------------------|
| Mains Voltage     | 100~240 VAC RMS, 50/60Hz, CAT II |
| Power Consumption | < 18W                            |
| Fuse              | 1A, T grade, 250V                |

### Environment

|                   |   |
|-------------------|---|
| Temperature       | Working temperature: 0 °C ~ 40 °C<br>Storage temperature: -20 °C ~ +60 °C |
| Relative Humidity | ≤ 90%   |
| Height            | Operating: 3,000 m<br>Non-operating: 15,000 m                             |
| Cooling Method    | Natural convection  |

### Mechanical Specifications

|           |                    |
|-----------|--------------------|
| Dimension | 370mm× 180mm×120mm |
| Weight    | 2.2 kilogram       |

### Interval Period of Adjustment:

One year is recommended for the calibration interval period.

## 9. Appendix

### Appendix A: Enclosure

#### Standard Accessories:

- Passive probe: 2, 1.2 m, 1:1 (10:1)
- CD: x 1 (PC link application software)
- RS232 data line or USB data line
- Power line: one, up to the standards of the country in which it is used.
- User Manual: One

#### Options:

- Battery

### Appendix B: Maintenance, Cleaning and Repairing

#### General Maintenance

Please don't store or put the instrument in the place where the liquid crystal display will be directly exposed to the sunlight for a long time.

**Caution:** The instrument or probe should not be stained with the spraying agent, liquid and solvent to avoid any damage to it.

#### Cleaning /

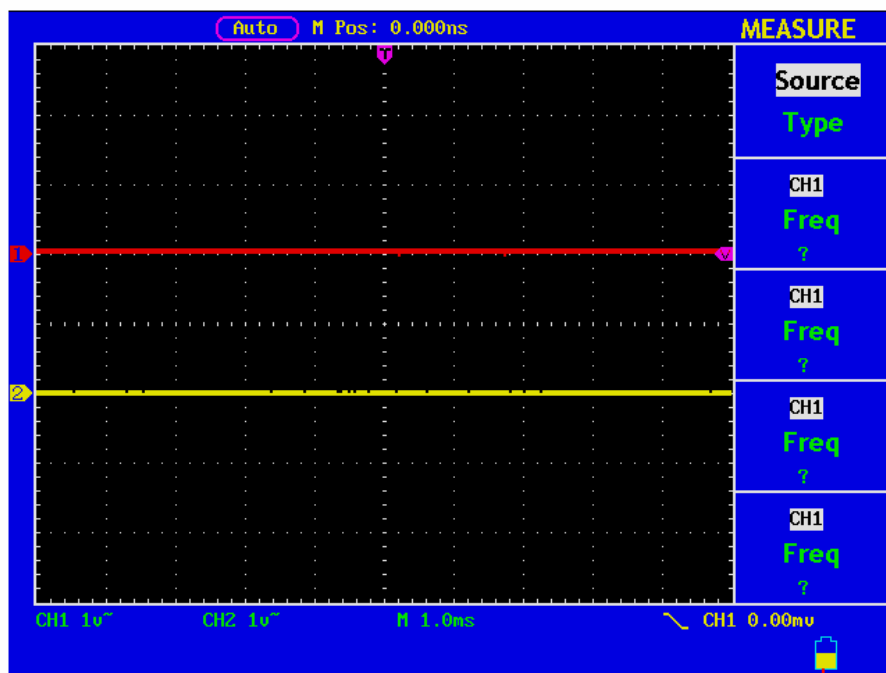
Check the probe and instrument regularly according to their operating state. Clean the external surface of the instrument following the steps shown below:

1. Please wipe the dust from the instrument and probe surface with a soft cloth. Do not make any scuffing on the transparent LCD protection screen when clean the LCD screen.
2. Clean the instrument with a wet soft cloth not dripping water, during the period of which please pay attention to the disconnection of power. It is recommended to scrub with soft detergent or fresh water. Please don't apply any corrosive chemical cleaning agent to prevent the instrument or probe from damage.



**Warn:** Before power on again for operation, it is required to confirm that the instrument has already been dried completely, avoiding any electrical short circuit or bodily injury resulting from the moisture.

## Appendix C: Battery Using Guide



Battery electric quantity indicating symbols including: and

### Charging the oscilloscope

The lithium battery maybe not be charged when delivery. Please charge the battery for 12 hours to make sure enough power to supply (the oscilloscope should be turned on during charging) to oscilloscope. The battery can supply power for 4 hours after being charged completely.

There will have battery power indication show on the top of panel when oscilloscope power supplied by the battery. and imply for different power consumption and when shows it means the power can only supply for 5 minutes maximum.

### Note:

To avoid superheat of battery during charging, the environment temperature is not allowed to exceed the permissible value given in technical specification.

### Replacing the Lithium Battery Unit

It is usually not required to replace the battery unit. But when it is required to replace it, only qualified personnel can carry out this operation, and only use the same specification lithium battery.