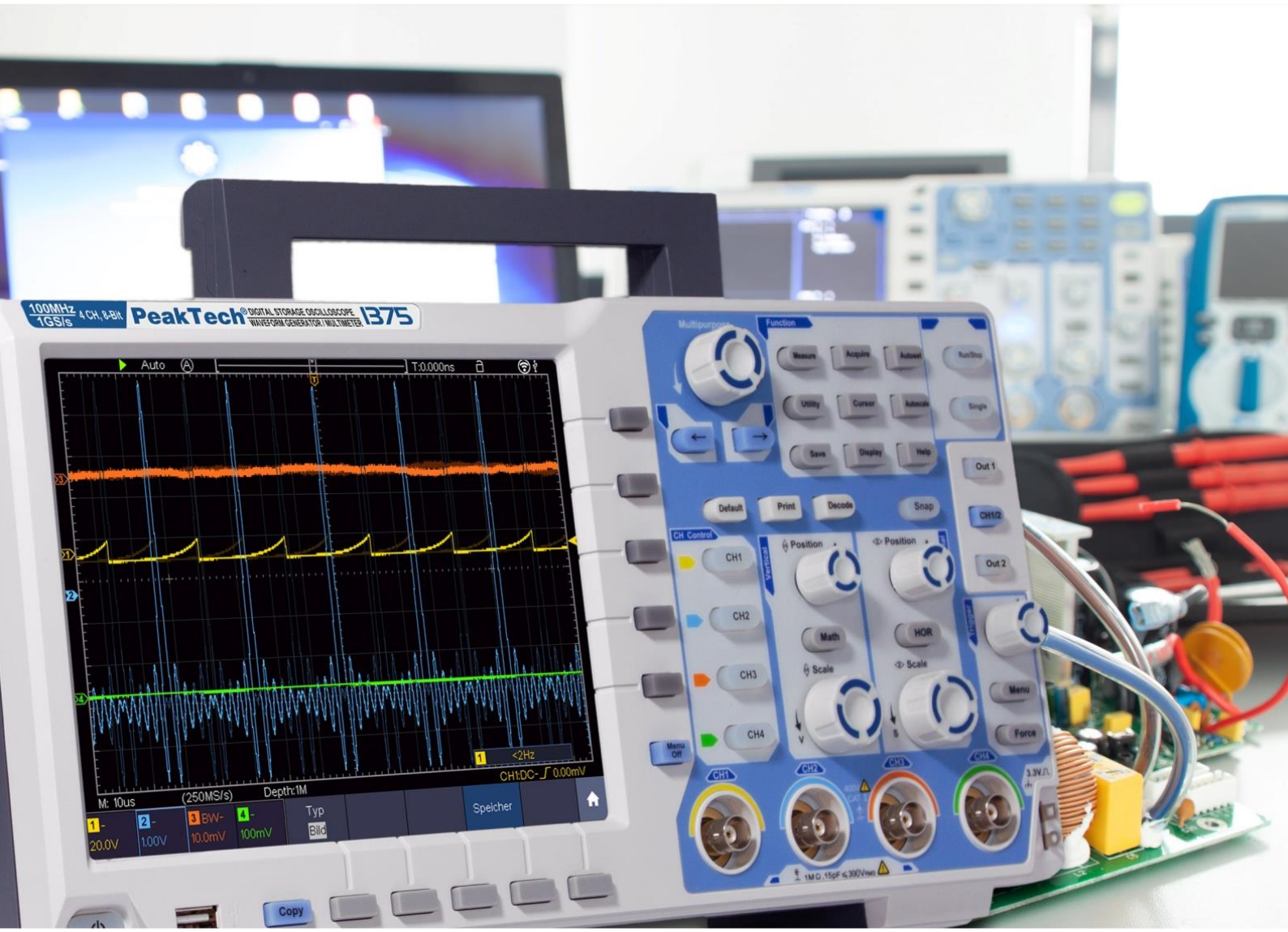
PeakTech®

Unser Wert ist messbar...



PeakTech® 1340 - 1375

Operating instructions
2 CH & 4 CH
Digital Memory Oscilloscopes

Table of contents

NOTE :

This series of oscilloscopes offers various models with many different additional functions and specifications. In this manual, these functions are also described for models that may not correspond to the functions of your model. For detailed information on the built-in functions of each model, refer to the technical specifications starting on page 98.

1. safety instructions for operating the appliance

This product complies with the requirements of the following European Union Directives for CE conformity: 2014/30/EU (Electromagnetic Compatibility), 2014/35/EU (Low Voltage), 2011/65/EU (RoHS).

Overvoltage category II; pollution degree 2.

To ensure the operational safety of the unit and to avoid serious injuries due to current or voltage surges or short circuits, it is essential to observe the following safety instructions when operating the unit.

Damage caused by non-compliance with these instructions is excluded from claims of any kind.

* This unit must not be used in high energy circuits.
* Before connecting the unit to a mains socket, check that the voltage setting on the unit corresponds to the existing mains voltage
* Connect the appliance only to sockets with earthed protective conductor.
* Do not place the appliance on a damp or wet surface.
* Do not operate the unit near strong magnetic fields (motors, transformers, etc.)
* Do not exceed the maximum permissible input values **under any circumstances** (serious risk of injury and/or destruction of the unit).
* The specified maximum input voltages must not be exceeded. If it cannot be excluded beyond doubt that these voltage peaks are exceeded due to the influence of transient disturbances or for other reasons, the measuring voltage must be pre-damped accordingly (10:1).
* Before switching to another measuring function, disconnect the test leads or probe from the measuring circuit.
* Check the unit, test leads and other accessories for possible damage or bare or bent cables and wires before commissioning. If in doubt, do not carry out any measurements.
* Only carry out measuring work in dry clothing and preferably in rubber shoes or on an insulating mat.
* Do not touch the measuring tips of the test leads.
* It is essential to observe the warnings on the unit.
* Unit must not be operated unattended
* Do not expose the unit to extreme temperatures, direct sunlight, extreme humidity or moisture.
* Avoid strong vibration.
* Keep hot soldering guns away from the immediate vicinity of the unit.
* Before starting measurement operation, the unit should be stabilised to the ambient temperature (important when transporting from cold to warm rooms and vice versa).
* Do not exceed the set measuring range during any measurement. This will prevent damage to the device.
* Clean the cabinet regularly with a damp cloth and a mild detergent. Do not use corrosive abrasive cleaners.
* This unit is suitable for indoor use only.
* Avoid any proximity to explosive and flammable substances.
* Opening of the unit and maintenance and repair work may only be carried out by qualified service technicians.
* Do not place the front of the unit on the workbench or work surface to avoid damage to the controls.
* Do not make any technical changes to the unit.
* **-Measuring instruments do not belong in children's hands-**

Warning:

If the oscilloscope is connected to an input signal greater than 42V peak (30Vrms) or circuits greater than 4800VA, please follow the instructions below to avoid fire or electric shock:

-Use only insulated probes and test leads.
-Inspect all accessories before use and replace if damaged. If in doubt, do not take measurements.
-Remove the USB cable connecting the oscilloscope to the computer.
Never exceed the maximum specified input voltages. Since the voltage is transmitted directly to the oscilloscope with the aid of the probe, the unit may be damaged or there is a risk of injury from electric shock.
-Do not use exposed BNC or banana plugs.
-Do not insert any metal objects into the connections.

Cleaning the appliance:

Before cleaning the appliance, disconnect the mains plug from the socket. Clean the appliance only with a damp, lint-free cloth. Use only commercially available detergents.

When cleaning, make absolutely sure that no liquid gets into the interior of the unit. This could lead to a short circuit and destruction of the unit.

2. safety symbols and terms

You can find the following symbols in this operating manual or on the meter.

WARNING!

"Warning" indicates conditions and operating steps that pose a danger to the operator.

CAUTION!

"Caution" indicates conditions and operations that may cause damage to the product or other property.

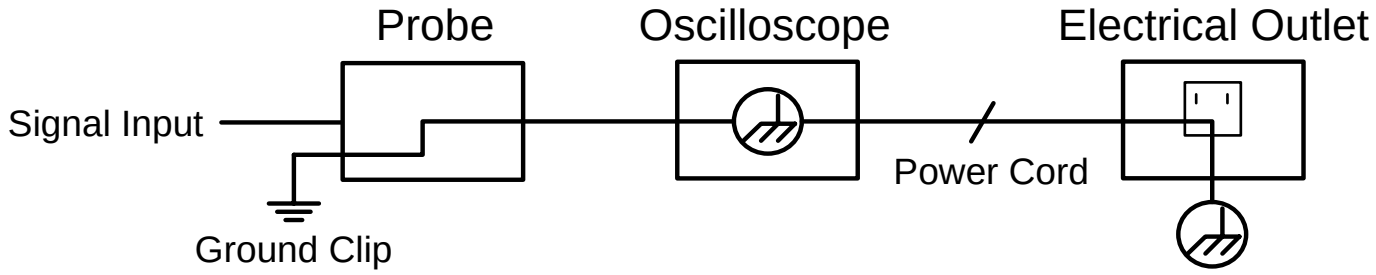
Danger: High-voltage	See operating instructions	Protective conductor terminal	Unit dimensions	Ground terminal (earth)

In order to avoid physical damage and damage to the measuring device and the objects to be measured, you should read the following paragraph carefully and also keep it in mind at all times during future use. This device may only be used for the intended applications.

Warning:

The channels of the oscilloscope are not electrically isolated from each other. Therefore, the measuring channels should be on a common ground during a measurement. To avoid short circuits, the earth terminals must not be connected to different, non-insulated DC levels.

Diagram of the internal ground wiring (GND):



Due to the internally connected earth terminals between the BNC socket, USB port and IEC plug, no measurement of the mains voltage should be carried out during mains voltage operation of the oscilloscope in conjunction with a mains voltage operated PC. In the event of an error, a voltage flashover via the GND of the PC could a

3. quick guide

This chapter covers the following topics:

- Structure of the oscilloscope
- Introduction to the user guidance
- Testing before commissioning
- Function test
- Probe compensation
- Probe attenuation
- Safety when using the scanner
- Carrying out the self-calibration
- Introduction to the vertical system
- Introduction to the horizontal system
- Introduction to the trigger system
- Introduction to touch screen operation

Structure of the oscilloscope

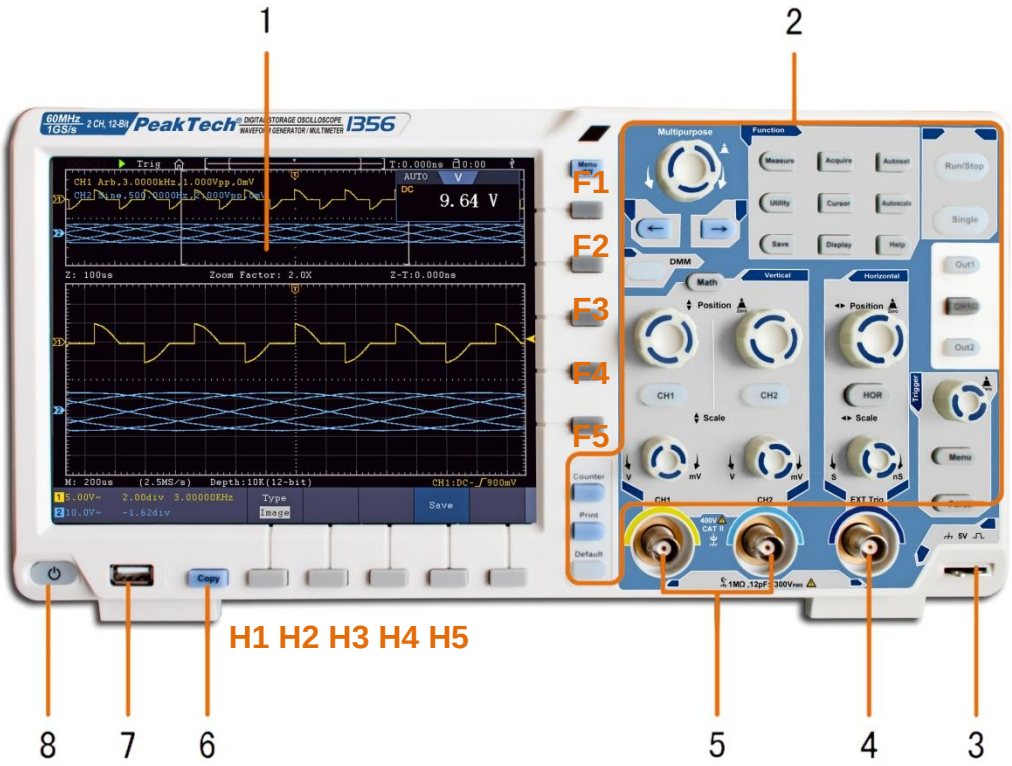
When you receive a new oscilloscope, the first thing you should do is familiarise yourself with its control panel. This chapter provides a simple description of the operation and functioning of the oscilloscope's control panel so that you can quickly become familiar with its use.

Front

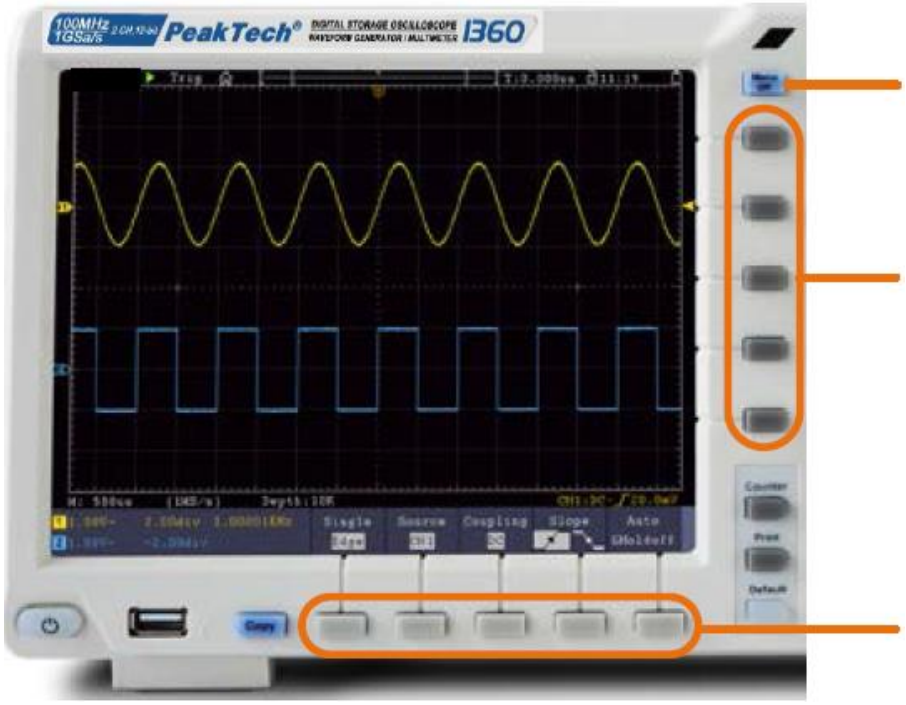
The oscilloscope has a simple control panel with rotary knobs and function keys that can be used to set the various functions for performing basic operations. The functions of the knobs are very similar to those of other oscilloscopes. The 5 keys (F1 ~ F5) to the right of the screen or in the row below the screen (H1 ~ H5) are menu selection keys that allow you to set the different options for the current menu. The other keys are function keys that allow you to enter different function menus or access a specific function directly.

1. Display range
2. Control (push buttons and rotary switch) Range
3. Probe compensation: Measuring signal (5 V / 1 kHz) Output
4. EXT trigger input
5. Signal input sockets (2 to 4, depending on model)
6. Copy button: Saves waveform directly
7. USB host port: For connecting an external storage medium
8. Power button ON/OFF: Red = unit switched off ; Green = unit switched on

Below the display are the H1 - H5 keys for operating the lower menu row. To the right of the display are the F1 - F5 keys for controlling the (superimposed) menu control on the right side of the screen.



Function keys



Switch off left/right menu

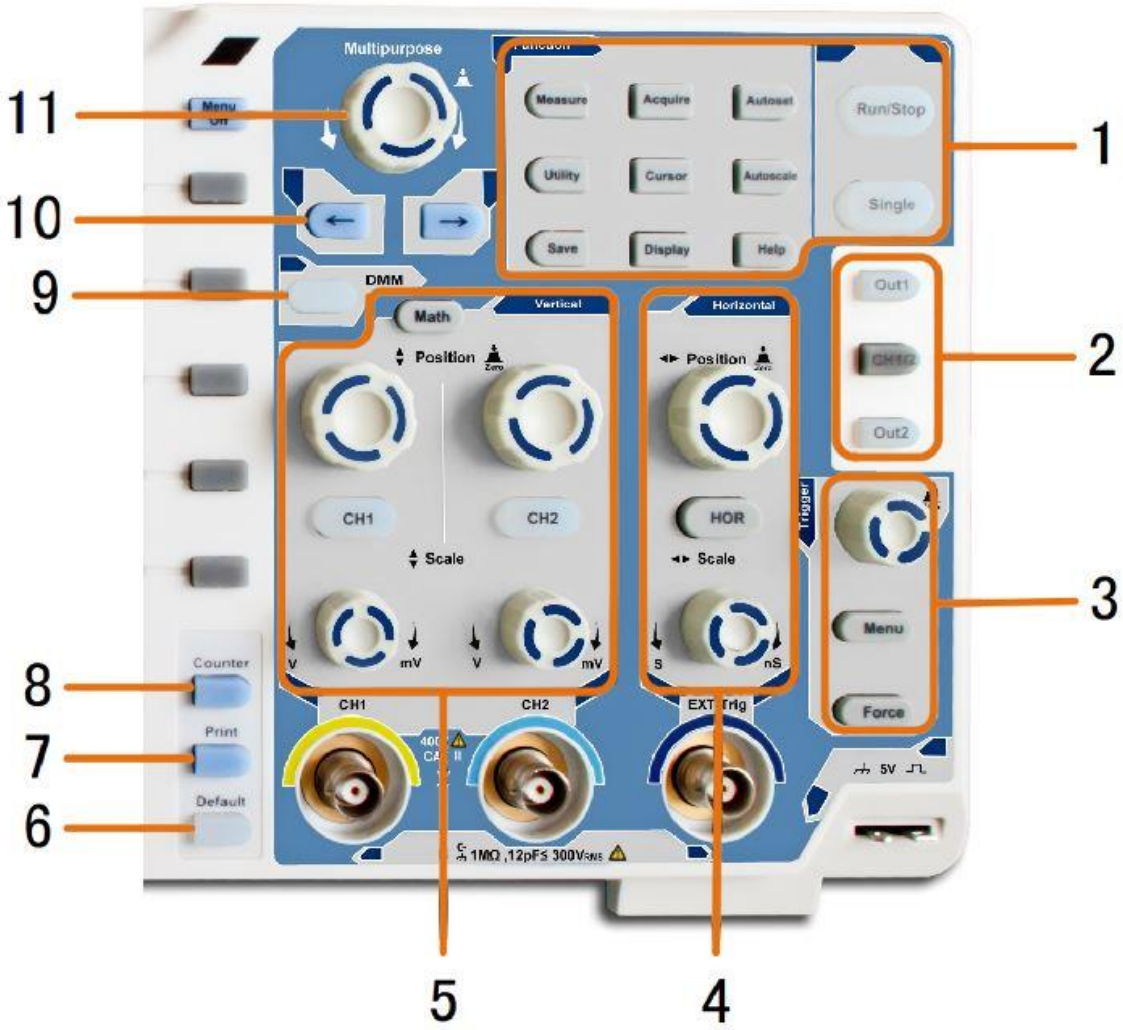
Right display menu

Lower display menu

Back cover

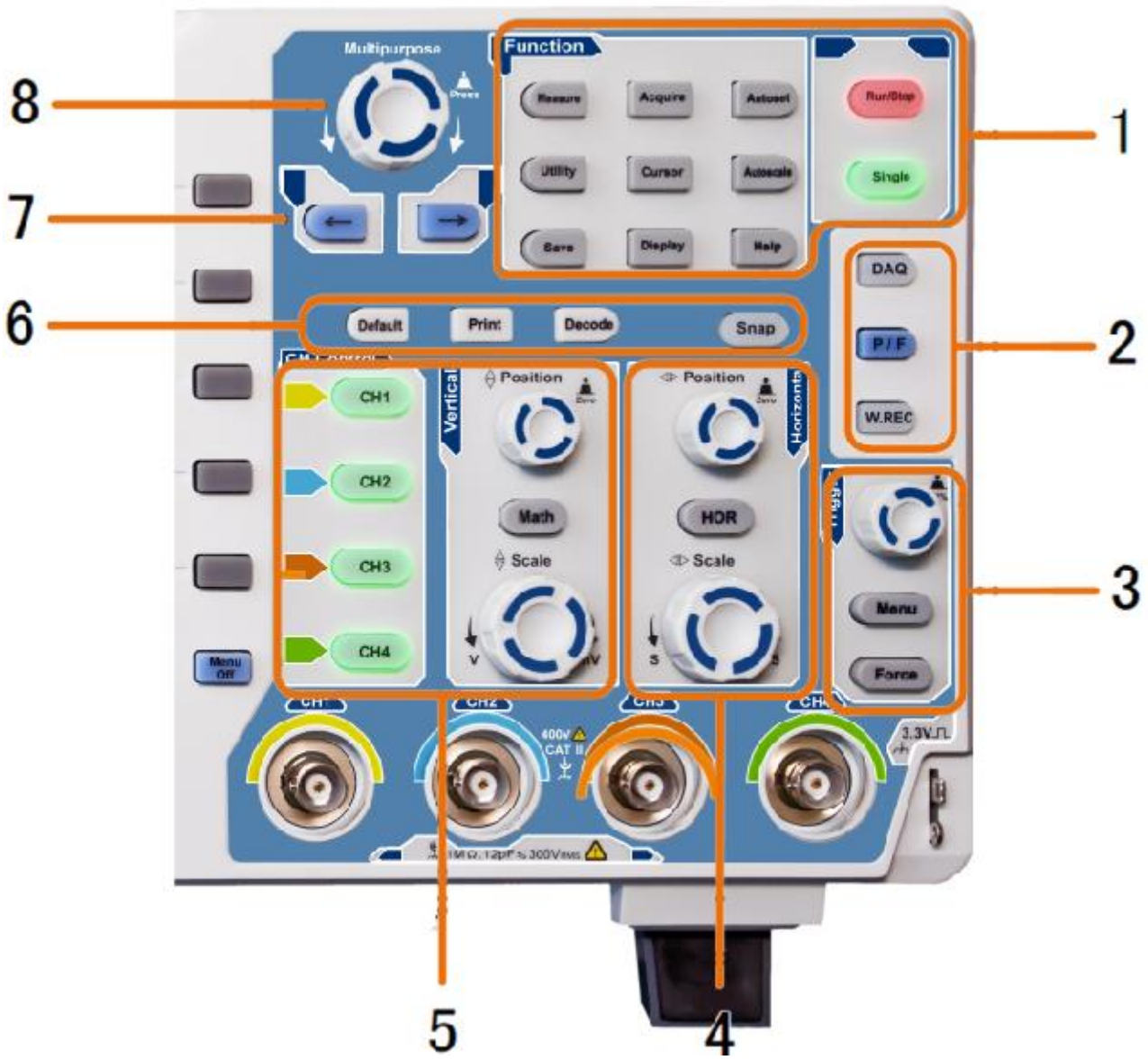
1. Handle
2. Ventilation slots
3. Multimeter sockets
4. Mains voltage socket
5. Fuse
6. Feet
7. VGA connection: connection of an external monitor
8. LAN connection: For connection to a network
9. USB device connection: For connection to the PC
10. Anti-theft device: Opening for fastening
11. AV Port: Signal output socket (optional)
12. Triger Out (P/F) Port: Trigger signal output & Pass/Fail connection
13. Out 1 Port: Output socket for function generator

Controls 2-channel



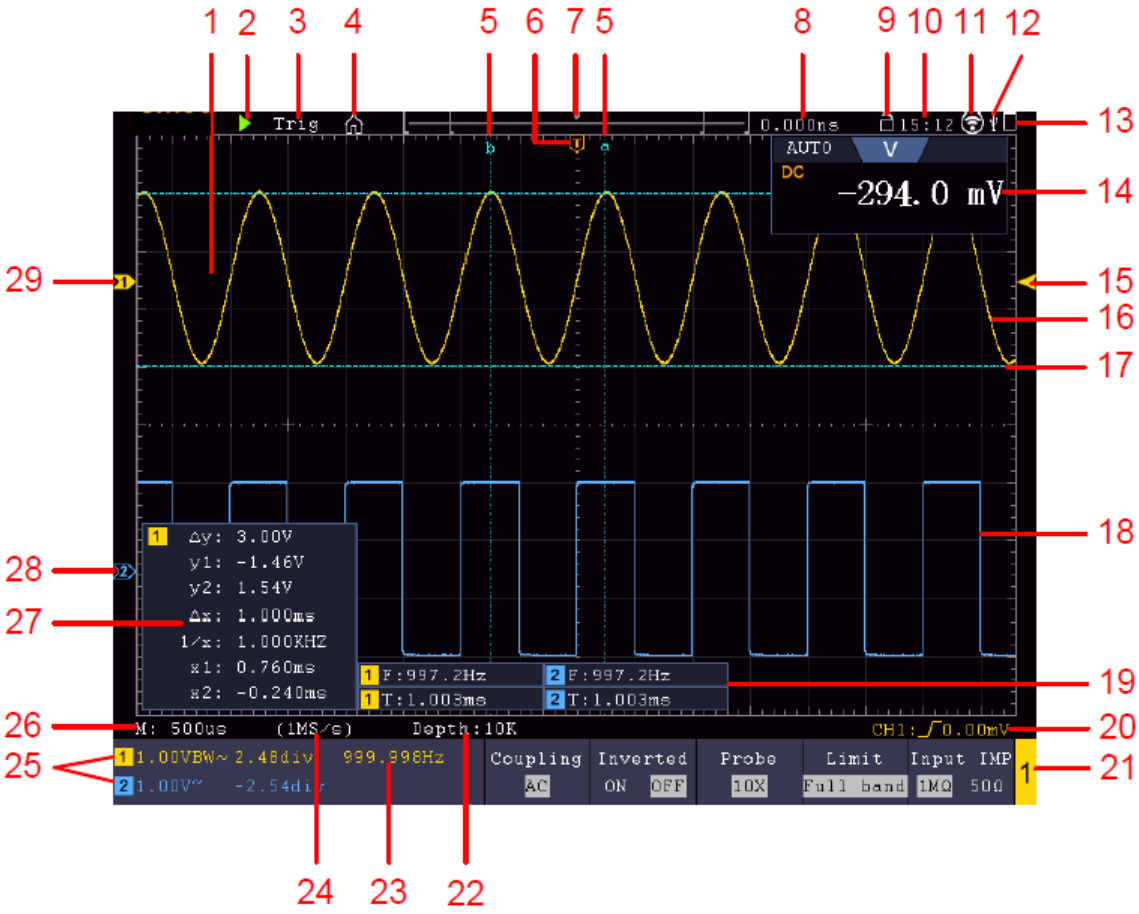
1. **Function key area:** Main control for all function menus
2. **Additional functions (depending on model):** Menu keys e.g. for the function generator
3. **Trigger control:** Rotary knob and menu buttons for trigger control
4. **Horizontal range:** Rotary and push buttons for the horizontal range
5. **Vertical range:** Rotary and push buttons for channel 1 and channel 2, as well as MATH function key
6. **Reset button:** Resets measurement function to standard
7. **Print button:** Prints screenshot
8. **Counter button:** Frequency counter function
9. **DMM button:** digital multimeter function
10. **Arrow keys:** Align cursor to parameter
11. **M-rotary knob:** Multifunctional rotary knob for navigation in all main menus

Controls 4-channel



1. **Function key area:** Main control for all function menus
2. **Additional functions (depending on model):** Menu keys e.g. for the function generator
3. **Trigger control:** Rotary knob and menu buttons for trigger control
4. **Horizontal range:** Rotary and push buttons for the horizontal range
5. **Vertical range & channel selection keys:** Keys for all channels, plus MATH function key
6. **Quick selection buttons (model dependent):** Reset, Print or Decode
7. **Arrow keys:** Align cursor to parameter
8. **M-rotary knob:** Multifunctional rotary knob for navigation in all main menus

Introduction to user control



Example: 2 channel model

1. Waveform display area
2. RUN/STOP: Can also be used via touch screen
3. Trigger status
4. Activate touch screen function menu
5. Blue line shows cursor position A and B (only with cursor measurement)
6. The [T] mark shows the horizontal trigger position
7. Displays the trigger position in the memory length
8. Shows the current trigger value and the location in the internal memory
9. Lock touch screen operation ( ) / enable ( )
10. Shows the current time (see configuration)
11. WiFi is activated (See Connection to the Android device)
12. Indicates the connection of an external USB device to the oscilloscope
13. Shows battery status (optional)
14. Multimeter window
15. Arrow shows the trigger level position
16. Waveform of CH1
17. The blue line shows the horizontal cursor position (only with cursor measurement)
18. Waveform from CH2
19. Shows the activated measuring function together with the corresponding measured value.
20. Shows the current trigger type
21. Shows the currently active channel for function control in the lower menu
22. Shows the memory depth
23. Shows the frequency of the trigger signal
24. Shows the current sampling rate
25. Shows voltage division, zero position and bandwidth limit, as well as symbol for coupling type
26. Displays the Main Time Base
27. Displays values of the cursor measurement
28. Blue pointer indicates the zero point line of CH2, if not present the channel is not active
29. Yellow pointer indicates the zero point line of CH1, if not present the channel is not active

Testing before commissioning

It is recommended that after receiving a new oscilloscope, a check of the unit is carried out as follows:

1. **check if the unit has been damaged during transport.**

   If you find that the cardboard packaging or the protective foam pads are badly damaged, save them until the entire unit and its accessories have passed the electrical and mechanical test.

2. **checking the accessories**

   The accessories supplied are described in Appendix B "Accessories" of this manual. Check the accessories against this description to ensure they are complete. If any accessories are missing or damaged, please contact your dealer.

3. **checking the unit**

   If you notice any damage to the exterior of the unit or if the unit does not function properly or does not pass the performance test, please contact your dealer. If the unit has been damaged during transport, please keep the outer packaging and also inform your dealer about the damage.

Function test

Check the proper functioning of the meter as **follows**

1. **connect the mains cable to a power source. Switch on the unit with the mains switch** " ⏻ ".

   The unit performs a self-test and displays the PeakTech logo. First press the Utility button and then the H1 button to access the Function menu. Select "Calibrate" using the multi-rotary knob and press the H3 button to select "Factory Set". The default value for the probe attenuation in the menu is 10X.

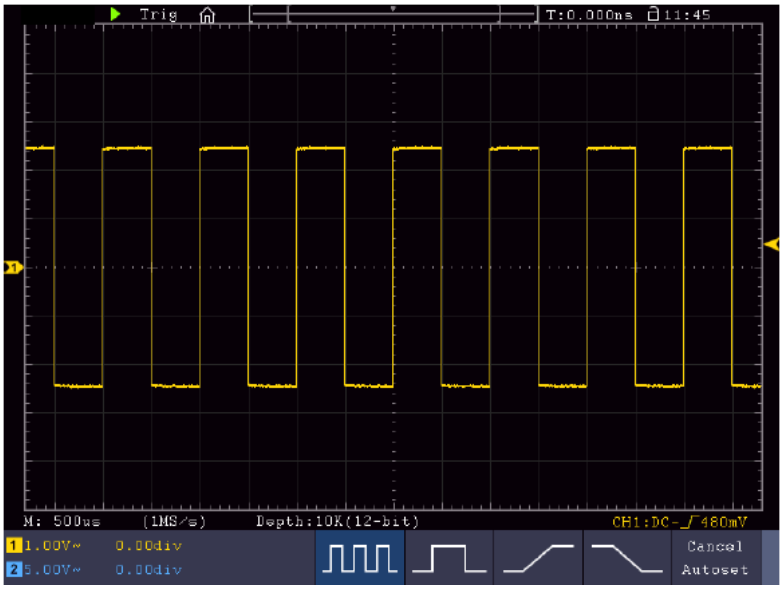
   Set an attenuation of 10x on the probe and connect the probe to the CH1 socket.

   Align the slot on the probe with the BNC connector of channel 1 and turn the probe clockwise to secure it.

   Connect the probe tip and earth terminal to the plug of the task head compensator.

3. **press the "Autoset" button.**

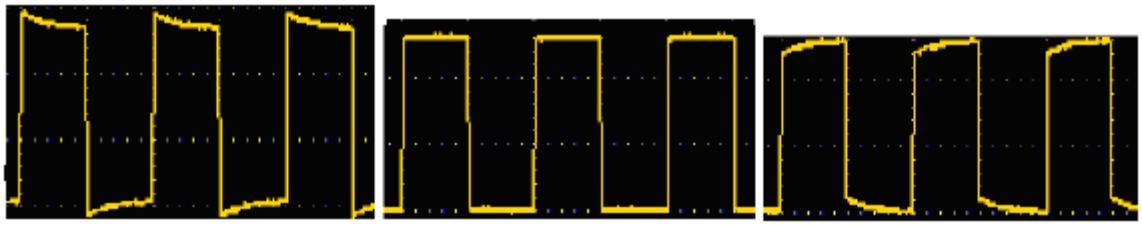
The square wave signal with a frequency of 1 KHz and a 5V SS value is displayed after a few seconds



Probe compensation

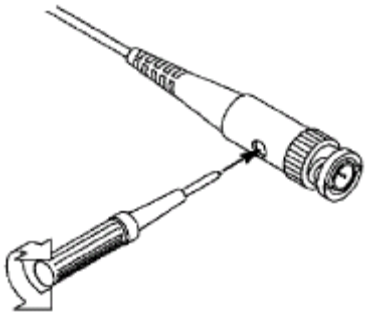
When you connect the probe to an input channel for the first time, you must adapt the probe to the input channel. An uncompensated or incorrectly compensated probe will result in measurement errors. Perform the probe compensation as follows:

1. Set the damping factor of the probe to 10X in the menu, also set the switch on the probe to 10X and connect the probe to channel 1. When using the hook tip, make sure that it remains securely connected to the probe. Connect the probe tip to the signal connector of the probe compensator and connect the clamp of the reference cable to the earth terminal of the probe compensator; then press the AUTOSET button.
2. Check the displayed waveforms and adjust the probe until correct compensation is achieved



Overcompensated Correct compensationUndercompensated

3. Repeat the process if necessary to obtain the most uniform image possible.



Setting the probe damping factor

The probe has several probe damping factors that affect the vertical scaling factor of the oscilloscope.

