



μCore
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UCE-DSO4200C FAULT LOCATOR

USER MANUAL

UCORE ELECTRONICS
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1. Introduction

With this unique device, you will have the basic devices needed for fault detection of electronic boards: Oscilloscope, curve tracer, signal generator and short circuit finder.

UCE-DSO4200C can transmit all data to a PC via USB connection. This USB connection provides the possibility to use the device with PC software.

In addition, this device can mirror the LCD screen image to a monitor via the HDMI output and can be controlled with a wireless mouse.

In the curve tracer mode, passive elements can be checked without triggering active elements with a 0.2V test signal. Thus, less component disassembly is ensured in troubleshooting.

In short-circuit finder mode, the short-circuit line on the PCB can be analyzed and its location can be found.

Specifications:

- **Display:** 5.0-inch 800× 480 pixel color LCD with Touch screen
- **Oscilloscope Channels:** 2
- **Curve Tracer Channels:** 2
- **Signal Generator Channel:** 1
- **PC connection:** mini USB connector (USB 2.0 HID protocol).
- **Storage:** internal 4GB disk (microSD card)
- **HDMI out** for TV or Monitor (800×480 @60Hz)
- Multi-Device Wireless **Mouse** for Device and PC
- **internal battery:** 3.7V 10,000mAh (~4.5 hours)
- **Power Consumption:** 15W
- **Dimensions:** 170 x 200 x 140 mm

Features of Oscilloscope:

- **Analog Bandwidth:** 20MHz
- **Maximum sampling rate:** 8-bit 250 MS/s Real-Time Sampling, 6 GS/s Equivalent-Time Sampling (ETS)
- **Sampling depth:** 8kB
- **Input impedance:** 1MΩ
- **Vertical sensitivity:** 5mV/div ~ 10V/div
- **Horizontal sensitivity:** 10ns/div ~ 500ms/div

- **Max input voltage:** $\pm 50\text{V}$ (X1 Probe), $\pm 500\text{V}$ (X10 Probe)
- **Coupling:** AC/DC
- **XY Mode**
- **Trig modes:** Run, single, hold functions
- **Trigger functions:** rising / falling edge
- **Auto Measurement:** frequency, peak-to-peak voltage, mean voltage, RMS voltage
- **Cursor:** differential measurement for time and voltage
- **FFT analyze:** 1024 points FFT analyze
- **Math Functions:** CH1+CH2, CH1-CH2, CH1*CH2, CH1/CH2, CH1 FFT, CH2 FFT.

Features of Signal Generator:

- **Signals:** Sine, square, triangle, sawtooth, sinC, noise, exponential, full wave, half wave, gauss, direct, staircase.
- **Max. Voltage:** $\pm 5.0\text{V}$ (10Vpp)
- **Frequency:** 0.001Hz ~ 20MHz

Features of Curve Tracer:

- **Waveform:** Sine wave
- **Test Frequencies:** 20Hz ~ 10kHz (36 steps)
- **Open circuit Voltage:** $\pm 0.2\text{V}$ ~ $\pm 20\text{V}$ (24 steps)
- **Source Resistance:** 10 Ω , 47 Ω , 100 Ω , 470 Ω , 1k Ω , 4.7k Ω , 10k Ω
- **5 programmable user buttons**

Package List:

- Carrying Case
- UCE-DSO4200C Device
- Multi-Device Wireless Mouse
- 2 sets 4mm banana multimeter probes
- 2 pcs X1, X10 Oscilloscope Probe
- 1 pc Test Hook Clip Probe for Signal Generator
- 12V 2A power supply (EU Type)
- Touch pen
- USB cable
- HDMI cable

2. Device Overview

There is a 5-inch LCD on the device. LCD has resistive type touch. While general control of the device can be made on the screen, it is also possible to perform basic controls more quickly with 3 rotary encoders. Additional features are gained with the buttons on the rotary encoder.

At the bottom of the device, there are curve tracer measurement tips. These are 4mm banana compatible probe inputs. There is one BNC connector for signal generator output and 2 BNC connectors for oscilloscope measurement input (Figure 1).

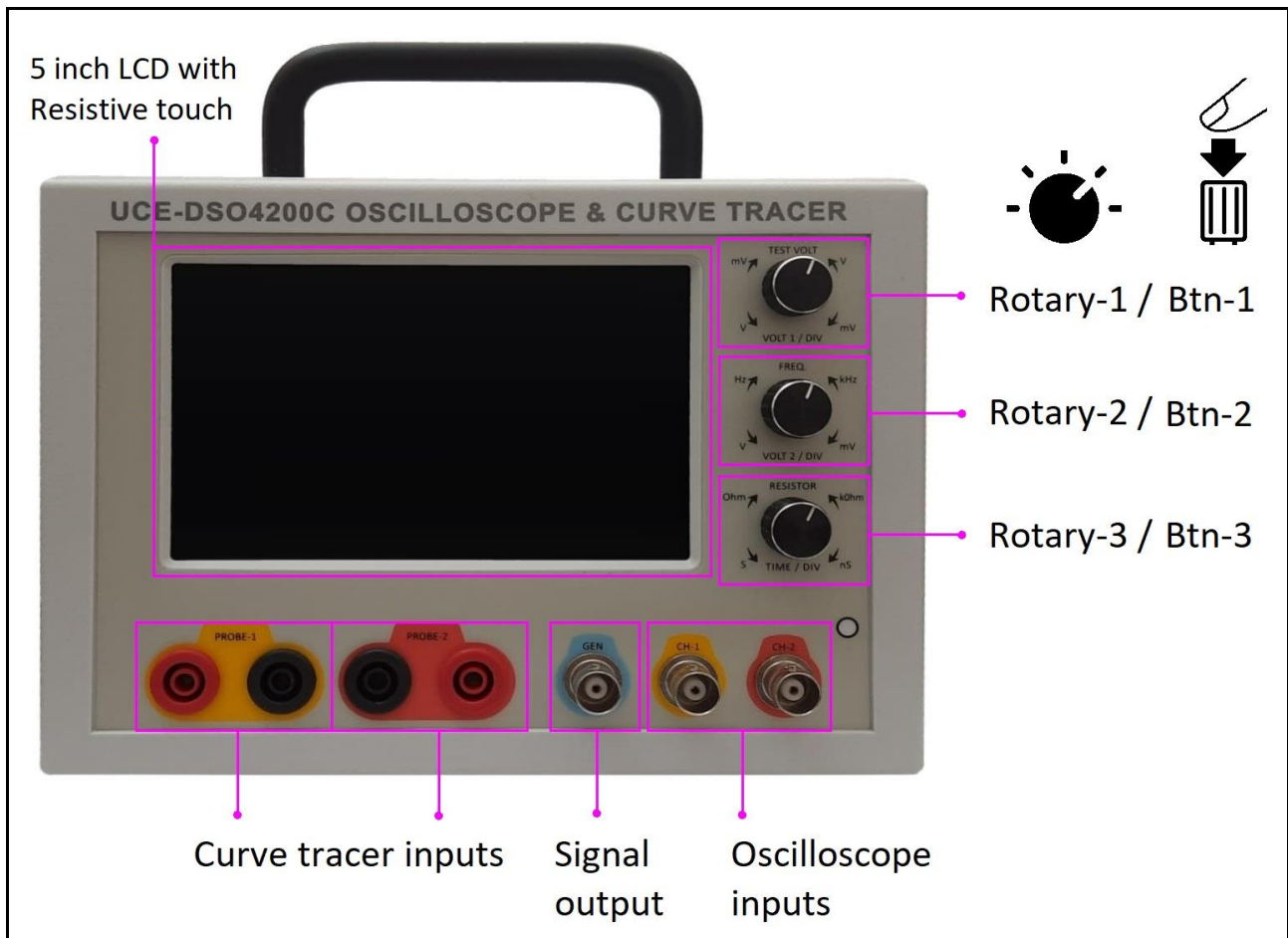


Figure 1. Front view of the device

There is an HDMI output on the right side of the device. It is used to mirror the LCD image to any monitor, projector or TV. The USB connection is used to communicate with a computer (Figure 2).

