HDS200 Dual Channel Series

Handheld Oscilloscope User Manual

- **HDS242（S）**
- **HDS272（S）**
- **HDS2102（S）**
- **HDS2202（S）**

For product support, visit:www.owon.com.hk/download

※：The illustrations, interface, icons and characters in the user manual may be slightly different from the actual product. Please refer to the actual product.

May 2026 edition V1.1.2

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General Warranty

We warrant that the product will be free from defects in materials and workmanship for a period of 3 years from the date of purchase of the product by the original purchaser from the our Company. The warranty period for accessories such as probes, adapter is 12 months. This warranty only applies to the original purchaser and is not transferable to a third party.

If the product proves defective during the warranty period, we will either repair the defective product without charge for parts and labour, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by our company for warranty work may be new or reconditioned like new. All replaced parts, modules and products become the property of our company.

In order to obtain service under this warranty, the customer must notify our company of the defect before the expiration of the warranty period. Customer shall be responsible for packaging and shipping the defective product to the designated service centre, a copy of the customers proof of purchase is also required.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. We shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than our company representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of not our supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

Please contact the nearest Sales and Service Offices for services.

Excepting the after-sales services provided in this summary or the applicable warranty statements, we will not offer any guarantee for maintenance definitely declared or hinted, including but not limited to the implied guarantee for marketability and special-purpose acceptability. We should not take any responsibilities for any indirect, special or consequent damages

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1. Safety Information

(Before using this product, please read the safety information in advance)

Safety Terms and Symbols

Terms in this manual

The following terms may appear in this manual:

⚠ **Warning:** Warning indicates conditions or practices that could result in injury or loss of life.

⚠ **Caution:** Caution indicates the conditions or practices that could result in damage to this product or other property.

Terms on the product

The following terms may appear on this product:

Danger: Indicates an immediate hazard or injury possibility.

Warning: Indicates a possible hazard or injury.

Caution: Indicates potential damage to the instrument or other property.

Safety Symbols

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

Hazardous Voltage

Refer to Manual

Protective Earth Terminal

Chassis Ground

Test Ground

Safety Requirements

Please read the following safety precautions to avoid personal injury and

prevent damage to this product or any other products connected to it. In order to avoid possible hazards, this product can only be used within the specified range.

- **Only a qualified person should perform internal maintenance.**
- **Check all Terminal Ratings.** To avoid fire or shock hazard, check all ratings and markings on this product. Refer to the user manual for more information about ratings before connecting to the instrument.
- **Do not operate without covers**. Do not operate the instrument with covers or panels removed.
- **Avoid exposed circuit**. Be careful when working on exposed circuitry to avoid risk of electric shock or other injury.
- **Do not operate if any damage.** If you suspect damage to the instrument, have it inspected by qualified service personnel before further use.
- **Do not operate in damp conditions.**
- **Do not operate in an explosive atmosphere.**
- **Keep product surfaces clean and dry.**
- **Using the equipment not in accordance with the method specified by the manufacturer may damage the protection provided by the equipment.**

⚠**Warning:**

To prevent electric shock or fire, use a suitable power adapter. Only power adapters that are dedicated to this product and approved for use in the country of use may be used.

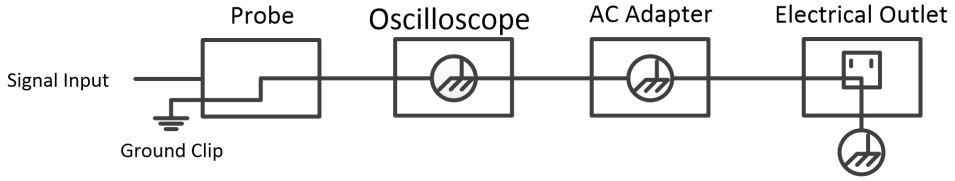
⚠**Warning:**

The two channels of the oscilloscope are non-isolated channels. Note that the channel should use a common reference when measuring, and the ground wires of the two probes cannot be connected to two non-isolated places with different DC electrical levels, otherwise it may cause a short circuit due to the ground wire connection of the oscilloscope probe.

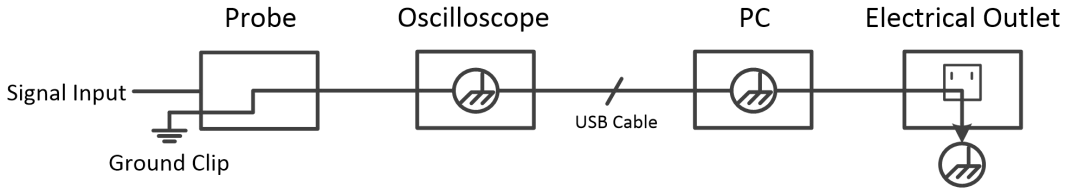
⚠**Warning:**

Note that the channel should use a common reference when measuring, otherwise it may cause a short circuit due to the ground wire connection of the oscilloscope probe.

Schematic diagram of the internal ground wire connection of the oscilloscope:



Schematic diagram of internal ground connection when oscilloscope is connected with computer through the port:



When the oscilloscope is AC powered by adapter or connected with AC powered computer through the port, it is not allowed to measure the primary power supply of power grid.

⚠**Warning:**

If the input port of the oscilloscope is connected to a voltage with a peak value higher than 42V (30vrms) or a circuit with a peak value of more than 4800 VA, the following measures shall be taken to avoid electric shock or fire:

- Only voltage probes, test wires and adapters with proper insulation attached to the oscilloscope or accessories suitable for oscilloscope instrument series products specified by our company shall be used.
- Before use, check the multimeter test probe, oscilloscope probe and accessories for mechanical damage. If damage available, replace it.
- Remove all unused multimeter test probes, oscilloscope probes and accessories (power adapter, USB, etc.).
- Firstly, plug the power adapter into the AC socket, and then connect it to the oscilloscope.
- When testing in a CAT II environment, do not connect a voltage higher than 400 V to any input port.
- When testing in a CAT II environment, do not connect a voltage with a voltage difference of more than 400 V to the isolated input port.

- Do not use an input voltage higher than the rated value of the instrument. Pay special attention when using 1:1 test wires, because the probe voltage will be directly transmitted to the oscilloscope.
- Do not touch the bare metal BNC or banana plug.
- Do not insert metal objects into the connector.
- Use the oscilloscope only in the specified way.
- The voltage rating mentioned in the "warning" information is the limited value of "working voltage". They represent V ac rms (50-60 Hz) in AC sine wave applications; and V dc in DC applications. CAT is the prefix, and II refers to the level. Level II is the low voltage and high energy level, which refers to the local electrical level applicable to electrical appliances and portable equipment.
- Do not input any electric such as signal, voltage or current into the GEN Out port of the signal generator.

2. How to Implement the General Inspection

After you get a new 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 A: List of 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 our distributor responsible for this service or our 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 our distributor responsible for this business or our local offices. If there is damage to the instrument caused by the transportation, please keep the package. With the transportation department or our distributor responsible for this business informed about it, a repairing or replacement of the instrument will be arranged by us.