If the set probe attenuation factor is to be changed or checked, press the function menu key for the respective channel and then the selection key corresponding to the probe until the correct value is displayed.

This setting remains valid until it is changed again.

Note: The damping factor of the probe in the menu is preset to 10X at the factory.

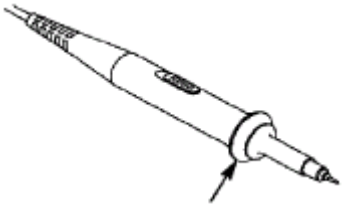
Make sure that the value set on the attenuation switch of the probe corresponds to the attenuation value set on the oscilloscope.

The values that can be set with the switch on the probe are 1 X and 10X (see ***picture***).

Note: When the attenuator switch is set to 1X, the probe limits the bandwidth of the oscilloscope to 5 MHz. You must set the switch to 10X if you want to use the entire bandwidth of the oscilloscope.

Safety instructions for the use of the scanner head

The handle protection ring around the probe handle prevents it from accidentally reaching over or slipping off and thus from touching the possibly live metal parts (see **Fehler! Verweisquelle konnte nicht gefunden werden..**)



Handle protection

Warning:

To avoid electric shock, always keep your fingers behind the safety protection ring of the probe.

To protect you from electric shock, do not touch any conductive metal parts of the probe tip when it is connected to a power source.

Before taking any measurements, always connect the probe to the oscilloscope first and then connect the earth terminal to the housing of the DUT.

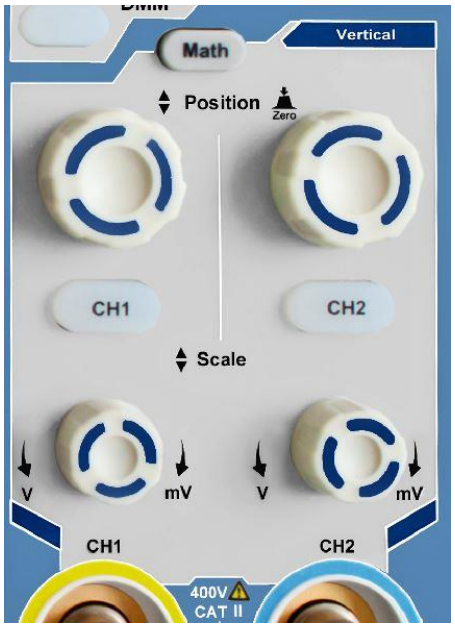
Self-calibration

With the auto-calibration, the oscilloscope can be quickly set to the optimum state for highly accurate measurements. You can run this programme at any time, but you must do so if the ambient temperature varies by more than 5°C.

Remove all probes and cables from the input sockets before performing the auto-calibration. Press the "**UTILITY**" button, then the "**H1**" button to enter the **FUNCTION** menu; turn the "**Multipurpose**" knob to select "Adjust". Press the "**H2**" menu selection button to access the "**Selfcal"** option and start the programme after confirming "**OK**" that all settings are correct.

Introduction to the vertical system

The following picture shows the buttons and keys for the **VERTICAL CONTROL**. The following exercises will familiarise you with the vertical control step by step.



1. With the rotary knob "**VERTICAL POSITION**" you can display the signal in the centre of the waveform window. With the "**VERTICAL POSITION**" adjustment knob, you set the vertical display position of the signal. Turning the "**VERTICAL POSITION**" adjustment knob moves the pointer of the channel's zero position up and down, following the waveform.

Measurement capabilities

If DC coupling is set for the channel, you can quickly measure the DC component of the signal by observing the difference between waveform and signal ground.

If AC coupling is set for the channel, the DC component is filtered out. This mode helps you to display the AC component of the signal with higher sensitivity.

Set the vertical offset to 0 again:

Turn the **VERTICAL POSITION** knob to change the vertical position of the channel and press the **VERTICAL POSITION** knob to reset the vertical position to 0. This is especially useful if the position track goes far out of the display area and the signal should immediately reappear in the centre of the screen.

2. Change the vertical setting and observe the resulting change in status information.

With the status information displayed at the bottom of the wave window, you can see changes in the vertical scaling factor for the channel.

- Turn the vertical **"VOLT / DIV"** knob and change the "Vertical scaling factor" (voltage range). Now you can see that the scaling factor of the channel has been changed according to the status bar.
- Press the **CH1 ~ CH2** and **Math** keys**.** In the operating menu, symbols, waveforms and scaling factor status information of the corresponding channel are displayed on the screen.

You can also change the vertical system via touchscreen. Refer to the paragraph "Adjust the vertical system via touchscreen".

Introduction to the horizontal system

The following picture shows a button and two adjustment knobs for **HORIZONTAL CONTROL**. The following exercises will familiarise you with the horizontal control step by step.

Horizontal control panel

1. Use the "**Scale**" adjustment knob to change the settings for the horizontal time base; you can then observe the resulting changes in the status information. Turn the "**Scale**" knob to change the horizontal time base; you will then see the corresponding changes in the "**Horizontal Time Base**" display in the status line.
   Use the "**HORIZONTAL POSITION**" adjustment knob to adjust the horizontal position of the signal in the waveform window. The "**HORIZONTAL POSITION**" adjustment knob is used to control the trigger shift of the signal or for other applications. When you use it to trigger the shift, you can observe that the waveform moves horizontally and follows the rotation of the "**Horizontal Position**" adjustment knob.

3. **Trigger shift back to 0**
   Turn the **HORIZONTAL POSITION** knob to change the horizontal position of the channel, press the **HORIZONTAL POSITION** knob to set the shift back to 0.

4. press the "**HOR**" key to determine the window section.

Introduction to the Trigger System

Picture 0-12 shows a setting knob and three buttons for the **TRIGGER CONTROL**. The following exercises will familiarise you step by step with the settings for the trigger system.

Trigger control panel

Press the "**Trigger MENU"** button to open the Trigger menu. Use the 5 menu items to change the trigger settings.

Use the "**TRIG**" adjustment knob to change the trigger level settings.
Turn the **TRIG LEVEL knob** and watch the trigger indicator on the screen move up and down as you turn the knob. As the trigger indicator moves, the trigger level value displayed on the screen changes.

Note: Pressing the trigger knob resets the trigger to the zero position.

3. press the "**FORCE**" key to preset a trigger signal that is mainly applied to the trigger modes "Normal" and "Single".

Introduction to touch screen operation (depending on model)

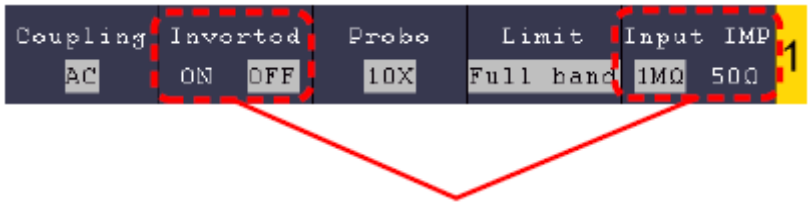
You can control various oscilloscope functions on touchscreen models by touching the display. Furthermore, you can always use the keys and knobs on the unit for the same settings.

The touchscreen lock at the top of the screen is for turning the touchscreen function on ( ) and off ( ). Tap the icon to make a change.

Set menu control via touch screen

- **Select menu item**: Tap the menu items in the bottom menu, in the right menu or in the left menu directly on the display.

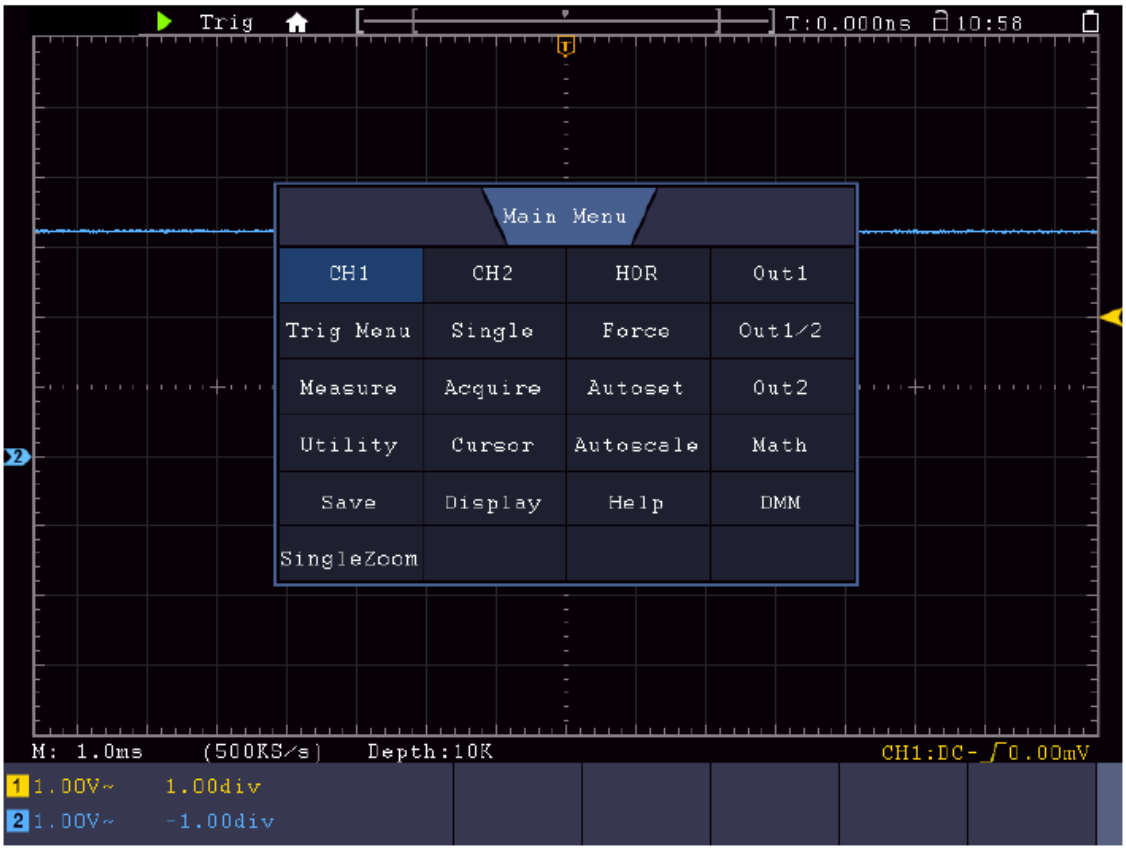
- **Select menu items**: If there are selectable options that can be switched in the menu, you can always change the area of the menu item by touching the display, or press the corresponding key. See illustration:



Press repeatedly to switch options

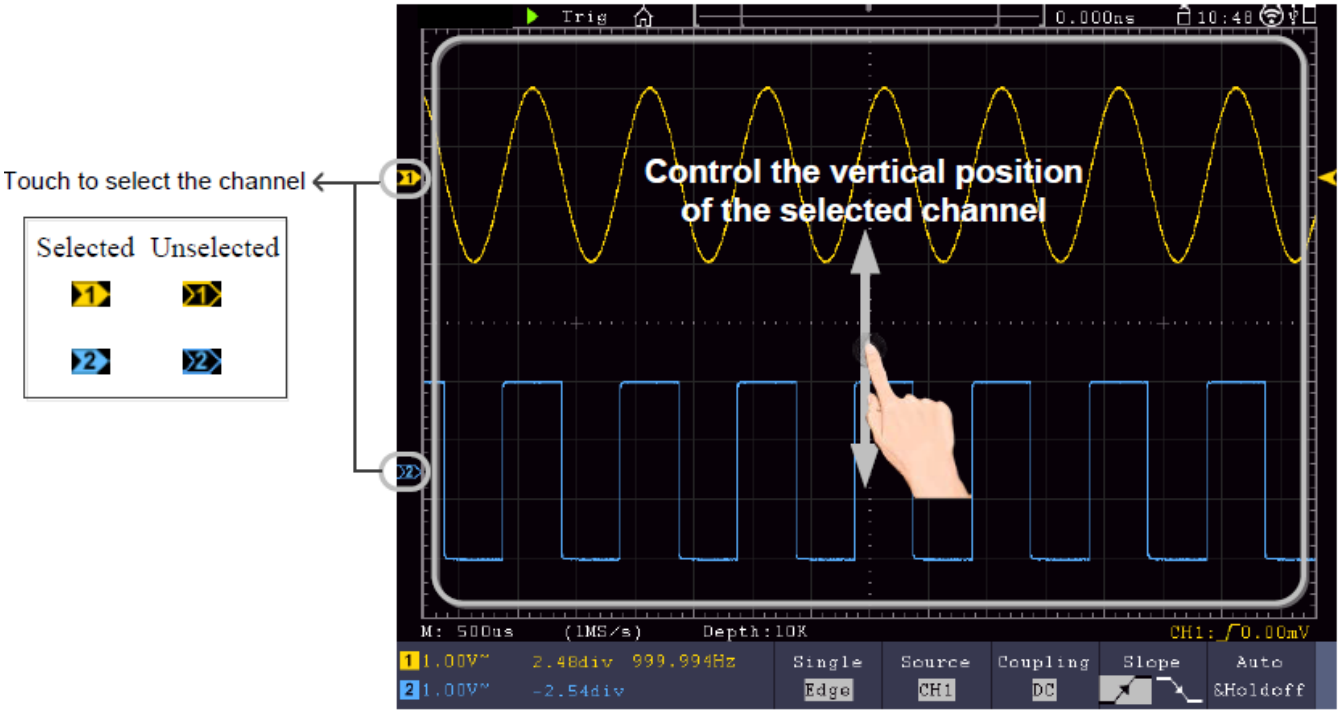
- **Scroll through the list**: If there is a scroll bar in the left menu or in the file system window, you can "swipe" up and down to scroll through the list.

- **Touchable menu windows**: Tap on the symbol and a menu window is displayed in the upper left edge of the display area. Tapping on the menu item with your finger has the same function as pressing the corresponding key.

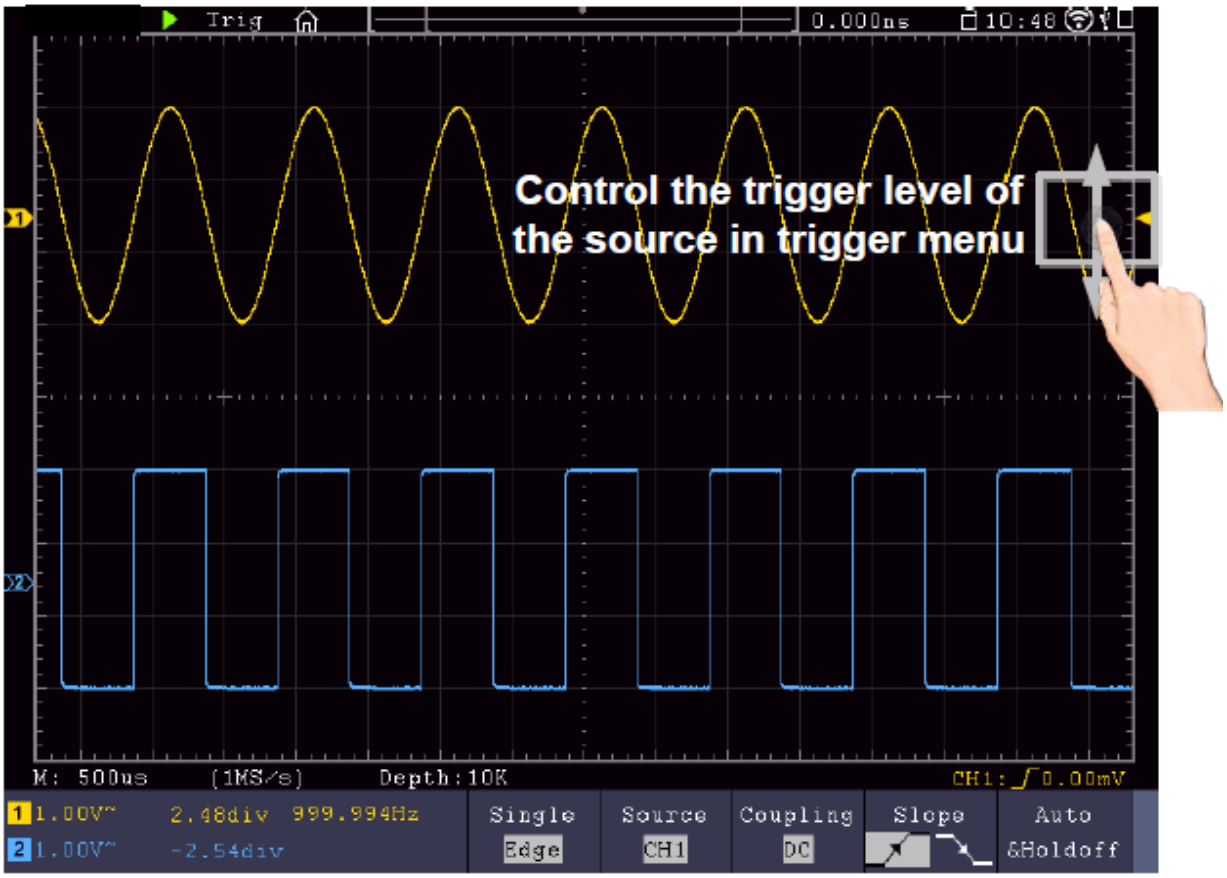


Gesture control in normal mode

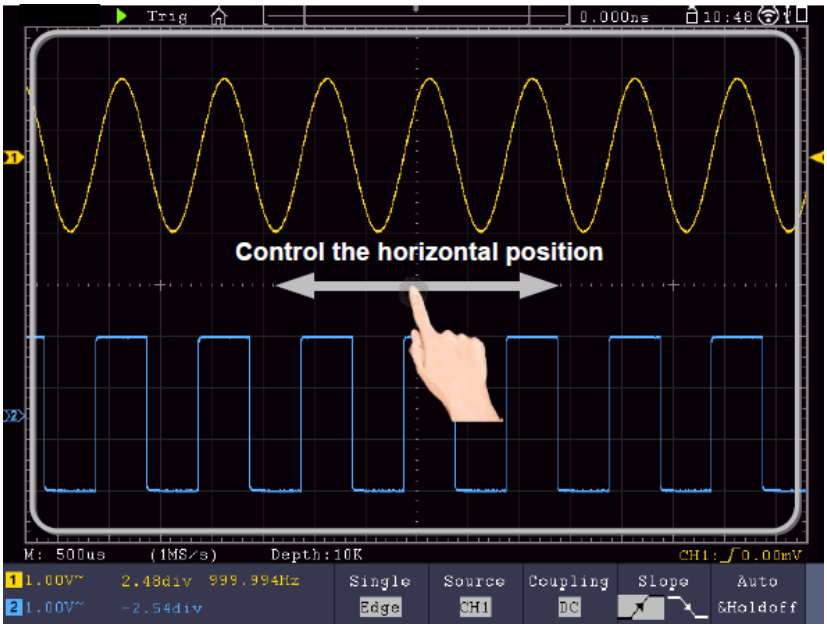
- Select a channel (CH1 to CH4 button): Press the pointer (yellow/blue) belonging to the channel on the left side of the display.



- Set the trigger level (trigger level rotary knob): "Swipe" at the pointer (yellow/blue) belonging to the channel on the right side of the display.

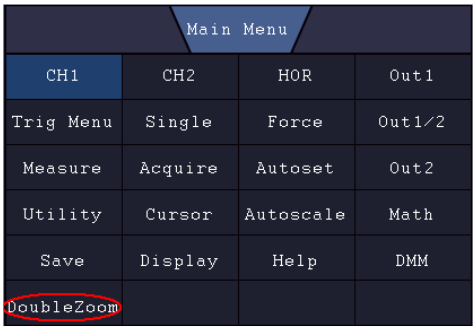


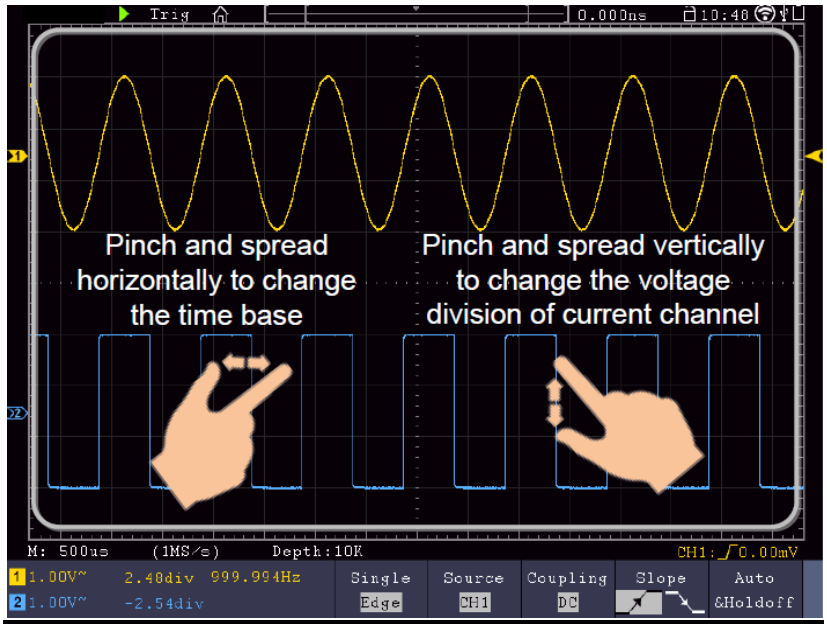
- Adjust the horizontal position (Horizontal Position knob): "Swipe" left/right in the display.



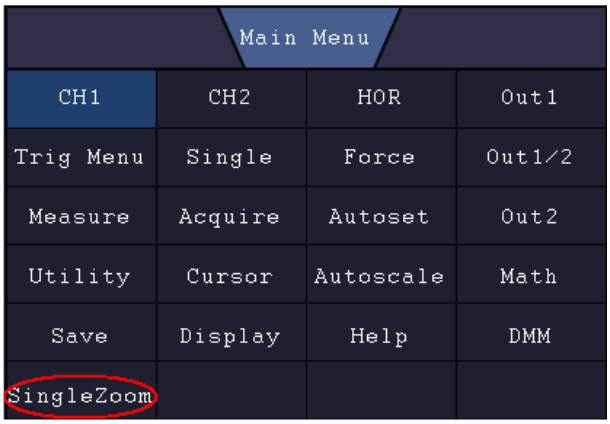
Double and single zoom

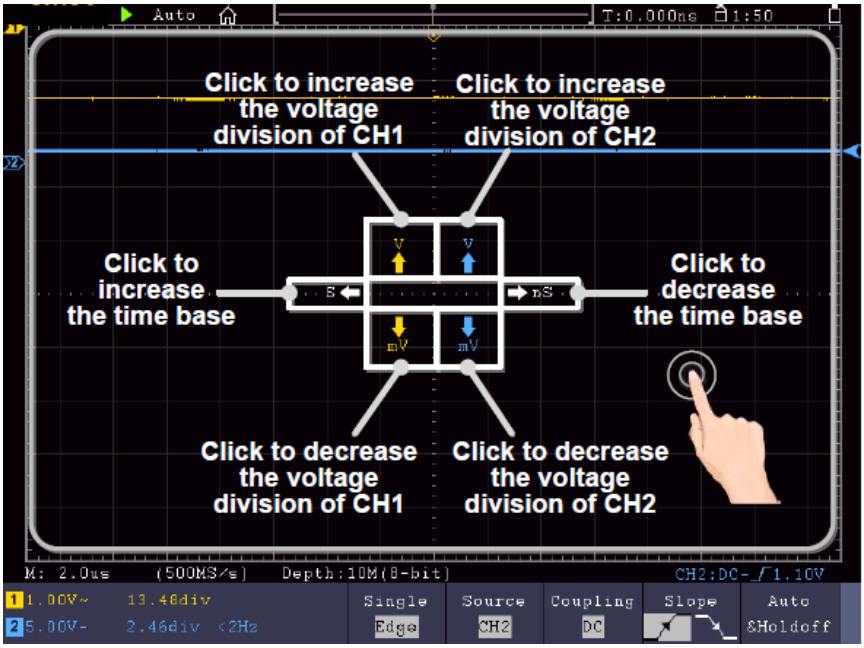
If **Double-Zoom** is selected in the touchscreen menu window ( ), you can change the time base in the display area by a horizontal swiping movement and the voltage division of the current channel by a vertical swiping movement:





If you select **Single Zoom**, a control panel for these functions appears when you touch any point in the main window:



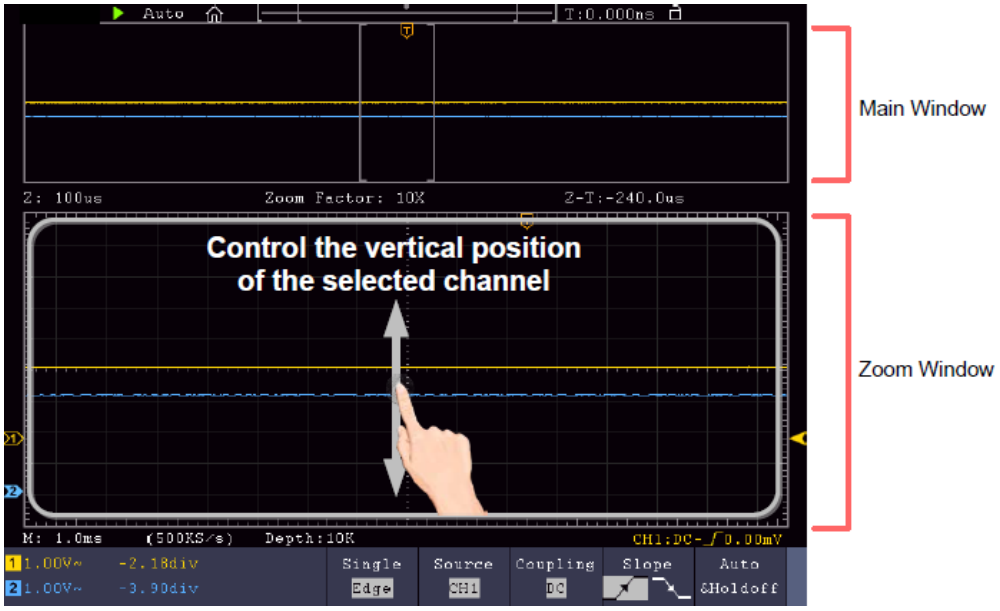


- **Set Voltage/Division (Vertical Scale knob):** Tap the upper left field of the displayed Single Zoom menu to change the Volt/Div of CH1 (yellow) or the lower left field to decrease it. For CH2, perform this operation in the right fields.

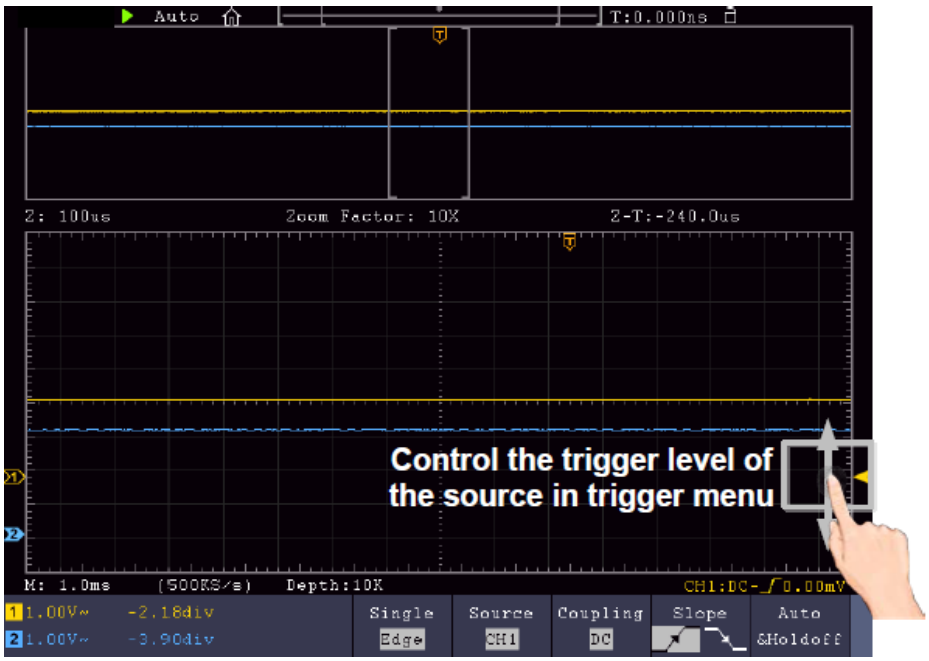
- **Change the horizontal time base (Horizontal Scale knob):** Use the left field of the displayed Single Zoom menu (S) to increase the time base and the right field (nS) to decrease this value.

Gesture control in Wave Zoom mode

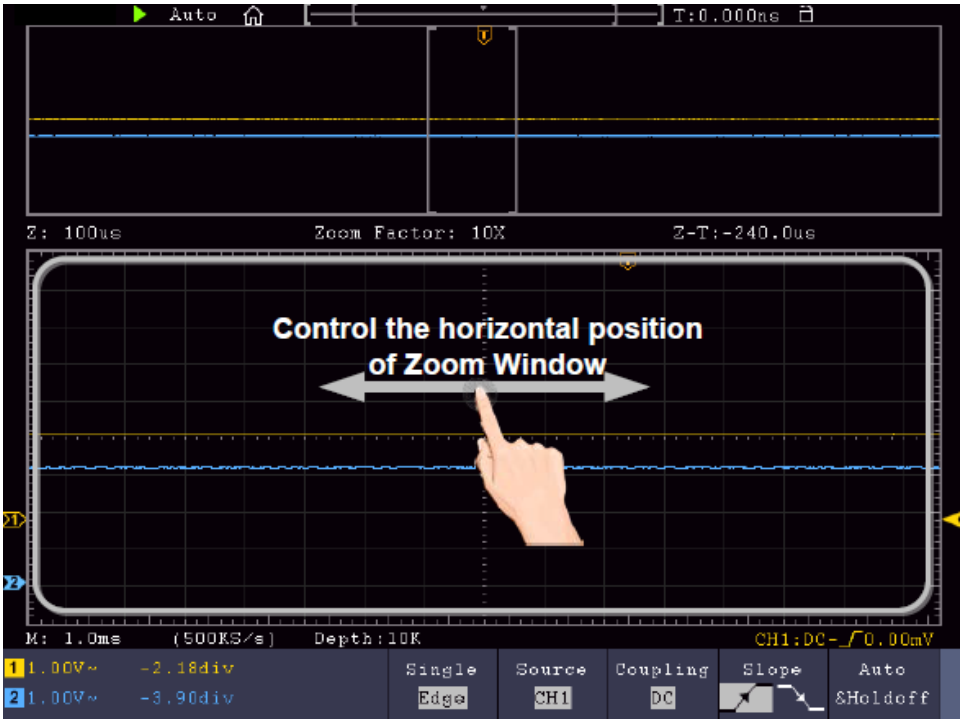
Press the **HOR button to** switch to zoom mode. The upper half of the display shows the main window and the lower half shows the zoom mode. Zoom mode is the enlarged display of the main window.



Swipe up/down in the centre to change vertical position

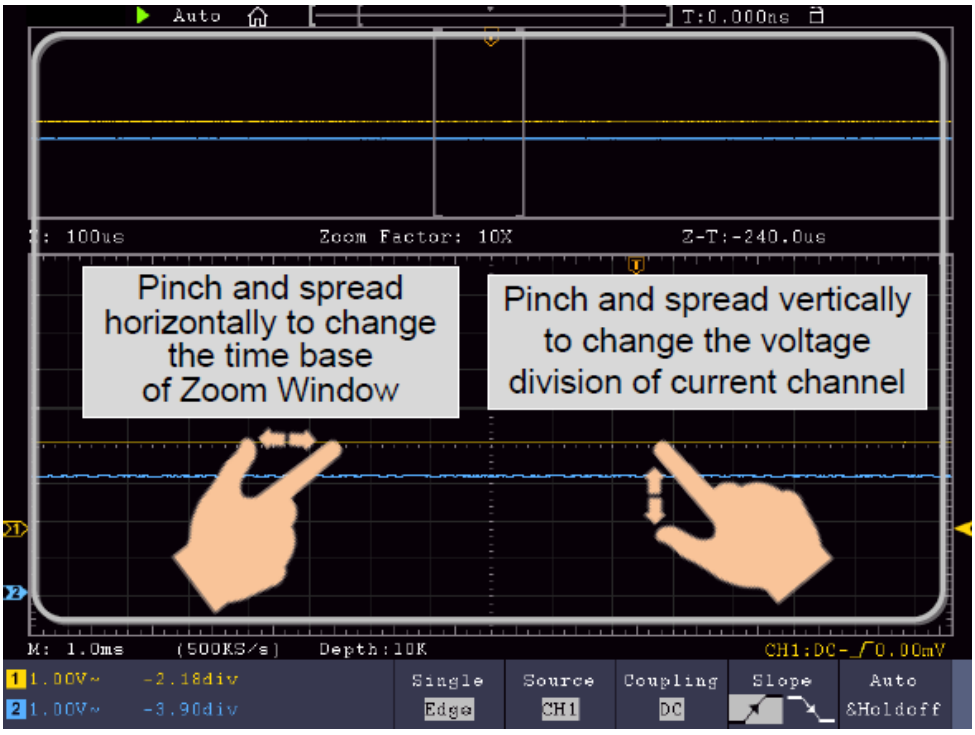


Swipe right up/down to change trigger level



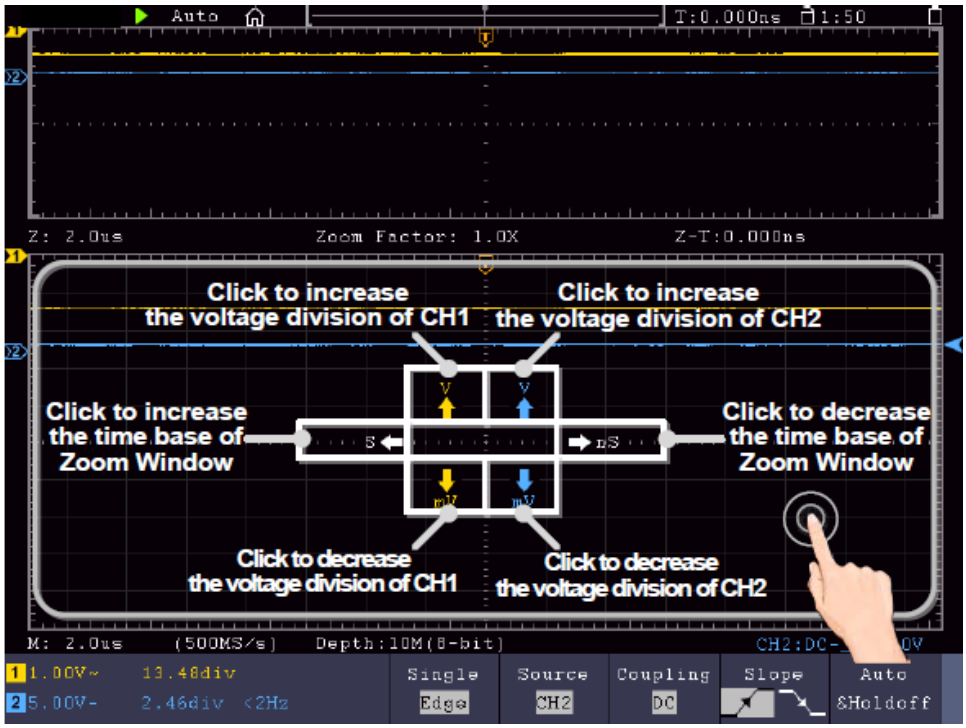
Swipe right/left in the centre of the zoom window to change the horizontal position.