There is a power input on the back of the device. The power supply of the device is provided by a 12V - 2A adapter. The device is turned on and off with the power switch (Figure 2).

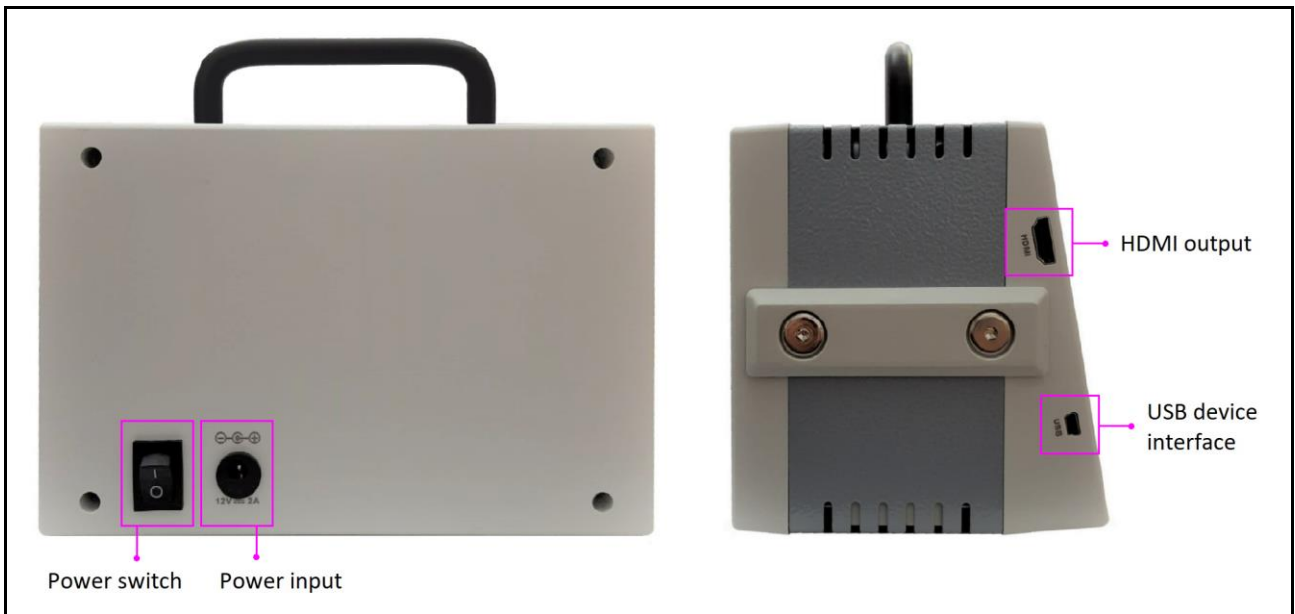


Figure 2. Back and side views of the device

When the device is turned on, the main menu in Figure 3 is displayed. There are 7 icons here. These menus will be explained in detail in the next sections.

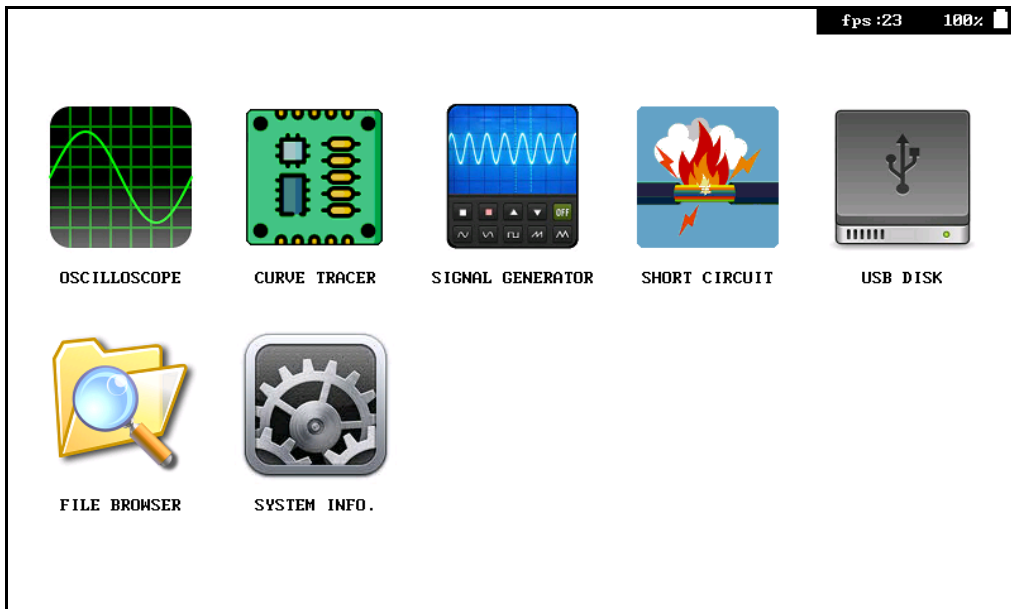


Figure 3. Device main menu

2.1. Rotary encoder functions

		Rotary-1		
Function		<i>Clockwise</i>	<i>counterclockwise</i>	<i>Button</i>
Menu				
Booting	-	-	-	When pressed and held, the device connects as a USB disk. (If connected to computer with USB cable)
Main menu	-	-	-	-
Oscilloscope	CH-1 Volt/div value decreases CH-1 offset value increases CH-math gain increases CH-math offset increases	CH-1 Volt/div value increases CH-1 offset value decreases CH-math gain decreases CH-math offset decreases		Pressing the button once will switch between Volt/div and offset . If the math function is active; Volt/div → offset → math gain → math offset toggle between them.
Curve Tracer	Test voltage value decreases	Test voltage value increases		Increases the scan period if the scan mode is active
Signal generator	Increases the digit value of the selected parameter	Decreases the digit value of the selected parameter		-
Short circuit	-	-		-
File browser	Scrolls down the page if the number of files exceeds the page.	Scrolls the page up		-
System	Increases first parameter in DDS OFFSET and DDS GAIN menu	Decreases first parameter in DDS OFFSET and DDS GAIN menu		-
		Rotary-2		
Function		<i>Clockwise</i>	<i>counterclockwise</i>	<i>Button</i>
Menu				
Booting	-	-	-	-
Main menu	-	-	-	-
Oscilloscope	CH-2 Volt/div value decreases CH-2 offset value increases	CH-2 Volt/div value increases CH-2 offset value decreases		Pressing the button once will switch between Volt/div and offset .
Curve Tracer	Frequency value decreases	Frequency value increases		Decreases scan period if scan mode is active
Signal generator	Shifts the active digit to the right	Shifts the active digit to the left		-
Short circuit	-	-		-
File browser	Selects the file (or folder) just below	Selects the file (or folder) just above		Opens the selected file or folder
System	Increases the second parameter in the DDS OFFSET and DDS GAIN menu	Decreases second parameter in DDS OFFSET and DDS GAIN menu		-
		Rotary-3		
Function		<i>Clockwise</i>	<i>counterclockwise</i>	<i>Button</i>
Menu				
Booting	-	-	-	When pressed and held, the device connects as a USB disk. (If connected to computer with USB cable)
Main menu	-	-	-	-
Oscilloscope	Time/div value decreases Trigger level value increases Shifts the buffer forward in STOP mode	Time /div value increases Trigger level value decreases Shifts the buffer back in STOP mode		Pressing the button once toggles between Time/div and trigger level . If triggering is stopped, toggle between Time/div and buffer scrolling
Curve Tracer	Limit resistor value decreases	Limit resistor value increases		-
Signal generator	The above parameter is selected	The below parameter is selected		-
Short circuit	-	-		-
File browser	-	-		-
System	Increases LCD backlight	Decreases LCD backlight		-