3. How to Use the Oscilloscope

The Structure of the Oscilloscope

Front Panel and Keys

The front panel and keys of the oscilloscope are shown in Figure 3- 1:

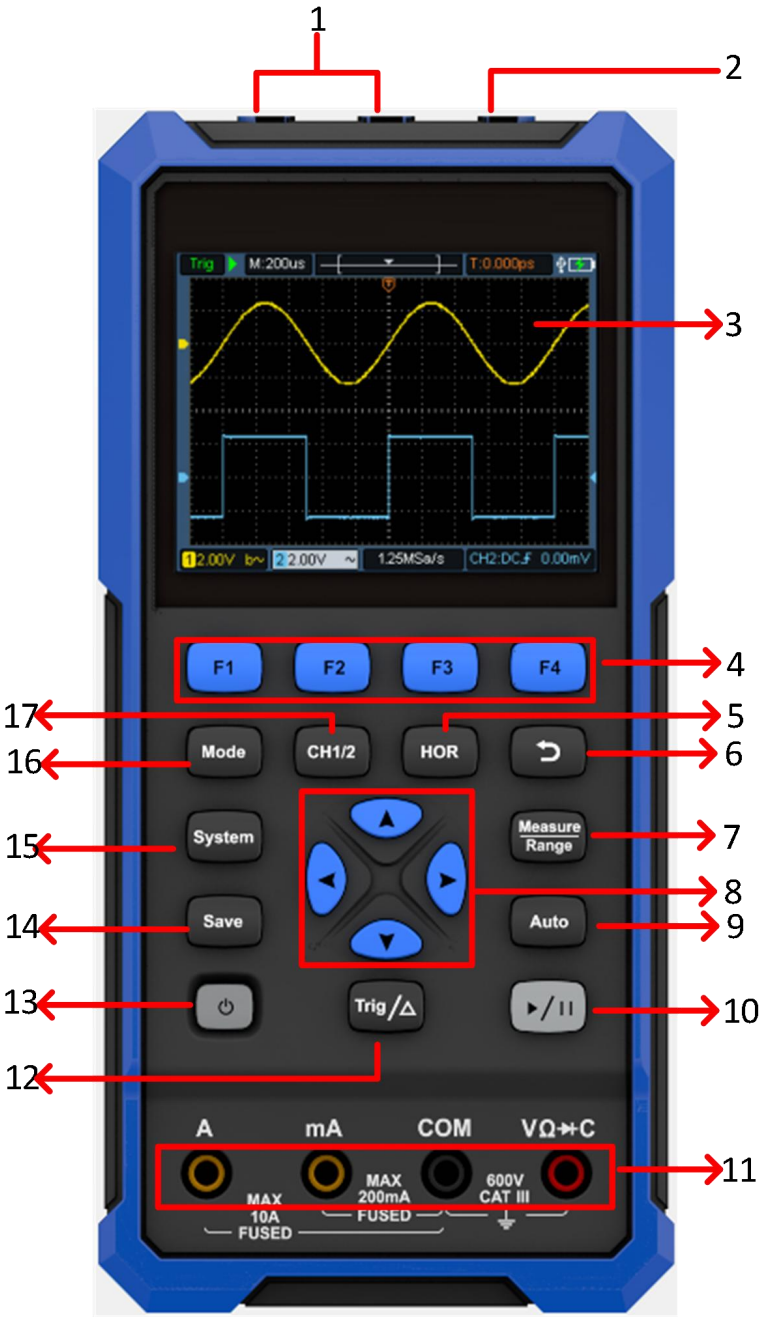


Figure 3- 1:Front Panel of the Oscilloscope

Description:

1. CH1 and CH2 input connectors.
2. Waveform generator output connector (optional).
3. Display area.
4. The **F1 - F4** keys are multi-function keys. In each menu mode, press the corresponding key to select the corresponding menu item.
5. After pressing the **HOR** key, through the key▲ ▼, you can change the horizontal time base setting, and observe the change of the state information caused by it; it can also be found that the **horizontal time base** display corresponding to the status bar has changed correspondingly; the horizontal displacement of the signal in the waveform window can be adjusted by pressing ◄ ►.
6. Return key. Press this key to return to the previous menu; when the menu is the first level, press the return key to close the menu.
7. Measurement menu key (oscilloscope) or range key (multimeter).
8. Zoom or move key:

   Function of direction keys▲ ▼: used for the up and down movements of waveform, the time base changing, the voltage cursor movements and the trigger of electrical level change in the oscilloscope;

   Function of direction keys◄ ►: used for the left and right movements of waveform, the voltage position changing and the movements of time cursor in the oscilloscope.
9. Automatic setting key (oscilloscope) or automatic range key (multimeter).
10. Stop / run key (oscilloscope) or value hold key (multimeter) or turn on/off the signal output (waveform generator - optional).
11. Input end of the multimeter.
12. Trigger menu key (oscilloscope) or relative value key (multimeter).
13. ⏻: Power switch key.
14. Enter the save settings key.

15. Enter the system settings key.
16. Switch key for working state of oscilloscope and multimeter.
17. CH1 / CH2 - channel switch key.

Side Panel

Figure 3- 2: Side Panel of the Oscilloscope

Description:

1. Probe compensation: 3.3V/1kHz square wave signal output.
2. Charging or USB communication interface.
3. Bracket.

Introduction to the User Interface of the Oscilloscope

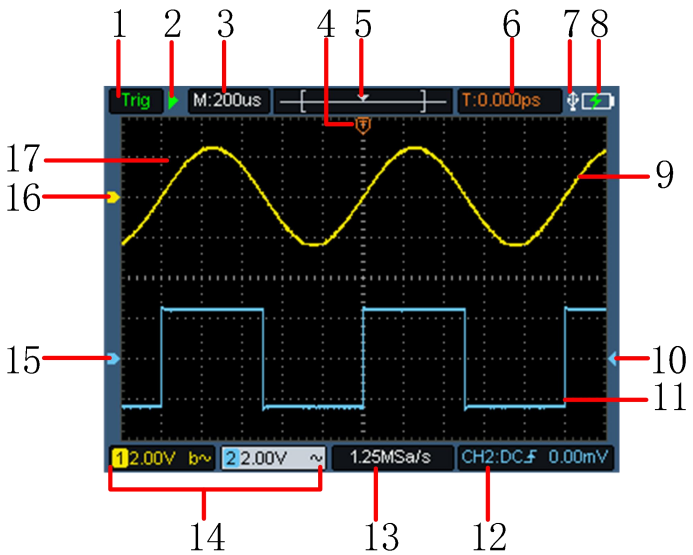


Figure 3- 3:Oscilloscope Interface

Description:

1. The trigger status indicates the following information:

   Auto: Automatic mode. The waveform is being collected without triggering.

   Trig: A trigger has been detected and post trigger information is being collected.

   Ready: All pre trigger data have been obtained and the oscilloscope is ready.

   Scan: Scan mode. Continuously collect and display waveform data.

   Stop: Stop collecting waveform data.

2. Run/stop.
3. Time base display.
4. The pointer indicates the trigger horizontal position.
5. The pointer indicates the trigger position within the current storage depth.
6. Indicating the value of the current trigger horizontal displacement, and displaying the position of the current waveform window in the memory.

7. It indicates that there is a USB disk connecting.
8. Battery power and external power supply indication.
9. Channel 1 waveform.
10. The pointer indicates the trigger electrical level position of the channel.
11. Channel 2 waveform.
12. The icon indicates trigger-related information, including trigger channel, coupling mode, trigger type and trigger electrical level. For details, please refer to P19 Trigger System.
13. The current sampling rate.
14. The channel information reading indicates the voltage position of the corresponding channel.

    The icon indicates the coupling mode of the channel:

    "—" means DC coupling;

    "～" means AC coupling;

    "⏚" means ground coupling.
15. The pointer indicates the grounding reference point (zero position) of the waveform displayed in CH2 channel. If there is no pointer indicating the channel, it means that the channel is not open.
16. The pointer indicates the grounding reference point (zero position) of the waveform displayed in CH1 channel. If there is no pointer indicating the channel, it means that the channel is not open.
17. Waveform display area.

Functional Check

Making a quick functional check to verify that the instrument is working properly. Please proceed as follows:

1. Press the switch at the bottom left of the main unit ⏻.

The internal relay will make a slight click. The instrument executes all self-check items, and the startup screen appears. Press the front panel key

System, the default probe menu attenuation coefficient setting value is **10X**.

2. The switch on the oscilloscope probe is set to 10X and connected with the CH1 channel.

Align the slot on the probe with the plug on the bayonet nut connector (**BNC**) of the **CH1** connector and insert it, then turn the probe to the right and tighten it.

Connect the probe tip and ground clamp to the connector of the probe compensator. Please pay attention to the terminal polarity. The square terminal represents the signal output, and the round terminal represents the reference ground.