Changing Horizontal/Vertical Settings in Double Zoom Mode



In the zoom window, swipe left/right simultaneously to change horizontal time base and swipe up/down simultaneously to change vertical volt/division.

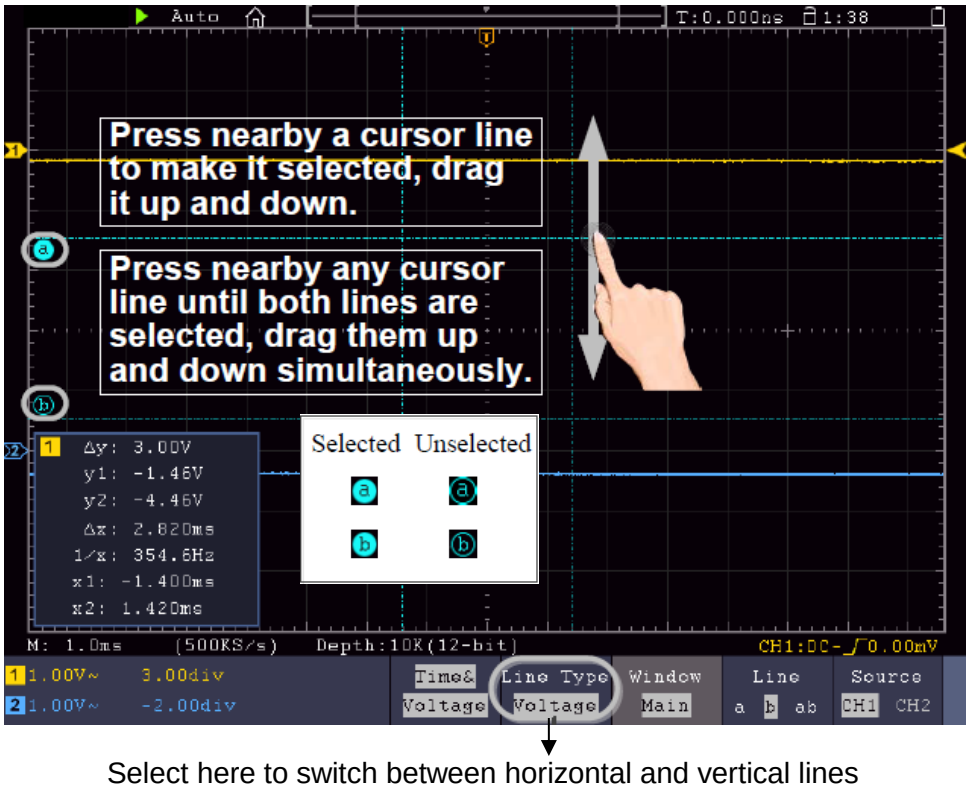
Changing Horizontal/Vertical Settings in Single Zoom Mode



Tap in the zoom window to open the menu, then tap the corresponding
Tap the icon to change the associated value.

Other Touchscreen Settings

- **Cursor measurements:**

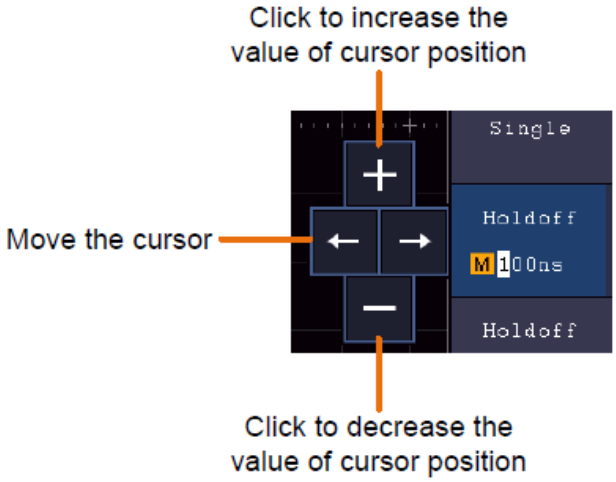


Select here to switch between horizontal and vertical lines

- **Run/Stop:** Double-tap the display area or select the corresponding icons or to start or stop the waveform display.

- **Touch Keyboard:** To enter words, e.g. when naming files, you can use the keyboard that appears:

- **Set menu value:** In some menus there are sliders for different values. You can change these by tapping the respective symbol:



4. User instructions (for advanced users)

In the preceding paragraphs, the user has already been familiarised with the basic functions of the function areas, keys and buttons on the front panel of the oscilloscope. Based on the introduction of the previous chapter, the user should already have gained first insights into changing the oscilloscope settings, selecting and evaluating the status bars and general operation.

The following chapter covers the following topics:

- **Set vertical system**
- **Set horizontal system**
- **Set trigger system**
- **Perform sampling settings**
- **Set display system**
- **Save and recall**
- **Cut waveform and output again**
- **Waveform recording and playback**
- **Carry out supporting system settings**
- **Perform automatic measurements**
- **Perform cursor measurements**
- **Use Autoscale Function**
- **Use executive buttons**

It is recommended that you read this chapter carefully in order to be able to use the various measurement functions and other operation methods of the touch screen oscilloscopes.

Adjust vertical system

The **VERTICAL functions** include 5 menu buttons such as **CH1** ～ **CH2** (2CH models) and **Math**, and 8 rotary controls such as **VERTICAL POSITION**, **VOLTS/DIV** for each measuring channel.

Settings CH1 ～ CH2

Each channel has an independent vertical menu with functions based on that channel.

Switch waveform display on/off (CH & Math function)

Pressing the **CH1** ～ **CH2** or **Math** buttons has the following effect:

- If the waveform is switched off, it is switched on and the channel menu is displayed.
- If the waveform is already switched on, the channel menu is also displayed.
- If the waveform is already switched on and the channel menu is displayed, switch the waveform and the channel menu off again with this action

Description of the functions / menu items of the channel menu:

Menu function	**Adjustment-ungen**	**Description**
Coupling	DC AC Ground	AC and DC signals are detected DC components are blocked Input signal switched off
Inverted	ON OFF	Waveform is displayed inverted. Waveform is displayed in the original.
Touch divider	X0,001 to X1000	Adjust this value to the selected (on the probe) probe attenuation value in 1-2-5 steps.
Current measurement	A/V (mA/V) V/A (mV/A)	Turn the M knob to set the amps / volts ratio. The range is 100 mA / V - 1 KA / V. Ampere / Volt ratio = 1 / resistance value The volt / amp ratio is calculated automatically.
Bandwidth-limit	Full 20M	Full bandwidth. Bandwidth limited to 20MHz to reduce interference.

1. Set channel coupling

For example, to represent channel 1 with a square wave signal on a DC coupling basis, proceed as follows:

(1) Press the **CH1** button to display the channel menu.
(2) Select **Coupling in** the lower menu.
(3) Select **DC** in the right-hand menu. DC and AC components are thus recorded.
(4) Alternatively, select **AC** in the right-hand menu. DC components are now blocked.

2. Set probe damping

For correct recording of the measured values, it is absolutely necessary that the probe attenuation selected on the probe has also been set correctly in the oscilloscope menu. Otherwise, measurement deviations may occur. If the probe attenuation is set to 1:1, for example, 1:1 must also be set in the channel menu.

Example- Select settings as 10:1 for channel CH1:

(1) Press the **CH1 button**.
(2) Select **Touch Divider** in the bottom menu and press the **×10** menu function in the menu that appears on the right.

3. Measure current via voltage drop

To measure a current via CH1 through a voltage drop, e.g. at a 1Ω resistor, proceed as follows:

(1) Press the **CH1 button to** open the channel menu

(2) Select **Sample** and select **MeasCurr** as **YES in** the right menu **to** open the "A/V Ratio" menu. Now set the desired value for the current/voltage ratio using the multipurpose dial or the touch screen operation. For our example with a 1Ω resistor, set the A/V ratio to 1.

4. Invert waveform

With an inverted waveform, the displayed signal is rotated 180° against the phase of the earth potential.

Example- Inverted representation of channel 1:

(1) Press the **CH1 key for** menu selection.

(2) Activate **ON** for the **Inverted** option by pressing the button**.**

(3) Selecting **OFF** returns the waveform to normal.

5. Set bandwidth limit

For lower measuring frequencies than 20MHz, a bandwidth limit can be set to filter high-frequency interfering signals. Signals above 20MHz are now blocked.

Example- Activate bandwidth limitation for channel 1:

(1) Press the **CH1 button** to open the Channel 1 menu.
(2) Activate the **bandwidth** option in the menu.
(3) Select **Full in** the right-hand menu to capture the full bandwidth.
(4) Alternatively, select **20M** to limit the bandwidth to 20 MHz.

Mathematical function

The **mathematical** functions are used to display measuring channels added, subtracted, multiplied or divided. Alternatively, the FFT function can be activated.

Functional scope of the mathematical functions:

Function menu		Setting	Description
Wfm Math	Factor1	CH1 CH2 CH3 CH4	Select signal source factor 1
	Sign	+ - × /	Selects the mathematical function to calculate from source 1 to source 2 (e.g. CH1 + CH2)
	Factor2	CH1 CH2 CH3 CH4	Select signal source factor 2
	Vertical	Div Voltage	Select voltage/division for displayed mathematical waveform with multi-controller
FFT	Source	CH1 CH2 CH3 CH4	Select channel as FFT source
	Window	Rectangle Hanning Hamming Blackman Bartlett Emperor	Select window type for FFT display.
	Format	Vrms dB	Select Vrms format. dB Select format.
	Hori	Hz Hz/div	Select horizontal position for FFT waveform with multi-controller
	Vertical	div v or dB	Select vertical position for FFT waveform with multi-controller

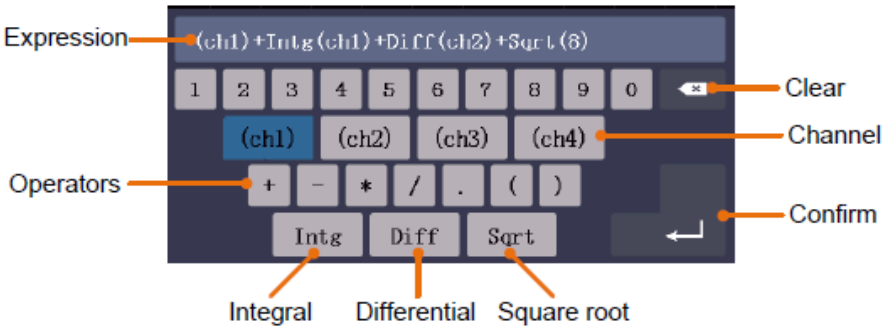
Example- Add waveforms CH1 & CH2:

1. Press the **Math button** to display the maths menu. The additional mathematical waveform (pink) is now shown in the display.
2. Select **Dual Wfm Math** from the bottom menu.
3. For **Factor1,** select channel 1 ①in the left selection menu.
4. Select the addition function **+ in** the right-hand menu as the mathematical **operator.**
5. For **Factor2,** select channel 2 ②in the left selection menu.
6. Select **Vertical** in the right menu; select the menu several times to change the M symbol in the display to the upper position or lower position. Depending on the position, change the zero position of the mathematical curve (pink) or the voltage/division for this curve by pressing the multi-controller.

User defined function

Press the Math button to display the Math menu below.

Select User Function in the bottom menu, an expression input keyboard appears.



3. create a representation. When you are finished, select ↵ on the keyboard to confirm. The division of the Math waveform is displayed at the bottom left of the screen.

FFT function

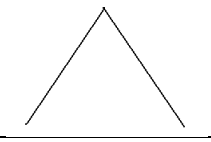
The FFT (Fast Fourier Transformation) function converts a time-based waveform into its individual frequency components. This function can be very useful in evaluating the input signals. You can match these obtained frequencies with known system frequencies from system clocks, oscillators or voltage supplies, for example. In the audio range, the FFT function splits any waveform into its individual components and thus shows the composition of a sound and the distance ratios of the individual tones in the frequency band, as well as the average levels.

Example- Activate and use the FFT function:

1. Press the **Math button** to display the maths function menu. The mathematical waveform (blue) is displayed.
2. Select **FFT from** the bottom menu.
3. Select **Source** in the right-hand menu; select ①for channel 1.
4. Select **Window from** the right-hand menu and choose a useful window type (see table).
5. Select **Format** in Vrms or dB.
6. Select **Hori** in the right-hand menu; press the menu function several times to display the M symbol above or below this menu item. This allows you to change the time base of the FFT wave with the multi-controller depending on the horizontal position.
7. Select **Vertical** in the right menu; press the menu function several times to display the M symbol above or below this menu item. This allows you to change the voltage/division or zero line of the FFT wave with the multi-controller depending on the position.

Select FFT window

■ There are six FFT windows. Each window makes trade-offs between frequency resolution and amplitude accuracy. Choose the window based on what you want to measure and the characteristics of your source signal. The following table will help you choose the best window:

Art	Characteristics	Windows
Rectangle (Rectangle)	This window is best for frequency resolutions, but is the worst for accurately measuring the amplitude of these frequencies. It is the best window for measuring the frequency spectrum of non-repetitive signals and measuring frequency components near DC. • Use the rectangular window for measuring transients or peaks where the signal level before and after the event is almost the same. • Also usable for sine waves with the same amplitude and with fixed frequencies • Broadband noise with relatively slowly varying spectrum.	
Hanning	This window is well suited for measuring amplitude accuracy, but less so for frequency resolutions. • Use the Hanning window to measure sine, periodic and narrowband noise. • Best suited for transients or peaks where the signal levels before and after the event differ significantly.	
Hamming	This is a very good window for frequency resolution with slightly better amplitude accuracy than the rectangular window. It has a slightly better frequency resolution than the Hanning window. • Use the Hamming window to measure sine, periodic and narrowband noise. • Best suited for transients or peaks where the signal levels before and after the event differ significantly.	
Blackman	This is the best window for measuring the amplitude of frequencies, but offers the poorest frequency resolution. • Use the Blackman-Harris window for single frequency signals and finding higher order harmonics.	
Bartlett	The Bartlett window is a slightly narrower version of the triangular windows, with "zero weight" at both ends.	
Emperor	The frequency resolution when using the Kaiser window is adequate, the spectral leakage and amplitude accuracy are both good. The Kaiser window is best when the frequencies are very close but have very different amplitudes (the sidelobe level and form factor are close to the traditional Gaussian RBE). This window is also good for the random signals.	

Notes for FFT use

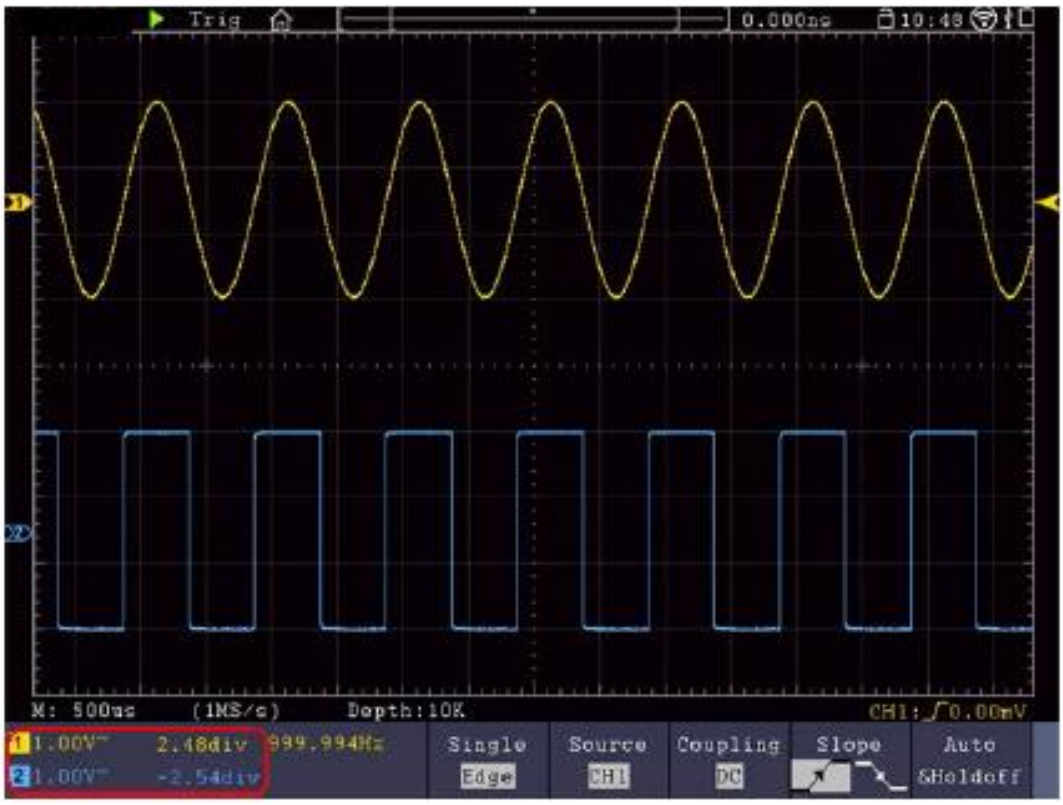
- The waveform zoom function also works for FFT.
- Use the dBV RMS scale for a detailed view of multiple frequencies, even if they have different amplitudes. Use the linear RMS scale to compare all frequencies in an overall view.
- Signals that contain a DC component or offset can lead to incorrect FFT signal amplitude values. To minimise the DC component for the source signal, select AC coupling.
- To reduce noise and aliasing in repetitive or single measurement waveforms, set the oscilloscope's acquisition mode to average.

Nyquist frequency: The highest frequency that an oscilloscope that digitises in real time can measure is equal to half the sampling rate and is called the Nyquist frequency. If not enough sampling points are acquired and the frequency is higher than the Nyquist frequency, the phenomenon of the "false waveform" occurs. Therefore, pay more attention to the relationship between the sampled and measured frequency.

Using VERTICAL POSITION and VOLTS/DIV knobs

1. Use the **VERTICAL POSITION** knob to change the vertical position of the waveforms of all channels (including those created by mathematical calculation).
   The resolution of this adjustment knob changes with the vertical division.

2. Use the **VOLTS/DIV adjustment knob to set the** vertical resolution of the waveforms of all channels (including those created by mathematical calculation), which determines the sensitivity of the vertical division in the order 1-2-5. The vertical sensitivity increases when you turn the adjustment knob clockwise and decreases when you turn it counterclockwise.



Set **horizontal system**

The HORIZONTAL CONTROLS consist of the **HORIZ-MENU** button and adjustment knobs such as **HORIZONTAL POSITION** and **SEC/DIV.**

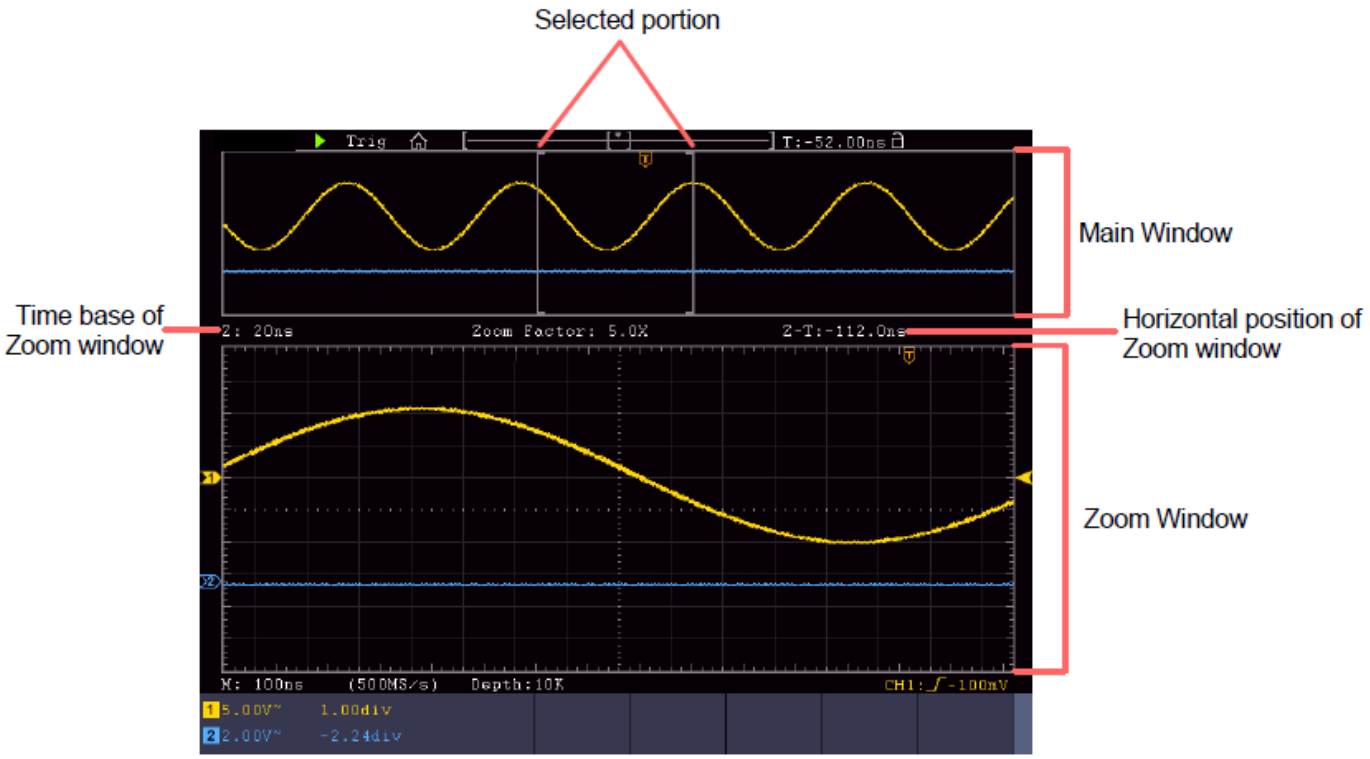
1. adjustment knob **HORIZONTAL POSITION**: with this adjustment knob you control the horizontal positions of all channels (including those created by mathematical calculation) whose resolution changes with the time base.

2. setting knob **SEC/DIV**: with this you set the horizontal scale factor with which you determine the main time base or window.

3. key **HORIZ** Menu**:** Press this key to display the operating menu on the screen**.**

Enlarge waveform (zoom)

Press the **HOR** button and the display splits in the middle. The upper half of the display shows the main window and the lower half shows the zoom window. The zoom window is a magnified area of the main window.



- When **Main Window** is selected in the bottom menu, **Horizontal Position** and **SEC / DIV are** used to adjust the horizontal position and time base of the main window. The time base of the zoom window is also changed.
- When **Zoom Window** is selected in the bottom menu, the **Horizontal Position** and **SEC / DIV are** used to adjust the horizontal position and time base of the zoom window.

Hint:

If the time base of the zoom window is the same as in the main window, the interface is automatically switched back to normal mode and the zoom mode is switched off.

You can also zoom in on the waveform using the touch screen, as described in the associated chapter.

Set trigger system

The trigger determines when the oscilloscope starts acquiring data and displaying the waveform. Once set correctly, the trigger can convert a fluctuating display into a meaningful waveform.

When the oscilloscope starts acquiring data, it records enough data to display the waveform to the left of the trigger point. The oscilloscope continues to record data while waiting for a trigger condition. When a trigger is detected, the unit continuously records enough data to display the waveform to the right of the trigger point.

The trigger control area consists of a 1 rotary knob and 2 menu buttons.

TRIG LEVEL: This knob sets the trigger level. When you press the knob, the level is reset to **zero.**

Force: Press this button to create a trigger signal. This function is primarily used with the trigger modes "Normal" and "Single".

Trigger Menu: The button calls up the trigger control menu.

Single trigger

Trigger control

The unit provides four types of triggers: single trigger, alt trigger, logic trigger and bus trigger. Each trigger type has different submenus.

There are two ways to get into trigger mode:

Key operation: Press **Menu** in the trigger field to open the trigger menu. With H1 you can then select the extended trigger menu, which you can scroll (turn) and select (press) with the M multipurpose knob.

Touch screen operation: Press the house icon to open the touch menu. Select **Trig Menu** and then the trigger (Single, Alt, Logic, Bus) in the lower menu. The trigger type can then be selected in the right-hand screen menu under **Type.**

Single: Uses a single trigger to display a stable waveform on both channels.

Logic Trigger: Triggers a signal according to the conditions of the logic ratio

Bus Trigger: Sets bus timing trigger

Trigger Brief description

The single, logic and bus trigger menus are described below:

Edge trigger: Occurs when the trigger input passes through a specific voltage level with the specified slope.

Video Trigger: Trigger on fields or lines for a standard video signal.

Slope Trigger: The oscilloscope starts triggering according to the rate of rise or fall of the signal.

Pulse Trigger: Finds pulses with specific widths.

Runt Trigger: Trigger pulses that pass through one trigger level but not through the other trigger level.

Windows trigger: Gives a high trigger level and low trigger level. The oscilloscope triggers when the input signal passes through the high or low trigger level.

Timeout Trigger: The oscilloscope triggers when the time interval from the time of the rising edge (or falling edge) by the trigger level when the adjacent falling edge (or rising edge) by the trigger level is greater than the set timeout time.

Nth Edge Trigger: The oscilloscope triggers on the Nth edge that appears on the specified idle time.

Detailed trigger description

RS232 Trigger: RS232 is a serial communication mode used in data transfer between PCs or between PC and terminal.

I2C trigger

The I2C serial bus consists of SCL and SDA. The transmission rate is determined by SCL and the transmission data is determined by SDA.

SPI trigger

Trigger the specified data when the timeout is met. When using SPI
Trigger, you must specify the SCL and SDA data sources.

CAN bus trigger

CAN (Controller Area Network) is a serial communication protocol of the international ISO standardisation.

Detailed trigger description:

1. edge trigger (edge)

An edge trigger occurs at the trigger threshold of the input signal. Select the edge trigger mode to trigger on the rising or falling edge of the signal.

Edge Trigger menu:

Menu	Setting	Description
Trigger Mode	Flank	Set vertical trigger type as edge triggering
Source	CH1 CH2 EXT EXT/5 AC Line	Channel 1 as trigger signal. Channel 2 as trigger signal. External trigger as trigger signal. 1/5 of the external trigger as trigger signal. AC mains voltage as trigger signal.
Coupling	AC DC	Blocks the DC component. Allows all components to pass through.
Gradient	Rising Falling	Trigger on rising edge. Trigger on falling edge
Mode & Holdoff	Car Normal Single Holdoff Reset	Capture waveform even if no trigger occurs Capture waveform when trigger occurs Capture a waveform when trigger occurs, then stop. 100ns~10s, use the M knob to set the time interval before another trigger occurs. Set the holdoff time as the default value (100ns).

Trigger level:

The trigger level shows vertical trigger position of the channel. Turn the Trigger Level knob or "slide" up or down on the touch screen to move the trigger level. While adjusting, an orange-red dashed line is displayed to show the "trig" position, and the value of the trigger level changes is shown at the right corner. After adjustment, the dotted line disappears.

2. video trigger

Select the video mode to trigger on video fields or video lines of NTSC, PAL or SECAM standard video signals. In video trigger mode, the setting information is displayed at the bottom right of the screen, e.g.:  indicates that video trigger on CH1 and sync type "even" has been selected.

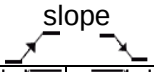
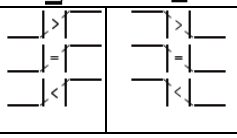
Video trigger menu:

Menu	Setting	Description
Trigger Mode	Video	Set vertical trigger type as video triggering
Source	CH1 CH2 EXT EXT/5	Channel 1 as trigger signal. Channel 2 as trigger signal. External trigger as trigger signal. 1/5 of the external trigger as trigger signal.
Modu	NTSC PAL SECAM	Select video modulation
Sync	Line Field Odd Even Line NO.	Synchronous trigger in video line Synchronous trigger in video field Synchronous trigger in odd video field. Synchronous trigger in straight video field. Synchronous trigger in created video line; set the line number using the M knob.
Fashion Holdoff	Car	Capture waveform even if no trigger occurs.

3. slope trigger (slope)

Slope mode allows the oscilloscope to trigger on the rising/falling edge of a signal within a specified time period. In slope trigger mode, the setting information is displayed at the bottom right of the screen, e.g.:  indicates that slope trigger is selected on CH1, slope rising and the difference between the up-level and low-level threshold is 0.00mV.

Slope Trigger Menu:

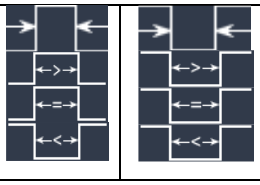
Menu	Setting	Description
Trigger mode	Slope	Set vertical trigger type as slope triggering
Source	CH1 CH2	Channel 1 as trigger signal. Channel 2 as trigger signal.
When	slope 	Set flank
		Set the slope condition; set the time using the **Multi (M)** knob.
Threshold &Slew Rate	High level Low level Slew Rate	Adjust the high level using the G knob. Adjust the low level using the G knob. Rise rate = (High level - Low level)/ settings
Fashion Holdoff	Car Normal Single Holdoff Reset	Capture waveform even if no trigger occurs Capture waveform when a trigger occurs. When trigger occurs capture a wave and then stop it 100ns~10s, use the **Multi (M)** knob to set the time interval before another trigger occurs. Set the holdoff time as 100ns.

4. pulse width trigger

The pulse trigger lets the oscilloscope trigger according to the pulse width of the signal. Unusual signals can be detected by adjusting the pulse width conditions.

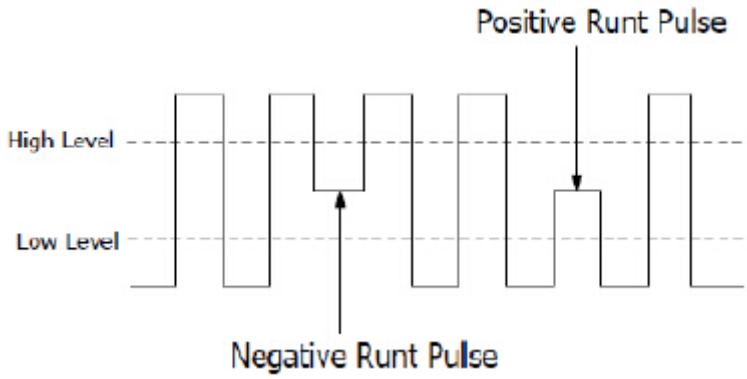
In pulse trigger mode, the setting information is displayed at the bottom right of the screen, e.g.: CH1:DC-⎍0.00mV indicates that pulse trigger on CH1 with DC coupling has been selected and the polarity is positive and the trigger level is 0.00mV.

Pulse Trigger menu:

Menu	Setting	Description
Trigger mode	Pulse	Set vertical trigger type as pulse triggering
Source	CH1 CH2	Channel 1 as trigger signal. Channel 2 as trigger signal.
Coupling	AC DC	Blocks the DC component. Allows all components to pass through.
When		Select polarity Select the pulse width conditions with the **Multi (M)** knob or touch +/- for the time setting and ← → to move the cursor.
Fashion Holdoff	Car Normal Single Holdoff Reset	Capture waveform even if no trigger occurs Capture waveform when a trigger occurs. When trigger occurs capture a wave and then stop it 100ns~10s, use the **Multi (M)** knob to set the time interval before another trigger occurs. Set the holdoff time as 100ns.

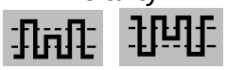
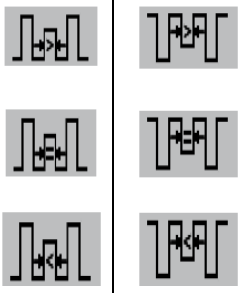
5. runt trigger

With the runt trigger, pulses are detected that run through one trigger level but not through another, as shown in the graphic.



In run-trigger mode, the setting information is displayed at the bottom right of the screen, e.g.: CH1:⎍⎍Δ0.00mV indicates that the run-trigger on CH1 has been selected with positive polarity and the difference between the up-level and low-level threshold is 0.00mV.