3. Oscilloscope Mode

To enter the oscilloscope mode, the "OSCILLOSCOPE" icon in the "Main Menu" is clicked. The general view of the scope mode is as in Figure 4.



Oscilloscope icon

OSCILLOSCOPE

At the top of the screen; Status information of measurement channels (Volt/div, coupling), operating status, time base mode, trigger status information, sampling status information (time/div), frame refresh rate and battery status information are included. On the right side, there is the menu area where various settings are made. At the bottom of the screen, there are submenu of these setting menus.

When returning to the main menu with the "EXIT" button in the lower right corner of the screen, the setting parameters are saved in the memory (dso_settings.cfg).

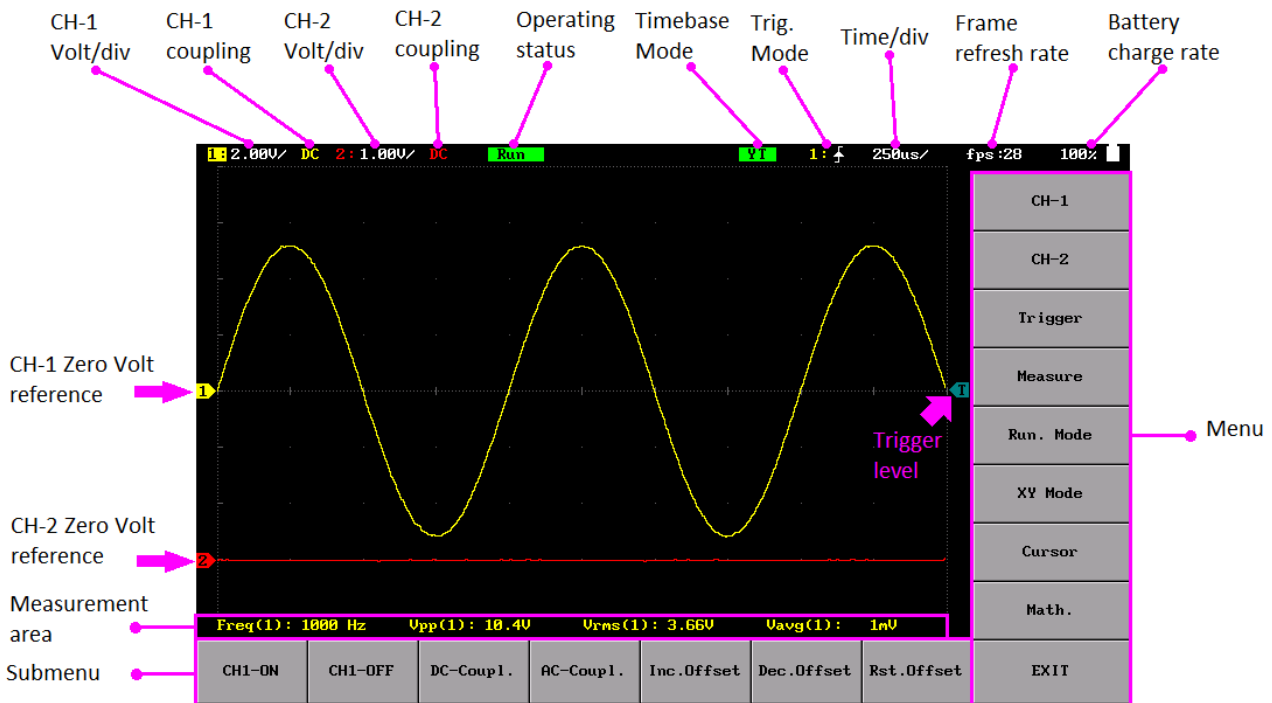


Figure 4. Oscilloscope menu overview

3.1. Adjusting the vertical system

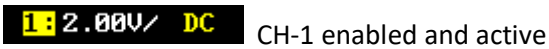
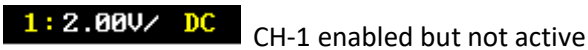
The UCE-DSO4200C has two analog input channels and each channel is equipped with an independent vertical control system. The adjustment methods for the vertical systems of the two channels are the same. This section takes **CH-1** as an example to introduce the vertical system adjustment method.

Enable or disable analog channel:

Click the “**CH-1**” button in the menu to enable CH-1. While the “**CH1-ON**” button in the submenu enables the channel, the “**CH1-OFF**” button makes the channel disable. In the figure below, CH-1 is disabled and CH-2 channel is enable. No status information is displayed on the disabled channel.



If CH-1 is enabled but not activated, the channel status label is shown as below. Click the “**CH-1**” menu in the menu to activate the channel. Other methods of channel activation are when the vertical scale setting of the corresponding channel is made or if the rotary encoder button is clicked, the channel is activated.



Vertical scale setting:

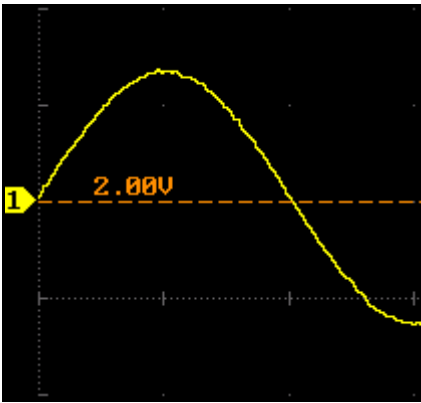
Vertical scale indicates the voltage value per grid in the vertical axis of the screen. It is often expressed in V/div. While you adjust the vertical scale, the display amplitude of the waveform would enlarge or reduce. The scale information of the channel status label (e.g., as shown in the following figure) at the top of the screen would change accordingly.



The adjustable range of the vertical scale is between 5 mV/div and 10 V/div. Turn the Rotary-1 corresponding to CH-1 to adjust the vertical scale (clockwise to decrease the scale and counterclockwise to increase). The vertically scaled channel becomes the active channel at the same time.