3. Press the "Auto" key on the front panel.

Within a few seconds, a square wave display (1kHz/3.3Vpp) can be seen, as shown in Figure 3-4.

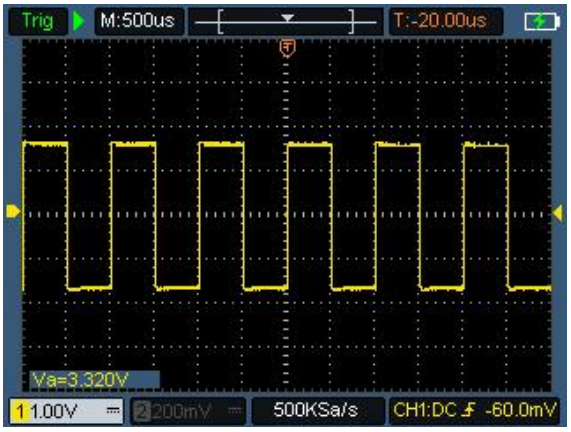


Figure 3-4: Automatic Setting

Repeat steps 2 and 3 on the CH2 channel.

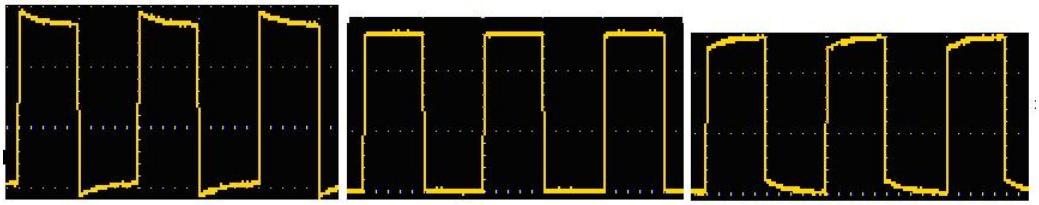
Probe Compensation

When connecting the probe to any input channel for the first time, make this adjustment to match the probe with the input channel. The probe without compensation or deviation compensation will lead to measurement error. To adjust the probe compensation, please follow the following steps:

1. Set the probe menu attenuation coefficient to **10X**, and set the switch on the

probe to **10X** (see "Probe Attenuation Coefficient Setting" in P9), and connect with CH1. If a hook probe is used, make sure it is in close contact with the probe. Connect the probe tip to the signal output connector of the probe compensator, and connect the reference wire clamp to the ground wire connector of the probe compensator, and then press the **Auto** key on the front panel.

2. Check the displayed waveform and adjust the probe until the compensation is correct. See Figure 3-5 and Figure 3-6.



Overcompensation **Correct compensation** **Under-compensation**

Figure 3-5: Display Waveform of Probe Compensation

3. Repeat the steps if necessary.

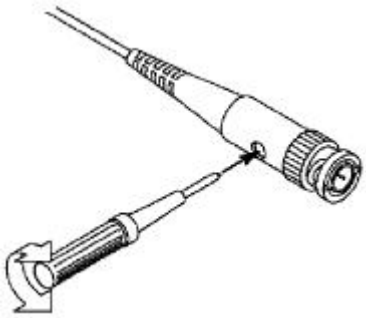


Figure 3-6: Probe Adjustment

Probe Attenuation Coefficient Setting

The probe has a variety of attenuation coefficients, which will affect the vertical position factor of the oscilloscope.

To change (check) the set value of probe attenuation coefficient in the oscilloscope menu, please follow the steps below:

(1) Press the **CH1/CH2** key to switch the channel to be used.

(2) Press the **F3** to select the desired attenuation coefficient. This setting is

valid until it is changed again.

Note: The preset setting of the probe attenuation coefficient in the menu when the oscilloscope is delivered is 10X. Make sure that the attenuation switch setting value on the probe is the same as the probe attenuation coefficient option in the oscilloscope menu.

The setting value of the probe switch is **1X** and **10X**. See Figure 3-7.

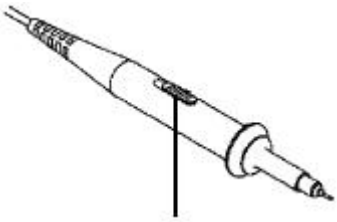


Figure 3-7: Probe Attenuation Switch

Note: When the attenuation switch is set to **1X**, the probe limits the bandwidth of the oscilloscope to **5 MHz**. To use the full bandwidth of the oscilloscope, be sure to set the switch to **10X**.

Safe Use of Probe

The safety ring surrounding the probe body provides a barrier to protect the fingers from electric shocks. See Figure 3-8.

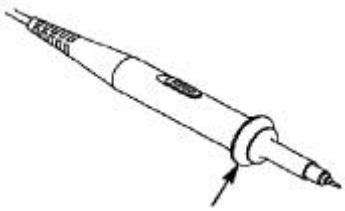


Figure 3-8: Finger Safety Ring of the Probe

Warning: To prevent electric shock when using the probe, please keep your fingers behind the safety ring on the probe body.

To prevent electric shock when using the probe, do not touch the metal part of the probe head when the probe is connected to a voltage source.

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

Vertical System

The vertical system can be used to adjust the vertical scale, the position and other settings of the channel. Each channel has a separate vertical menu, which can be set individually for each channel.

Vertical position

Press the **CH1/CH2** keys to select the channel, and move the vertical position of the selected channel up or down by pressing the ▲ or ▼ direction keys. Press the ▲ and ▼ direction keys at the same time to center the vertical position.

Vertical Volt/Div Setting

The volt/div range is 10mV/div-10V/div (probe 1X), stepping in the 1-2-5 way, or 100mV/div-100V/div (probe 10X), 1V/div-1000V/div (probe 100X), 10V/div-10000V/div (probe 1000X) , 100V/div-100000V/div (probe 10000X).

Press the **CH1/CH2** key to select the channel, and press the ◀ or ▶direction key to change the volts/div setting of the selected channel.

The description of the vertical system setting menu is as follows:

Function menu	Setting	Description
Switch	ON OFF	Turn on the waveform display. Turn off the waveform display.
Coupling	DC AC GND	The normal sampling method uses the AC and DC components of the input signal. Block the DC component of the input signal. Disconnect the input signal.
Probe	1X 10X 100X 1000X 10000X	Choose one of the values according to the probe attenuation factor to keep the vertical scale reading accurate.
Bandwidth	20MHz Full band	Limit the bandwidth to 20MHz to reduce display noise.

		The bandwidth of the oscilloscope.

Horizontal System

Press the **HOR** key to enter the horizontal system setting menu. Use the ◀ and ▶ direction keys to change the horizontal scale (time base) and horizontal trigger position. When changing the horizontal scale, the waveform is enlarged or reduced relative to the center of the screen. When the horizontal position changes, the position relative to the waveform trigger point changes.

Note: Press the ◀ and ▶ direction keys at the same time to center the horizontal position.

The description of the horizontal system setting menu is as follows:

Function menu	Setting	Description
Acqu Mode	Sample	Normal sampling method.
	Peak Detect	Used to detect interference glitches and reduce the possibility of confusion.
Length	4K 8K	Select the length to be recorded.
XY Mode	ON OFF	Choose to turn XY mode on or off.
1/2		Enter the next menu.
Refresh	High Low	Set the refresh rate to "High" or "Low".
Hor center		Set the horizontal trigger position in the middle of the screen.
Counter	ON OFF	Turn on/off counter.
2/2		Return to the previous menu.

Measuring System

Automatic Measurement

Press Measure/Range and **F1** key to realize automatic measurement. There are up to

9 types of measurement can be displayed at the bottom left of the screen.

For bandwidth ≤**100MHz** models, automatic range types include Frequency, Period, Amplitude, Maximum, Minimum, Peak-to-Peak value, Mean, and RMS.

For bandwidth **200MHz** models, automatic range types include Frequency, Period, Amplitude, Maximum, Minimum, Peak-to-Peak value, Mean, RMS, Rise Time, Fall Time, +PulseWidth, -PulseWidth.