Runt Trigger Menu:

Menu	Setting	Description
Trigger mode	Runt	Set Vertical Trigger Type as Runt Triggering
Source	CH1 CH2	Channel 1 as trigger signal. Channel 2 as trigger signal.
Threshold	Up Level Low Level	Select the level setting with the **Multi (M)** rotary knob or tap +/- via touch screen for threshold setting
Condition	Polarity 	Positive polarity: The unit triggers on the positive runt pulse. Negative polarity: The unit triggers on the negative runt pulse.
		Select the pulse width conditions with the **Multi (M)** knob or touch +/- for pulse width and ← → to move the cursor to the desired digital digit. Triggers when runt pulse is greater than set pulse width. Triggers when the runt pulse is equal to the set pulse width. Triggers when runt pulse is smaller than set pulse width.
Fashion Holdoff	Car Normal Single Holdoff Reset	Capture waveform even if no trigger occurs Capture waveform when a trigger occurs. When trigger occurs capture a wave and then stop it 100ns~10s, use the **Multi (M)** knob to set the time interval before another trigger occurs. Set the holdoff time as 100ns.

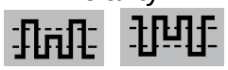
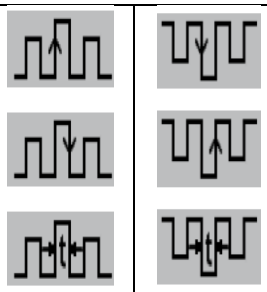
Windows Trigger

Provides a high and a low trigger level, whereby the oscilloscope triggers when a signal passes through the high or low trigger level.

In Windows trigger mode, the setting information is displayed at the bottom right of the screen, e.g.: 

indicates that the Windows trigger on CH1 has been selected with positive polarity and the difference between the up-level and low-level threshold is 0.00mV.

Windows Trigger Menu:

Menu	Setting	Description
Trigger mode	Windows	Set Vertical Trigger Type as Windows Triggering
Source	CH1 CH2	Channel 1 as trigger signal. Channel 2 as trigger signal.
Threshold	Up Level Low Level	Select the level setting with the **Multi (M)** rotary knob or tap +/- via touch screen for threshold setting
Condition	Polarity 	Positive polarity: The unit triggers on the positive Windows pulse. Negative polarity: The unit triggers on the negative Windows pulse.
		Enter: Triggers when the signal enters the specified trigger level range. Exit: Triggers when the trigger signal leaves the specified trigger level range. Time: Triggers when the hold time is greater than the Windows time. Available is 30ns to 10s. Default setting is 100ns
Fashion Holdoff	Car Normal Single Holdoff Reset	Capture waveform even if no trigger occurs Capture waveform when a trigger occurs. When trigger occurs capture a wave and then stop it 100ns~10s, use the **Multi (M)** knob to set the time interval before another trigger occurs. Set the holdoff time as 100ns.

7. timeout trigger

The unit triggers when the time interval (from when the rising edge (or falling edge) passes through the trigger level to when the adjacent rising or falling edge passes through the trigger level) is greater than the set timeout time.

In timeout trigger mode, the setting information is displayed at the bottom right of the screen, e.g.: 

indicates that the timeout trigger on CH1 has been selected with positive polarity and the up-level and low-level threshold is 0.00mV.

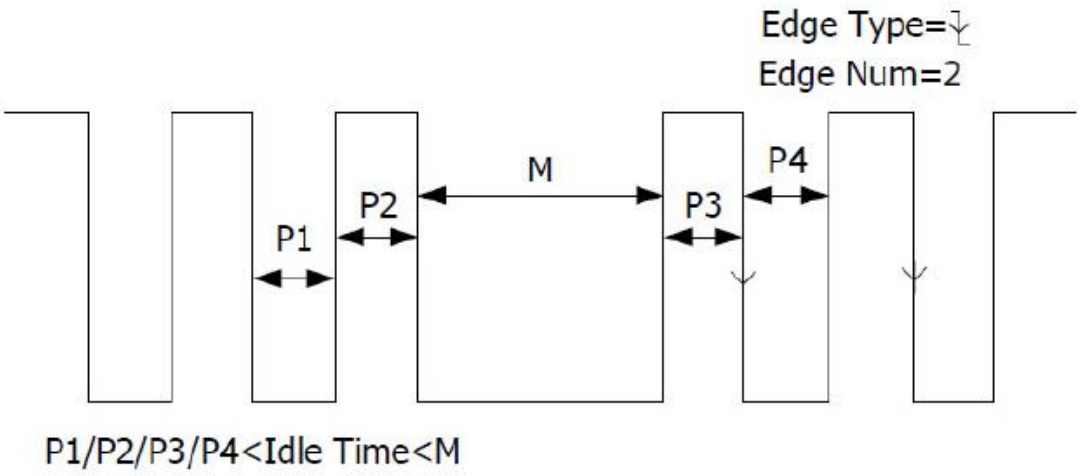
Timeout trigger menu:

Menu	Setting	Description
Trigger mode	Timeout	Set vertical trigger type as timeout triggering
Source	CH1 CH2	Channel 1 as trigger signal. Channel 2 as trigger signal.
Threshold	Up Level Low Level	Select the level setting with the **Multi (M)** rotary knob or tap +/- via touch screen for threshold setting
Polarity	Polarity 	Starts timing when the rising edge passes through the trigger level. Starts timing when the falling edge passes through the trigger level.
Configure	Idle Time	Sets the idle time. This means the minimum time of an idle time before the trigger conditions can be met. Selectable is 30ns-10s, default is 100ns.
Fashion Holdoff	Car Normal Single Holdoff Reset	Capture waveform even if no trigger occurs Capture waveform when a trigger occurs. When trigger occurs capture a wave and then stop it 100ns~10s, use the **Multi (M)** knob to set the time interval before another trigger occurs. Set the holdoff time as 100ns.

8 Nth Edge Trigger

The oscilloscope triggers on the Nth edge that appears after a specified idle time. As shown in the diagram, the unit shall trigger on the second falling edge after the specified idle time P1/P2/P3/P4<idle time>M, where M, P1,P2,P3 and P4 are positive or negative pulse widths that are included in the count.

In Nth edge trigger mode, the setting information is displayed at the bottom right of the screen, e.g.: CH1 : Nth 0.00mV indicates that the trigger on CH1 has been selected as edge trigger and the up or low level threshold is 0.00mV.



Menu	Setting	Description
Trigger mode	Nth Edge	Set Vertical Trigger Type as Nth Edge Triggering
Source	CH1 CH2	Channel 1 as trigger signal. Channel 2 as trigger signal.
Edge	Edge 	Triggers on the rising edge of the input signal when the voltage level hits the specified trigger level. Triggers on the rising edge of the input signal when the voltage level hits the specified trigger level.
Configure	Idle Time	Sets the idle time. This means the minimum time of an idle time before the trigger conditions can be hit. Selectable is 30ns-10s, default is 100ns.
	Edge Num	Sets the edge number value of "N" from Nth Edge for triggering.
Fashion Holdoff	Car Normal Single Holdoff Reset	Capture waveform even if no trigger occurs Capture waveform when a trigger occurs. When trigger occurs capture a wave and then stop it 100ns~10s, use the **Multi (M)** knob to set the time interval before another trigger occurs. Set the holdoff time as 100ns.

Logic Trigger

Trigger regarding the logic relation.

In logic trigger mode, the setting information is displayed at the bottom right of the screen, e.g.: 

indicates that the trigger is in logic mode AND, CH1 is 2.00V as high trigger level and CH2 is 0.00mV as low trigger level.

Menu	Setting	Description
Trigger mode	Logic	Set Vertical Trigger Type as Logic Triggering
Logic Mode	AND OR XNOR XOR	Set logic mode as AND Set logic mode as OR Set logic mode as XNOR Set logic mode as XOR
Input Mode	CH1 CH2	Sets CH1 as high level, low level high or low level, as well as rising or falling Sets CH2 as high level, low level high or low level, as well as rising or falling
Out Mod	Goes True Goes False Is True> Is True< Is True=	Trigger when condition changes from False to True Trigger when condition changes from True to False Triggers when True time is higher than Setting Triggers when True time is less than Setting Triggers when True time is equal to the time of the setting
Fashion Holdoff	Car Normal Single Holdoff Reset	Capture waveform even if no trigger occurs Capture waveform when a trigger occurs. When trigger occurs capture a wave and then stop it 100ns~10s, use the **Multi (M)** knob to set the time interval before another trigger occurs. Set the holdoff time as 100ns.

Note: If one channel is set as "Rise" or "Fall", the other channel cannot also be set as "Rise" or "Fall" at the same time

Bus Trigger

1. SPI

Trigger on specified data when timeout conditions are met. When using the SPI trigger, SCL and SDA data must be specified.

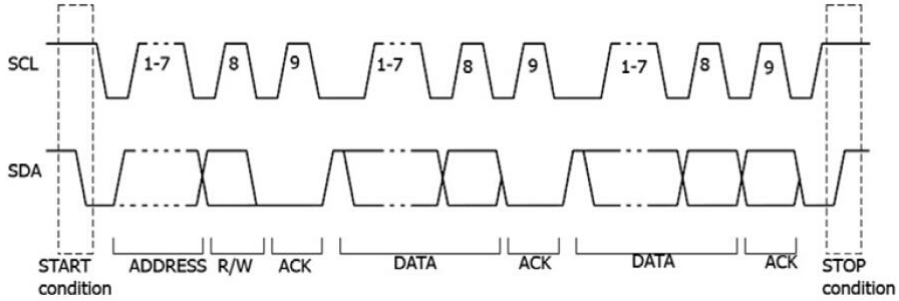
In SPI trigger mode, the setting information is displayed at the bottom right of the screen, e.g.: SPI CH1:0.00mV CH2:0.00mV indicates that the trigger is in SPI mode, CH1 as trigger level is 0.00mV and CH2 as trigger level is 0.00mV.

Menu	Setting	Description
Bus Type	SPI	Set vertical bus type as SPI triggering
Source	CH1 CH2	Set CH1 as SCL or SDA Set CH2 as SCL or SDA
Timeout	Time out	Set the minimum time that SCL must be inactive. A range of 100ns~10s is available before the oscilloscope starts searching for the measurement data (SDA) to be triggered. Use the **Multi (M)** knob or the touch control to set.
ClockEdge & Data	Clock Edge 	Set Clock Edge as a rising or falling edge. Thus, the SDA data is sampled on the rising or falling edge.
	Data Bits	Set the number of the serial data bit string. This value can be set between 4 and 32. Use the **Multi (M)** rotary knob or the touch control.
	Current Bits	Set the number of the data bits from 0-31.
	Data	Use the **Multi (M)** knob or touch control to set the Current Data Bit value as H, L or X(H or L).
	All Bits	Set all data bits as specified values.
Fashion Holdoff	Car Normal Single	Capture waveform even if no trigger occurs Capture waveform when a trigger occurs. When trigger occurs capture a wave and then stop it

2. I2C trigger

The I2C Serial Bus consists of SCL and SDA. The transmission rate is determined by SCL and the transmission data by SDA. As shown in the picture, the oscilloscope can be triggered to Start, Restart, Stop, Ack Lost, a specific device address or a data value.

In I2C trigger mode, the setting information is displayed at the bottom right of the screen, e.g.: I2C CH1:0.00mV CH2:0.00mV indicates that the trigger is in I2C mode, CH1 as trigger level is 0.00mV and CH2 as trigger level is 0.00mV.

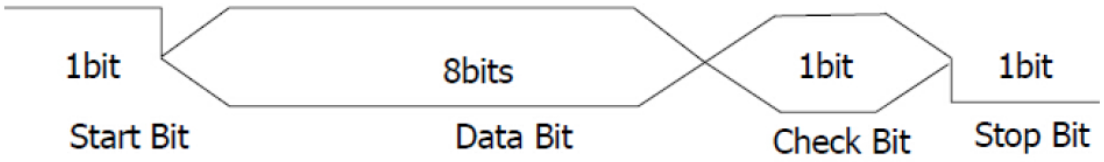


Menu	Setting		Description
Bus Type	I2C		Set vertical bus type as I2C triggering
Source	CH1 CH2		Set CH1 as SCL or SDA Set CH2 as SCL or SDA
When	Start		Triggers when SDA data passes from High to Low while SCL is High
	Restart		If another start state occurs before a stop state
	Stop		Triggers when SDA data passes from Low to High while SCL is High
	Ack Lost		Triggers when SDA data is "High" during a confirmation of the SCL clock position.
	Address		Triggers a read or write bit when the set address is hit.
	Adr Format	Addr Bits	Set bit address aud 7, 8 or 10
		Address	Set address according to the set bit address. Address range is 0-127, 0-255, 0-1023
		Direction	Set data direction to Read or Write Note: If address bit is set to 8, this is not available
	Data		Searches for the preset data value of SDA and triggers on the falling edge of the SCL, on the last bit of the data range
	Data Format	Byte length	Set data byte length, available is 1-5. Use the **multi (M)** knob or the touch control to set the byte length.
		Current Bit	Select data bit, range from 0 to (byte length *8-1).
		Data	Set data to H, L or X (H or L).
		All Bits	Set all data bits as specified values.
	Addr / Data		Triggers when address and data conditions are met at the same time
Fashion Holdoff	Car Normal Single		Capture waveform even if no trigger occurs Capture waveform when a trigger occurs. When trigger occurs capture a wave and then stop it

3. RS232 trigger

RS232 is a serial communication type used for data transmission between PC and terminal. A character is transmitted as a frame of data consisting of 1 start bit, 5-8 data bits, 1 check bit and 1-2 stop bits.

In RS232 trigger mode, the setting information is displayed at the bottom right of the screen, e.g.: RS232 CH1:0.00mV indicates that the trigger is in RS232 mode and the trigger level of CH1 is 0.00mV.



Menu	Setting		Description
Bus Type	RS232		Set vertical bus type as RS232 triggering
Input	Source	CH1	Set CH1 as SCL or SDA
		CH2	Set CH2 as SCL or SDA
	Polarity	Normal	Set the polarity of the data transmission as Normal
		Inverted	Set polarity of data transmission as Inverted
When	Start		Triggers on the start frame position. After selecting this condition, select Configure for detailed setting options.
	Error		Triggers on the error frame position. After selecting this condition, select Configure for detailed setting options.
	Chk Error		Trigger when a Chk Error was found. After selecting this condition, select Configure for detailed setting options.
	Data		Triggers on the last bit of preset data. After selecting this condition, select Configure for detailed setting options.
	Start		**Common Baud**: Multi (M) to select common baud **Custom Baud:** Multi (M) knob to select custom baud, range from 0 to 10000000 possible.
	Error		**Stop bit:** Select 1 or 2 **Parity:** "No", "Even" or "Odd" **Common Baud**: Multi (M) to select common baud **Custom Baud:** Multi (M) knob to select custom baud, range from 0 to 10000000 possible.
	Chk Error		**Even-Odd:** Select Even or Odd **Common Baud**: Multi (M) to select common baud **Custom Baud:** Multi (M) knob to select custom baud, range from 0 to 10000000 possible.
	Data		**Data Bits:** Set 5, 6, 7 or 8 bits **Data:** Set associated data bits from 0-31, 0-63, 0-127 or 0-255.
Fashion	Car		Capture waveform even if no trigger occurs
	Normal		Capture waveform when a trigger occurs.
Holdoff	Single		When trigger occurs capture a wave and then stop it

4. CAN bus trigger

CAN (Controller Area Network) is a serial communication protocol of the international ISO standardisation. When using the CAN bus trigger, you can trigger on Frame Start, Frame Type, Identifier, Data, ID & Data, Frame End, Missing Acknowledgement or Bit Fill Error.
You must specify the signal source, trigger signal type, sample point and signal rate of the CAN signal.
In CAN bus trigger mode, the trigger setting information is displayed at the bottom right of the screen, e.g. 

indicates that the trigger type is CAN, the CH1 trigger level is -126 mV

Menu	Setting		Description	
Bus type	CAN		Sets vertical bus types as CAN triggers	
Input / Input	Source		CH1	CH1 as trigger source
			CH2	CH2 as trigger source
			CH3	CH3 as trigger source
			CH4	CH4 as trigger source
	Type		CAN_H	Actu. CAN_H Bus Signal
			CAN_L	Actu. CAN_L Bus Signal
			TX	Transm. Signal on CAN signal line
			RX	Receive signal on CAN signal line
	Sample Point		Turn the M knob (or tap + − on the touch screen) to set the sample point, which is a point within a bit time. The oscilloscope samples the bit level at this point. "Sample point" is represented by the percentage of "the time from the beginning of the bit time to the sample point time" in the "bit time". The bandwidth is 5% to 95%.	
	Common baud		Turn the M button to select the Baud number from the list on the left.	
	Custom Baud		Turn the M knob (or tap + − on the touch screen) to set the baud. The range is 10,000 to 1,000,000. Tip: You can select the closest value in Common Baud and then adjust it in this menu.	
Condition	Start		Trigger on the start frame of the data frame	
	Type	Type (Lower menu)	Data	Sets trigger on selected frame
			Remote	
			Error	
			Overload	
	ID	Configure (Lower Menu)	Format	Standard or Advanced
			ID	M-knob and arrow keys for selection
	DATA	Configure (Lower Menu)	Byte Length	M-regulator for setting between 1 and 8 bytes
			Data	M-knob and arrow keys for selection
	ID&Data	Configure (Lower Menu)	Format	Standard or Advanced
			ID	M-knob and arrow keys for selection
			Byte Length	M-regulator for setting between 1 and 8 bytes

			Data	M-knob and arrow keys for selection
	End	Triggers on end frame of the data frame		
	Missing Ack	Triggers on missing ack (good message)		
	Bit Stuffing	Triggers on Bit-Stuffing Error		
Fashion Holdoff	Car Normal Single	Capture waveform even without trigger Capture waveform with trigger Capture waveform with trigger, then stop		

Operating the function menu

The operating area of the function menu comprises 8 function menu keys: **Measure, Acquire, Utility, Autoscale, Save, Display** and **Help,** as well as 3 instant selection keys: **Autoset, Run/Stop, Single.**

Sampling settings (sampling function)

Press the **Acquire button**; select **Acyu Mode, Length or PERF Mode** to set the sampling function.

Description of the **Acqu Mode** menu:

Menu		**Setting**	**Description**
Acqu Mode	Sample		General scanning mode.
	Peak Detect		Used to detect interference peaks and reduce interference
	Average	4、16、64、128	Used to reduce random interference of any kind with an optional number of averages.

Description of the **Length** menu:

Menu	**Setting**	**Description**
Length	1000	Selection of the recording length
	10K	
	100K	
	1M	
	10M	
	20M	
	40M (Single CH)	

Description of the **PERF Mode** menu:

Menu	**Setting**	**Description**
PERF Mode	8-bit	Set vertical resolution (A/D)
	12-bit	

If the sample rate is <=250MS/s, the ADC resolution is set to 12-bit by default.
If the sample rate is > 250MS/s, the ADC resolution is set to 8-bit by default.
If the sample rate is <250MS/s and only one channel is activated, the ADC resolution can be set to 8-bit or 12-bit.

Menu	**Setting**	**Description**
Interpl	Sinx/x	Use sine(x)/x interpolation Use linear interpolation
	x	

The interpolation method is a processing method to connect the sampled points, using some points to calculate the whole appearance of the waveform. Select the appropriate interpolation method according to the actual signal.

Sine (x) / x-interpolation: Connect the sampled points with curved lines.

Linear interpolation: Connect the sampled points with straight lines. This method is suitable for reconstructing the straight-line signals, such as the square wave or pulse wave.

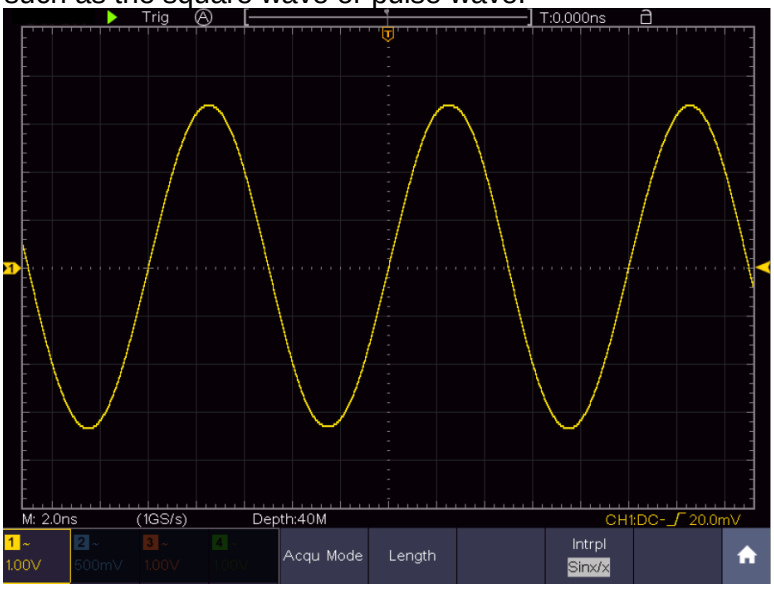
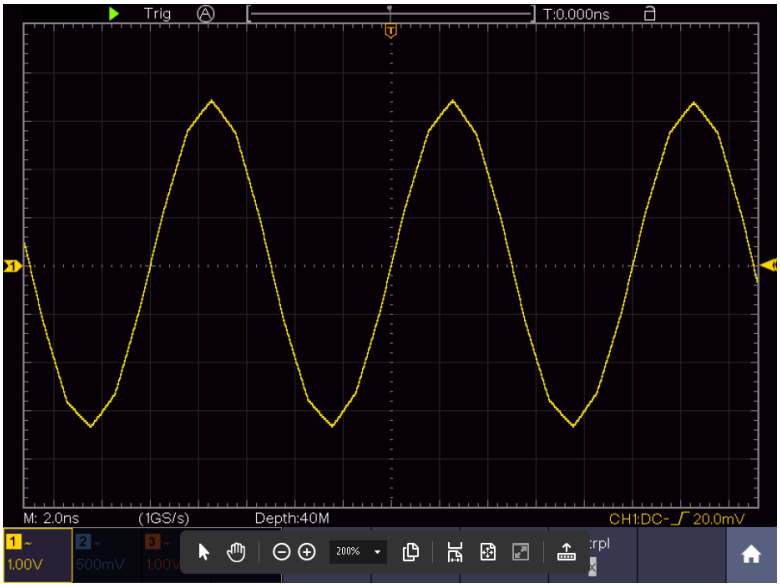


Figure 4-3 Sine(x)/x interpolation



Display menu Settings (in Acquire)

Press the **Acquire button;** select **Wave Display**, **XY Mode** or **Cymometer** as the setting.

Description of the **Acquire menu**:

Menu	Setting		Description
Type	Dots Vect		Only the sample points of the waveform are displayed. The space between the sampling points is connected with a line.
Persist	Time	OFF 1 sec. 2 sec. 5 sec. Infinity	Persist adjusts the afterglow of the waveform. Use the **multi-rotary control (M)** to change the value settings. "Infinity" means maximum persistence.
XY Fashion	ON OFF		Turns on the XY function. Switches the XY function off.
Counter	ON OFF		Switches frequency counter ON and OFF
Clear			Clears the afterglow waveforms from the display and restarts the afterglow.

Display:

Press the Display menu selection button. In the lower selection menu, select **Type** and press the button to switch between **Dot** and **Vect.**

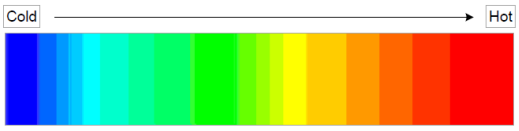
Afterglow (Persist):

With the Persist function, you can simulate the afterglow effect of a tube oscilloscope: the stored original data is faded, the new data is displayed in vivid colour.

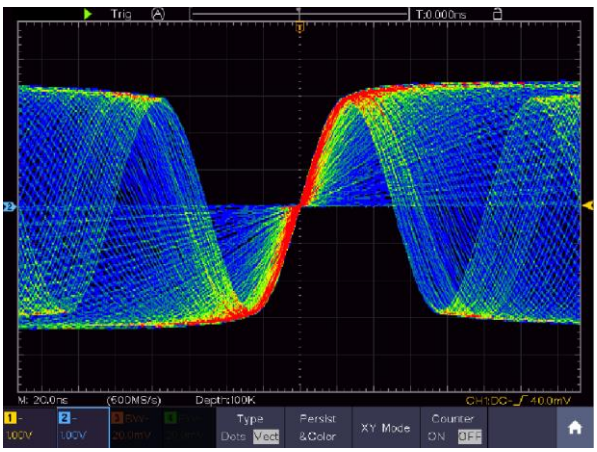
(1) Press the display button
(2) Select Persist from the bottom menu
(3) Use the right menu buttons or the touch screen operation to change the afterglow of the display between OFF, 1second, 2second, 5second and Infinity. If you select Infinity, the waveform will continue to be overlaid until you change this setting again or press the Clear button. Select OFF to turn off the afterglow and "clean" the display of the superimposed waveforms.
(4) Select Clear to clear the already displayed overlaid waveforms from the display and start the afterglow again

Colour

The colour temperature function uses colour correction to indicate frequency of occurrence. The hot colours like red / yellow indicate frequently occurring events and the colder colours like blue / green indicate rarely occurring events.



(1) Press the display key.
(2) Select Persist & Colour from the bottom menu.
(3) Select Colour in the right menu, choose between ON / OFF.



XY Mode:

XY mode is used to display the amplitude from one waveform against the amplitude from another. The data point from the first waveform sets the horizontal position, while the corresponding data point from the second waveform shows the vertical position for each point.

The oscilloscope is in untriggered sampling mode: the data is displayed as bright dots.

How to use the knobs and buttons:

- The Vertical Scale and **Vertical POSITION** adjustment knobs for Channel 1 are used to adjust the horizontal scale and position of the yellow waveform.
- The Vertical Scale and **Vertical POSITION** adjustment knobs for channel 2 are used to adjust the vertical scale and position of the blue waveform.

The following functions cannot be activated in XY mode

- Reference or digital waveform
- Cursor
- Trigger control
- FFT

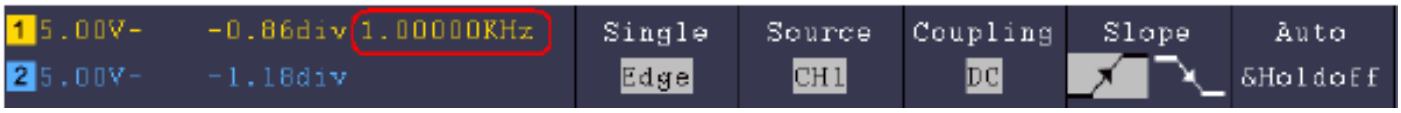
Application steps:

1. Press the **display key**
2. Select **XY Mode** as **ON** or **OFF** in the lower menu

Frequency counter:

This is a 6-digit frequency counter. This can measure frequencies from 2Hz to full bandwidth. However, it can only measure the frequency accurately if the measured channel has a trigger signal and is in **edge mode of** the **single trigger mode**. The counter is displayed at the bottom right of the screen.

2 CH:



4CH:

Application steps:

1. Press the **trigger menu button** and set it to Single, the trigger mode to Edge and select the source to be measured.
2. Press the **display key**.
3. Select the **counters** as **ON** or **OFF**

Save and recall waveform

Press the **Save button to** open the Save menu at the bottom of the screen. Here you can save waveforms, configurations, screenshots or record waveforms as a movie.

Menu		Setting	Description
Type		Wave Configure Image Record Clone	Select memory type Configuration Create screenshot Record waveform as a film Clone waveform between cursors on generator
If the type is **Wave**, the menu shows the following:			
Source		CH1 - CH4 Math	Select the waveform to be saved
Object & Show	Object	0-99	Select the address/memory number where the waveform is to be stored or retrieved
	Show	ON OFF	Recall or close the waveform stored in the currently selected address. When "Show" is ON, the waveform stored at the address is displayed, the associated address number and relevant information is shown in the top left of the display. If the memory address is empty, a message "None is saved" is displayed.
	Close All		Closes all waveforms that are stored under the object address.
Save			Saves the waveform at the selected address. Regardless of the type selected in the Save menu, you can always save the current waveform directly as a BIN file with the **Copy** button, without having to take a diversion via the Save menu.
Storage		Internal External	Saves to internal or external memory (USB). If the file is saved to an external USB memory, you can set the file name yourself and call up the saved file via the PC software supplied.
If the type is **Configure**, the menu shows the following:			
Configure		Setting 1 ..... Setting 8	The address of the settings to be saved
Save			Saves the current oscilloscope configuration at the selected memory address.
Load			Recalls the saved configuration from the selected memory address
If the type is **Image**, the menu shows the following:			
Save			Saves the current screen completely with all displays as a screenshot. This is only possible on an external memory, so please connect a USB memory first. Data format is BMP

Waveform recording

The oscilloscope can store 100 waveforms, which can be displayed again simultaneously with the current waveform. The recalled waveform cannot be adjusted subsequently, but remains in the form in which it was recorded.

For example, to save a waveform from CH1 to memory address 1, proceed as follows:

1. Press the **Save button**
2. Save: Select **Type** in the lower menu and use the M-rotary knob to go to **Wave in** the left menu.
3. Select **Source** in the lower menu and then **CH1** in the right menu to select channel 1 as the source.
4. Select **Object & Show from** the lower menu, then turn the M knob to select **1** as the memory address from the left menu.
5. Then select **Storage from** the bottom menu and **Internal** from the right menu.
6. Then select **Save in** the lower menu to save the waveform.
7. **Recall**: Select **Object&Show** in the lower menu, then select the location **1** in the left menu. Then select **Show** as **ON** so that the waveform saved under 1 is displayed. Address number and all other relevant information are shown in the top left of the display.

Tip:

Regardless of the type selected in the Save menu, you can always save the current waveform directly as a BIN file by pressing the **Copy** key without having to go via the Storage menu. If the **storage** has been set to external, make sure that there is also an external storage medium attached to the oscilloscope. Please carry out the setup of the USB storage as shown in the following chapters.

Save screenshot

A screenshot can only be stored on an external USB memory.

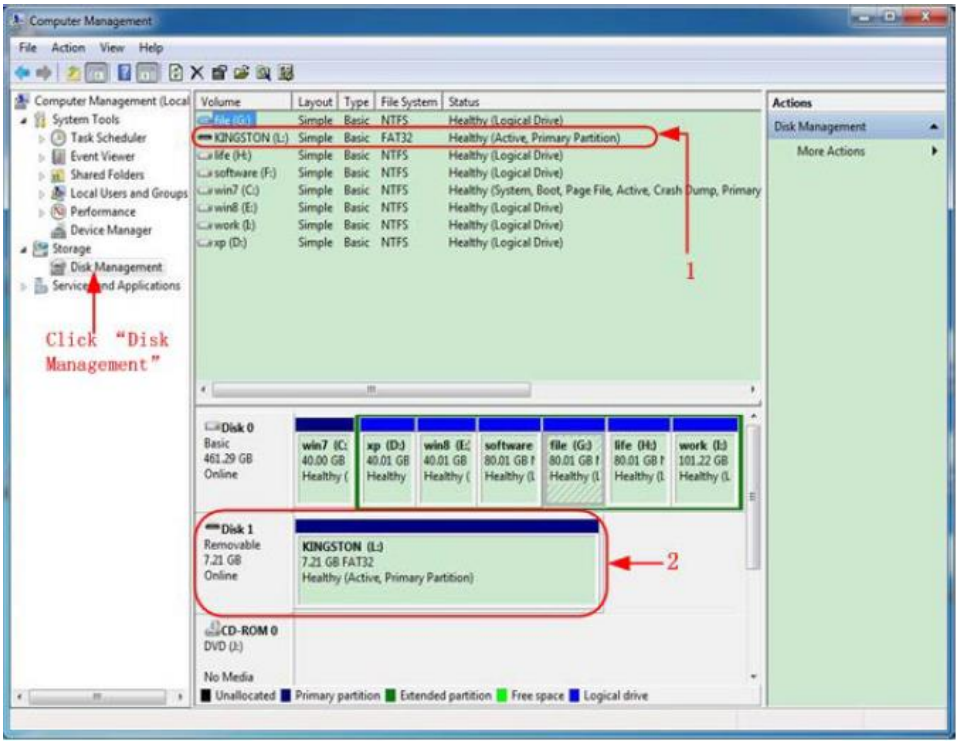
1. **Install a USB memory:** Insert a USB stick into the **"USB Host Port" of** the unit. If a USB symbol is displayed at the top right, the USB memory has been correctly recognised and connected. If the USB memory is not recognised correctly, please proceed as described in the corresponding chapter.
2. After the USB memory has been connected, press the **Save button** so that the Save menu is displayed at the bottom of the screen.
3. Select **Type** in the lower menu and turn the M knob until **Image** appears.
4. Press the **Save button to** save the screenshot. A virtual keyboard opens, which you can operate with the M rotary knob or via the touch screen function. Enter a file name with a maximum of 16 characters and confirm with the Enter key ↵.

USB memory requirements

The supported file format of a USB memory is: FAT21 file system with a cluster size of no more than 4KB. A USB mass storage device is also supported. If a connected USB memory does not work, format it as described in the following two options: The system tool or a formatting tool. (8Gbyte or larger USB memory sticks can be formatted with the second method).