Vertical offset adjustment:

Vertical offset indicates the offset of the signal ground level position of the waveform from the screen center in the vertical direction. When adjusting the vertical offset, the waveforms of the corresponding channel moves up and down. As it moves, the offset level is shown on the screen with a horizontal line, and the vertical offset information (as shown in the figure below) will change accordingly just above the offset level line.



Vertical offset can be adjusted in three ways.

- When the channel is active, the signal is moved up and down the graphics area by holding and dragging the touchscreen pen (left button if using the Mouse).
- When the Rotary-1 button is pressed once, the offset adjustment mode is entered. After switching to offset mode, the offset level is changed by rotating Rotary-1.
- It is increased and decreased with the “**Inc. Offset**” and “**Dec. Offset**” buttons in the submenu of the **CH-1** menu. In addition, when the “**Rst. Offset**” button in the submenu is clicked, the offset value is set to 0V.

Coupling adjustment:

The undesired signals can be filtered out by setting the coupling mode. For example, the signal under test is a square waveform with DC offset.

- When the coupling mode is “**DC**”: the DC and AC components of the signal under test can both pass the channel.
- When the coupling mode is “**AC**”: the DC components of the signal under test are blocked.

Click the “**CH-1**” menu button. The desired coupling can be selected with the “**DC-Coupl.**” and “**AC-Coupl.**” buttons in the submenu.

1: 2.00V / DC DC coupling

1: 2.00V / AC AC coupling

3.2. Adjusting the horizontal time base

Horizontal time base, also called the horizontal scale, refers to the time of each grid in the horizontal direction of the screen. It is usually expressed in s/div.

When changing the horizontal time base, the displayed waveforms of all channels are expanded or compressed horizontally relative to the trigger reference point. The horizontal time base in the upper right corner of the screen is as shown in the figure below.



Turn the Rotary-3 to set the horizontal time base within the usable range (clockwise to decrease the horizontal time base and counterclockwise to increase it). It will adjust the horizontal time base of the waveforms of all channels in 1-2.5-5 steps within the adjustable range.

3.3. Trigger mode

For a digital oscilloscope, it continuously samples the waveform regardless of whether it is triggered stably or not. Only in stable trigger condition can the signal be displayed stably. In order to keep the observed signal constant on the screen, the trigger source must be selected for that channel. But only channel setting is not enough. The trigger level should also be set to a level from the maximum and minimum range of the signal. Otherwise, it will be difficult to observe because the signal will be very moving on the screen.

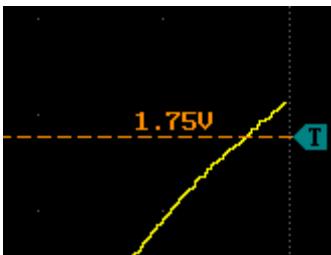
Trigger source:

The submenu is opened by clicking the “**Trigger**” button to select the trigger source. To set the trigger to the CH-1 channel, the “**Trig CH1**” button in the submenu is clicked.

Trigger level:

After the trigger source is selected, Rotary-3 button is pressed once and trigger level adjustment mode is entered. Turn the Rotary-3 to adjust (clockwise to increase level and counterclockwise to decrease). It is also possible to adjust with the “**Increase**” and “**Decrease**” buttons in the “**Trigger**” submenu.

The trigger level will be displayed on the screen with a horizontal line while moving, and the trigger level information (as shown in the figure below) will change according to the level just above the trigger level line.



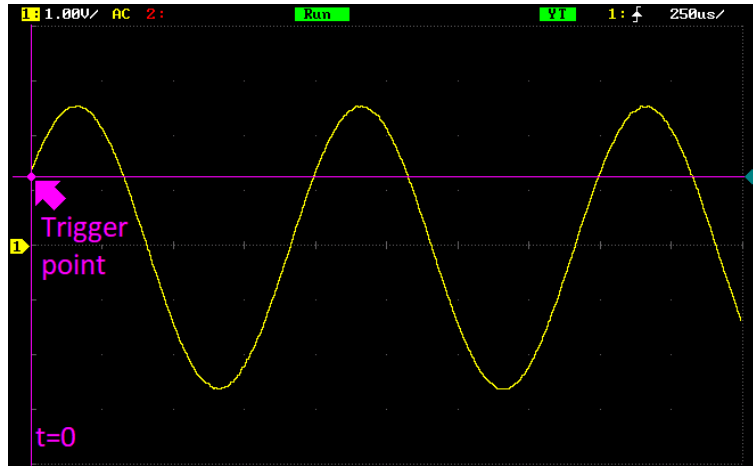
When you stop changing the trigger level, the level line disappears in about 1 s.

Trigger edge:

Triggering occurs at the trigger level of the specified edge of the input signal. At this time, the current trigger setting information (trigger edge and trigger source) is displayed in the upper right corner of the screen, as shown in the figure below.



When the voltage of the waveform reaches a required level, then a comparator switches and send a start signal to the time base. This enables the time base to exactly synchronize with the displayed waveform so that it remains stable on the screen.



3.4. Operations and measurements

The device can perform math operations, automatic measurements, and cursor measurements on sampled and displayed data.

Mathematical operations:

Click the “**Math.**” button to open the math operation menu. In the Math submenu, channels can perform multiple math operations between waveforms:

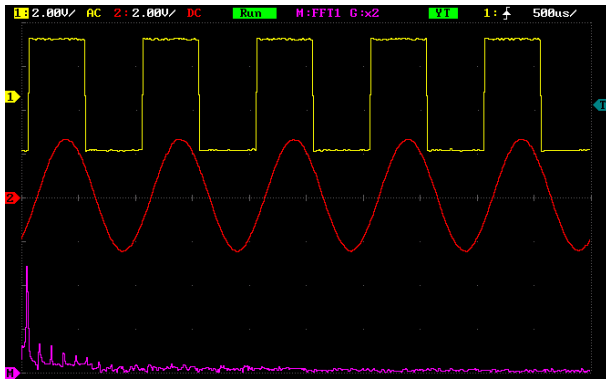
- Mathematical operations ($A+B$, $A-B$, $A \times B$ and A/B)
- FFT operation

The mathematical operation and the gain value of the math channel are shown at the top of the screen as follows.

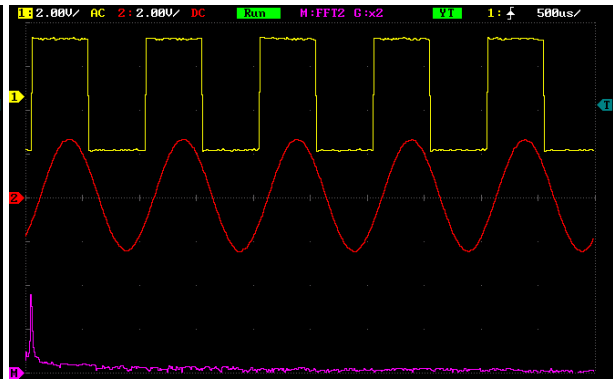


Mathematical operation: $CH1 + CH2$, gain $\frac{1}{2}$

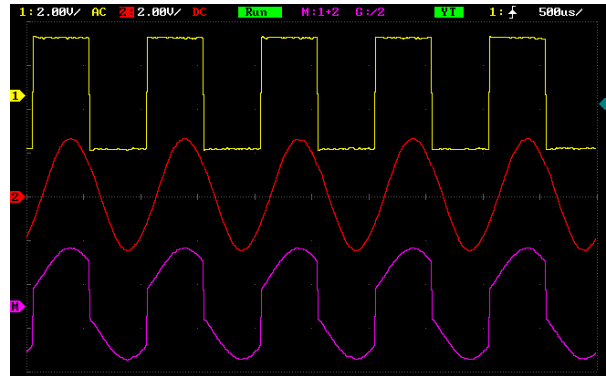
By pressing the Rotary-1 button (Volt/div \rightarrow Ch offset \rightarrow math gain \rightarrow math offset) the modes are switched and the math gain and offset values can be adjusted.