The description of the automatic measurement **Function Menu** is as follows:

Function Menu			Description
Measure	ON OFF		Turn automatic measurement on or off.
	Source	CH1 CH2	Set the source.
	Add Del	Freq (F) ☐ Period (T) ☐ Amp (Va) ☐ Min (Mi) ☐ Max (Ma) ☐ PK - PK (Vpp) ☐ Mean(V) ☐ RMS (RMS) ☐ Rise Time (RT) ☐ Fall Time (FT) ☐ +PulseWidth (PW) ☐ -PulseWidth (NW) ☐	Add or delete the selected measurement type (displayed in the lower left corner, up to 9 types). Note: The unselected state is ☐; The selected state is ■.

The automatic measurement of voltage parameters

The oscilloscopes provide automatic voltage measurements including Mean, PK-PK, RMS, Max, Min and Vamp. Figure 3-9 below shows a pulse with some of the voltage measurement points.

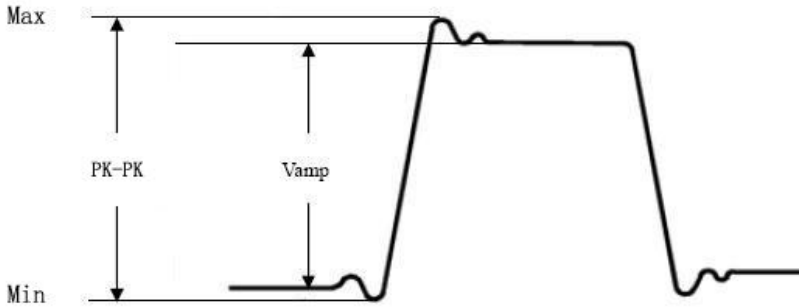


Figure 3- 9

Mean: The arithmetic mean over the entire waveform.
PK-PK: Peak-to-Peak Voltage.
RMS: The true Root Mean Square voltage over the entire waveform.
Max: The maximum amplitude. The most positive peak voltage measured over the entire waveform.
Min: The minimum amplitude. The most negative peak voltage measured over the entire waveform.
Vamp: Voltage between Vtop and Vbase of a waveform.

The automatic measurement of time parameters

The oscilloscopes provide time parameters auto-measurements include Period, Frequency, Rise Time, Fall Time, +D width and -D width.

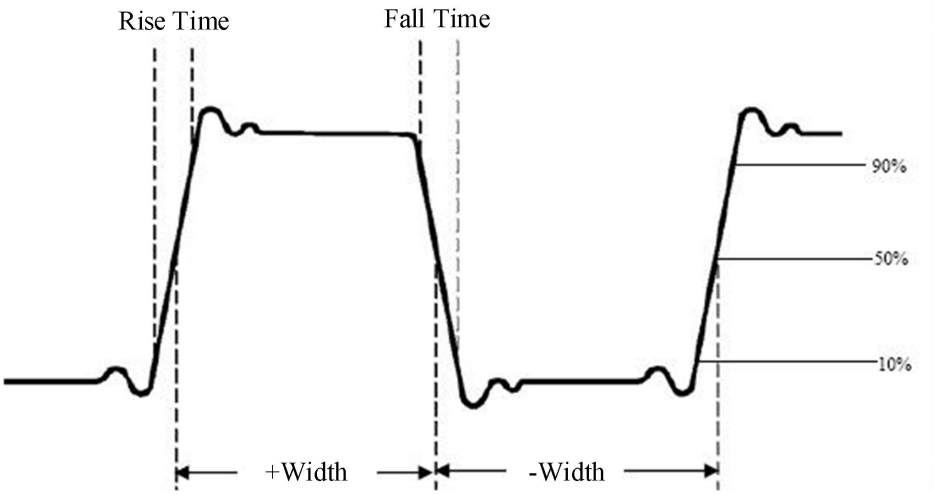


Figure 3- 10

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.

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

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

Cursor Measurement

Press Measure/Range and **F2** key to realize cursor measurement.

The description of **Cursor Measurement Menu** is as follows:

Function Menu	Setting	Description
Type	CH1 Voltage	Select to display the CH1 voltage measurement cursor and menu.
	CH2 Voltage	Select to display the CH2 voltage measurement cursor and menu.
	Time	Select to display the time measurement cursor and menu.
	None	Turn off the cursor measurement.
A		When the type is selected as **CH1 Voltage** or **CH2 Voltage**, press the arrow keys ▲ ▼ to move the cursor line A; when the type is selected as **Time**, press the arrow keys ◄ ► to move the cursor line a.
B		When the type is selected as **CH1 Voltage** or **CH2 Voltage**, press the arrow keys ▲ ▼ to move the cursor line B; when the type is selected as **Time**, press the arrow keys ◄ ► to move the cursor line b.
AB		Link A and B. When the type is selected as **CH1** or **CH2**, by pressing the arrow keys ▲ ▼ two cursors can be moved at the same time; when the type is selected as **Time**, by pressing the arrow keys ◄ ►, two cursors can be moved at the same time.

FFT Measurement

Press Measure/Range and **F3** key to realize FFT measurement. FFT decomposes the signal into component frequencies, and the oscilloscope uses these component frequencies to display the graph of signal frequency domain, which corresponds to the standard time domain graph of the oscilloscope. Then match these frequencies with known system frequencies, such as the system clock, oscilloscope or power supply.

The description of **FFT Measurement Menu** is as follows:

Function Menu	Setting	Description
FFT		Enable or disable the FFT measurement function.
Unit	dB Vrms	Select measurement unit.
Wave		Enable or disable the CH1 waveform; disabling CH1 waveform prevents it from covering the FFT waveform.
1/3		Enter the next menu.
Window	Hamming Rectangle Blackman Hanning Kaiser Bartlett	Select the desired window function type.
Center Fre		Adjust the center frequency value using directional keys.
Fre Scale		Adjust the frequency range using directional keys.
2/3		Enter the next menu.
Vertical		Adjust the vertical scale using directional keys.
Amp		Adjust the FFT vertical cursor position using directional keys ▲ ▼ .
AutoSetting		Auto- set vertical amplitude and center frequency.
3/3		Return to the first menu.

The Description of FFT Window

There are 6 FFT windows. Each one has trade-offs between frequency resolution and amplitude 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	Descriptions	Window
Rectangle	Best solution for frequency, worst for amplitude. Best type for measuring the frequency spectrum of nonrepetitive signals and measuring frequency components near DC. Recommend to use for: ● Transients or bursts, the signal level before and after the event are nearly equal. ● Equal-amplitude sine waves with frequencies those are very close. Broadband random noise with a relatively slow varying spectrum.	
Hanning	Good for amplitude, but poorer frequency resolution than Hamming. Recommend to use for: ● Sine, periodic and narrow band random noise. ● Transients or bursts where the signal levels before and after the event are significantly different.	
Hamming	Better solution for amplitude than Rectangle, and good for frequency as well. It has slightly better frequency resolution than Hanning. Recommend to use for: ● Sine, periodic and narrow band random noise. ● Transients or bursts where the signal levels before and after the event are significantly different.	
Blackman	Best solution for amplitude, worst for frequency. Recommend to use for: ● Single frequency waveforms, to find higher order harmonics.	
Bartlett	The Bartlett window is a slightly narrower variant of the triangular window, with zero weight at both ends.	
Kaiser	The frequency resolution when using the Kaiser window is fair; the spectral leakage and amplitude accuracy are both good. The Kaiser window is best used when frequencies are very close to the same value but	

	have widely differing amplitudes (the side lobe level and shape factor are closest to the traditional Gaussian RBW). This window is also good for random signals.	

Notes for using FFT

- Use the default **dB** scale for details of multiple frequencies, even if they have very different amplitudes. Use the **dB** scale to compare frequencies.
- DC component or offset can cause incorrect magnitude values of FFT waveform. To minimize the DC component, choose AC Coupling on the source signal.