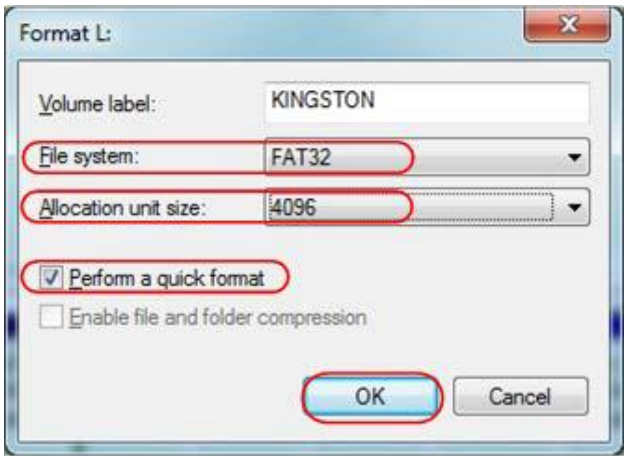
System's own function for formatting

1. Connect the USB stick to the PC.
2. Right-click on **Computer→ Manage (Win7)** or right-click on the Windows icon **(Win10)** and then on **Disk Management**.
3. In the Disk Management menu you will find all the information about the connected data carriers, Select the USB storage device as marked in red in the following example 1 and 2:

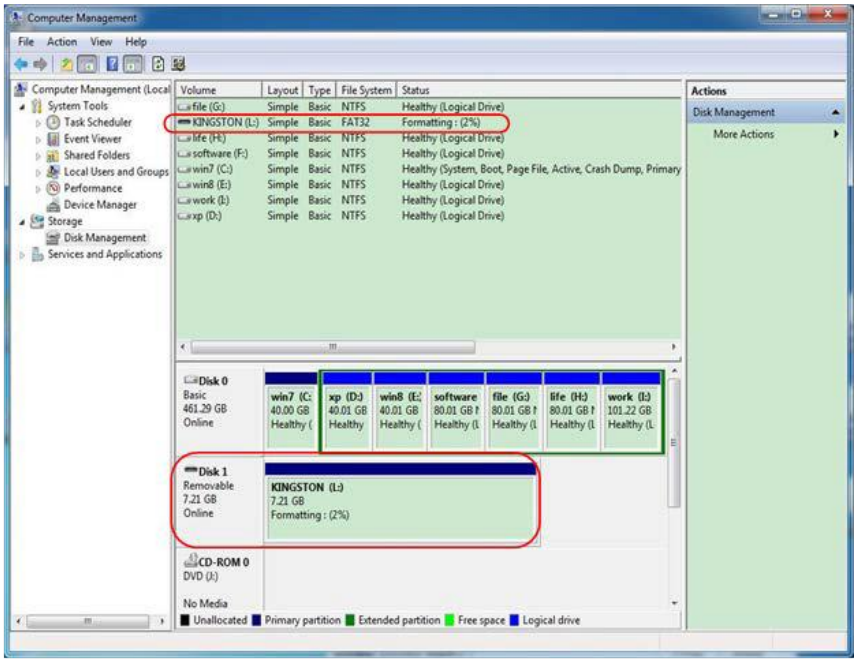


4. Right-click on the area marked in red and select **Format and** a warning message appears, which you confirm with **YES.**

5. Set the file format as FAT32 with a cluster size of 4096. Select quick format "**Perform a quick Format**" and confirm with **OK** and confirm with **YES.**



6. Formatting process



7. Check that the formatting has been carried out and that FAT32 is now displayed with a cluster size of 4096.

Cloning a waveform

To clone a waveform that lies between the cursors, please refer to **Appendix C.**

Saving and playing back recordings

Waveform recording can record the current waveform and save it as a movie. You can set the interval between 1ms and 1000s, with a maximum of 1000 frames recorded. You can save the recording internally or externally.

For internal storage, you can choose between 4 options: **OFF, Record, Playback** and **Storage.**

For external storage, you can choose between 2 options: **OFF and Record.**

Record: To record a waveform until the set interval reaches the end frame. The Record menu is displayed as follows:

Menu	Setting	Description
Fashion	OFF Record Playback Storage	Close Wave Record Set Record Menu Set Playback Menu Set memory menu
Record Mode Frame Set	End Frame	Turn the M-rotary knob to set the number of the recording frames (1-1000).
	Interval	Turn the M-rotary knob to set the interval of the recording frames (1ms-1000s).
Refresh	ON OFF	Renew waveform during recording No renewal
Operate	Play Stop	Start recording Stop recording

Hint:

Both waveforms - channel1 and channel2- are recorded. If a channel is switched off during recording, this channel is invalid during playback.

Playback: Playback plays back the recorded waveforms

The playback menu is displayed as follows:

Menu	Setting	Description
Playback Mode Frame Set	Start Frame	Turn the M-rotary knob to set the number of the start recording frame (1-1000).
	End Frame	Turn the M-rotary knob to set the number of the end recording frame (1-1000).
	Cur Frame	Turn the M-rotary knob to set the number of the current recording frame (1-1000).
	Interval	Turn the M-rotary knob to set the interval of playback (1ms-1000s)
Play Mode	Loop	Playback is repeated as an endless loop
	Once	Playback only once
Operate	Play	Starts playback
	Stop	Stops playback

Storage: Saves the current waveform recording with respect to the defined start and stop frames.

The storage menu is displayed as follows:

Menu	Setting	Description
Storage Fashion Frame Set	Start Frame	Turn the M-rotary knob to set the number of the start recording frame (1-1000).
	End Frame	Turn the M-rotary knob to set the number of the end recording frame (1-1000).
Save		Saves selected waveform recording to internal memory
Load		Loads selected waveform recording from internal memory

Use the waveform pick-up as described below:

1. Press the Save button.
2. Select Type in the lower picture menu, select Record with the M-rotary knob or touch screen.
3. Select Mode in the lower picture menu and OFF in the right menu.
4. In the bottom menu, select **Storage** as **Internal**.
5. Select **Mode** in the bottom menu and then **Record** in the right menu.
6. Then select **FrameSet** in the bottom menu, set the **EndFrame** and the **Interval in** the right menu.
7. Press **Refresh** in the lower menu.
8. Then select **Operate** as **Play**.
9. Select **Mode** in the lower menu, then **Playback** in the right menu. Set **FrameSet** and **Playmode,** then **Operate** as **Play.**
10. To save a waveform image, select **Mode** in the lower image menu, then **Storage in** the right menu. Select **FrameSet** in the lower menu to select the range of frames, which are then saved via **Save.**
11. To load the waveform from the internal memory, select **Load in** the lower menu and then **Playback of** the **mode** to analyse the waveform.

Note: Sampling, triggering and display functions are not available during waveform playback.

If the storage medium is set to external, only two modes are available: OFF and Record.

The Record menu (external memory) is displayed as follows:

Menu	Setting	Description
Fashion	OFF Record	Closes shaft form receptacle Sets recording menu
Record mode FrameSet	End Frame	Turn the M-rotary knob to set the number of the end recording frame (1-1000).
	Interval	Turn the M-rotary knob to set the interval of playback (1ms-1000s)
	Infinity	Recording until the storage medium is full
Refresh	ON OFF	Renew waveform during recording Stop renewal
Operate	Play Stop	Start recording Stop recording

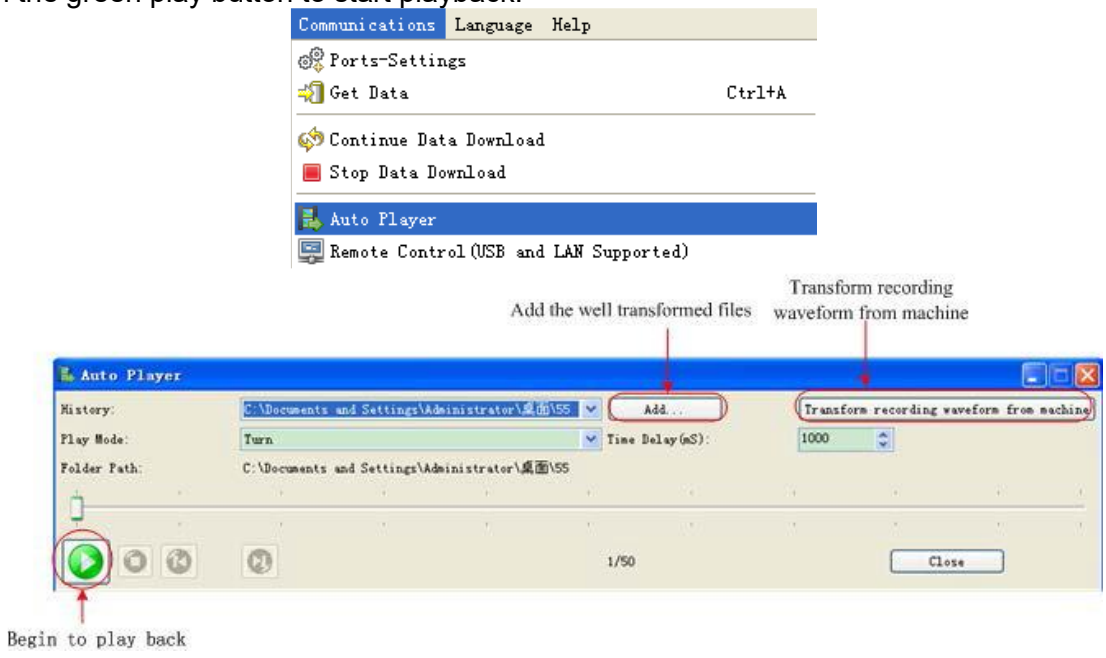
Hint:
Both waveforms (channel 1 & 2) are recorded. If you switch off a channel during recording, the channel is not available during playback.

Use the waveform pick-up as described below:

1. Press the **Save button**.
2. Select **Type** in the lower picture menu, select Record with the M-rotary knob or touch screen.
3. Select **Mode** in the lower picture menu and **OFF** in the right menu.
4. In the bottom menu, select **Storage** as **External**.
5. Select **Mode** in the bottom menu and then **Record** in the right menu.
6. Then select **FrameSet** in the lower menu, set the **EndFrame** and the **Interval in** the right menu. If you want to record the waveform without limit, select **Infinity in** the right menu. The end frame display is shown as "-".
7. Press **Refresh** in the lower menu.
8. Then select **Operate** as **Play**.

Connect the external storage medium to your computer, open the PC software and load the "*wave_record_0.bin*" file.

1. Select **Communications→ Auto Player.**
2. Transforming the waveforms from the unit (Transform recording...).
3. Add the transformed files.
4. Set **Play Mode** and **Time Delay.**
5. Click on the green play button to start playback:



Set additional system functions

- **Config**

Press the **Utility** button and select **Function** in the lower screen menu, then select **Configure in** the left menu.

The configuration menu is displayed as follows:

Menu	Setting		Description
Language	Chinese English Others		Sets the system language. The selectable languages may vary with different firmware versions.
Set Time	Display	ON OFF	Date display Switch on/off
	Hour Min		Set hour/minute
	Day Month		Set day/month
	Year		Set year
KeyLock			Key lock: To deactivate, press the **Trigger Menu** key and then the **Force** key. Repeat this three times quickly
About			Show version number and serial number

- **Display**

Press the **Utility** button, then **Function** in the lower menu. Then select **Display in** the left menu.

Use the **display** menu as shown below:

Menu	Setting	Description
Backlight	0% - 100%	Turn the M-rotary knob to adjust the display illumination
Graticule		Select the four options to display and adjust the grid line
Battery	ON OFF	Switch on battery indicator or switch off if battery is installed in the unit.
Menu Time	OFF, 5s - 30s	Set the display duration of the pop-up menus

- **Adjust**

Press the **Utility** button, then **Function** in the lower menu. Then select **Adjust in** the left menu.

Use the **Adjust** menu as shown below:

Menu	Description
Self Cal	Carries out a self-calibration of the unit
Default	Resets the unit to factory settings
Sample CH	Checks the probe compensation

Self-Calibration

Self-calibration can help to achieve a better measurement result in the event of faulty measurement or a large influence of ambient temperatures. If the ambient temperature increases significantly (over 5°C), self-calibration should always be carried out to achieve the best possible accuracy.

Before performing a self-calibration, remove all probes from the terminals of the unit. Press the **Utility** button, then select **Function from** the lower menu and then **Adjust.** Finally, press the **SelfCal** button in the lower screen menu to perform the self-calibration.

Sample Checking

Checks whether the probe compensation is OK. The result shows three possibilities: Excessive compensation, Good probe compensation and Insufficient probe compensation.

Proceed as follows:

1. Connect the probe to CH1 and set the **Probe Attenuation** to maximum.
2. Press the **Utility** button and select **Function from** the bottom menu, then **Adjust** from the left picture menu.
3. Select **ProbeCh. in** the lower menu and notes are shown in the display.
4. Press **ProbeCh.** again and the test starts. The result is then displayed.

- **Pass/Fail**

The **pass/fail check** detects whether the input signal is within the limits of the rule. If it exceeds the rule limits, it does not pass the check and is classified as a "fail"; if it is within the rule limits, it is allowed as a "pass". It can also output fail or pass signals via an integrated and configurable output port.

Description of the **Pass/Fail** menu:

Menu	Setting	Description
Operate	Enable Operate	Activate control Switch on/off
Output	Passport Fail Beep Stop Info	Tested signal fulfils rule Checked signal does not fulfil rule Beep when rule is fulfilled Stops when rule is fulfilled Show Pass Fail information window
Rule	Source Horizontal Vertical Create	Select source CH1, CH2 or Math Change horizontal tolerance via M-rotary knob Change vertical tolerance via M-rotary knob
SaveRule	Number Save Load	Select the name of the rule between Rule 1 and Rule 8. Select **Save to** save the rule Load a rule as a test rule

Pass/Fail Test:

The pass/fail check detects whether the input signal is within the limits of the rule. If it exceeds the rule limits, it does not pass the check and is classified as a "fail"; if it is within the rule limits, it is allowed as a "pass". It can also output fail or pass signals via an integrated and configurable output port. To perform a pass/fail check:

1. Press the **Utility** button, then **Function** in the lower menu. Select **Pass/Fail in** the left menu.
2. **Enable switch on:** Select **Operate** in the lower menu and then **Enable** in the right menu as **ON.**
3. **Create rule:** Select **Rule** in the bottom menu, then **Source in** the right menu and Source selection in the left menu. Set the **Horizontal** and **Vertical** Tolerance in the right menu. Finally, select Create in the right menu to create the rule.

4. **Set output type:** Select **Output** in the lower menu to make the output settings. Use one/two of the following options: **"Pass", "Fail"** or **"Beep". Pass"** and **"Fail"** are mutually exclusive options that cannot be activated at the same time. "**Stop"** means the unit stops when the set conditions are successfully met.
5. **Begin to test:** Select **Operate** in the lower menu, then **Operate** in the right menu as **Start** so that the test begins.
6. **Save Rule:** Select **SaveRule** in the lower menu. Then select the storage location in the left menu, which you use with **Save in** the right menu to save the defined test rule. You can then load and use it again if necessary. Select **Load** to recall a saved rule**.**

Hint:

1. If Pass/Fail is on and you switch to XY or FFT, Pass/Fail is closed and is no longer available as long as XY or FFT is used.
2. Factory setting closes Pass/Fail, AutoSet and AutoScale.
3. If no more "save settings" are available, a message "NO RULE SAVED" is displayed.
4. Under the status "Stop", the data comparison is interrupted. If the status is changed back to "Running", Pass/Fail will continue to run at the point where it was stopped and will not restart completely.
5. When the waveform recording is running as playback, Pass/Fail can be used to analyse the recorded waveform.

- **Output**

Press the **Utility** button, then **Function** in the lower menu. Then select **Output in** the left menu.

The **Output** menu sets the behaviour of the **Trig Out (P/F)** output on the back of the unit.

Use the **output** menu as shown below:

Menu	Setting	Description
Type	Trig Level	Output synchronous trigger signal
	Pass/Fail	Outputs a high level signal on pass and a low level signal on fail.
	AG Output	Outputs the signal of the arbitrary waveform generator (AG)

In the **VGA** menu you can activate the video signal outputs of the unit.

Use the **video** menu as shown below:

Menu	Setting	Description
Video	OFF	Switch off video output
	VGA	Enable VGA output
	AV	Activate AV output (optional)

Device / **Print Setup:**

Device and **Print Setup** menus are described in the paragraph "**Print screenshot**"

- **LAN Set:** To use the LAN network connection or Wi-Fi (wi-fi) with the computer or data connection with an Android phone via WiFi, please refer to the related articles "**Connection with the PC**".
- **Update:** Use the USB port on the front to update the unit firmware using a USB memory device.
- **DAQ:** You can use the multimeter data recorder to record the measurements when measuring current / voltage with a multimeter.

Automatic measuring functions

Press the **Measure** button to switch to the menu for the automatic measurement functions.

The oscilloscope has 30 parameters for automatic measurement such as: Period, Frequency, Mean, PK-PK, RMS, Max, Min, Top, Base, Amplitude, Overshoot,Preshoot, Rise Time, Fall Time, +PulseWidth, -PulseWidth, +Duty Cycle, -Duty Cycle, Delay A→B卐 , Delay A→B卍 , Cycle RMS, Cursor RMS, Screen Duty, Phase, +PulseCount, -PulseCount, RiseEdgeCnt, FallEdgeCnt, Area, and Cycle Area....

The "Automatic measurement functions" menu is described below:

Menu		Setting	Description
Add	Meas Type (left menu)		Selecting the measuring function
	Source	CH1	Selecting the source for the measurement function to be applied (2 & 4 CH models)
		CH2	
		CH3	Selecting the source for the measurement function to be applied (4 CH models)
		CH4	
	Add		Adds the measurement function to the measurement field (displayed at the bottom left), with a maximum of 8 measurements possible at the same time
Remove	Meas Type (left menu)		Selects the measurement functions to remove
	Remove		Removes the selected measuring function
	Remove All		Removes all measuring functions
Show CH1 / CH2	ON	Displays all measurement functions for CH1 or CH2 simultaneously	
	OFF	Hides the measurement window for all CH1 or CH2 measurements	
Snapshot (4 CH models)	ON	Displays all measurement functions for CH1 to CH4 simultaneously	
	OFF	Hides the measurement window for all CH1 to CH4 measurements	

Trade fairs

A measurement can only be carried out when the channel is switched on. The automatic measurement function cannot be activated in the following three situations:

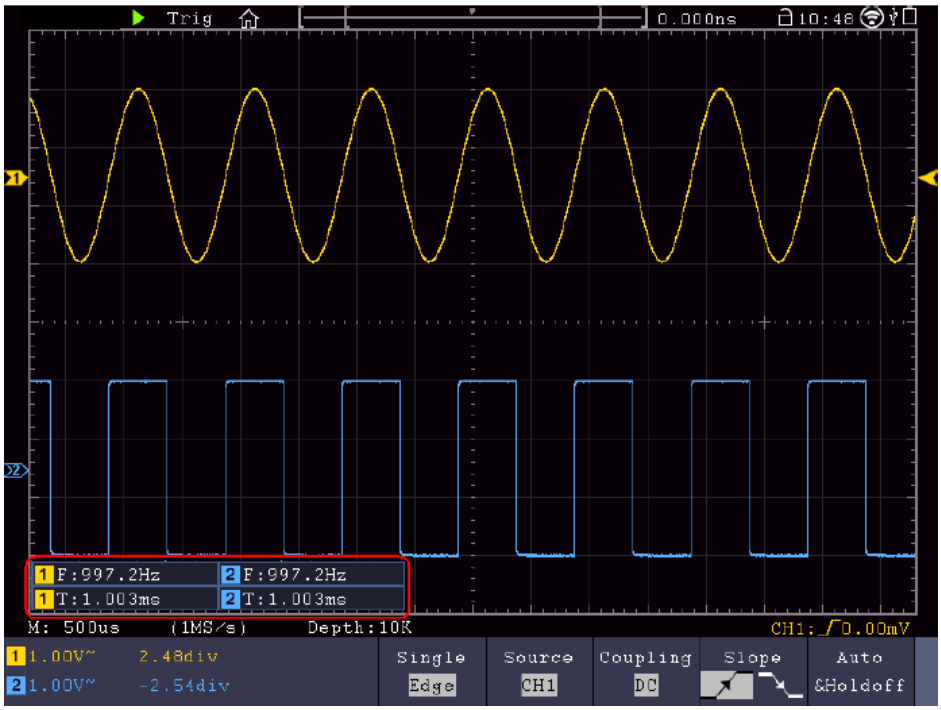
1) With a stored waveform
2) For the Dual Wfm Math waveform (mathematical function)
3) In video trigger mode.

Period and frequency cannot be measured in scan format.

For example, to measure period and frequency for channel 1, proceed as follows:

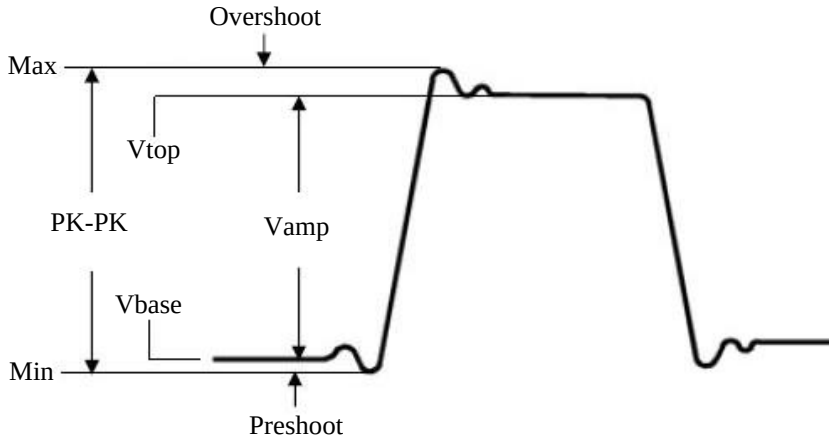
1. Press **Measure in** the lower menu to open the automatic measurement functions.
2. Select Add from the bottom menu.
3. In the right-hand menu, select **CH1** under the **Source** menu.
4. In the left menu, turn the **M knob** to select the **period.**
5. In the right menu, press **Add** to add the period to the measurement field.
6. In the left menu, turn the **M-rotary knob** to select the **frequency.**
7. In the right menu, press **Add** to add the frequency to the measurement field.

The measured values are automatically displayed in the lower, left-hand measuring field (red marking).



Automatic measurement of the voltage parameters

The oscilloscope provides automatic voltage measurements including Vpp, Vmax, Vmin, Vavg, Vamp, Vrms, Vtop, Vbase, Overshoot and Preshoot. The image below shows a pulse with some voltage measurement points.



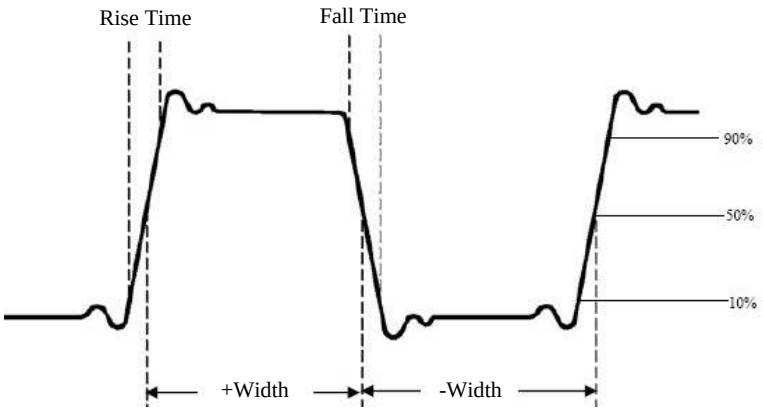
.

Mean**:** Arithmetic mean value over the entire waveform.
PK-PK: Peak-to-peak tension.
Max: Maximum amplitude. The highest positive peak voltage measured over the entire curve.
Min: Minimum amplitude. The highest negative peak voltage measured over the entire curve.
Vtop: Flat-top voltage of the curve, useful for square/pulse signals.
Vbase: Flat-base voltage of the curve, useful for square/pulse signals.
Vamp: Voltage between Vtop and Vbase of a curve.
Overshoot: (Overshoot) Defined as (Vmax-Vtop)/Vamp, useful for square wave and pulse signals.
Preshoot: Defined as (Vmin-Vbase)/Vamp, useful for square and pulse signals.
Cycle RMS: True Root Mean Square voltage over the entire length of the period of the current waveform.
Cursor RMS: True Root Mean Square voltage over the range of two cursors.

Automatic measurement of the time parameters

The oscilloscope provides automatic measurements of time parameters including Frequency, Period, Rise Time, Fall Time, +Width, -Width, Delay A→B⨍ , Delay A→B⨎ and Duty Cycle.

The following picture shows a pulse with some timing points:



Rise Time: The time it takes for the leading edge of the first pulse in the curve to rise from 10% to 90% of its amplitude.

Fall Time: The time it takes for the leading edge of the first pulse in the curve to fall from 90% to 10% of its amplitude.

+D Width: The width of the first positive pulse at the 50% amplitude point.

-D Width: The width of the first negative pulse at the 50% amplitude point.

+ Duty: + duty cycle, defined as +width/period.

- Duty: - duty cycle, defined as -width/period.

Delay A→B⨍ **:** The delay between the two channels on the rising edge.

Delay A→B⨎ **:** The delay between the two channels at the falling edge.

Duty cycle: Defined as (Width of positive pulse)/(Total period)

Phase: Compares the rising edge of CH1 and CH2, calculates the phase difference of the two channels.

Phase difference= [(delay between channels of the rising edge) x PI]/period

Other measurement functions

+PulseCount : Displays the number of positive pulses that rise above the centre reference transition.

-PulseCount : Displays the number of negative pulses that are under the centre reference transition.

+PulseCount : Displays the number of positive passes from the low reference value to the high reference value.

-PulseCount : Displays the number of negative passes from the high reference value to the low reference value.

Area : Calculates the total area of the waveform as volt-seconds. The area above the zero reference (the vertical offset) is positive and the area below the zero reference is negative. The measurement area is the algebraic sum of the waveform displayed on the screen.

Cycle Area : Calculates the range of the first period of the waveform as a volt-second. The area above the zero reference (the vertical offset) is positive and the area below the zero reference is negative. The measurement area is the algebraic sum of the first period of the waveform.
Note: If less than a complete period is shown on the display, the measuring range is 0.

Cursor measurements

Press the **cursor** key to switch on a cursor and show it in the display. Press the key again to switch the cursor off.

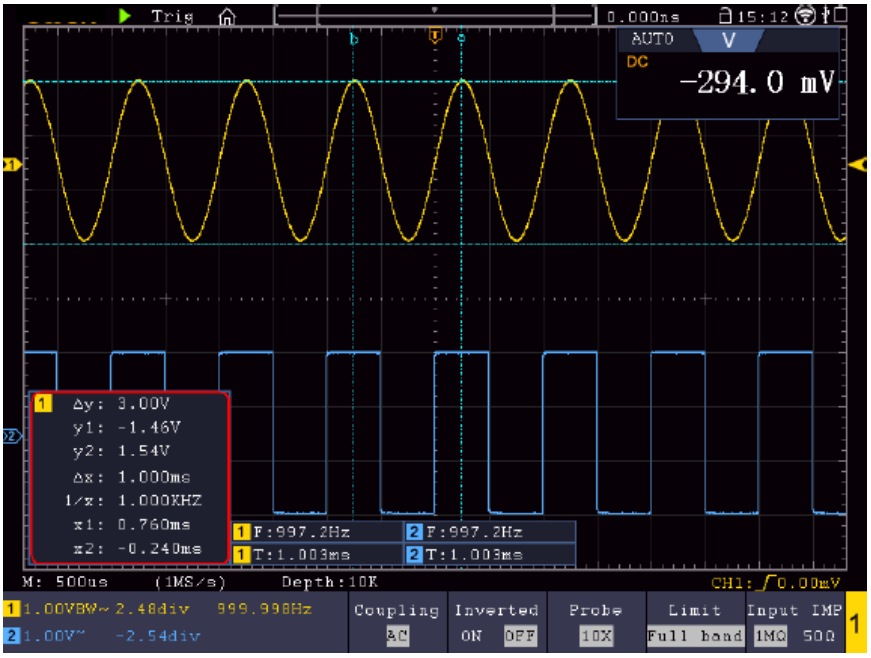
Cursor measurements in normal mode

The cursor menu is described below:

Menu	Setting	Description
Type	Voltage Time Time&Voltage Auto Cursor	Displays the cursor of the voltage measurement Displays the timing cursor Displays cursor of time and voltage measurement Horizontal cursors are displayed as the intersections of the vertical cursors with the waveform
Line Type (time and voltage type)	Time Voltage	Activates vertical cursor Activates horizontal cursors
Window (Wave Zoom Mode)	Main Extension	Activates cursor in main window Activates cursor in zoom window (HOR button)
Line	a b from	Move M-rotary knob to move line a Move M-rotary knob to move line b Move M-rotary knob to move line a and b at the same time, as they are connected
Source	CH1 - CH4	Select the channel as source which is used for the cursor measurement.

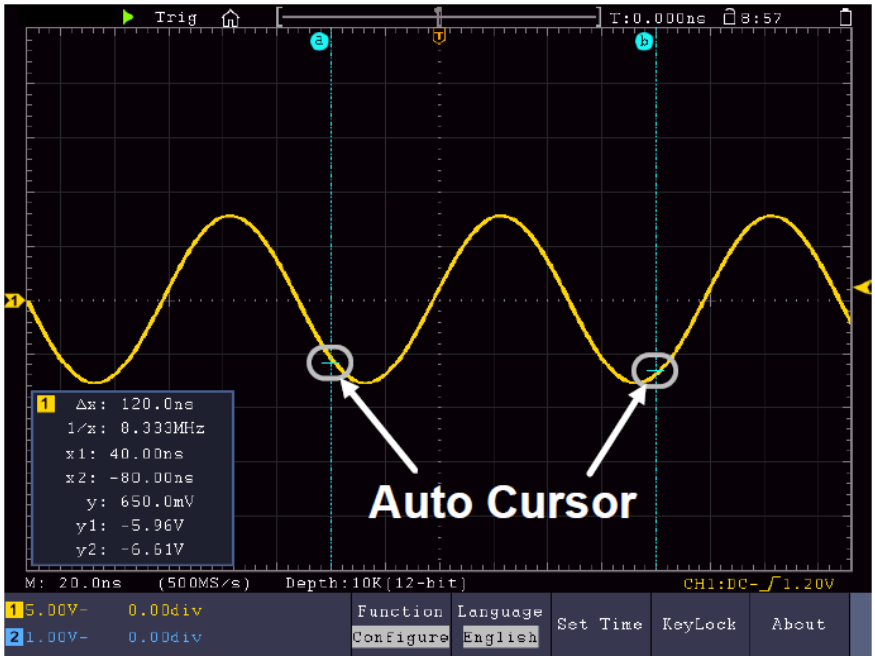
Follow the steps below to set a time and voltage cursor for channel 1:

1. Press the **cursor** key to open the menu.
2. Select **Source** as **CH1.**
3. Press the first menu field in the lower screen menu (H1) to change the setting to **Time&Voltage.** Two blue dash lines for the horizontal voltage range and two blue dash lines for the vertical time range are now displayed.
4. In the bottom menu, please select **LineType** as **Time to** activate the vertical cursors. If the **line is selected** as "**a" in the** lower menu, turn the M-rotary knob to move the line to the right or left in the display. If "**b"** was selected, move this line to the right or left with the M-rotary knob.
5. In the lower menu, please select **LineType** as **Voltage to** activate the horizontal cursors. If the **line is selected** as "**a" in the** lower menu, turn the M-rotary knob to move the line up or down in the display. If "**b"** was selected, move this line up or down with the M-rotary knob.
6. Press the horizontal control **HOR** to activate the wave zoom mode. In the lower menu under **Window**, select **Main** for cursor control in the main window or **Extension for** cursor control in the zoom window.



Auto Cursor

With the Auto Cursor setting, the horizontal cursor is set at the intersections of the vertical cursors with the waveform.



Move the cursors with gesture control

Please read the article "Other Touchscreen Settings".

Cursor measurements in FFT mode:

In FFT mode, press the **cursor** key to open the cursor menu.

A description of the cursor menu in FFT mode is given below:

Menu	Setting	Description
Type	Vamp Freq Freq&Vamp Auto Cursor	Displays the vamp cursor measurement Displays the frequency measurement cursor of the Displays cursor of frequency and vamp measurement Horizontal cursors are displayed as the intersections of the vertical cursors with the waveform
Line Type (time and voltage type)	Freq Vamp	Activates vertical cursor Activates horizontal cursors
Window (Wave Zoom Mode)	Main Extension	Activates cursor in main window Activates cursor in FFT zoom window
Line	a b from	Move M-rotary knob to move line a Move M-rotary knob to move line b Move M-rotary knob to move line a and b at the same time, as they are connected
Source	Math FFT	Select the channel as source which is used for the cursor measurement.

Perform the following steps for amplitude and frequency measurement via cursor in FFT mode as follows:

1. Press the **Math** button and select **FFT.**
2. Press the **cursor** key to open the menu.
3. Select **Window** as **extension in** the lower menu.
4. Press the first menu field in the lower screen menu (H1) to change the setting to **Freq&Vamp.** Two blue dash lines for the horizontal voltage range and two blue dash lines for the vertical time range are now displayed.
5. In the lower menu, please select **LineType** as **Freq to** activate the vertical cursors. If the **line is selected** as "**a" in the** lower menu, turn the M-rotary knob to move the line to the right or left in the display. If "**b"** was selected, move this line to the right or left with the M-rotary knob.
6. In the lower menu, please select **LineType** as **Vamp to** activate the horizontal cursors. If the **line is selected** as "**a" in the** lower menu, turn the M-rotary knob to move the line up or down in the display. If "**b"** was selected, move this line up or down with the M-rotary knob.
7. In the lower menu under **Window**, select the setting **Main for** the cursor control in the main window.

Autoscale function

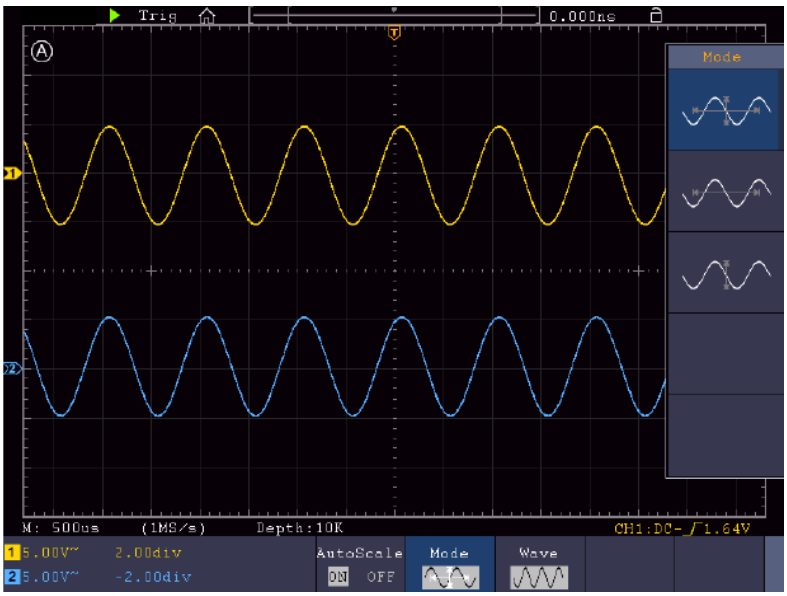
This is a very useful function for first-time users who want to perform a simple and quick check of the input signal. This function is used to automatically track signals even if the signals change at any time. Using the Autoscale function, the instrument can automatically set up the trigger mode, voltage division and time scale according to the type, amplitude and frequency of the signals.