CH-1 FFT



CH-2 FFT



CH-1 + CH-2

Automatic measurement:

Some data of the waveform can be automatically calculated. When the “**Measure**” button is clicked, there are 4 different measurements in the submenu.

- Frequency: Frequency (channel triggering needs to be set accordingly to be calculated)
- Vpp: Peak-to-peak voltage value
- Vrms: Effective voltage value
- Vavg: Average voltage value

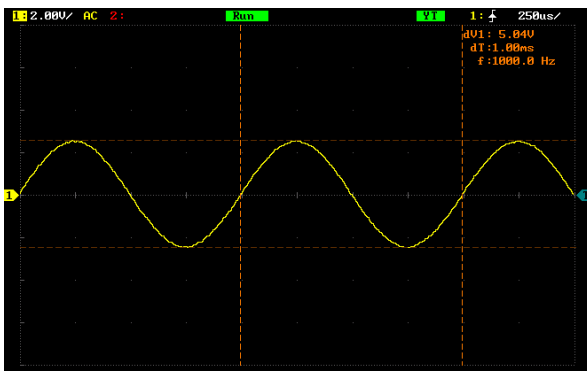
When the relevant buttons in the submenu are clicked, the selected measurement is added to the bottom of the graph. Whichever channel is active, measurement is made for that channel. Channel activation is explained in the section “**Enable or disable analog channel**”.

Freq(1): 1000 Hz Vpp(1): 10.4V Vrms(1): 3.66V Vavg(1): 1mV

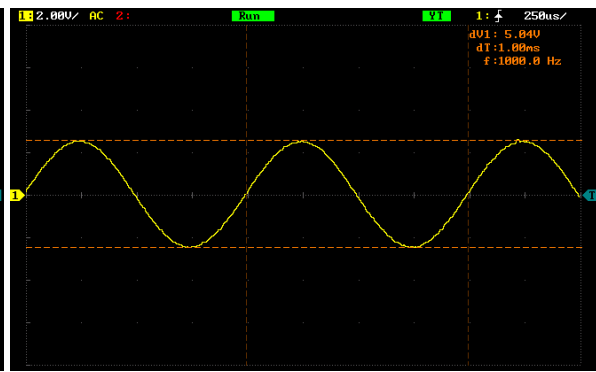
A maximum of 4 values are displayed simultaneously. If the measurement area is desired to be deleted, the “**Clear All**” button is clicked.

Cursor measurement:

Cursor measurement can measure X-axis values (time) and Y-axis values (voltage) of the selected waveform. By clicking the “Cursor” button, the submenu is opened and activated by clicking the “ON” button in the submenu. A total of 4 orange colored and dashed cursors appear on the screen, 2 horizontally and 2 vertically. If you want to measure on the Y axis, the “Amplitude” button is clicked. In this case, the horizontal cursors will be bright color. Rotary-1 and Rotary-2 encoders are used to move cursors. Moving the cursors changes the measurement values in the upper right of the screen. Since CH-1 and CH-2 may have different volt/div values, the button of that channel (CH1 or CH2) is clicked in the submenu for which channel the measurement is made. If it is desired to measure on the X axis, the “Time” button in the submenu is clicked for this. In this case, the vertical cursors will be bright color. Rotary-1 and Rotary-2 encoders change the position of cursors. As the cursors are moved, the time values change in the upper right of the Screen. In order to make the cursors passive, the “OFF” button in the submenu is clicked.



Time measurement cursors active



Voltage measurement cursors active

3.5. Running mode

The triggering requirement of the oscilloscope defined in the running mode. There are three different buttons in the submenu of the “Run. Mode” menu.

- **Run:** Determines wave form even if it cannot define triggering requirement in this mode. If the triggering does not occur although the oscilloscope waits for a certain time, triggering is initiated necessarily. If it forces occurrence of an invalid trigger, the oscilloscope may not synchronize the wave form and waves are seen as rolling over in the display. In case of a valid triggering, the display remains constant.
- **Single:** In this mode, if it could not define triggering requirement, no signal is seen in display and waits in this way until triggering occurs. After occurrence of the initial triggering saves the signal and reflects in the display and freezes the display.
- **Stop:** When this button is clicked in any moment, the last signal in the display is frozen.

The running mode is located at the top of the screen.



If the Rotary-3 button is pressed in the **stop** mode, it is possible to view the sampled but not displayed data by rotating the Rotary-3. At the top of the screen, it is shown which position of the buffer is reflected on the screen.

3.6. Time base mode

The device supports two available time base modes: YT mode and XY mode. By default, the time-based mode is YT.

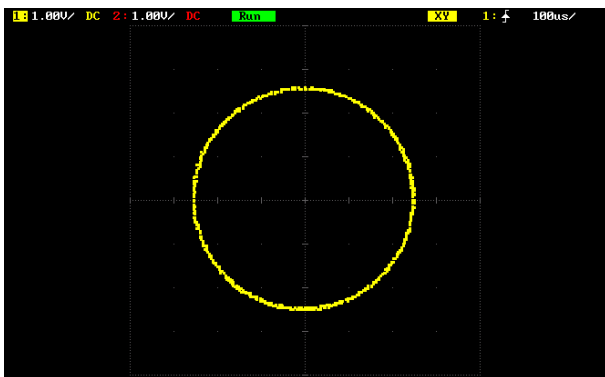
YT mode:

In this mode, the Y-axis represents voltage and the X-axis represents time.

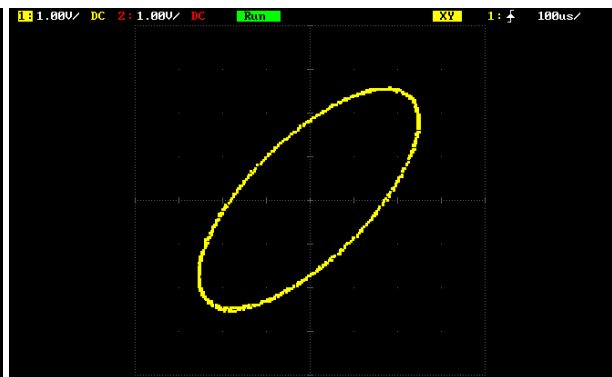
When the horizontal time base is greater than or equal to **25ms/div**, the device enters slow scan mode.

XY mode:

In this mode, both the X-axis and Y-axis represent voltage. The mode changes the screen from voltage-time display mode to voltage-voltage display. You can use the Lissajous method to measure the phase deviation of two input signals with the same frequency. Below, the same frequency and sinusoidal signals are applied to both channels. The effect of the phase angle between the two signals on the signal is shown in the picture below.



Phase angle 90°

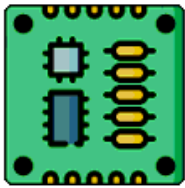


Phase angle 45°

Note: In XY mode, CH-1 and CH-2 are forced to be enabled.