What is Nyquist frequency:

The Nyquist frequency is the highest frequency that any real-time digitizing oscilloscope can acquire without aliasing. This frequency is half of the sample rate. Frequencies above the Nyquist frequency will be under sampled, which causes aliasing. So pay more attention to the relation between the frequency being sampled and measured.

Waveform Calculate Measurement

Press Measure/Range and **F4** key to realize math measurement.

The description of **Math Measurement Menu** is as follows:

Function Menu	Setting	Description
Param1		Select CH1 or CH2 as parameter 1.
Param2		Select CH1 or CH2 as parameter 2.
Calc Type	OFF + - * / Intg Diff Sqrt Abs Lg Ln	Select calculate type.
1/2		Enter the next menu.
Amplitude		Adjust the vertical scale using directional keys ◄

		➤ .
Offset		Adjust the vertical offset using directional keys ▲ ▼ .
2/2		Return to the previous menu.

Display unknown signals using automatic Settings

The automatic setting function enables the oscilloscope to automatically display and measure unknown signals. This function optimizes position, range, timebase, and trigger and ensures a stable display of any waveform. This feature is particularly useful for quickly checking several signals.

To enable auto-setup, perform the following steps:

1. Connect the oscilloscope probe to the measured signal.
2. Press the Auto key, the oscilloscope enters the automatic measurement state, and the measured signal will be displayed on the screen.

Trigger System

The trigger determines when the oscilloscope starts to acquire data and display waveforms. Once the trigger is set correctly, it can convert an unstable display into a meaningful waveform.

When the oscilloscope starts to acquire data, it first acquires enough data to draw the waveform on the left side of the trigger point. The oscilloscope continuously acquires data while waiting for the trigger condition to occur. When a trigger is detected, the oscilloscope continuously acquires enough data to draw a waveform on the right of the trigger point.

The trigger mode of this series of oscilloscopes is edge trigger.

The edge trigger mode is to trigger on the trigger electrical level of the edge of the input signal, that is, trigger on the rising and falling edges of the input signal.

Entering the edge trigger, the trigger setting information is displayed at the bottom right corner of the screen, e.g. CH1:DC ⊥ -20.0mV. It indicates that the trigger type is rising edge, the trigger source is CH1, the trigger coupling is DC, and the trigger electrical level is -20.0mV.

The description of the trigger system setting menu is as follows:

Function Menu	Setting	Description
Source	CH1 CH2	Set Channel 1 as the source trigger signal. Set Channel 2 as the source trigger signal.
Coupling	AC DC	Set to prevent DC component from passing through. Set to allow all components to pass through.
Type	Auto Normal Single	Waveforms can be acquired without detecting trigger conditions. The waveform is acquired only when the trigger conditions are met. When a trigger is detected, a waveform is sampled and then stopped.
1/2		Enter the next menu.
Slope	Rising edge Falling edge	Trigger on the rising edge of the signal. Trigger on the falling edge of the signal.
Trigger center		The trigger position is set in the middle of the waveform.
Force		Forced trigger key, which forcibly generates a trigger signal, mainly used in the "normal" and "single" modes of the trigger mode.
2/2		Return to the previous menu.

Trigger electrical level: The amplitude level that the signal must cross when setting the waveform acquisition. Press the **Trig/**△ key to enter the trigger menu, and press the ▲ or ▼ key to move the trigger electrical level up and down.

Save Settings

Press the **Save** key to enter the save function menu. By operating the save function menu, oscilloscope settings, reference waveforms, and files can be

stored.

- **Configure**

Any setting can be saved inside the oscilloscope, and restore settings can also be called.

The description of **Configure** menu is as follows:

Function Menu	Setting	Description
Object	S1 S2 S3 S4	Set waveform name.
Save		Save the current parameter settings of the oscilloscope to the internal memory.
Recall		Call the settings saved in the current storage location.

- **Reference Waveform**

The actual waveform can be compared with the reference waveform to find out the difference. Press the **Save** key to enter the save function menu, and press **F2** to select the reference waveform to enter the reference waveform menu.

The description of the **Reference Waveform** menu is as follows:

Function Menu	Setting	Description
Source	CH1 CH2	Select the reference waveform to be saved.
Object	R1 R2 R3 R4	Set waveform name.
Display	ON OFF	Call or close the waveform of the current target address in the internal memory. When it displays "On", if there is a stored waveform at the current address, the waveform will be displayed, and the address number and waveform related information will be displayed in the upper left corner; if the current address is not stored, it will display "Address No.: No waveform saved".
Save		Save the reference waveform of the source to the

		memory.

- **File**

The file can be saved as waveform or image. The waveform and image can be read by plugging and unplugging the USB data cable or selecting MSC in the USB option on the next page of system settings.

The description of **File** menu is as follows:

Function Menu	Setting			Description
File	Wave	File name	wave1 wave2 wave3 wave4	Select the file name of the stored waveform.
		Source	CH1 CH2	Select the waveform channel to be saved.
		Save		Store the waveform of the source in a csv file named by the specified file name.
	Image	File name	image1 image2 image3 image4	Select the file name of the stored wave image.
		Save		Store the current screen image in the bmp file named by the specified file name.

System Settings

Press the **System** key to enter the system function menu.

- **Display**

The description of the menu is as follows:

Function Menu	Setting	Description
Brightness	10% - 100%	Set the screen backlight to increase in a 10% cycle.
Backlight time	30s 60s 120s	Set the screen backlight luminance time. Unlimited means always on.

	Unlimited	
Menu Time	5s 10s 20s 30s 60s	Set the menu display time.
Turned on	00h：00m	Display how long it has been powered on.

- **System**

The description of the menu is as follows:

Function Menu	Setting	Description
Language		Set the menu language.
Shutdown Time	10 min 30 min 60 min Unlimited	Set the automatic shutdown time. Unlimited means no shutdown. Please pay attention to this setting if you use the battery only.
1/2		Enter the next menu
About		After pressing this key, the instrument model, serial number, version, and checksum can be displayed.
Upgrade		To upgrade the system. The version of the upgrade package must be higher than the version of the instrument itself.
2/2		Return to the previous menu

- **Default setting**

Press the **System** key to enter the system setting menu. Select **F3** "Default setting", the screen will prompt "Press < F3 >for default setting Otherwise press the Return key". If you need to perform the default setting, press F3 again to complete the default setting, otherwise, press the return key.

- **USB Connection**

Press the **System** key to enter the system setting menu. Select **F4** to enter the next page. Press **F1** to select **HID** or **MSC**.

1) **MSC [Mass Storage Class]** is used to make USB read the files stored in the built-in memory.

2) **HID [Human interface Device]** is used to select the oscilloscope device as

the host computer to control and communicate with the computer.

- **Factory Settings**

To set the factory settings, press the **System** key. Press the menu selection key **F4** to enter the next page. Select **F2** "Factory setting", the screen will prompt "Press < F2 >for factory setting Otherwise press the Return key". If you need to perform the factory setting, press F2 again to complete the factory setting, otherwise, press the return key.

- **Automatic Calibration**

The automatic correction program can quickly make the oscilloscope reach the best condition to obtain the most accurate measurement value. You can execute this program at any time, but if the ambient temperature variation range reaches or exceeds 5℃, you must execute this program.

To perform automatic correction, disconnect all probes or wires from the input connector. Then, press the **System** key. Press the menu selection key **F4** to enter the next page, select **F3** "Auto calibration", the screen will prompt "Disconnect all inputs Press < F3 >to execute auto calibration Otherwise press the Return key". If you need to perform the auto calibration, please disconnect all inputs, perform automatic correction after confirming readiness.