Press **Autoscale** to display the following menu:

Menu	Setting	Description
AutoScale	ON OFF	Switching on the autoscale function. Switch off the autoscale function.
Fashion	  	Track and adjust both vertical and horizontal settings. Track and adjust horizontal scale only. Track and adjust vertical scale only.
Wave	 	Display waveforms with multiple periods. Show only one or two periods.

To measure the autoscale signal:

Press the Autoscale button. The function menu is displayed.
Press the H1 button to select the ON option.
Press H2 and select  for Mode.
Press H3 and select  for Wave.



1. When you call up the autoscale function, a Ⓐ is displayed at the top left of the screen.
2. In autoscale mode, the oscilloscope can estimate the "trigger type" (single) as well as the "mode" (edge, video) itself. At this point, the trigger menu is not available.
3. In XY mode and STOP status, press the Autoset button to switch to Autoscale mode. The oscilloscope switches to YT mode and AUTO triggering.
4. In autoscale mode, the oscilloscope is always set to DC coupling and AUTO triggering. In this case, making trigger or coupling settings has no effect.
5. In autoscale mode, if the vertical position, voltage division, trigger level or time scale is adjusted from CH1 to CH4, the oscilloscope turns off the autoscale function. Press the Autoset button to return to the Autoscale function.
6. If you switch off the submenu in the autoscale menu, the autoscale is off; if you switch on the submenu, you switch on the function.
7. With video triggering, the horizontal time scale is set to 50µs. If one channel is set to edge signal while the other is set to video, the time scale is set to 50µs.
8. In autoscale mode, the following settings are enforced: If zoom mode is activated, it is deactivated.

Help function

1. Press the **Help button** and the overview appears.
2. Press **Prev Page** or **Next Page to** scroll through the help topics or use the M-rotary knob and the touch screen function to select.
3. Press **OK** if you want to view details of the theme.
4. Select **Quit** to leave the help menu again.

Executing keys

The executing keys are **AUTOSET, RUN/STOP, SINGLE** and **COPY.**

Autoset

This key is used to automatically set all the control values of the unit needed to generate a viewable waveform. Press the **AUTOSET** key; the oscilloscope then performs a quick automatic measurement of the signal

The following table shows the parameter values of the **AUTOSET** function:

Menu	**Setting**
Vertical Coupling	Current
Channel Coupling	Current
Vertical Scale	Adjust to appropriate pitch.
Bandwidth	Full
Horizontal Level	Medium or +/- 2 div
Horizontal Scale	Adjust to appropriate pitch.
Trigger Type	Slope or video
Trigger Source	CH1 or CH2 (2 channel) or CH1 to CH4 (4 channel)
Trigger Coupling	DC
Trigger Slope	Current
Trigger Level	3/5 of the waveform
Trigger Mode	Car
Display format	YT
Force	Stop
Help	Leaving
Pass/Fail	From
Inverted	From
Zoom Mode	Leaving

Evaluate waveform via autoset

5 types: Sine, Square, Video Signal, DC Level, Unknown Signal

The corresponding menus are shown below:

Sine (Multi-Period, Single-Period, FFT, Cancel Autoset)

Rectangle (Multi-Period, Single-Period, Rising Edge, Falling Edge, Cancel Autoset)

Video Signal:

DC Level, Unknown Signal:

Description of the icons:

Multi Period:	Displays several periods at the same time
Single Period:	Displays one period
FFT:	Switches to FFT mode
Rising Edge:	Shows rising edge of the waveform
Falling Edge:	Shows falling edge of the waveform
Cancel Autoset:	Back to previous menu and waveform information

Run/Stop: Activates or deactivates the sampling of the waveform display.

Note: If there is no sampling in STOP status, the vertical divisions or the horizontal time base can still be adjusted in a certain range. In other words, the signal can still be extended in the horizontal or vertical range. If the horizontal time base is <50ms, the horizontal time base can still be reduced by 4 divisions.

Single: Pressing this button allows the trigger mode to trigger a single sample, with waveform capture stopping after one sample.

Copy: You can save the waveform using the **Copy** button in any menu. The source of the waveform and the storage location are defined in the **Save** menu. Please also read the corresponding chapter "Saving and recalling data".

Print screenshot

To print a screenshot directly, proceed as follows:

1. Connect a printer to the **USB device port** on the back of the unit.
   Note: The printer must have **PictBridge** compatible drivers.
2. Press the **Utility** button and select **Output** under **Function.**
3. In the lower picture menu under **Device,** select **Pict.** (If the **PC** option is selected, you can transfer a screenshot to the PC).
4. If you have activated **Pict in** the lower menu, a new menu symbol **Print Set** appears on the right in which you can define various settings for printing. Activate **Ink Saver** with **ON to print** the image on a white background and thus save printer ink.
5. Once you have set up the printer in this way, you can initiate another print by simply pressing the **Print** button.

5. arbitrary function generator

The oscilloscope has an integrated single-channel arbitrary function generator with 25 MHz. The generator provides 4 basic waveforms (sine, square, ramp and pulse), as well as 46 integrated arbitrary waveforms (e.g. noise, exponential rise, exponential fall, sin(x)/x, stair step). You can also create your own waveforms and save them internally or externally on USB.

Connection

Press the **Utility** button, then **Function** in the lower menu. Under the **Output** setting in the left menu under **Type,** select **AG Output** so that the BNC socket on the back of the unit is used for the generator.

Connect the BNC cable to the BNC socket marked **Out** on the back of the unit.

Channel settings

Press the **OUT** key to switch the output on and off. The corresponding symbol (values) is displayed in the upper left corner of the screen when the output is switched on.

Signal settings

1. Press the **AFG** key to display the generator menu.
2. Select the desired waveform in the lower screen menu .
3. The corresponding menu with the settings of the selected waveform appears on the right edge of the screen.

Sine signal

The parameters of the sine signal in the right menu are: **Frequency/Period, Amplitude/High Level, Offset/Low Level.**

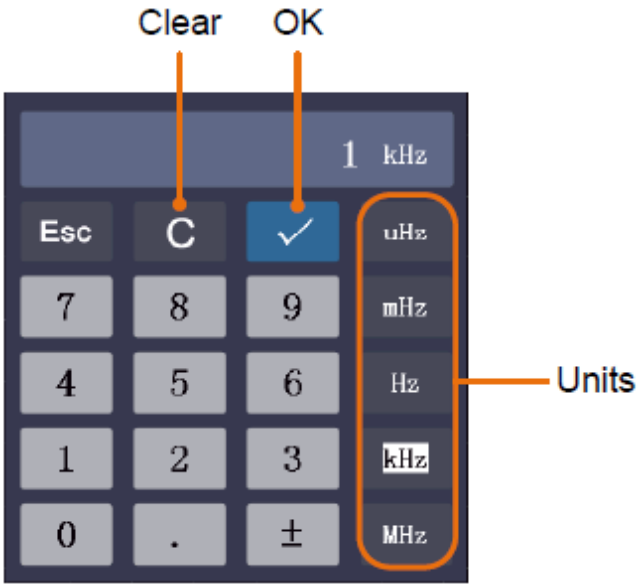
Frequency settings

Set the **Frequency** in the right menu (if **Frequency is** not displayed, select **Period** and press this button again to switch back to **Frequency**).

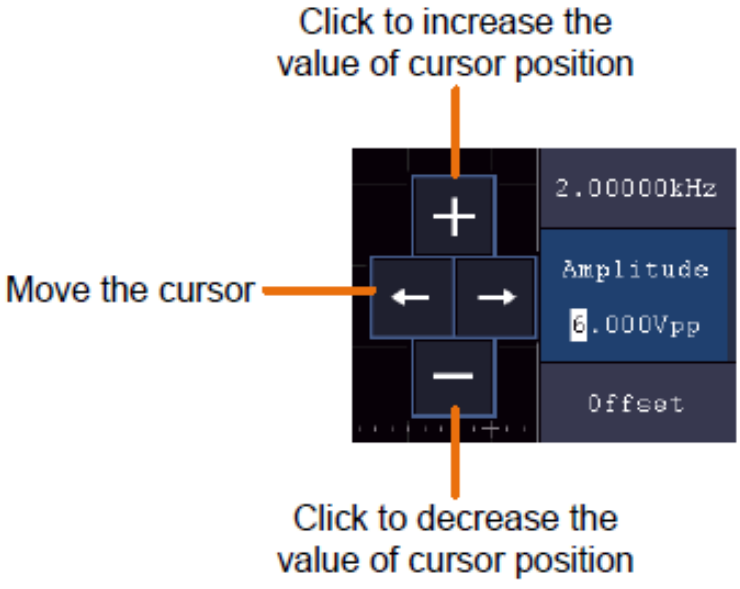
To set the parameters in the right-hand menu, proceed as follows:

There are three ways to change the parameters:

1. **M-rotary knob**: Turn the M-rotary knob to change the value of the current cursor position. Press the ←→ arrow keys under the M knob to move the cursor and highlight the desired frequency setting location in white.
2. **Input field:** Press the M rotary knob and a numeric input field appears for direct input of the frequency via the M rotary knob or touch screen:



3. **Touchscreen:** Use the touchscreen fields that appear next to the frequency value:



Period setting

Select **Period** from the right-hand menu (if **Period is** not displayed, select **Frequency** and then press this button again to switch back to **Period**).

Amplitude setting

Select **Amplitude** in the right-hand menu (if **Amplitude** is not displayed, select **High Level** and then press this button again to switch back to **Amplitude**).

Offset settings

Select **Offset** in the right-hand menu (if **Offset is** not displayed, select **Low Level** and then press this button again to switch back to **Offset**).

High Level Settings

Select **High Level** in the right-hand menu (if **High Level** is not displayed, select **Low Amplitude** and then press this button again to switch back to **High Level**).

Low Level Settings

Select **Low Level** in the right-hand menu (if **Low Level** is not displayed, select **Offset Amplitude** and then press this button again to switch back to **Low Level**).

Rectangle signal

The parameters of the square wave signal in the right menu are: **Frequency/Period, Amplitude/High Level, Offset/Low Level.**

Note: Do the possible settings for frequency, amplitude etc. as described on the previous page for the sine signal.

Ramp signal

The parameters of the ramp signal in the right menu are: **Frequency/Period, Amplitude/High Level, Offset/Low Level, Symmetry.**

Note: Do the possible settings for frequency, amplitude etc. as described on the previous page for the sine signal.

Symmetry adjustment

Select **Symmetry in** the right menu of the Ramp waveform, then set the parameters in the right menu.

Pulse signal

The parameters of the pulse signal in the right menu are: **Frequency/Period, Amplitude/High Level, Offset/Low Level, PulseWidth/Duty.**

Note: Do the possible settings for frequency, amplitude etc. as described on the previous page for the sine signal.

Pulse width settings

Select **Width** in the right menu of the pulse waveform, then set the parameters in the right menu. (If **Width** is not displayed, select **Duty** and then press this button again to switch back to **Width**).

Duty cycle setting

Select **Duty Cycle** in the right menu of the pulse waveform, then set the parameters in the right menu. (If **Duty Cycle** is not displayed, select **Width** and then press this button again to switch back to **Duty Cycle**).

Arbitrary signals

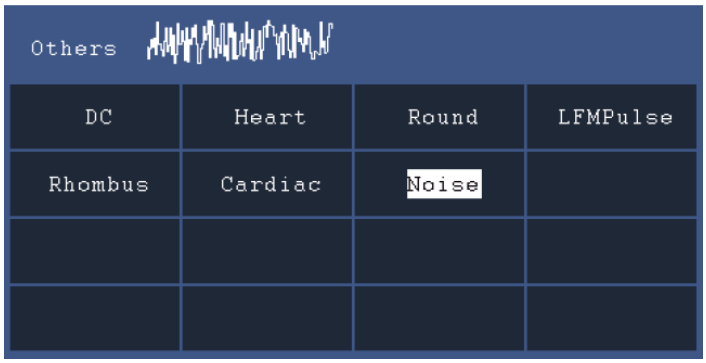
The parameters of the arbitrary signal in the right menu are: **Frequency/Period, Amplitude/High Level, Offset/Low Level, Built-in Waveform, Editable Waveform.**

Note: Do the possible settings for frequency, amplitude etc. as described on the previous page for the sine signal.

There are two types of arbitrary waveforms: Built-in waveforms and user-generated waveforms.

Integrated waveforms:

1. Press the **AFG** button on the unit to display the generator menu.
2. Select **Arb in** the bottom menu, then **Built-in in** the right menu.
3. Select **Common, Math, Windows** or **Others from** the right-hand menu. Use **Others, for example, to** open the following interface:



4. Turn the M-rotary knob to select the desired waveform (or via touchscreen) and confirm the selection with the **Select** function in the right menu.

Note: To output a DC voltage, press the **DC** button on the unit.

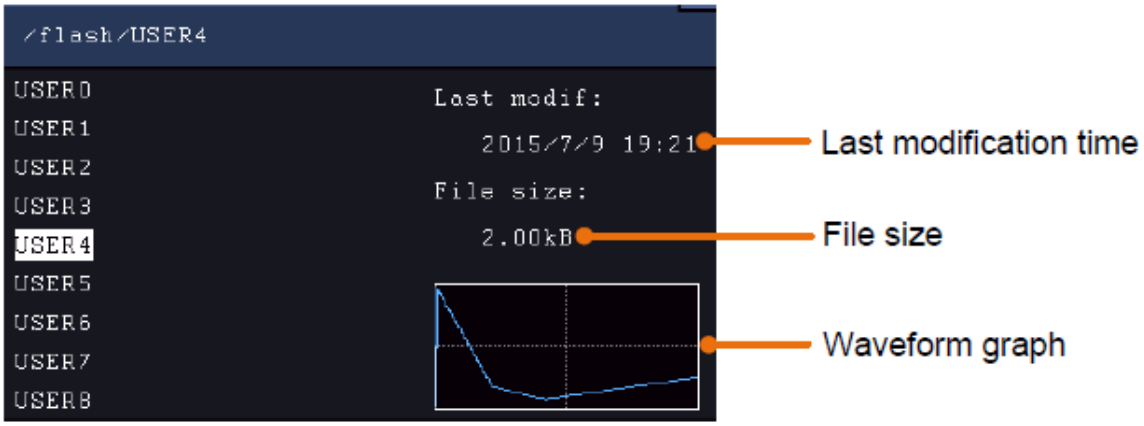
Integrated arbitrary waveforms

Name	Explanation
Common waveforms	
StairD	Step down
Stair U	Stair step upwards
Stair DU	Stairs down and up
Trapezia	Trapezoidal waveform
RoundHalf	Semicircular waveform
AbsSine	Absolute value of a sine
AbsSineHalf	Absolute value of a half sine
SineTra	Transverse truncated sine wave
SineVer	Vertical truncated sine wave
NegRamp	Negative ramp
AttALT	Increasing oscillator curve
AmpALT	Weakening oscillator curve
CPulse	Coded pulse
PPulse	Positive pulse
NPulse	Negative pulse
Mathematical waveforms	
ExpRise	Exponentially increasing
ExpFall	Exponentially decreasing
Sinc	Splitting function
Tan	Tangent
Cot	Kotangens
Sqrt	Square root
XX	Square function
HaverSine	Semiversus
Lorentz	Lorentz function
In	Natural logarithm function
Cubic	Cubic function
Cauchy	Cauchy distribution
Besselj	Bessel Genus-J Function
Bessely	Bessel Gen Y Function
Erf	Error function
Airy	Airy function
Windows	
Rectangle	Rectangle window
Gauss	Gaussian distribution
Hamming	Hamming windows
Hann	Hanning windows
Bartlett	Bartlett Fernster
Blackmann	Blackmann windows
Laylight	Laylight window
Triang	Triangular window (Fejer)
Other	
DC	DC Signal
Heart	Heart signal
Round	Circle signal
LFMPulse	Linear FM pulse
Rhombus	Rhombus signal
Cardiac	Cardiosignal
Noise	Noise signal

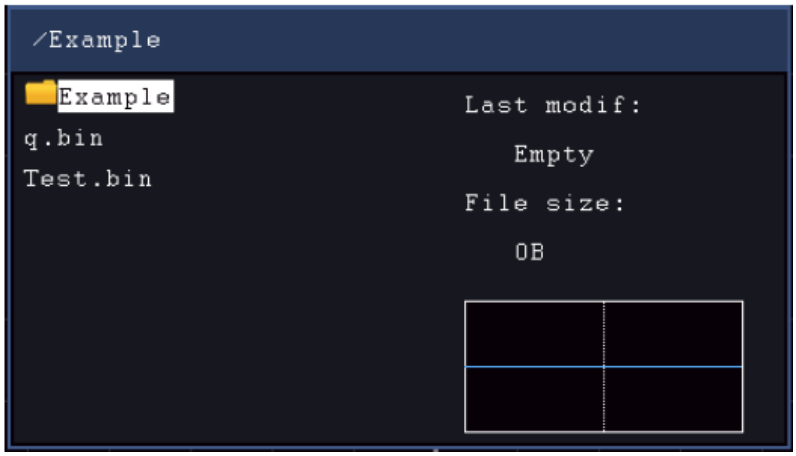
User generated waveforms

1. Press the **AFG** key to open the generator menu. Select **Arb in** the lower menu, then **Others** and **New to enter** waveform creation.
2. **Set the number of points of the waveform:** Select **Points** in the right-hand menu, then turn the M knob to set the number or use the touch screen field. You can create a waveform with 2 to 8192 points.
3. **Set interpolation: For Intrpl,** select **On/Off in** the right-hand menu to connect the points of the waveform to be adjusted in an increasing/decreasing manner or to insert them without connection. Without connection, the voltage between the points is not automatically adjusted and only jumps to the new value when the next point is reached.
4. **Edit waveform points:** Select Edit **Points in** the right-hand menu:
   - Under **Point**, select the point of the waveform you want to edit. Only as many points are available as you have selected for the waveform.
   - Select **Voltage to** set the voltage value of the selected point.
   - Repeat these steps for all necessary points of your waveform.
   - Save the created waveform with **Save**.

   If you want to save the waveform in the internal memory, press **Memory in** the right menu until **Internal is** displayed (default if no USB is connected). Turn the M-turn control or use the touch screen function to select a memory location **USER0** to **USER31.** Then press **Save in** the right-hand menu.



If a USB memory is connected and you want to save the waveform to it, select **Memory** and then **USB**. The unit lists the folders on the USB memory. Select a folder with the M knob to scroll up and down the list. To change to the folder, select **Change Dir in** the right-hand menu. Select this again to change to the parent directory.



Enter the file name via the soft keyboard and confirm it with the ↵ key. The waveform is now saved as a BIN file in the selected folder.

Note: You can enter file names with a maximum of 35 characters.

Recalling a saved waveform

1. Press **AFG** and then select **Arb from** the bottom menu. Then select **Others** and **File browse.**
2. Select the desired waveform from one of the memory locations in the internal or external memory.
3. Confirm **Read in** the menu on the right.

6. multimeter

Input sockets

The input sockets of the digital multimeter are located on the back of the unit and are marked accordingly with **10A, mA, COM** and **V/Ω/C.**

DMM menu

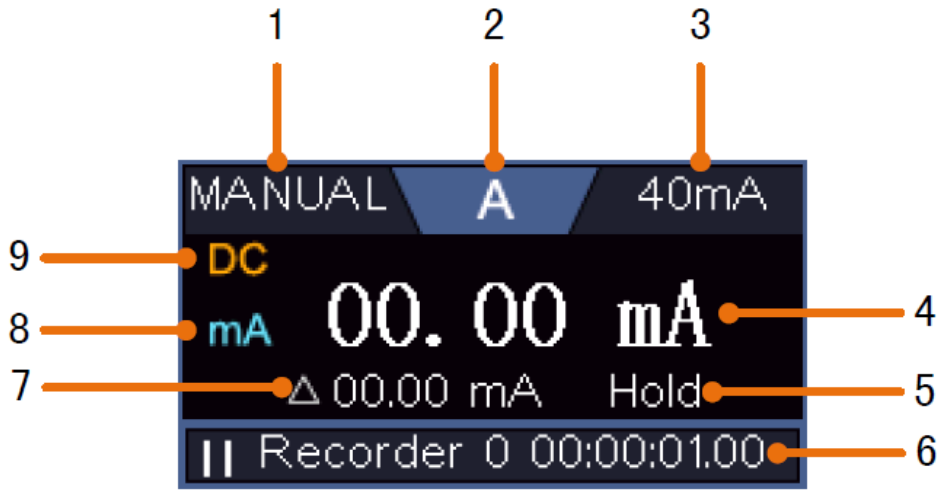
Press the **DMM** button on the front of the unit to switch the multimeter function on and off. When the multimeter function is on, this button is illuminated.

The multimeter menu is described below:

Menu	Setting	Description
Current	ACA DCA	AC current measurement DC current measurement
Voltage	ACV DCV	AC voltage measurement DC voltage measurement
R	R ⊳| C	Resistance measurement Diode measurement Capacity measurement
On-Off		Switches to continuity test (On-Off measurement)
Configure	Hold ON OFF	Freezes the measured value acquisition
	Show Info ON OFF	Shows/hides the multimeter window
	Fashion Car Manu	Selects automatic or manual mode
	Relative	Sets the current measurement value to zero. The measurement is the difference value of the reference value to the current measurement display.
	Current mA 10A	Selects the current measuring range

DMM information window

The digital multimeter window is shown in the upper right corner of the display.



Description

1. Manual/Auto range indicator: **Manual** means that the measuring range must be set manually, whereas **Auto** switches the measuring range automatically.
2. Measuring mode pointer:

V	Voltage measurement
A	Current measurement
R	Widertandsmessung
	Diode measurement
C	Capacity measurement
	Continuity check

3. Current measuring range
4. Measured value with unit
5. Data hold is activated
6. Multimeter recorder
7. Reference value of the relative value function
8. Measuring range for current measurement: mA or 10A
9. AC or DC display for current or voltage measurement

AC or DC voltage measurement:

1. Press the **DMM** button on the front of the unit. Then press **Voltage** in the lower menu several times to switch between **ACV** (alternating voltage) and **DCV** (direct voltage).
2. Connect the black test lead to the **COM** socket and the red test lead to the **V/Ω/C** socket.
3. Connect the test probes to the voltage to be measured and read the measured value in the digital display of the multimeter window.

AC/DC current measurement

Measure a current below 400mA as follows:

1. Press the **DMM** button on the front of the unit. Then press **Current** in the lower menu several times to switch between **ACA** (alternating current) and **DCA** (direct current).
2. Connect the black test lead to the **COM** socket and the red test lead to the **mA** socket.
3. Select **Configure in** the lower screen menu, then switch to **mA in** the right menu.
4. Switch off the circuit to be tested and discharge all capacitors still present in the circuit.
5. Disconnect the circuit under test and connect the black test lead to the open end of the disconnected lead facing the load and the red test lead to the other open end of the disconnected lead facing the voltage source. If this has been reversed, a negative "-" sign is displayed.
6. Switch the circuit on again and read the current value in the measuring display.
7. Disconnect the circuit under test and discharge any remaining capacitors in the circuit before reconnecting the disconnected line.

Measure a current above 400mA to 10A as follows:

1. Press the **DMM** button on the front of the unit. Then press **Current** in the lower menu several times to switch between **ACA** (alternating current) and **DCA** (direct current).
2. Connect the black test lead to the **COM** socket and the red test lead to the **10A** socket.
3. Select **Configure** in the lower screen menu, then switch to **10A** in the right menu.
4. Switch off the circuit to be tested and discharge all capacitors still present in the circuit.
5. Disconnect the circuit under test and connect the black test lead to the open end of the disconnected lead facing the load and the red test lead to the other open end of the disconnected lead facing the voltage source. If this has been reversed, a negative "-" sign is displayed.
6. Switch the circuit back on and read the current value in the measuring display.
7. Disconnect the circuit under test and discharge any remaining capacitors in the circuit before reconnecting the disconnected line.

Resistance measurement:

1. Press the **DMM** button on the front of the unit. Then press **R** in the lower menu several times to switch between resistance, diode and capacitance until **R** is highlighted.
2. Connect the black test lead to the **COM** socket and the red test lead to the **V/Ω/C** socket.
3. Connect the test probes to the (voltage-free) electrical conductor to be measured and read the measured value in the digital display of the multimeter window.

   Note: Never perform a resistance measurement on a live conductor to avoid damaging the unit.

Diode measurement:

1. Press the **DMM** button on the front of the unit. Then press **R** in the lower menu several times to switch between resistance, diode and capacitance until  is highlighted.
2. Connect the black test lead to the **COM** socket and the red test lead to the **V/Ω/C** socket.
3. Connect the red test probe to the anode of the diode and the black test probe to the cathode of the diode. The cathode is marked here with a ring around the body. Read the measured value in the digital display of the multimeter window.

Capacity measurement:

1. Press the **DMM** button on the front of the unit. Then press **R** in the lower menu several times to switch between resistance, diode and capacitance until **C** is highlighted.
2. Connect the black test lead to the **COM** socket and the red test lead to the **V/Ω/C** socket.
3. Connect the test probes to the (discharged) capacitor to be measured and read the measured value in the digital display of the multimeter window.

   Note: Measurements on a charged capacitor can damage the device. If you want to measure a capacitance of less than 5nF, use the relative function before the measurement to improve the measurement result.

Continuity test:

1. Press the **DMM** button on the front of the unit. Then press **On-off** in the lower menu.
2. Connect the black test lead to the **COM** socket and the red test lead to the **V/Ω/C** socket.
3. Connect the test probes to the (voltage-free) electrical conductor to be measured and read the measured value in the digital display of the multimeter window. If the resistance value is below 50Ω, the continuity signal sounds.

   Note: Never perform a resistance measurement on a live conductor to avoid damaging the unit.

Other multimeter functions

Data Hold Mode:

You can freeze the measured value in the display.

1. Select **Configure** in the lower menu and then press **Hold in** the right menu as **ON.** The display shows **HOLD.**
2. Press **OFF to** close the data storage again.

Information display:

1. Select **Configure in** the lower menu and then press **Show Info** in the right menu as **ON. The** measurement display is shown.
2. Press **OFF to** switch off the multimeter's measuring display.

Auto or Manual Range Selection:

You can freeze the measured value in the display.

1. Select **Configure** in the lower menu and then press **Hold in** the right menu as **ON. The** display shows **HOLD.**
2. Press **OFF to** close the data storage again.

Relative value measurements:

Sets the current measurement value to zero. The measurement is the difference value of the reference value to the current measurement display.

1. Select **Configure** in the lower menu and then press **Relative** in the right menu**.** The display shows the reference value with a Δ as a sign and the main measurement display is reset to approx. 0.

   In this mode, the current measured value = input measured value- reference measured value
2. Press **OFF to** close the relative value display again.

Note: This function is not available for resistance, diode or continuity test.

Multimeter Recorder

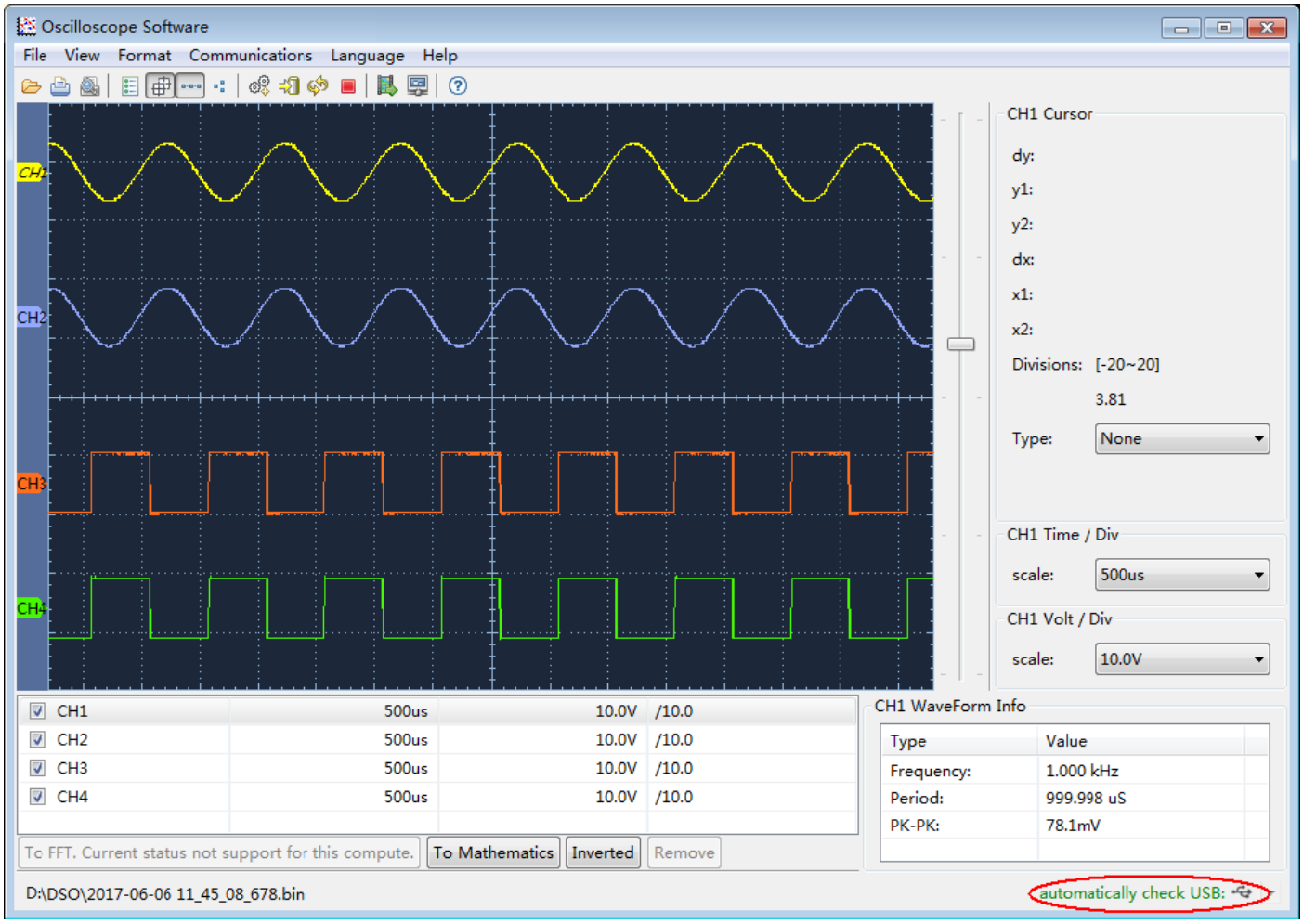
Please refer to **Appendix D** for information on the multimeter's recording function**.**

7. communication with the PC

This touch screen oscilloscope series can be integrated into a network via LAN or connected directly to a PC via USB for data recording. To connect, proceed as described in the following sections.

USB Interface

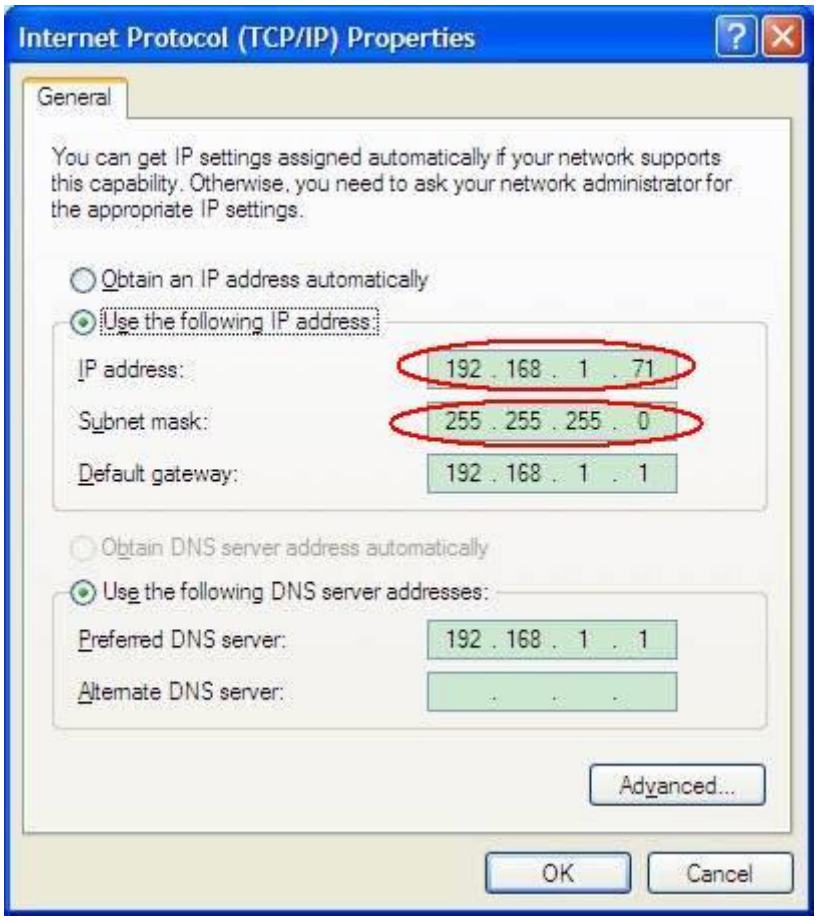
1. **Connection:** Use a standard USB cable and connect it to the USB device port on the back of the unit.
2. **Driver installation:** Install the PC software from the enclosed CD. The USB driver will be installed automatically.
3. **Port settings in the software:** Start the software and click on "Connections". Select "Ports Settings" and in the following menu under "Use Connection" click on "USB". Under "Available Ports" the detected oscilloscope is listed and in the main menu "automatically check USB" is displayed in green writing in the lower left corner. With the arrow key next to the lettering, you can reinstall the USB driver if necessary.