4. Curve Tracer Mode

To enter the Tracer mode, click the “**CURVE TRACER**” icon in the “**Main Menu**”. The general view of the Tracer mode is as in Figure 5.



Curve Tracer icon

CURVE TRACER

At the top of the screen; test voltage, test frequency, limit resistance and scanning period (if scanning mode is active). In addition to these, frame refresh rate and battery status information are also included. On the left side of the screen is the impedance curve area. On the right side of the screen, there is a menu area consisting of buttons (Figure 5).

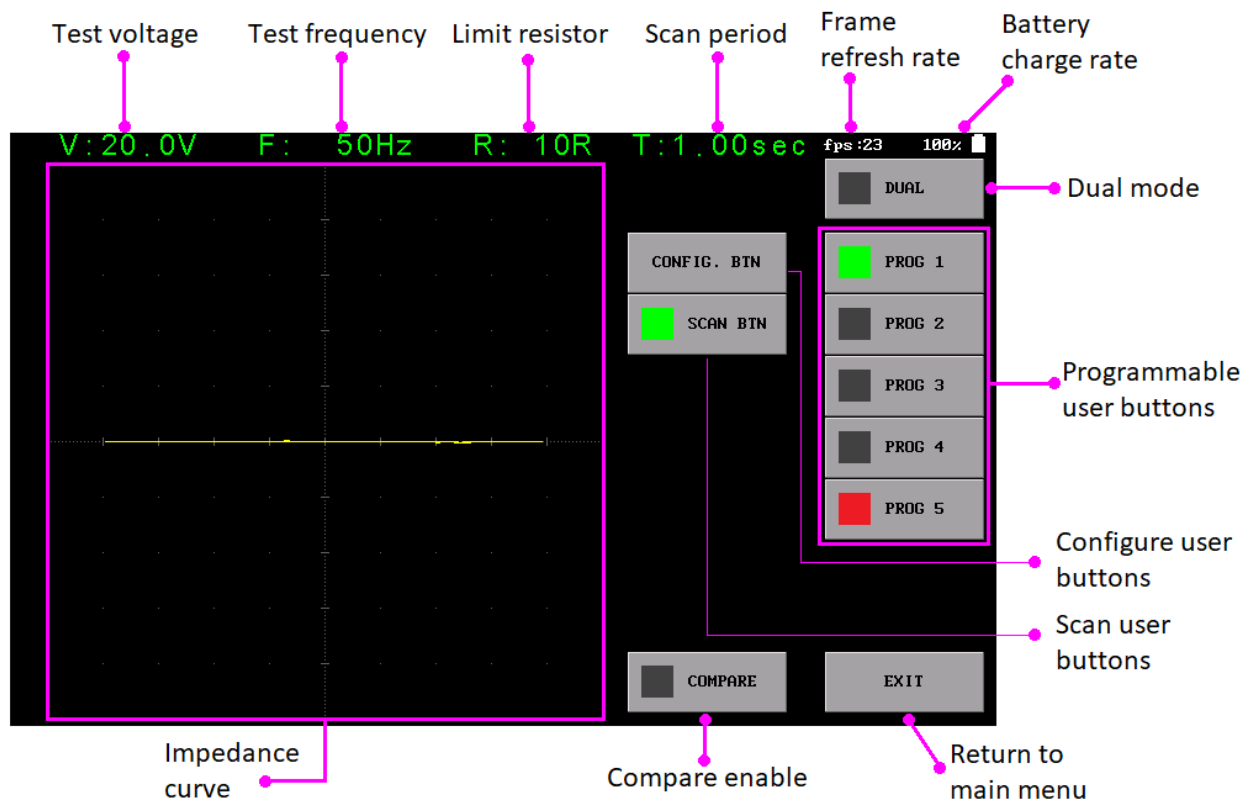


Figure 5. Curve tracer menu overview

4.1. Before test

Some rules must be followed before fault detection.

- The PCB to be measured **must** be powered off.
- **Make sure that the capacitors on the PCB are discharged.** Higher than 24V charged capacitors may damage the device. Otherwise, the product will be out of warranty.

4.2. Theory

The device works by applying a current-limited AC signal across two points of a component. The current flow causes a vertical trace deflection, while the applied voltage causes a horizontal deflection. Together they form a unique V-I signature that represents the overall health of the device under test.

The signature of all analog components is a combination of one or more of the four basic signatures: resistance, capacitance, inductance, and semiconductor. Each of these components reacts differently to the applied AC test signal. For this reason, recognizing the four basic signatures on the oscilloscope display is a key to understanding analog signature analysis.

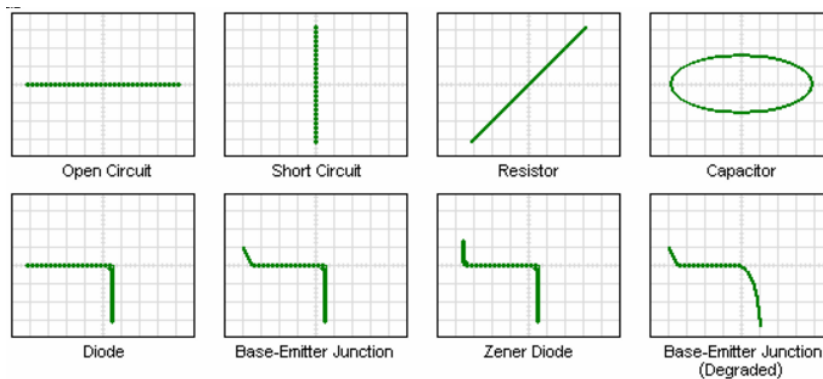


Figure 6. Component characteristics in XY mode (horizontal trace voltage, vertical trace current)

UCE-DSO4200C is designed to diagnose the failures in all types of electronic circuit boards. The product is provided with two channels and allows the comparison of the defective boards with the intact boards. All V-I impedance curves consist of 12-bit 256 different measurements per channel.

The following components can be tested with this device.

Passive components: resistance, capacitor, coil

Diodes: general purpose, zener, varistor

Transistor: NPN, PNP, bipolar, Darlington, JFET, MOSFET, UJT

Triggered components: SCR, TRIAC, relay

Optoelectronics: LED, photo-transistor, optocoupler

Integrated circuits: digital, analog

4.3. Setting test parameters

The component to be tested may be requested to be tested in different conditions. For this purpose, the device has Test voltage, Limit resistance and Frequency values in different stages. Although the UCE-DSO4200C curve tracer mode is dual channel, unlike the oscilloscope, test parameters are common to both channels.

Test voltage setting:

The test voltage can be adjusted between 0.2V and 20V. It is adjusted at 200mV intervals up to 1V, after 1V with 1V intervals. It is 24 steps in total. Rotate the Rotary-1 to adjust the voltage (counterclockwise to increase, clockwise to decrease).

V: 0.2V V: 20.0V

The test voltage and limit resistance also determine the test current. In order to limit the energy flow, the maximum value of the test voltage is limited depending on the limit resistor.

Voltage limitation due to limit resistor;

- 2V (*1V) for 10R range,
- 7V (*4V) for 47R range,
- 10V (*7V) for 100R range,
- 18V (*15V) for 470R range,
- 20V for 1K, 4.7K and 10K ranges.