4. How to Use the Multimeter

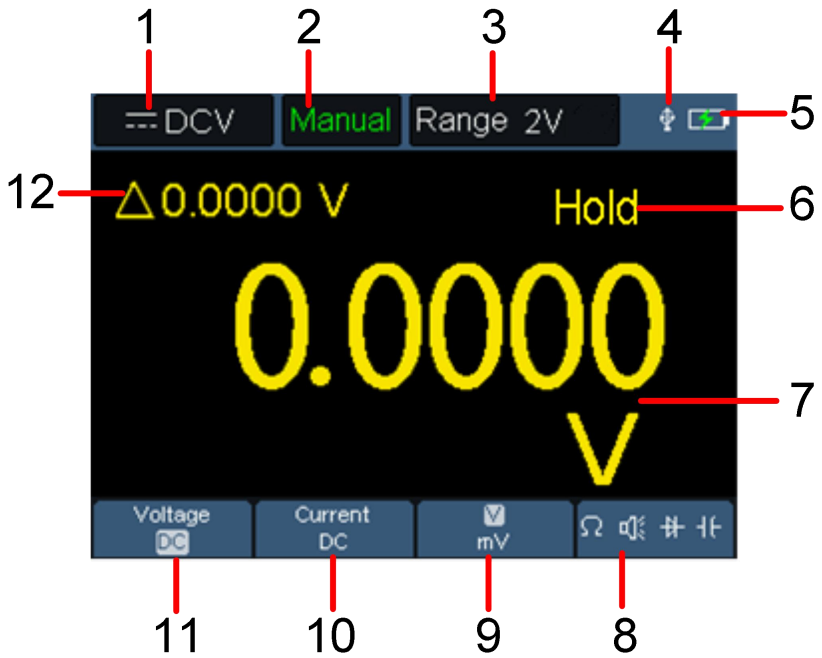
About This Chapter

This chapter introduces the multimeter function of the oscilloscope step by step, and provides some basic examples of basic operations and how to use the menu.

Instrument Interface

The multimeter uses four 4-mm safety banana plug input ends: **A, mA, COM, and VΩ⊣⊢C**.

Multimeter interface:



Multimeter Interface

Description:

1. Measurement type indication:

⎓ **DCV**	------	DC voltage measurement
~ **ACV**	------	AC voltage measurement
⎓ **DCA**	------	DC current measurement
~ **ACA**	------	AC current measurement

Ω **Resist**	------	Resistance measurement
⊳| **Diode**	------	Diode measurement
🔊 **Cont**	------	On/Off measurement
⊣⊢ **Cap**	------	Capacitance measurement

2.Range indication: **Manual** means manual range; **Auto** means automatic range.

3. Current measurement range.

4. Indicating that there is a USB cable inserted.

5. Battery power indication.

6. “Hold” can keep the current reading on the display.

7. Measurement value and unit.

8. Display of switching resistance, buzzer, diode and capacitance measurement function.

9. The selected range V or mV in voltage measurement; the selected current range A or mA in current measurement.

10. To choose AC or DC current measurement.

11. To choose to AC or DC voltage measurement.

12. Display of relative value measurement function (only available when measuring DC current, DC voltage and resistance).

5. How to Use the Waveform Generator(optional)

The instrument can provide 4 basic waveforms, sine wave, square wave, ramp wave, pulse wave, and 8 arbitrary waveforms.

Connect the output

Press the **Mode** button to switch the instrument interface to the waveform generator function interface. Check whether the upper left corner of the screen is **ON**, if it is **OFF**, press the **Run/Stop** key to switch.
Connect the BNC cable to the port marked **GEN Out** in the top of the oscilloscope.

Warning：

BNC output ports not allowed to input any signal such as voltage, current and other electrical signal, otherwise, it will be burned.

Figure 5-1：Generator Output Ports

To observe the output of the waveform generator, connect the other end of the BNC cable to the signal input connector of the oscilloscope.

Set the waveform

(1) Press the **Mode** button to switch the instrument interface to the waveform generator function interface.

(2) Press **F1** to select the desired waveform, and the screen will display the corresponding waveform setting menu.

(3) Set the parameters of the desired waveform through the operation panel **F2-F4** and the ▲ ▼ ◄ ► panel keys.

Set the load

1. Press the **System** key to enter the system function menu.
2. Press the **F4** key to enter the next page of menu.
3. Press the **F3** key to switch **High Z** / ***Ω** ("*" represents a value, the default is 50Ω).

Note: To change the load value, after selecting *Ω, press ◀/▶ direction key to move the cursor left and right; press ▲/▼ direction key to change the value. The load range is 1 Ω - 10 kΩ.

Output the sine waveform

The sine waveform setting menu includes: Freq/Period, Amplitude/High level, Offset/Low level.

Set the Frequency / Period

Press the **F1** key to enter the sine waveform setting interface.
Press the **F3** or **F4** key to switch to the Freq/Period parameter, the selected parameter item will be displayed in green (the same below), and then use the ▲ ▼ ◀ ▶ direction keys to set the desired value in the parameter column. Press **F2** to switch between Freq / Period.

Use the direction keys to change the selected parameter value:

Press ▲/▼ to increase or decrease the value at the cursor. Press ◀/▶ to move the cursor left and right to different numerical digits.

Note: When setting parameters, long press the key to accelerate the change of the value.

Set the Amplitude / High level

Press the **F3** or **F4** key to switch to the Amplitude/High level parameter, and then use the ▲ ▼ ◀ ▶ direction keys to set the desired value in the parameter column. Press **F2** to switch between Amplitude / High level.

Set the Offset / Low level

Press the **F3** or **F4** key to switch to the Offset/Low level parameter, and then use the ▲ ▼ ◄ ► direction keys to set the desired value in the parameter column. Press **F2** to switch between Offset / Low level.

Output the square waveform

Press the **F1** key to enter the square waveform setting interface.

The square waveform setting menu includes: Freq/Period, Amplitude/High level, Offset/Low level.

For the setting Freq/period, Amplitude/High level, Offset/Low level, please refer to *Output the sine waveform* on page 31.

Output the ramp waveform

Press the **F1** key to enter the ramp waveform setting interface.

The ramp waveform setting menu includes: Freq/Period, Amplitude/High Level, Offset/Low Level, Symmetry.

For the setting Freq/period, Amplitude/High level, Offset/Low level, please refer to *Output the sine waveform* on page 31.

Set the symmetry of the ramp waveform

Press the **F3** or **F4** key to switch to the Symmetry parameter, use the ▲ ▼ ◄ ► direction keys to set the desired value in the parameter column.

Output the pulse waveform

Press the **F1** key to enter the pulse waveform setting interface.

The pulse waveform setting menu includes: Freq/Period, Amplitude/High level, Offset/Low level, Pulse width/Duty, Rise Time/Fall Time.

For the setting Freq/period, Amplitude/High level, Offset/Low level, please refer to *Output the sine waveform* on page 31.

Set the Pulse Width / Duty Cycle of the pulse waveform

Press the F3 or F4 key to switch to the Pulse width/Duty parameter, use the ▲ ▼ ◀ ▶ direction keys to set the desired value in the parameter column. Press F2 to switch between Pulse width / Duty.

Set the Rise Time/Fall Time

Press the F3 or F4 key to switch to the Rise Time/Fall Time parameter, use the ▲ ▼ ◀ ▶ direction keys to set the desired value in the parameter column. Press F2 to switch between Rise Time / Fall Time.

Output the Arbitrary waveform

Press the F1 key to enter the arbitrary waveform setting interface.

The arbitrary waveform setting menu includes: Freq/Period, Amplitude/High Level, Offset/Low Level, Type.

For the setting Freq/period, Amplitude/High level, Offset/Low level, please refer to *Output the sine waveform* on page 31.

Type (built-in waveform)

The system has 8 built-in waveforms. To select the built-in waveform:

Press the F3 or F4 key to switch to the Type parameter, and then use the F2 or ▲ ▼ ◀ ▶ direction keys to select the desired built-in waveform in the parameter column.