LAN interface

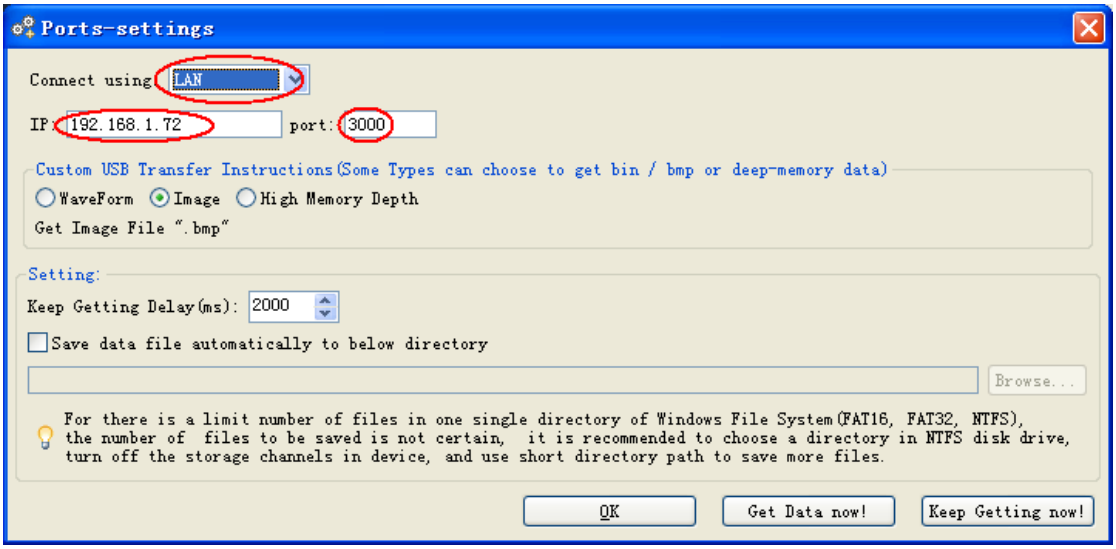
Direct connection to the LAN input of the PC:

1. **Connection**: Plug the LAN cable into the LAN port on the back of the oscilloscope. Plug the other end into the LAN port of the PC.
2. **Setting the computer's network parameters:** Since the oscilloscope does not support automatic IP address retrieval, you must assign a static IP address. In the following example, we set the IP address to 192.168.1.71 and the subnet mask is 255.255.255.0.



3. **Setting the network parameters of the *PeakTech*® oscilloscope software:**
   Run the software on the computer. From the Communications menu, select Ports-settings. Set the Connect using option to LAN. The first three bytes of the IP address are the same as the IP address in step (2). The last byte should be different. In this example, we set the address to 192.168.1.72. The setting range of the port number is 0 ~ 4000, but since a port lower than 2000 is always used, it is recommended to set a value higher than 2000. In this example, we use 3000.

-



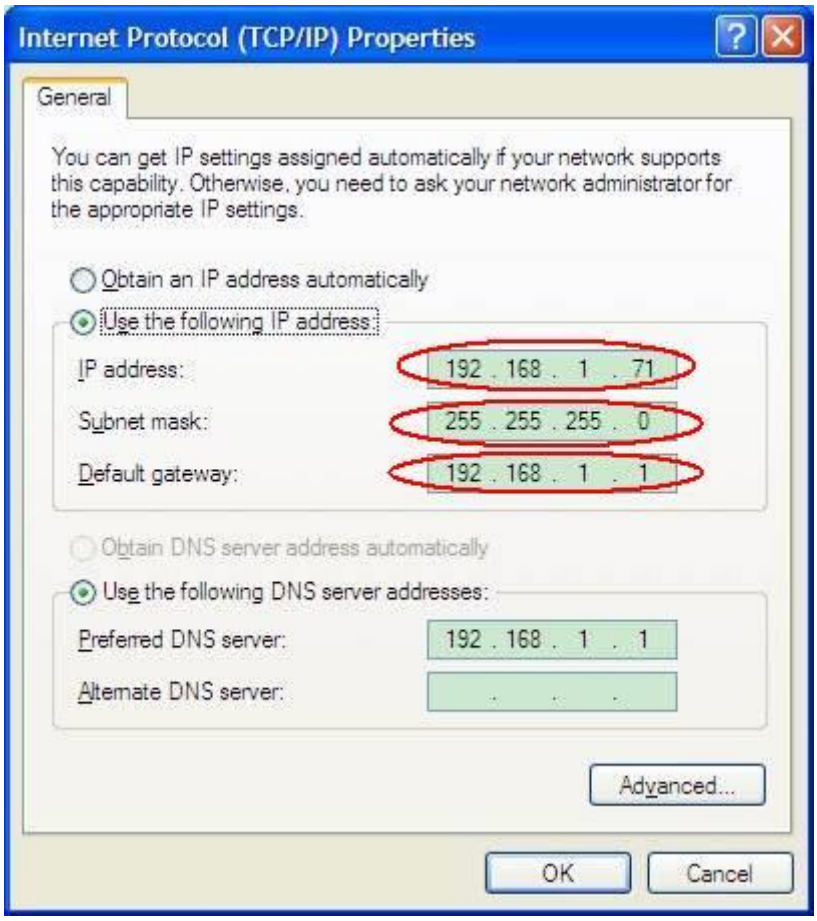
Change the network settings in the oscilloscope:

Press the **Utility** button and select **LAN Set from** the bottom menu. Set the desired connection type as **LAN** under **Type** and select **Set to** open the right-hand settings menu. Then, in the right menu, make the same settings as those made in the PC software. In the right menu, set the **IP** and **Port** Settings. Finally, select **Set to** apply the settings so that a message "Reset to update the config" appears. After resetting the oscilloscope, the settings have been accepted and you should be able to establish a connection to the software.

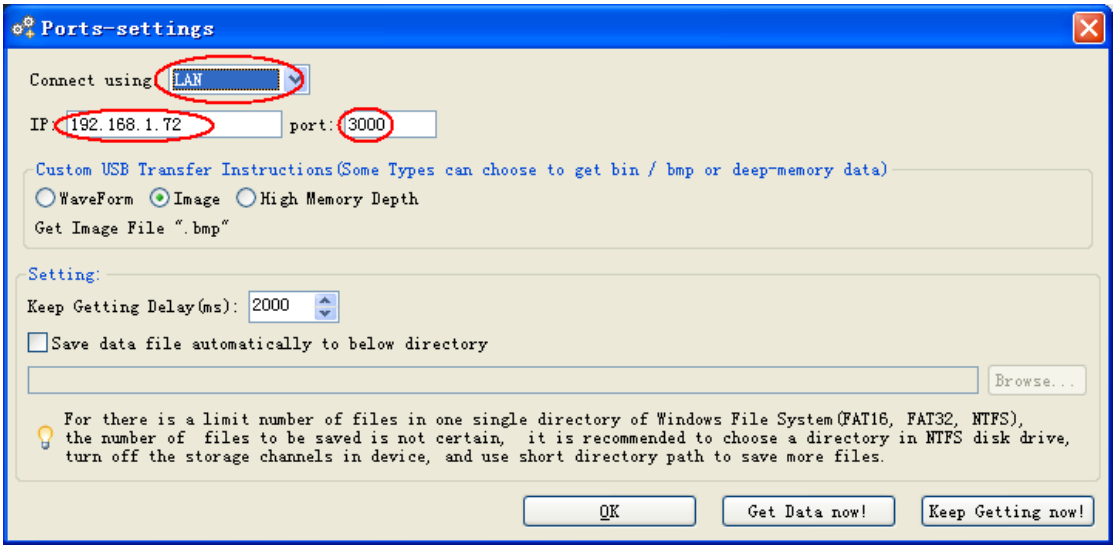
Connection via a router

1. **Connection:** Connect the oscilloscope to a router with a LAN cable. The oscilloscope's LAN port is located on the rear panel. Now also connect the computer to the router.

2. **Setting the computer's network parameters:** Since the oscilloscope does not support automatic IP address retrieval, you must assign a static IP address. The default gateway should be set according to the router. In the following example, we set the IP address to 192.168.1.71; the subnet mask is 255.255.255.0, and the default gateway is 192.168.1.1.



3. **Setting the network parameters of the PeakTech® oscilloscope software:**
   Run the software on the computer. From the Communications menu, select Port-settings. Set the "Connect using" option to LAN. The first three bytes of the IP address are the same as the IP address in step (2). The last byte should be different. In this example, we set the address to 192.168.1.72. The setting range of the port number is 0 ~ 4000, but since a port lower than 2000 is always used, it is recommended to set a value higher than 2000. In this example, we use 3000.



Change network settings in the oscilloscope:

Press the **Utility** button and select **LAN Set from** the bottom menu. Set the desired connection type as **LAN** under **Type** and select **Set to** open the right-hand settings menu. Then, in the right menu, make the same settings as those made in the PC software. In the right menu, set the **IP** and **Port** Settings. Gateway and **Subnet** Mask settings must also be adjusted to the network. Finally, select **Set to** apply the settings, so that a message "Reset to update the config" appears. After resetting the oscilloscope, the settings have been applied and you should be able to connect to the software.

WiFi connection to the PC

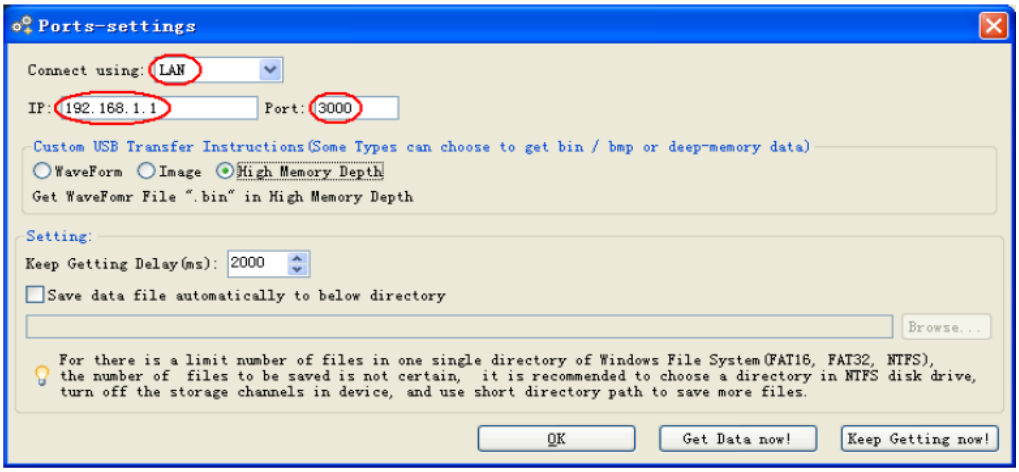
Connect to the PC as a WiFi access point:

You can set the oscilloscope as a W-LAN access point so that you do not need an existing W-LAN to connect the oscilloscope to a PC via W-LAN. The PC must support WiFi (W-LAN).

1. Press the **Utility** key and select **LAN Set** under **Function** in the lower menu. Set this for WiFi under **Type** to **WIFI-AP** and confirm with **Set in the** lower menu.
2. Select **Set in** the lower menu and then **SSID**. Now you can specify a name for the W-LAN network using the keyboard that appears or leave the default name.
3. In the right-hand menu, use **Enscription to** select whether you want to assign a password to the W-LAN network. **Open** means that you do not need a password. Under **WPA** or **WEP the** encryption is activated and you need a password. You can set this under **Password** in the right-hand menu, whereby you can use a soft keyboard for the entry (8 - 32 letters).
4. Select the **port** under **IP:PORT** in the right-hand menu. Use the M rotary knob or the touch screen for this. The **IP is** fixed when used as an access point and cannot be changed. Here it is 192.168.1.1. Turn the M-rotary knob to change the **PORT** number, which is currently set to 3000.
5. After selecting **ON** under **Status**, the access point is active and a symbol is shown in the upper right corner of the display.

6. Select **Save Set in** the lower menu to save the settings you have made.
7. **Open the WiFi connection on the PC.** Select the WiFi created by the oscilloscope via the access point and enter the selected password.

8. Run the software on the computer. From the Communications menu, select Ports-settings. Set the "Connect using" option to LAN. Enter the **IP** 192.168.1.1 and set the same port that you have set in the unit.



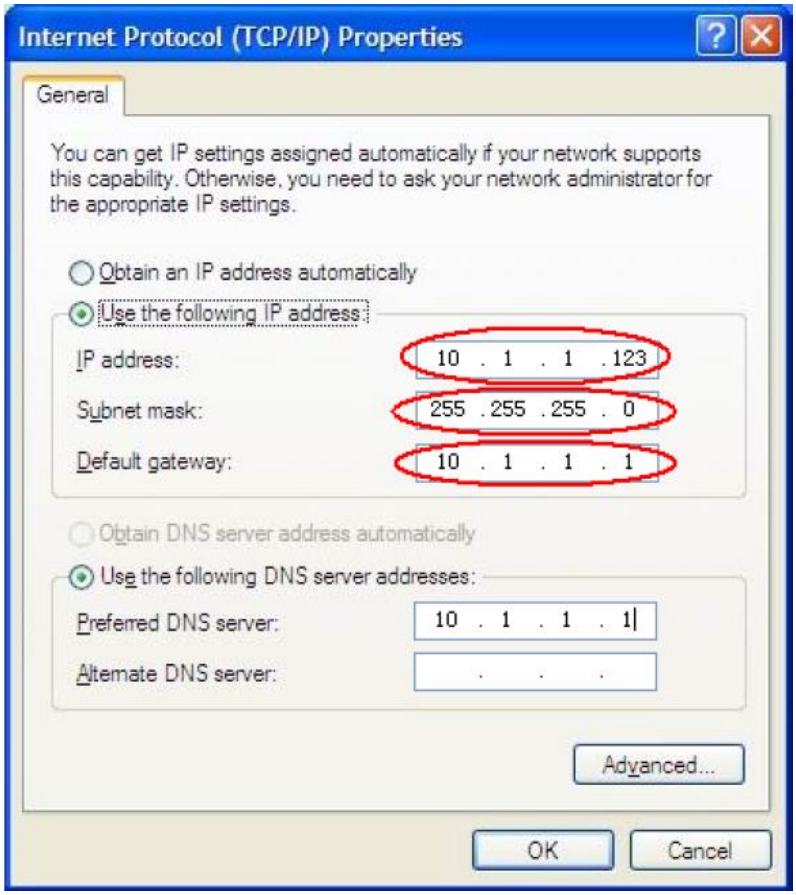
9. Start the data connection via **"Get Data now!"** or **"Keep Getting now!".**

Connect to WiFi Station:

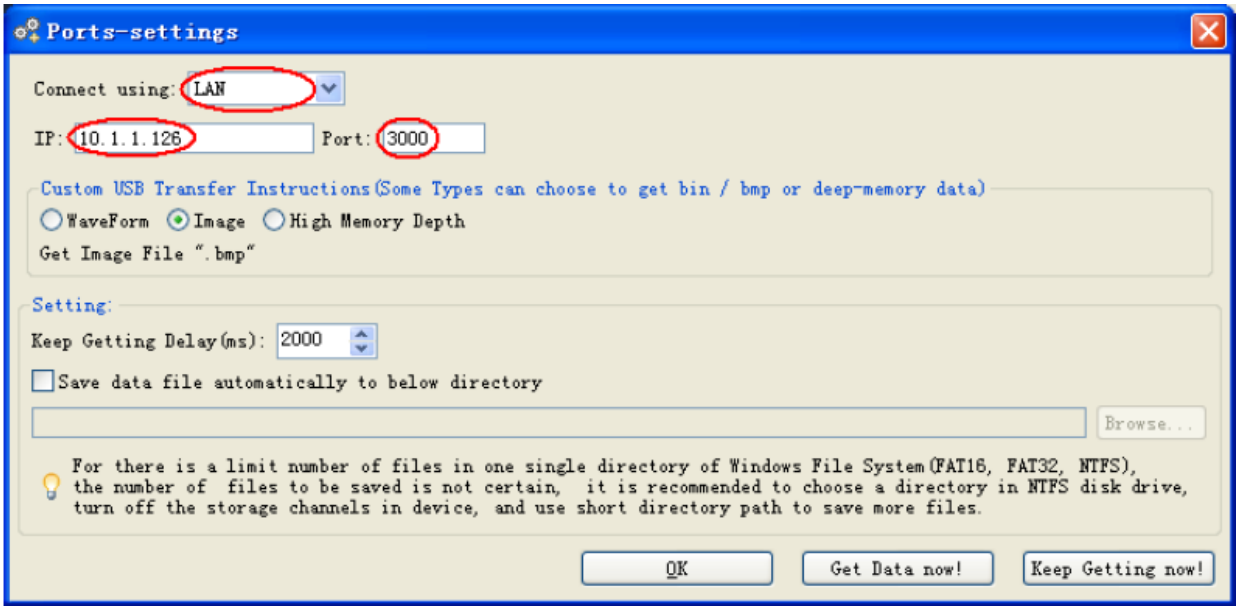
You can also connect the oscilloscope via an existing W-LAN to a PC that is connected to the same W-LAN.

1. Press the **Utility** key and select **LAN Set** under **Function** in the lower menu. Set this for WiFi under **Type** to **WIFI-STA** and confirm with **Set in the** lower menu.
2. Select **Set in** the lower menu and then **SSID**. Now you must enter the name of the existing W-LAN network with which a connection is to be established (e.g. "HEIMNETZ1234" etc.) via the keyboard that appears and confirm it with the Enter key .↵
3. In the right-hand menu, use **Enscription to** select whether the W-LAN network is encrypted with a password. **Open** means that you do not need a password to establish a connection to the W-LAN. With **WPA** or **WEP, the** encryption is activated and you must enter the existing password. You can set this under **Password** in the right-hand menu and use a soft keyboard to enter it (8 - 32 letters).
4. Select the **port** under **IP:PORT** in the right-hand menu. Use the M-rotary knob or the touch screen for this. Turn the M knob to change the **PORT** number, which is currently set to 3000. The **IP** address is assigned by the existing network and cannot be set.
5. After selecting **ON** under **Status**, the connection is active and a symbol is shown in the upper right corner of the display. Here in the example, the IP is 10.1.1.126.

6. Select **Save Set in** the lower menu to save the settings you have made.
7. Now set the network parameters of your computer. The first three bytes of the IP address should be the same as those displayed in the oscilloscope, while the last byte should be different. In our example, we set the IP address of the computer to 10.1.1.123 (IP of the oscilloscope 10.1.1.126). The default gateway and subnet mask should correspond to the settings of the router.



8. Run the software on the computer. From the Communications menu, select Ports-settings. Set the "Connect using" option to LAN. Enter the **IP** 192.168.1.1 and set the same port that you have set in the unit.



9. Start the data connection via **"Get Data now!"** or **"Keep Getting now!".**

8. Application examples

Example 1: Measuring a simple signal

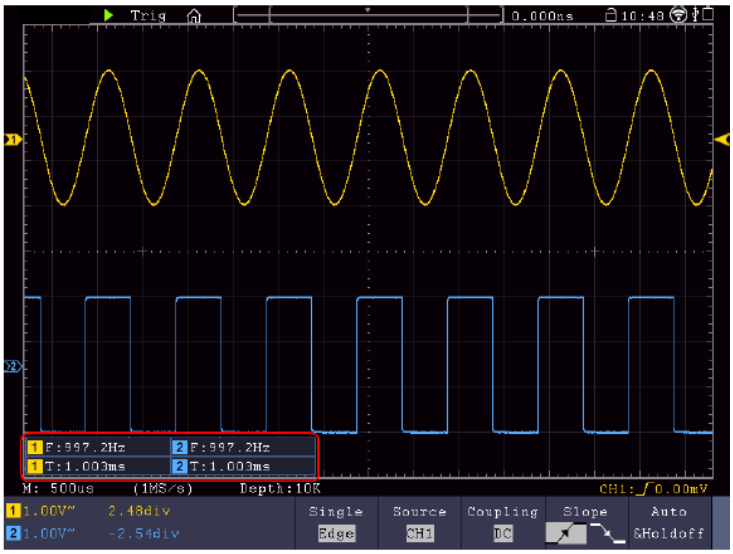
You can observe an unknown signal and quickly display and measure the frequency and peak-to-peak value of that signal.
For a quick display of this signal, proceed as follows:
1. Set the probe attenuation to **10X** in the menu and also to **10X with the** switch on the probe.
2. Connect the probe of **CH 1** to the desired measuring point.
3. Press the **AUTOSET** button.

The oscilloscope automatically optimises the waveform and you can adjust the vertical and horizontal divisions on this basis according to your requirements.

Perform automatic measurement
The oscilloscope can measure most of the displayed signals automatically. Use the following procedure to measure frequency, period, average and peak-to-peak values:
1. Press the **Measure** button to display the function menu for automatic measurement.
2. Press the **H1** button to display the **Add** menu.
3. Select **CH1** as the source in the right-hand menu.
4. A selection of available measurements is displayed on the left side of the screen. Turn the **multi knob** to select **Period.**
5. Select **Add in** the right menu to add the period measurement.
6. A selection of available measurements is displayed on the left side of the screen. Turn the **multi knob** to select **Frequency.**
7. Select **Add in** the right menu to add the frequency measurement and finalise the settings for **CH1.**
8. Select **CH2** as the source in the right-hand menu.
9. Press the **Add** button. A selection of available measurements is displayed on the left side of the screen. Turn the **Multi knob** to select **Main** (average measurement).
10. Press the **Add** button to add **funds.**
11. A selection of available measurements is displayed on the left side of the screen. Turn the **M knob to** select **Pk-Pk** (peak-to-peak).

    Press the **Add** button to add the **Pk-Pk** (Tip-Tip) and finalise the settings for CH2.

Now the measured values (period, frequency, average value and peak-to-peak voltage) are automatically displayed in the lower left corner of the screen.



Example 2: Measuring the gain of an amplifier

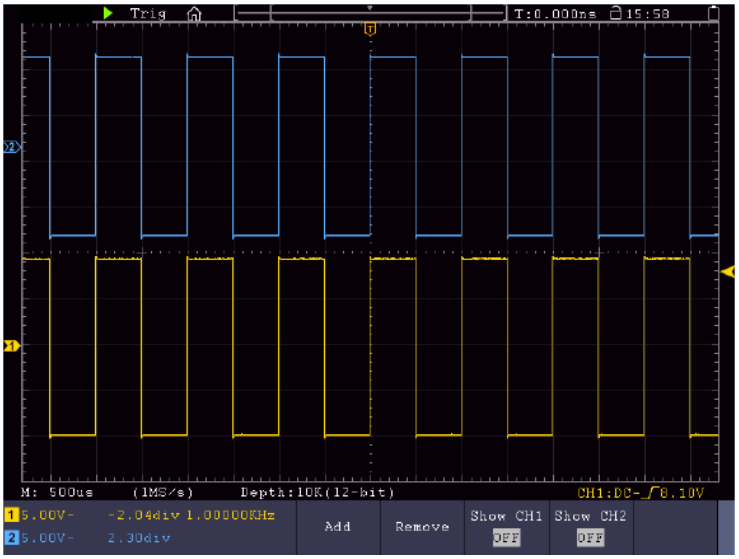
Set the probe attenuation to **10X** in the menu and also to **10X with the** switch on the probe. Connect CH1 of the oscilloscope to the signal input of the circuit and CH2 to the output.

Operation:

1. Press the **Autoset** button; the oscilloscope automatically makes the correct setting of the two channels.
2. Press the MEASURE button to display the MEASURE menu.
3. Press the **Add** button.
4. Press the **Source** menu selection button and select CH1 as the source.
5. Press the menu selection button **Add** and select the **Pk-Pk** function with the multi knob.
6. Press the **Source** menu selection button and select CH2.
7. Press the menu selection button **Add** and select the **Pk-Pk** function with the multi knob.
8. Read the peak-to-peak values of channel 1 and channel 2 in the displayed menu.
9. Calculate the amplifier gain with the following formulas.

Gain = output signal / input signal

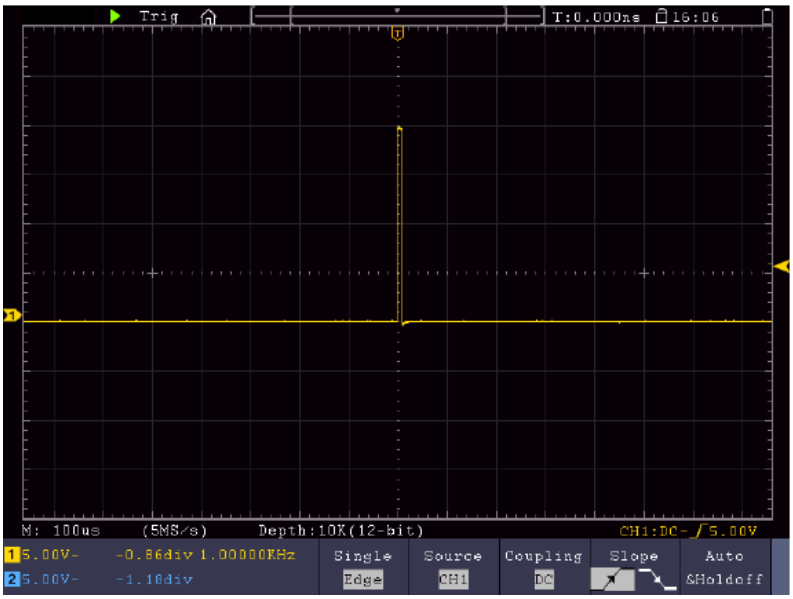
Gain (dB) = 20Xlog (Gain)



Example 3: Measurement of a single signal

With the digital oscilloscope it is quite easy to record a non-periodic signal such as a pulse or a signal peak etc.. However, the general problem is how to set up a trigger if you do not know the signal? For example, if the pulse is a TTL logic signal, you should set the trigger level to 2 V and set the trigger edge to the rising edge. Since our oscilloscope supports various functions, the user can solve this problem quite easily. First, a test with automatic triggering must be performed to determine the obvious trigger level and trigger type. Then the user just needs to make some adjustments to get the correct trigger level and mode. Proceed as follows:

1. Set the probe attenuation to 10x
2. Press the **Vertical Scale** and **Horizontal Scale** adjustment buttons to make the appropriate vertical and horizontal settings for the signal you want to observe.
3. Press the **Acquire** Menu button.
4. Select **Acqu Mode** in the lower menu and then **Peak Detect**.
5. Press the **Trigger Menu** button.
6. Press **Single** in the bottom menu and then **Single** in the right menu.
7. Select **Edge** in the left menu via the M rotary knob or touch screen.
8. Select **Source** in the lower menu and then **CH1.**
9. Select **Coupling** in the lower menu and then **DC.**
10. Select **Slope** in the bottom menu and then  rising.
11. Turn the **Trigger Level** adjustment knob and set the trigger level to approximately 50% of the signal to be measured.
12. Check the trigger status indicator at the top of the screen. If it is not ready, press the **Run/Stop button** to start recording and wait for a trigger. When a signal reaches the set trigger level, a sample is taken and then output to the screen. In this way, a random pulse can be easily captured. For example, if we want to find a high amplitude pulse, we set the trigger level to a slightly higher value than the average of the signal level, then press the **Run/Stop button** and wait for a trigger. When a pulse occurs, the unit will automatically trigger and record the waveform generated in the period around the trigger time. Turn the HORIZONTAL POSITION adjustment knob in the Horizontal control panel to change the horizontal trigger position to create a negative delay that allows you to easily observe the waveform before the pulse.



Example 4: Detailed signal analysis

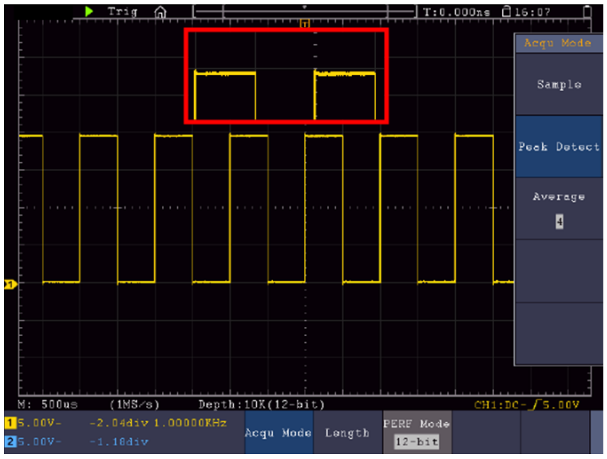
Most electronic signals have noise. This oscilloscope provides the very important function of determining what is in the noise and reducing the noise level.

Noise analysis

The noise level sometimes indicates a fault in the electronic circuit. You can find out more about this noise using the Peak Detect function. To do this, proceed as follows:

1. Press the **Acquire button to** enter the **Acquire menu.**
2. Press the **Acqu Mode** button to display the menu.
3. Press the **Peak** Detect button to access the Peak Detect option.

If the signal displayed on the screen contains noise, you can slow down the incoming signal by turning on the **Peak Detect** function and changing the time base. Any peaks or distortion will be detected by this function.



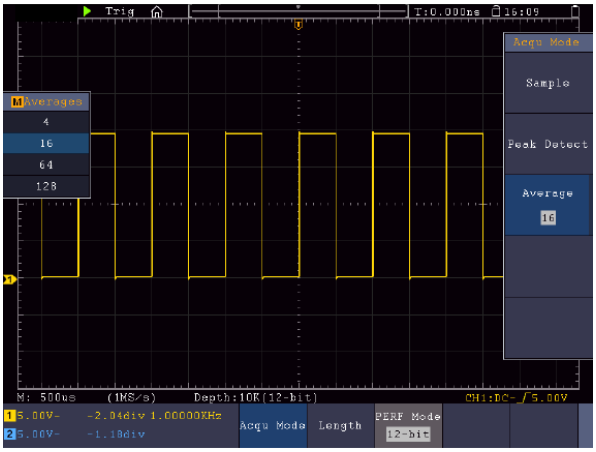
Separate signal from noise

When focusing on the signal itself, it is important to reduce the noise level as much as possible so that the user gets more signal detail. The averaging function of this oscilloscope can help you do this.

To activate the average function:

1. Press the **Acquire button to** enter the Acquire menu**.**
2. Press the **Acqu Mode** button in the lower menu.
3. Select **Average** in the right-hand menu**,** turn the M knob and observe the waveform resulting from the respective averaging.

   The user sees a greatly reduced random noise level and can more easily view more signal detail. After averaging, the user can easily see the distortion on the rising or falling edges of the signal.



Example 5: Application of the X-Y function

Examining the phase difference between the signals of both channels

Example: Testing the phase change of a signal after passing through a circuit.

The X-Y mode is very useful for checking the phase shift of two connected signals. This example shows you step by step how to check the phase change of the signal after it has passed through a certain circuit. The input and output signals of the circuit are used as source signals.

Please proceed as follows to view the input and output of the circuit in the form of an X-Y coordinate curve:

1. Set the probe attenuation to **10X** in the menu and also to 10X with the switch on the probe.
2. Connect the probe of channel 1 to the input and the probe of channel 2 to the output of the circuit.
3. Switch on channel CH1 and CH2.
4. Press the **Autoset key**. The oscilloscope switches on the signals of the two channels and displays them on the screen.
5. Adjust the two signals to approximately the same amplitude with the **Vertical Scale** adjustment knob.
6. Press the **display key to** call up the menu.
7. Switch **XY Mode to ON** with the button.
8. The oscilloscope displays the input and output signals of the circuit as a Lissajous figure.
9. Use the **Vertical Scale** and **Vertical Position** knobs to optimise the waveform.
10. Observe and calculate the phase difference using the elliptical oscillogram method.

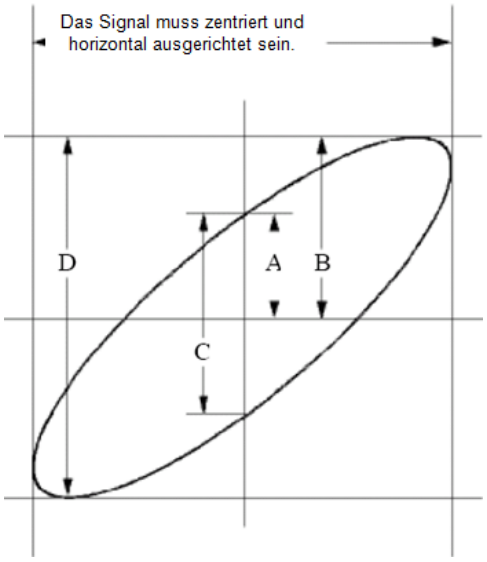
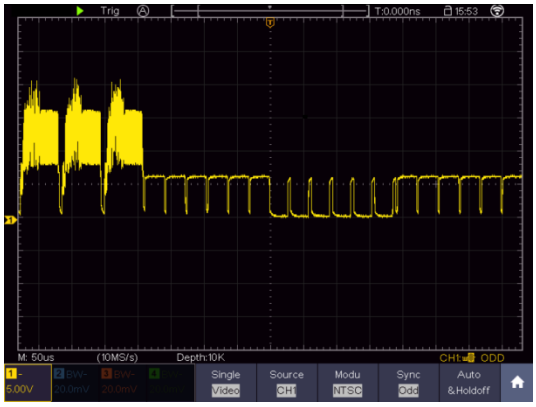


Image: Lissajous figure

Based on the expression **sin(q) =A/B** or **C/D, q** is the phase angle difference and the definitions of A, B, C and D are illustrated in the diagram above. As a result, the phase angle difference can be determined, namely **q = ± arcsin (A/B)** or **± arcsin (C/D)**. If the major axis of the ellipse is in quadrants I and III, the determined phase angle difference should be in quadrants I and IV, i.e. in the range (0 ~ π /2) or (3πc / 2 ~ 2π). If the major axis of the ellipse is in quadrants II and IV, the determined phase angle difference should be in quadrants II and III, i.e. in the range (π / 2 ~ π) or (π ~ 3π /2).

Example 6: Video Signal Trigger

Observe the video circuit of a TV, apply the video trigger and get the stable video output signal display.



(1) Press the trigger menu button to display the trigger menu.

(2) Select the first menu item in the bottom menu. Select Single in the right-hand menu.

(3) Select Video as the mode in the left menu.

(4) Select Source in the bottom menu. Select CH1 in the right menu.