*** Voltage limitation in dual mode**

One of the biggest features of the device is undoubtedly the 200mV test voltage stage. Since active components such as diodes and transistors are not triggered in the measurements made at this stage, only the curve of the passive components is obtained in the measurement.

Figure 7 shows the impedance curves of the parallel connected diode and 47R resistor at 5V and 0.2V stages. At 5V, a combination of resistor and diode characteristics is seen, while at 0.2V only the resistance curve is seen.

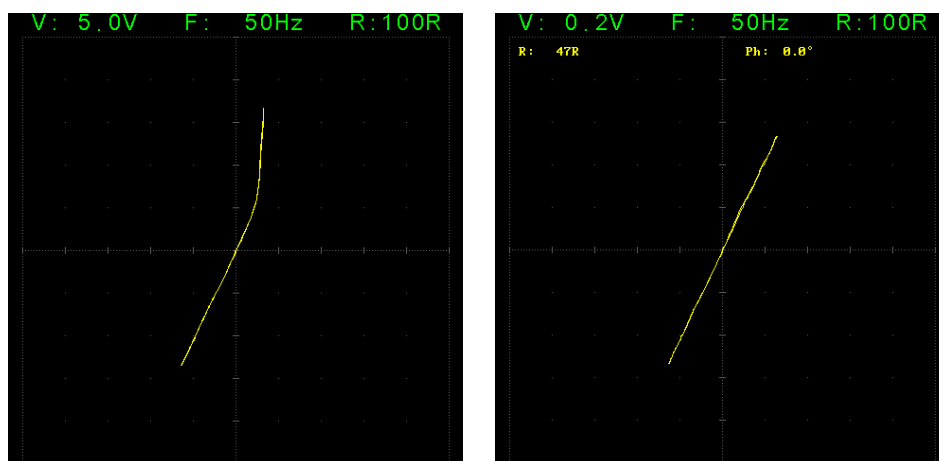


Figure 7. Impedance curve of parallel connected diode and resistor at different stages

Figure 8 shows the impedance curves of a parallel connected diode and 10uF capacitor at 5V and 0.2V stages. While a combination of diode and capacitor characteristics is seen at 5V, only the capacitor curve is seen at 0.2V.

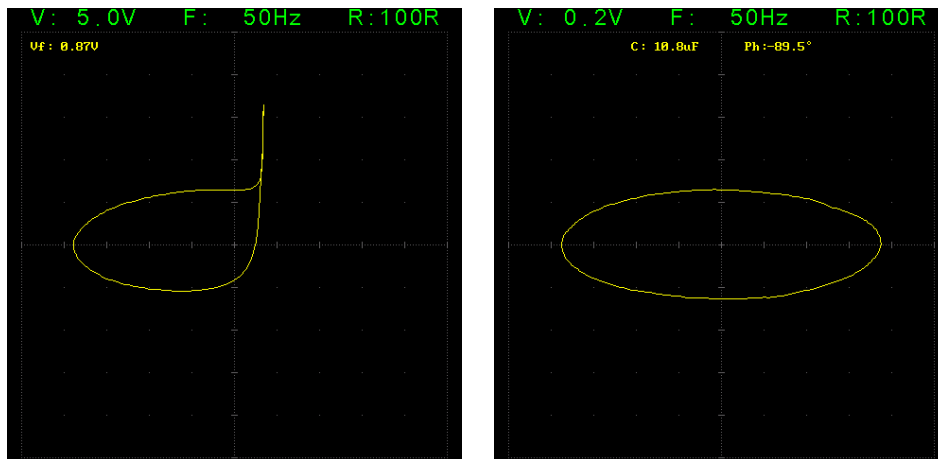


Figure 8. Impedance curve of parallel connected diode and capacitor at different stages

As seen in the examples above, the diode impedance is eliminated at the 0.2V stage and only the curves of passive components such as resistors and capacitors are obtained. Thus, in the testing of electronic boards, passive components can be tested independently of active components. There is a serious decrease in the amount of components that need to be tested discretely by removing them from the electronic board.

Test frequency setting:

The test frequency can be adjusted between 20Hz and 10kHz. It is adjusted in 10Hz steps between 20Hz and 200Hz, in 100Hz steps between 200Hz and 1kHz, and in 1kHz steps between 1kHz and 10kHz. It consists of 36 levels in total. Rotate the Rotary-2 to adjust the frequency (counterclockwise to increase and clockwise to decrease).

F: 50Hz

F: 1.0kHz

Passive components such as capacitors and coils are frequency sensitive. Frequency ranges are often important in such component measurements.

- The low frequency - high current (e.g., 20Hz – 10R) range is suitable for high capacitance capacitors (mF).
- High frequency – low current (e.g., 5kHz – 1K) stage is suitable for low capacitance capacitors (nF).
- The high frequency – high current (e.g., 10kHz – 10R) stage is suitable for coils with low inductance (uH).

Limit resistance setting:

There are 7 different stages as 10R, 47R, 100R, 470R, 1K, 4.7K and 10K. Rotate the Rotary-3 to adjust the limit resistor (counterclockwise to increase and clockwise to decrease).

10R is high current mode and 10K is low current mode.

Maximum current calculation:

In the previous section, it was stated that the horizontal axis is the voltage and the vertical axis is the current. The voltage-division value (V/div) is 1/4 of the test voltage. Ex. V/div value for 5V test voltage is 1.25V.

The maximum test current value is the test voltage divided by the limit resistance.

$$I_{\max} = V_{\text{test}} / R_{\text{limit}}$$

The current-division value is 1/4 of the maximum current value. For example, when the test voltage is 5V and the limit resistance is 1KΩ, the maximum current value;

$$I_{\max} = 5V / 1K\Omega = 5mA$$

The current-division value (I/div) is 5mA / 4 = 1.25mA /square.

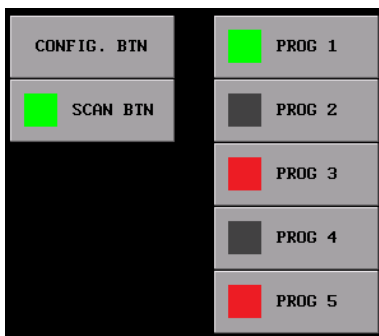
4.4. Menu usage

In this section, the tracer menu usage of the UCE-DSO4200C device is explained. There are some buttons in the tracer menu in Figure 5;

EXIT: Used to return to the Main Menu. Also, during this process, the setting data is saved in the memory (ct_settings.cfg).

DUAL: It allows simultaneous use of Probe-1 (yellow color) and Probe-2 (red color) channels. If a single channel is used, only the Probe-1 channel is enabled.

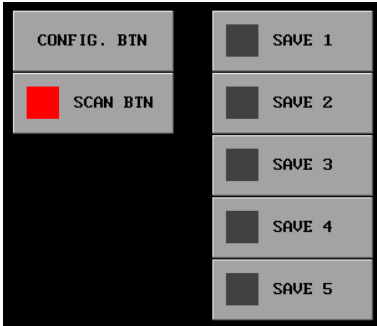
SCAN BTN: Scans user buttons at regular intervals. When scanning is active, the “SCAN BTN” button is marked in green. The user button marked with green color is the step where the measurement is made at that moment. When the step that does not want to be scanned is clicked, that step is cancelled. Inactive stages are marked in red. Click again if it is desired to be reactivated. The buttons marked in gray are the levels that will be scanned but are not active at that moment.