Built-in waveform list

Name	Explanation
AmpALT	Attenuation oscillation curve
AttALT	Gain oscillation curve
StairDn	Stair-down waveform
StairUD	Stair-up and stair-down waveform
StairUp	Stair-up waveform
Besselj	Besselj function
Bessely	Bessely function
Sinc	Sinc function

6. Communication with PC

The oscilloscope supports communications with a PC through USB. You can use the Oscilloscope communication software to store, analyze, display the data and remote control.

To learn about how to operate the software. Please download the oscilloscope communication software on our official download website and view it.

Here is how to connect with PC. Please download the Oscilloscope software package from our official website onto your computer, double-click it, and follow the prompts until the installation is complete.

(1) **Connection:** Use a USB data cable to connect the **USB Device port** in the right panel of the Oscilloscope to the USB port of a PC.

(2) **USB Port Settings:** The USB protocol type of the oscilloscope needs to be switched to **HID** (Press **System** → **F4**→ **USB**, and switch to **HID**).

(3) Run the Oscilloscope software after, the connection information in the bottom right corner of the software will turn green.

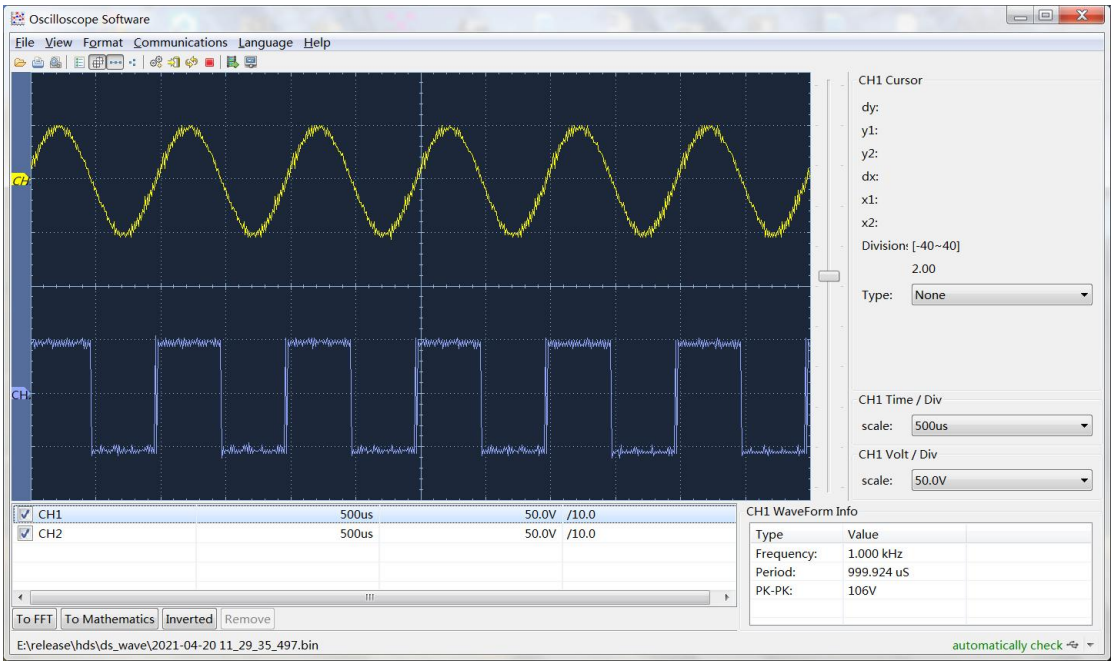


Figure 6- 1 Connect with PC through USB port

7. Troubleshooting

1. The oscilloscope cannot be turned on.

It may be that the battery is completely exhausted. At this time, even if the oscilloscope is powered by the power adapter, the oscilloscope cannot be turned on. You need to charge the battery first, and do not turn on the oscilloscope. Wait for about 15 minutes, and then try to turn on the oscilloscope. If the oscilloscope still cannot be turned on, please contact us to serve you.

2. The oscilloscope turns off after a few seconds of startup.

It may be that the battery is exhausted. Check the battery symbol at the top left of the screen. ▭ symbol indicates that the battery is exhausted and must be charged.

3. After switching to the multimeter, the measurement type is displayed as E.

It may be that the measurement type was not selected. At this time, press **F4**, the measurement type should display the corresponding measurement type. If E is still displayed, restart the oscilloscope.

4. In the oscilloscope state, the measured voltage amplitude value is 10 times larger or smaller than the actual value.

Check whether the channel attenuation coefficient is consistent with the actual probe error ratio.

5. In the oscilloscope state, there is a waveform display, but it cannot be stabilized.

- Check whether the source item in the trigger mode menu is consistent with the signal channel actually used.
- Check whether the trigger electrical level has exceeded the waveform range. Only by setting the parameters reasonably, the waveform can be displayed stably.

6. In the oscilloscope state, nothing is displayed after pressing

RUN/STOP.

Check whether the trigger mode of the trigger mode menu is normal or single, and the trigger electrical level is out of the waveform range. If so, center the trigger electrical level or set the trigger mode to automatic. In addition, you can press **Auto** to automatically complete the above settings.

7. In the oscilloscope state, the display speed becomes slower when the average value sampling is set in the acquisition mode or the duration is set longer in the display settings.

It is normal.

8. Technical Specifications

Unless otherwise stated, all technical specifications are applicable to the probe with the attenuation switch set to 10X and this series of oscilloscopes. The oscilloscope must first meet the following two conditions to meet these specifications and standards:

- The instrument must be operated continuously for more than 30 minutes at the specified operating temperature.
- If the operating temperature variation range reaches or exceeds 5 ℃ , the system function menu must be opened to execute the "automatic correction" program (see automatic correction in "**System Settings**" on P18).

All specifications are guaranteed except those marked "typical".

Oscilloscope

Characteristics		Description	
Bandwidth		HDS242(S)	40 MHz
		HDS272(S)	70 MHz
		HDS2102(S)	100 MHz
		HDS2202(S)	200 MHz
Channel		2	
Sampling	Sampling method	Sampling, peak detection	
	Real-time sampling rate	HDS242(S) HDS272(S)	125 MSa/s (Dual channel) 250 MSa/s (Single channel)
		HDS2102(S)	250 MSa/s (Dual channel) 500 MSa/s (Single channel)
		HDS2202(S)	1 GSa/s
	Waveform refresh rate	10,000 wfms/s	
Input	Input coupling	DC, AC, ground	
	Input impedance (DC coupling)	1 MΩ±2%, in parallel with 16 pF±10 pF	
	Probe attenuation	1X 、10X、100X、1000X 、10000X	

Characteristics		Description	
	Maximum input voltage	400 V (DC + AC ,PK - PK)	
	Bandwidth limit	20 MHz, Full bandwidth	
Horizontal	Sampling rate range	0.25 Sa/s～250 MSa/s	
	Waveform interpolation	(Sinx)/x	
	Sweep speed range (S/div)	HDS242(S) HDS272(S)	5ns/div - 1000s/div,Stepping in the 1-2-5 way
		HDS2102(S) HDS2202(S)	2ns/div - 1000s/div,Stepping in the 1-2-5 way
	Time base accuracy	±100 ppm	
	Record length	8K or 4K optional	
Vertical	Sensitivity (Volt/div) range	10 mV/div～10 V/div	
	Displacement range	HDS242(S) HDS272(S) HDS2102(S)	±6 div
		HDS2202(S)	±2 V (10 mV/div – 200 mV/div); ±100 V (500 mV/div – 10V/div);
	Analog bandwidth	HDS242(S)	40 MHz
		HDS272(S)	70 MHz
		HDS2102(S)	100 MHz
		HDS2202(S)	200 MHz
	Single bandwidth	Full bandwidth	
	Low frequency response (AC coupling, -3dB)	≥10 Hz	
	Rise time (typical on BNC)	HDS242(S)	≤ 8 ns
		HDS272(S)	≤ 5 ns
		HDS2102(S)	≤ 3.5 ns
		HDS2202(S)	≤ 1.75 ns
	DC gain accuracy	3%	
Measurement	Cursor	ΔV, ΔT	