(5) Select Modu in the bottom menu. Select NTSC in the right menu.

(6) Select Sync in the bottom menu. Select Field in the right menu.

(7) Turn the vertical scale, vertical position and horizontal scale knobs to get a correct waveform display.

9. Troubleshooting

1. **The oscilloscope is switched on, but no display appears.**

- Check that the power is connected correctly.
- Check that the fuse next to the mains input socket has not blown (the cover can be prised open with a flat-blade screwdriver).
- Restart the unit after carrying out the above checks.
- If the problem persists, please contact your dealer so that we can help you.

2. **After capturing the signal, the waveform is not displayed on the screen.**

- Check that the probe is correctly connected to the electrical line of the signal.
- Check that the signal line is correctly connected to the BNC socket (namely the channel connection).
- Check that the probe is correctly connected to the object to be measured.
- Check if the object to be measured emits a signal (the problem can be solved by connecting the channel that emits the signal to the faulty channel).
- Perform signal acquisition again.

3. **The measured voltage amplitude value is 10 times or 1/10 of the actual value.**

- Make sure that the damping factor for the input channel and the damping factor of the probe match.

4. **A waveform is displayed, but it is not stable.**

- Check that the source in the **TRIG MODE menu** corresponds to the signal channel used in practice.
- Check the trigger type: the ordinary signal selects **edge trigger mode** and the video signal selects **video trigger mode**. If alternating trigger was selected, the trigger levels of both channel 1 and channel 2 should be adjusted to the correct position. Only when the correct trigger mode is applied can the waveform be displayed stably.
- Try changing the trigger coupling to RF suppression and LF suppression to smooth out the high-frequency and low-frequency noise triggered by the interference, respectively.

5. **No reaction of the display to pressing the Run/Stop button.**

- Check if Normal or Signal is selected in the TRIG MODE menu for Polarity and the trigger level exceeds the waveform range. If this is the case, set the trigger level to the centre of the display or set the trigger mode to Auto. The above setting can be done automatically by pressing the Autoset button.

6. **The waveform display seems to slow down after increasing the average value in Acquire mode.**

- (see "Setting up the scanning function") or a longer duration was set for Persist under Display (see "Afterglow")**.** This is normal because the oscilloscope has to process many more data points.

10.technical specifications

Unless otherwise stated, the technical data apply only to oscilloscopes with a set probe attenuation of 10X. The technical data only apply if the oscilloscope fulfils the following two conditions: at least

- The unit should run continuously for 30 minutes.
- Perform "self-calibration" if the operating temperature changes by up to or even more than 5℃ (see "Performing self-calibration").
- All technical data, with the exception of those marked "typical", can be met.

Performance features		Notes	
Bandwidth		P 1340	60 MHz
		P 1341	100 MHz
		P 1355	60 MHz
		P 1356	60 MHz
		P 1360	100 MHz
		P 1362	200 MHz
		P 1363	300 MHz
		P 1370	60 MHz
		P 1375	100 MHz
Channels		P 1340	4 CH
		P 1341	4 CH
		P 1355	2 CH
		P 1356	2 CH
		P 1360	2 CH
		P 1362	2 CH
		P 1363	2 CH
		P 1370	4 CH
		P 1375	4 CH
Vertical resolution (A/D)		P 1340	8 bit
		P 1341	8 bit
		P 1355	12 bit
		P 1356	12 bit
		P 1360	12 bit
		P 1362	8 bit
		P 1363	8 bit
		P 1370	8 bit
		P 1375	8 bit
Capture	Mode	Normal, Peak Detect, Average	
	Waveform capture rate	P 1340	45,000 wfms/s
		P 1341	45,000 wfms/s
		P 1355	75,000 wfms/s
		P 1356	75,000 wfms/s
		P 1360	75,000 wfms/s
		P 1362	75,000 wfms/s
		P 1363	75,000 wfms/s
		P 1370	45,000 wfms/s
		P 1375	45,000 wfms/s

Performance features		Notes		
	Max sample rate (real time)	P 1340	1 CH / 2CH / 4CH	1GS/s 500MS/s 250MS/s
		P 1341	1 CH / 2CH / 4CH	1GS/s 500MS/s 250MS/s
		P 1355	1 CH/ 2CH	1GS/s 500MS/s
		P 1356	1 CH/ 2CH	1GS/s 500MS/s
		P 1360	1 CH/ 2CH	1GS/s 500MS/s
		P 1362	1 CH/ 2CH	2GS/s 1GS/s
		P 1363	1 CH/ 2CH	2.5GS/s 1.25GS/s
		P 1370	1 CH / 2CH / 4CH	1GS/s 500MS/s 250MS/s
		P 1375	1 CH / 2CH / 4CH	1GS/s 500MS/s 250MS/s
Entrance	Input coupling	DC, AC , Ground		
	Input impedance	1MΩ±2%, in parallel with 15pF±5pF		
	Probe damping factor	0.001X - 1000X in 1-2-5 steps		
	Max. Input voltage	1MΩ input impedance: ≤ 300V Vrms 400 V (DC+AC peak)		
	Bandwidths Limit.	20MHz or full bandwidth		
	Channel - Channel Isolation	50Hz: 100 : 1 10MHz: 40 : 1		
	Time delay between channels (typical)	150ps		
Horizontal system	Interpolation	(sin x)/x		
	Max memory length	1 CH: 40,000,000 points 2 CH: 20,000,000 points 4 CH: 10.000.000 points (only 4 - channel units)		
	Scan speed (S/div)	1 or 2ns/div～1000s/div, step by 1～2～5		
	Measuring rate Sampling / time delay accuracy	±1ppm - 2.5 ppm		
	DC accuracy	Delta volts between any two mean values of ≥16 waveforms acquired with the same oscilloscope setup and environmental conditions (△ V): ± (3% rdg + 0.05 div)		
Vertical system	A/D converter	See vertical resolution		
	Sensitivity	1mV/div~10V/div		
	Lowest frequency	2 CH	≥5Hz (at input, AC coupling, -3dB)	
		4CH	≥ 10 Hz (at input, AC coupling, -3dB)	

Performance features		Notes	
		P 1340 P 1341 P 1355 P 1356 P 1360 P 1362 P 1363 P 1370 P 1375	≤5.8ns (at the input, typical) ≤3.5ns (at the input, typical) ≤5.8ns (at the input, typical) ≤5.8ns (at the input, typical) ≤3.5ns (at the input, typical) ≤1.75ns (at the input, typical) ≤1.17ns (at the input, typical) ≤5.8ns (at the input, typical) ≤3.5ns (at the input, typical)
	DC accuracy	Delta volts between any two mean values of ≥16 waveforms acquired with the same oscilloscope setup and environmental conditions (△ V): ± (3% rdg + 0.05 div)	
	DC accuracy (mean value)	Average≥16: ±(3% rdg + 0.05 div) for △V	
	Waveform inverted On/Off		
Measurements	Cursor	△V, △T, △T&△V between cursors	
	Automatic	Period, Frequency, Mean, PK-PK, RMS, Max, Min, Top, Base, Amplitude, Overshoot, Preshoot, Rise Time, Fall Time, +Pulse Width, -Pulse Width, +Duty Cycle, -Duty Cycle, Delay A→B , Delay A→B , Cycle RMS, Cursor RMS, Screen Duty, Phase, +Pulse Count, FRR, FRF, FFR, FFF, LRR, LRF, LFR, LFF, -Pulse Count, Rise Edge Count, Fall Edge Count, Area, and Cycle Area	
	Waveform math. Functions	＋, -, *, / ,FFT, FFTrms, Intg, Diff, Sqrt, User Defined Function, digital filter (low pass, high pass, band pass, band reject)	
	Decoding	P 1362 P 1363 P 1370 P 1375	RS232, I2C, SPI, CAN RS232, I2C, SPI, CAN CAN RS232, I2C, SPI, CAN
	Waveform memory	100 waveforms	
	Lissajou's figure	Bandwidth	Full bandwidth
		Phase difference	±3 degrees
Data interfaces	P 1340 P 1341 P 1355 P 1356 P 1360 P 1362 P 1363 P 1370 P 1375	USB host, USB device, LAN USB host, USB device, LAN USB host, USB device, LAN, VGA USB host, USB device, LAN, VGA USB host, USB device, LAN, WiFi, VGA USB host, USB device, LAN, WiFi, VGA USB host, USB device, LAN, WiFi, VGA USB host, USB device, LAN, WiFi, VGA USB host, USB device, LAN, WiFi, VGA	
Frequency counter	Full bandwidth (depending on model)		

Trigger:

Performance features		Comments
Trigger level range	Internal	±5 div from centre of screen
	EXT	±2 V
	EXT/5	±10 V
Trigger level accuracy (typical)	Internal	±0.3div
	EXT	± (10mV + 6% of the Set Value)
	EXT/5	± (50mV + 6% of the Set Value)
Displacement trigger	According to the memory length and time base	
Trigger Holdoff Range	100ns~10s	
50% level (typical)	Input signal frequency ≥50Hz	
Edge trigger	Slope	Rising, Falling
Pulse trigger	Trigger condition	Positive pulse：>, <, = Negative pulse：>, <, =
	Pulse width range	30ns～10s
Video Trigger	Modulation	Supports standard NTSC, PAL and SECAM systems
	Line number range	1-525 (NTSC) and 1-625 (PAL/SECAM)
Slope Trigger	Trigger condition	Positive pulse：>, <, = Negative pulse：>, <, =
	Time setting	30ns～10s
Runt Trigger	Polarity	Positive, Negative
	Trigger condition	>, =, <
	Pulse width range	30ns～10s
Windows Trigger	Polarity	Positive, Negative
	Trigger position	Enter, Exit, Time
	Window Time	30ns～10s
Timeout Trigger	Polarity	Positive, Negative
	Idle time	30ns～10s
Nth Edge Trigger	Flank type	Rising, Falling
	Idle time	30ns～10s
	Flank number	1 to 128
Logic Trigger	Logic mode	AND, OR, XNOR, XOR
	Input mode	H,L, X, Rising, Falling
	Output mode	Goes True, Goes False, Is True >, Is True <, Is True =
SPI Trigger	Trigger Conditions	Timeout
	Timeout value	30 ns to 10 s
	Data Bits	4 bit to 32 bit
	Data Line Setting	H, L, X
I2C Trigger	Trigger Conditions	Start, Restart, Stop, ACK Lost, Address, Data, Addr/Data
	Address Bits	7 bit, 8 bit, 10 bit
	Address area	0 to 127, 0 to 255, 0 to 1023
	Byte length	1 to 5
RS-232 trigger	Polarity	Normal, Inverted
	Trigger Conditions	Start, Error, Check Error, Data
	Baud rate	Common, Custom
	Data Bits	5 bit, 6 bit, 7 bit, 8 bit
CAN Trigger	Signal Type	CAN_H, CAN_L, TX, RX
	Trigger Condition	Start of Frame, Type of Frame, Identifier, Data, ID & Data, End of Frame, Missing Ack, Bit Stuffing Error
	Baud rate	Common, Custom
	Sample Point	5% to 95%
	Frame Type	Data, Remote, Error, Overload

Waveform generator

Performance features	Comments	
Integr. waveform generator	P 1340	No
	P 1341	No
	P 1355	No
	P 1356	1 channel / 25 MHz
	P 1360	1 channel / 25 MHz
	P 1362	1 channel / 25 MHz
	P 1363	1 channel / 25 MHz
	P 1370	No
	P 1375	2 channel / 25 MHz
Sampling	125 MS/s	
Vertical resolution	14 bits	
Amplitude range	10mVpp - 6Vpp or 2mVpp-6Vpp (only P 1375)	
Waveform length	8 kPts.	
Standard waveforms	Sine, square, ramp, pulse	
Arbitrary waveforms	46 Built-in	

Digital multimeter

Performance features	Comments	
Integr. multimeter	P 1340	No
	P 1341	No
	P 1355	No
	P 1356	Yes
	P 1360	Yes
	P 1362	Yes
	P 1363	Yes
	P 1370	Yes
	P 1375	Yes
Display	3 ¾ digital digits (max. 4000 counts)	
Diode	0V - 1.5V	
Input impedance	10 MΩ	
Continuity tester	<50Ω (+/-30Ω) acoustic signal	
Capacity measurement	51.2nF - 100µF: ±(3%±3 dgt.)	
Voltage measurement	**DCV:** 400mV, 4V, 400V: ±(1%±1dgt.), Max. Input: DC 1000V **ACV:** 4V,40V,400V:±(1%±3dgt.), Max. input: AC 750V (virtual value). Input: AC 750V (virtual value) Frequency: 40Hz-400Hz	
Current measurement	**DCA:** 40mA,400mA: ±(1.5%±1 dgt.), 10A: ±(3%±3dgt.) **ACA:** 40mA: ±(1.5%±3 dgt.) 400mA: ±(2%±1 dgt.) 10A: ±(3%±3dgt.)	
Resistance measurement	400Ω: ±(1%±3 dgt.), 4KΩ~40MΩ: ±(1%±1 dgt.), 40MΩ: ±(1.5%±3 dgt.)	

General specifications

Display		
Display type	P 1340	8" colour LCD
	P 1341	8" colour LCD
	P 1355	8" touch screen colour LCD
	P 1356	8" touch screen colour LCD
	P 1360	8" Touchscreen colour LCD
	P 1362	8" Touchscreen colour LCD
	P 1363	8" touch screen colour LCD
	P 1370	8" touch screen colour LCD
	P 1375	8" touch screen colour LCD
Display resolution	800 (Horizontal) × 600 (Vertical) Pixel	
Display colours	65536 colours, TFT display	

Probe compensation	
Output voltage (Typical)	Approx. 3.3 or 5V, with Pk-Pk voltage at ≥1MΩ.
Frequency (Typical)	Square wave 1KHz
Power supply	
Power supply	100～240 VAC RMS, 50/60Hz, CAT II
Power consumption	< 24W
Fuse	T 2A, 250V
Battery	3.7V, 13200mAh (Optional accessory: "Battery 6" model)
Environmental conditions	
Temperature / humidity	Operating temperature: 0°C ~ 40°C @ <90% r.h. Storage temperature: -20°C ~ 60°C @ <90% r.h.
Altitude a. s. l.	3000 m in operation / 15000m switched off
Cooling	Integrated fan
Other	
Dimensions	340mm× 180mm ×90mm (L*H*W)
Weight	Approx. 2.6kg

11. Appendix

Appendix A: Scope of delivery

Standard accessories (depending on model):

1 x Carry bag
2 x probes 1.2 m, 1:1 (10:1) for 2-channel models / 4 x probes 1.2 m, 1:1 (10:1) for 4-channel models
2 x BNC cable (4 x for 4 channel models)
1 x CD (software, BDA and driver)
1 x power cable
1 x USB cable
2 x test leads multimeter (multimeter models only)
1 x multifunctional base

Appendix B: Maintenance and care

General maintenance:

Please do not store or operate the unit in locations where the LCD screen is exposed to direct sunlight for extended periods of time.

Caution:
Avoid damaging the unit or probe with sprays, liquids or thinners.

Cleaning:

Check the condition of the probe and the unit at regular intervals. Clean the outer surfaces of the unit as follows:

Remove dust from the unit and the probe with a soft cloth. Avoid scratching the transparent protective screen of the LCD screen when cleaning it.

Clean the appliance with a soft, damp cloth that has been wrung out well, unplugging the power cord from the wall socket first. Use a mild detergent or clear water. Avoid using aggressive cleaners, which can damage the unit and the probe.

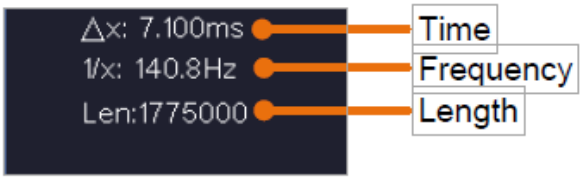
 **Warning:** Make sure the appliance is completely dry before putting it back into operation. Otherwise there is a risk of short circuits or electric shocks.

NOTE:

Please install the supplied software including all USB drivers before connecting the PeakTech® Oscilloscope to your PC.

Appendix C: Cloning a Waveform

Press Save. Select Type in the lower menu, in the left menu, turn the M knob to select Clone.
You can clone one or two channel waveforms between two cursors and save them as a cloned waveform in the internal memory or on a USB storage device. You can store four cloned waveforms in the instrument's internal memory. The cloned waveform files stored on a USB memory device are saved with the extension "ota".
If the optional Arbitrary Function Generator is available in your instrument, you can output the stored waveform from a file in internal memory or a USB memory device. and the waveform between two cursors can be output directly without any memory operation.
You can also use the PeakTech 4125 or 4165 signal generator to read * .ota files and retrieve the cloned waveforms.
Clone Wave menu shows the following:

Menu	Setting	Description
Type	**Clone**	
Source	**Fashion** **Out1** **Out2** **Out1&Out2**	Select the source mode. The cloned waveform contains a waveform that is used for AG Out1 The cloned waveform contains a waveform that is used for AG Out2 The cloned waveform contains two waveforms that are used for AG Out1 and AG Out2
	AG Output Out1 **CH1 CH2 CH3 CH4**	Selects the source that is used for the generator Out1
	AG Output Out2 **CH1 CH2 CH3 CH4**	Selects the source that is used for the generator Out2
Line	**a** **b** **from** **x**	Turn knob M to move line a. Turn the knob M to move the line b. Two cursors are linked together. Turn the M knob to move the pair of cursors. Set the cursors so that the whole screen is automatically selected. The waveform information is displayed in the lower left corner of the screen.
		
		Note: If "Out of Limits" appears in the information or in the message "Waveform points over- the limit". appears on the screen, i.e. the length of the cloned waveform exceeds the limit. If the source mode is Out1 or Out2, the maximum length is 2M. If the source mode is Out1 and Out2, the maximum length is 1M. Press the Acquire button, select Length in the bottom menu and set the recording length to a smaller value.
Clone (for generator use)	**Clone**	Clone the waveform between two cursors and output it via the built-in generator.
Save	**Save**	Saves waveform between cursors
	Storage	You can select one of the four objects in the list on the left. When you select an object, a message appears in the centre of the screen displaying the information of the selected object. "Current object: Out1 has no output, Out2 has no output" means that no waveform is stored in this object. "Current object: Out1 has output, Out2 has no output" means that a waveform is stored in this object whose source mode is Out1. "Current object: Out1 has no output, Out2 has output" means that a waveform is stored in this object, the source mode is Out2. "Current object: Out1 has output, Out2 has output" means that two waveforms are stored in this object, its source mode is Out1 & Out2.
	External	Save the waveform to a USB storage device. Insert a USB memory device into the port on the front. If the icon is displayed at the top right of the screen, the USB storage device has been successfully installed. If the USB storage device cannot be recognised, format the USB storage device according to the methods described in "USB disk requirements". The name is default as the current system date and time. The cloned waveform is saved as an OTA file on the USB storage device.
	Output	(The generator is available and the internal memory is selected.) Outputs the waveform stored in the selected object.

The following steps are for an oscilloscope with dual channel AG. To save the CH1 waveform and store it in the internal / USB memory:

(1) Press the Save button.
(2) Select Type in the lower menu, turn the M knob to select Clone in the left menu.
(3) Select Source in the bottom menu, select Mode as Out1. in the right menu.
(4) Select AG Output Out1 as CH1. in the right menu.
(5) Select Line in the bottom menu. If a or b is selected, turn the M knob to move the cursor. If ab is selected, turn the M knob to move the cursor pair. If x is selected, the whole screen is automatically selected.
(6) Select Save in the bottom menu.
● To save the waveform in the internal memory, select Memory in the right menu as Internal. Turn the M knob to select an object in the left menu and select Save in the right menu.
● To save the waveform to a USB storage device, select Save in the right menu as External. Select Save in the right-hand menu. An input keyboard for editing the file name is displayed. Turn the M knob to select the keys and press the knob to enter. Select the button on the keyboard to confirm. The cloned waveform is saved as an OTA file on the USB storage device.

To output a waveform stored in the internal memory via the generator: (generator model dependent)

(1) Press the Save button.
(2) Select Type in the lower menu, turn the M knob to select Clone in the left menu.
(3) Select Save in the lower menu and select Memory as Internal in the right menu.
(4) Turn the M button to select an object in the left menu.
(5) Select Output in the right-hand menu.

To output a waveform stored on a USB data carrier via the generator:

(1) Press the button CH1/2 to set the output channel of the generator.
(2) Select "Arb" in the bottom menu, select "Others" in the right menu and then "File".
search
(3) Select Storage in the right-hand menu as USB. The unit lists a directory of folders and files on the USB storage device. Select a folder or file with the M button to scroll up and down the list. To open the current folder, select Change
in the right-hand menu and then again to return to the parent directory.
(4) Select the desired OTA file and then select Read in the right-hand menu.

To output the waveforms CH1 and CH2 directly through the generator:

(1) Press the Save button.
(2) Select Type in the lower menu and turn the M control to select Clone in the left menu
(3) Select Source in the bottom menu and then Mode as Out1 & Out2 in the right menu.
(4) In the right-hand menu, select AG Output Out1 as CH1; select AG Output Out2 as
CH2.
(5) Select Line in the bottom menu, then the cursor and move it to select the desired waveform.
(6) Now select Clone in the bottom menu. The generator will output the selected waveform between the cursors.

Data format description of the OTA waveform file

If the source mode is set to Out1 or Out2, the OTA file consists of two parts: the file header and the channel data. If the source mode is set to Out1 and Out2, the OTA file consists of three parts: File Header, First Channel Data and Second Channel Data. The file header represents the parameter of the file data expressed in "parameter name + value". Each parameter name consists of a 4-byte case-sensitive string. The parameter value is at least 4 bytes.

1. format designation of the file header

1) HEAD

Parameter Name	Meaning	Value	Comment
HEAD	Header size	4 bytes int	

2) TYPE

Parameter Name	Meaning	Value	Comment
Type	Model	12 bytes char	

3) BYTE

Parameter Name	Meaning	Value	Comment
Byte	Data length in bit	4 bytes int	

4) SIZE

Parameter Name	Meaning	Value	Comment
Size	File size	4 bytes int	Used to check data integrity

5) VOLT

Parameter Name	Meaning	Value	Comment
Volt	The voltage division divided by 400 is ADC resolution. (If the source mode is Out1 and Out2, this is the first channel voltage division).	4 bytes float	The value indicates the voltage (the unit is mV), for example 200 mV.

6) SAMP

Parameter Name	Meaning	Value	Comment
Samp	Sampling Rate	4 bytes float	The unit under Sa/s

7) ADCB

Parameter Name	Meaning	Value	Comment
ADCB	ADC bit, ADC resolution	4 bytes int	8-bit or 12-bit

8) CHAN

Parameter Name	Meaning	Value	Comment
Chan	Channel size	4 bytes int	1 or 2

9) VOL2

Parameter Name	Meaning	Value	Comment
VOL2	The voltage division divided by 400 is ADC resolution. (If the source mode is Out1 and Out2, this is the second channel voltage division).	4 bytes float	The value indicates the voltage (the unit is mV), for example 200 mV.

2.Data

The data type is a signed integer. You can determine the data type (char, short int or int) based on the BYTE parameter. The valid range is determined by the ADCB parameter, e.g. The valid range for 8-bit ADC is -127 to +127.

Appendix D: Multimeter recorder recording

You can use the multimeter data recorder to record the measurements when measuring current / voltage with a multimeter (optional).

Press the Utility button, select Function in the lower menu and select DAQ in the left menu.

The DAQ menu control is displayed as follows:

Function menu	Settings	Description
Set	Interval	Set the recording interval (0.5s - 10s, step by 0.5s)
	Duration	"d h m s" stands for day, hour, minute, second. E.g. "1 02:50:30" stands for one day and 2 hours, 50 minutes and 30 seconds. Press Duration to switch between the time units. Turn the M knob to set the value. Maximum duration: 3 days for internal memory, 10 days for external memory.
	Enable	Switching the recorder function on or off
START STOP	Start or stop recording	
Storage	Internal External	Save to internal or external memory
Export	When the internal memory is selected, you can export the internal recording file to a USB storage device.	

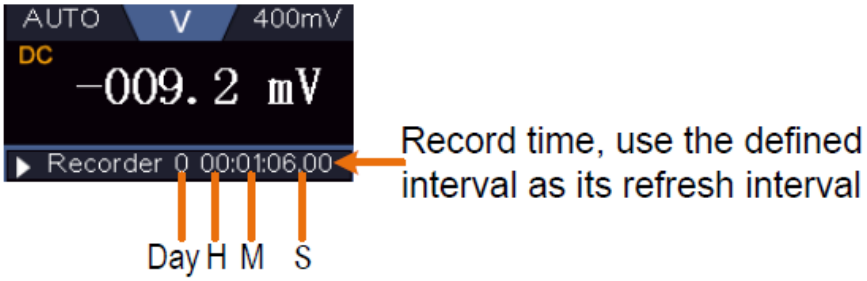
To record the current / voltage measurements in the multimeter, proceed as follows:

Press the DMM button on the front panel to access the multimeter function. Select Current or Voltage in the lower menu.

If you want to switch to relative mode, select Configure in the bottom menu and then Relative in the right menu.

Press the Utility button, select Function from the bottom menu and select DAQ from the left menu.
Select Storage in the bottom menu, select Internal or External in the right menu. If you select external, insert the USB storage device into the USB port on the front.
Select Set in the lower menu and select Enable as ON in the right menu.
Select Interval in the right-hand menu, turn the M knob to set it.
6. select Duration in the right menu, press it to switch between time units, turn the M knob to set the corresponding value.
Select START from the bottom menu.
8. if external memory is selected: the instructions are displayed on the screen. The recording file is named as "Multimeter_Recorder.csv". If a file with the same name already exists on the USB storage device, it will be overwritten. (If you want to keep the existing file, save it to another location beforehand). Select STRT in the lower menu to start the recording.

When the recording time reaches the set duration, the recording stops. If you want to end the recording prematurely, select STOP in the lower menu.

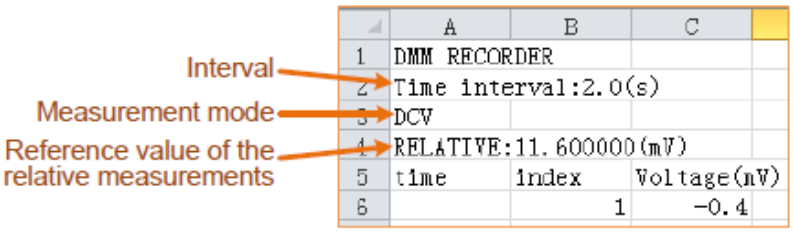


10. when internal memory is selected: you can export the internal recording file to a USB memory device. Insert the USB memory device into the USB port on the front of the unit. Select Export from the bottom menu. The instructions are displayed on the screen. The export file is named as "Multimeter_Recorder.csv". If a file with the same name already exists on the USB storage device, it will be overwritten. (If you want to keep the existing file, save it in advance to another location). Select Export in the bottom menu to export.

Graphical representation of the measurement data with spreadsheet:

You can open the CSV file with Microsoft Excel or your favourite spreadsheet application and create charts based on the data. In the following steps, Microsoft Excel 2010 is used as an example.

1. open Multimeter_Recorder.csv in Excel.



Select the data you want to graph (see Figure 6-4).
On the Insert tab, in the Charts group, click Line and then click Draw line in 2D line (see Figure 6-5).
The chart is displayed (see Figure 6-6). If you want to keep the chart, save the file in XLS format.

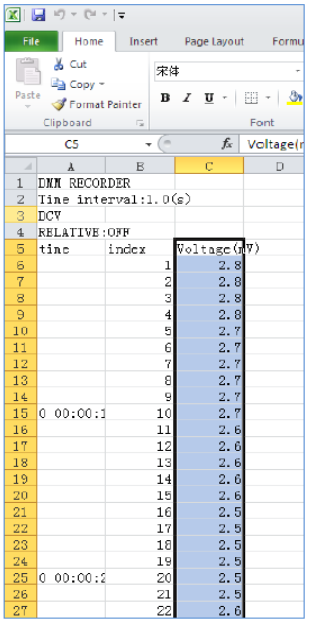


Bild: 6-4

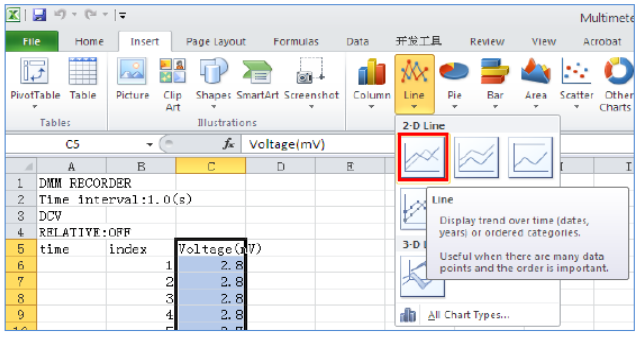


Bild: 6-5

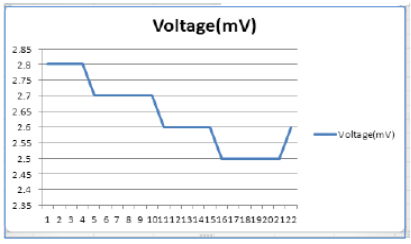
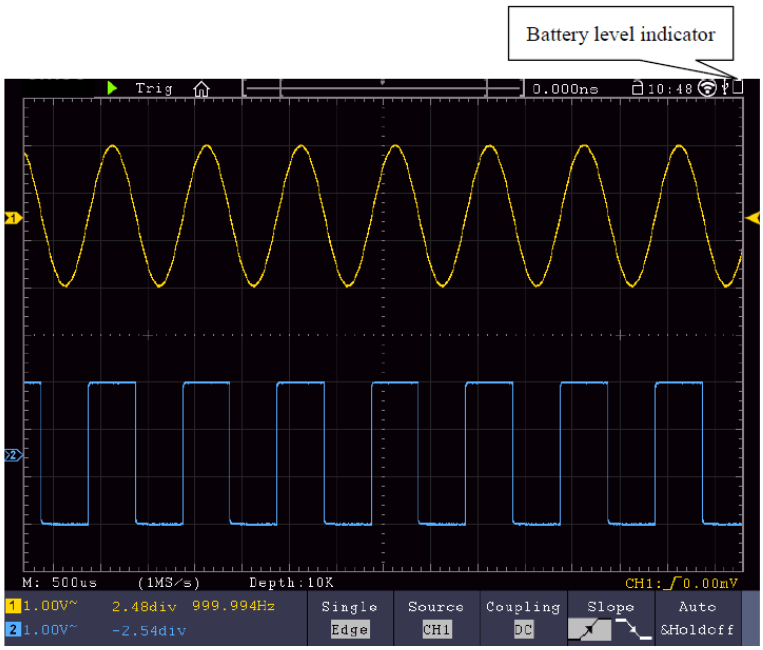


Bild: 6-6

Notes on the battery



Battery status indicator

Loading the oscilloscope
Connect the mains cable to a power source. Switch on the unit with the power switch - ○ on the back of the unit (make sure the "-" side is pressed down). If the
battery status indicator on the control panel is yellow, the battery is charging. When fully charged, the indicator lights up green. The lithium battery may not be fully charged when you receive the unit. Therefore, please charge the battery for 12 hours before using it for the first time. The battery will last up to 4 hours after fully charging, depending on use.
A battery indicator appears at the top of the screen when the oscilloscope is running on battery power and shows the battery charge status.
The empty battery symbol indicates that the battery will only supply power for a maximum of 5 minutes.

Hint:
To avoid overheating the battery during charging, the ambient temperature must not exceed the value specified in the technical data.

Replacing the lithium battery
Under normal conditions, it is not necessary to replace the battery. However, if this should become necessary, the replacement can only be carried out by qualified personnel; a lithium battery with the same technical data must be used.

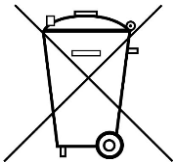
Notes on the use of the lithium-ion battery:

Caution: Be sure to observe the following precautions when handling Li-Ion batteries:

- When using Li-Ion batteries, do not work in environments with extreme temperatures or very high pressure differences, as this can lead to unwanted chemical reactions within the battery. This can lead to smoke, fire or bursting of the battery.
- Never bring the battery into contact with fire or heat it. Avoid storing the battery in direct sunlight.
- Never destroy or open the battery casing by drilling, cutting, hitting or any other physical action to avoid an internal short circuit with possible heat/fire development.
- Never immerse the battery in water or connect the positive (+) and negative (-) terminals with a metallic object.
- Store the battery at a minimum of 0°C and a maximum of 40°C.
- To maintain battery performance even during prolonged storage, charge the battery at least once every six months.
- Replace the battery only with an original part of identical construction.
- A Li-Ion battery does not belong in household waste and should be taken separately to the local waste disposal station or returned directly to the dealer/manufacturer.

Legally required information on the battery ordinance

Many devices come with batteries that are used, for example, to operate remote controls.
Batteries or rechargeable batteries may also be permanently installed in the devices themselves. In connection with the
distribution of these batteries or accumulators, we are obliged as an importer under the Battery Ordinance to inform our
to draw the attention of customers to the following:
Please dispose of used batteries as required by law - disposal in household waste is expressly prohibited by the Battery Ordinance - at a municipal collection point or return them to your local retailer free of charge. Batteries received from us can be returned to us free of charge after use at the address given on the last page or sent back to us by post with sufficient postage.



Batteries that contain harmful substances are marked with the symbol of a crossed-out bin marked, similar to the symbol in the illustration on the left. Under the
The chemical name of the pollutant can be found on the dustbin symbol.
B. "CD" for cadmium, "Pb" stands for lead and "Hg" for mercury.

Further information on the Battery Ordinance can be found at the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. Reactor safety.

Last status at time of printing. Technical changes to the device, which serve the progress, reserved.

We hereby confirm that all units meet the specifications stated in our documentation and that they are are delivered calibrated at the factory. A repetition of the calibration after 1 year is recommended. recommended.

PeakTech Prüf- und Messtechnik GmbH - Gerstenstieg 4 -
DE-22926 Ahrensburg / Germany
☎+49-(0) 4102-97398 80 +49-(0) 4102-97398 99
info@peaktech.de www.peaktech.de