Characteristics			Description	
	Automatic		HDS242(S) HDS272(S) HDS2102(S)	Period, Frequency, Mean, PK-PK, Max, Min, Amplitude
			HDS2202(S)	Period, Frequency, Mean, PK-PK, Max, Min, Amplitude, RMS,Rise Time,Fall Time, +PulseWidth, -PulseWidth
Trigging	Source		CH1, CH2	
	Type		Edge	
	Coupling		DC, AC	
	Trigger type		Auto, normal, single	
	Trigger electrical level range		±4 div from the center of the screen	
	Trigger electrical level accuracy		±0.3 div	
	Trigger displacement		According to Record length and time base	
	Edge trigging	Slope	Rising edge, falling edge	

The output of the probe compensator:

Characteristics	Description
Output voltage (typical)	3.3Vpp, High-Z
Frequency (typical)	Square wave 1 kHz (±1%)

Multimeter

Characteristics	Description
Digital display	20,000 readings
Measurement type	Voltage, current, resistance, capacitance, on/off, diode
Maximum Input voltage	AC : 750V DC : 1000V
Maximum Input current	AC : 10A DC : 10A

Basic function	Range	Minimum resolution	Accuracy
DC voltage	200.00mV	0.01mV	±(0.3%+10dig)
	2.0000V	0.1mV	±(0.3%+5dig)
	20.000V	1mV	
	200.00V	0.01V	

Basic function	Range	Minimum resolution	Accuracy
	1000.0V	0.1V	
AC voltage[1]	200.00mV	0.01mV	±(0.8%+10dig)
	2.0000V	0.1mV	
	20.000V	1mV	
	200.00V	0.01V	
	750.0V	0.1V	±(1%+10dig)
	Frequency range：40Hz-1000Hz		
DC current	200.00mA	0.01mA	±(0.8%+10dig)
	10.000A	1mA	±(2.5%+10dig)
	Overload protection: mA function: self-healing fuse 400 mA/250 V; Ampere function: 10 A/600 V, D5.2*20, fast-acting fuse		
AC current[1]	200.00mA	0.01mA	±(1%+10dig)
	10.000A	1mA	±(2.8%+10dig)
	Frequency range：40Hz-1000Hz Overload protection: mA function: self-healing fuse 400 mA/250 V; Ampere function: 10 A/600 V, D5.2*20, fast-acting fuse		
Resistance	200.00Ω	0.01Ω	±(0.8%+10dig)
	2.0000kΩ	0.1Ω	±(0.8%+5dig)
	20.000kΩ	1Ω	±(0.8%+3dig)
	200.00kΩ	10Ω	
	2.0000MΩ	0.1kΩ	
	20.000MΩ	1kΩ	±(1%+3dig)
	100.00MΩ	0.01MΩ	±(5%+10dig)
Capacitance[1]	20.000nF	1pF	±(3.0%+10dig)
	200.00nF	10pF	
	2.0000μF	0.1nF	
	20.000μF	1nF	
	200.00μF	10nF	
	2.0000mF	0.1uF	
Others	On/Off test	√ (<50Ω)	
	Diode test	√(<0-2V)	
	Auto range	√	
	TRMS	√	

[1] : When measuring AC voltage/current or capacitance, accuracy guarantee range is 5% to 100% of the range.

Arbitrary Waveform Generator (Optional)

Characteristics	Description		
Waveform Frequency	Sine	HDS242(S) HDS272(S) HDS2102(S) HDS2202(S)	0.1Hz～25MHz
	Square	0.1Hz~5MHz	
	Ramp	0.1Hz~1MHz	
	Pulse	0.1Hz~5MHz	
	EXP	0.1Hz~5MHz	
Sampling	125MSa/s		
Amplitude(50Ω)	0.01Vpp ~ 2.5Vpp		
DC offset(High Z)	±(2.5V – Amplitude Vpp/2)		
Frequency Resolution	0.01%		
Channel	1		
Waveform Depth	8k		
Vertical Resolution	14 bit		
Output Impedance	50 Ω		

General Technical Specifications

Display:

Characteristics	Description
Display type	3.5-inch color LCD display
Display resolution	320 horizontal × 240 vertical pixels
Display color	65536 colors
Display Contrast	Adjustable

Power supply:

Characteristics	Description	
Power supply	100 - 240 VACRMS, 50/60 Hz, CAT Ⅱ DC INPUT: 5VDC, 2A	
Power consumption	HDS242(S) HDS272(S) HDS2102(S)	＜5 W
	HDS2202(S)	≤6 W
Battery	HDS242(S) HDS272(S)	2200mAh*2（3.7V，18650）
	HDS2102(S) HDS2202(S)	2600mAh*2（3.7V，18650）

Surroundings:

Characteristics	Description
Temperature	Working temperature: 0℃ - 40℃ Storage temperature: -20℃- +60℃
Relative humidity	≤90%
Height	Operating: 3,000 meters Non-operating: 15,000 meters
Cooling method	Natural cooling

Mechanical specifications:

Characteristics	Description
Dimensions	198 mm (length) × 96mm (height) × 38 mm (width)
Weight	About 0.6 kg (main unit, without battery)

Calibration interval: The recommended calibration interval is one year.

9. Appendix

Appendix A: List of Accessories

- 1 power adapter
- 1 USB cable
- 1 passive probes
- 1 crocodile clip cable (HDS242/HDS272/HDS2102/HDS2202)
- 2 crocodile clip cable (HDS242S/HDS272S/HDS2102S/ HDS2202S)
- 1 set of multimeter probes (one red and one black)
- 1 user manual
- 1 probe correction adjustment knife

Appendix B: Maintenance and Cleaning

General maintenance

Do not store or place the instrument in a place where the LCD screen will be exposed to direct sunlight for a long time.

Caution: Do not let spray, liquid or solvent touch the instrument or probe to prevent damage to the instrument or probe.

Cleaning:

Check the instrument and probe frequently according to the operation. Clean the external surface of the instrument as follows:

1. Please wipe the floating dust outside the instrument and probe with a soft cloth. When cleaning the LCD, be careful not to scratch the transparent LCD protection screen.

2. Wipe the instrument with a damp but non dripping soft cloth. Please disconnect the power supply. It can be scrubbed with soft detergent or water. Do not use any abrasive chemical cleaning agent to avoid damaging the

instrument or probe.

Warning: Please make sure the instrument is dry before re-energizing to avoid electrical short circuit or personal injury caused by moisture.

Charging and Replacement of Battery

During the long-term storage of the device, the battery may be too low due to the self-discharge of the lithium battery and the device cannot be turned on. This is a normal phenomenon.

Please use the attached adapter to pre-charge the device for 0.5 to 1 hour (depending on the storage time) before turning it on. In addition, if the device is not used for a long time, it is recommended to charge it at regular intervals to avoid over-discharge of the lithium battery.

Battery Charging

The lithium battery may not be fully charged when delivered. To make the battery be charged, refer to the following table to charge and discharge:

Model	Charging	Discharging
For models＜100MHz	⩾4.5h	⩾4h
For models⩾100MHz	⩾4h	⩾3h

The power supply and battery indicator symbols in the upper right corner of the screen are explained as follows:

symbol indicates the power-on charging status;

symbol indicates battery power supply;

symbol indicates that there is only about five minutes of use time left. Please charge as soon as possible according to the relevant tips to avoid damage to the battery.

Charging Method

Charging the battery through the power adapter: Connect the oscilloscope to the power socket through the USB data cable and power adapter delivered with the machine for charging.

Charge the oscilloscope through the USB interface: Connect the oscilloscope to a computer or other equipment through a USB data cable for charging (pay attention to the load capacity of the power supply equipment to avoid abnormal operation of the equipment).

Note

To avoid overheating of the battery during charging, the ambient temperature must not exceed the allowable value given in the technical specifications.

Replacement of Lithium Battery

Generally, the battery does not need to be replaced. However, when necessary, it can only be replaced by qualified personnel, and only **lithium batteries of the same specification** can be used.