When the scan mode is active, the scan period is displayed at the top of the screen. Indicates the time between two steps. The period time can be adjusted between 0.25 sec and 2 sec. Rotary-1's button is pressed to increase the time, and Rotary-2's button to decrease it.

T:1.00sec

PROG 1-5: There are 5 programmable user buttons. The voltage, frequency and limit resistor combinations selected with rotary encoders (Rotary1-3) are stored in the memory. Thus, these settings are restored very quickly when the button is clicked. Click the “**CONFIG. BTN**” button to memorize the set combination. When the button is clicked, the names of the user buttons change to “**SAVE 1-5**”. When the button to be saved is clicked, the button names return to their original state (PROG 1-5) and the save process is completed. When “**CONFIG. BTN**” button is clicked, “**SCAN BTN**” becomes inactive and scan mode is disabled.



COMPARE: Compares similarity of impedance curves between channels. When the comparison is active, the button is marked in green. DUAL mode must also be enabled for comparison.



The impedance curve in both channels is compared with the algorithm. As a result of the comparison, the difference between the impedances is calculated with a percentage value. If this value exceeds the set tolerance value (set with the PC program), the comparison fails and a red frame appears around the graphics area. If the comparison is successful, the green frame appears (Figure 9).

If the **Buzzer** is activated on the device, it gives a different sound warning in case of success and failure as a result of the comparison.

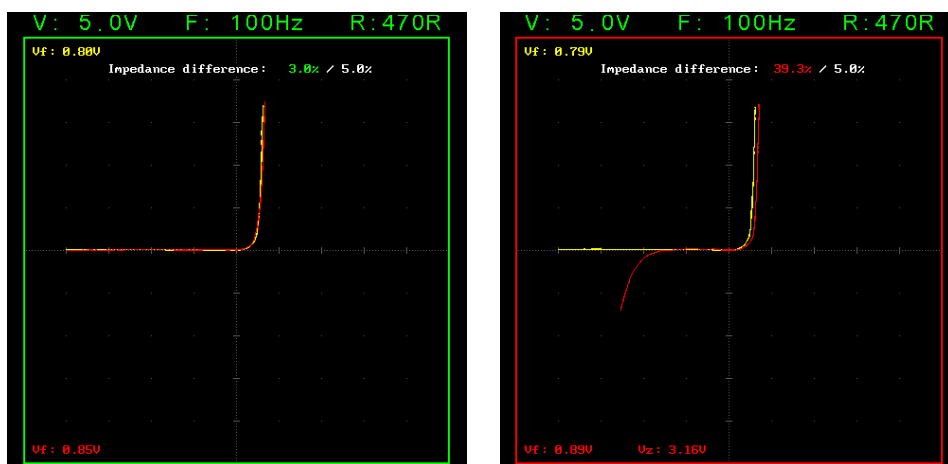


Figure 9. Comparison in dual mode

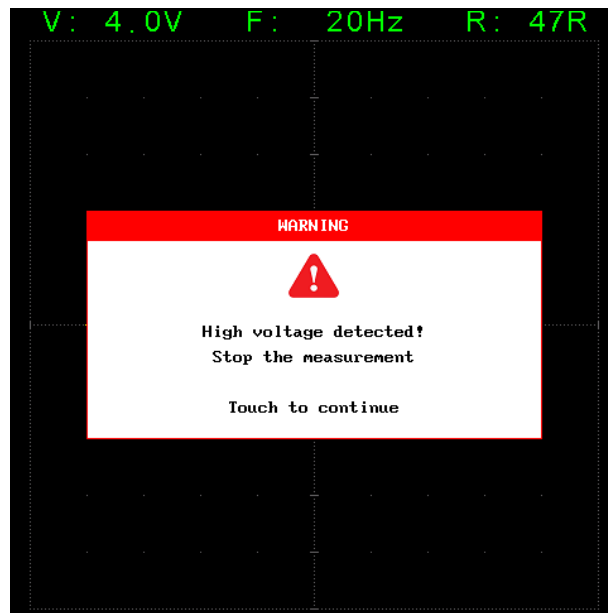


Figure 10. High voltage measurement detection

There are protection and detection circuits on both inputs of the device against high voltage measurement. The device gives a warning when high voltage is detected in any of the channels during the measurement. In this case, the measurement must be terminated immediately. Then the warning screen is touched to continue normal operation (Figure 10).

High voltage detection can occur in three different ways.

- Capacitor measurement with charge over 24V
- Voltage source measurement over 24V

Long-term measurements **can damage the device**.

5. Signal Generator

The UCE-DSO4200C has a single channel, 20 MHz (-3dB) signal source and provides great convenience for users who need to use the signal source and the oscilloscope (or curve tracer) simultaneously. Click the “**SIGNAL GENERATOR**” icon in the “**Main Menu**” to enter the signal generator menu. Its general view is as in Figure 11.



Signal generator icon

SIGNAL GENERATOR

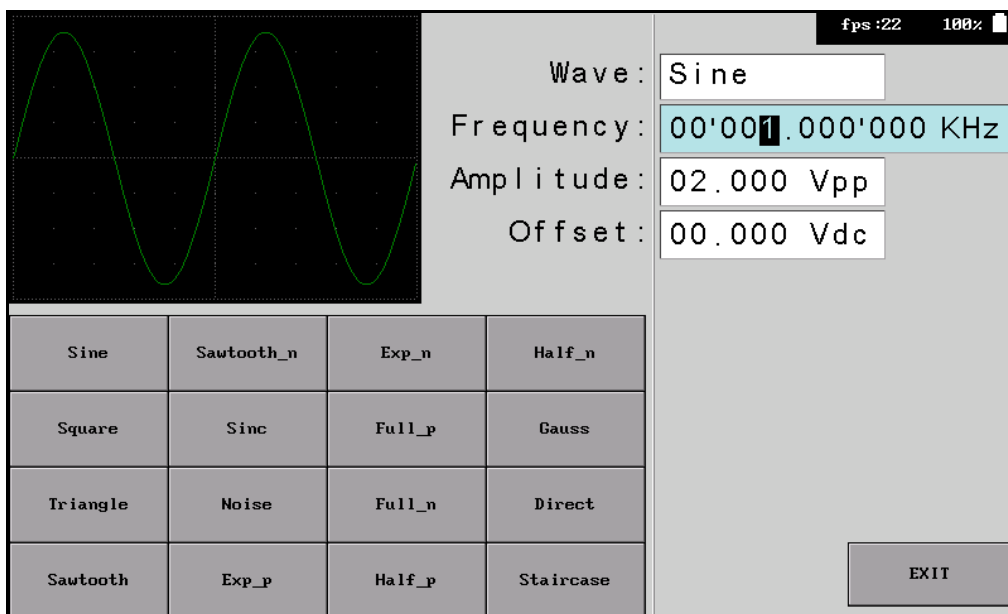


Figure 11. Signal generator menu overview

At the top left of the screen is the image of the waveform. In the upper right, parameter settings of the waveform are made. At the bottom, there are 16 buttons for waveform selection.

When returning to the main menu with the “**EXIT**” button in the lower right corner of the screen, the setting parameters are saved in the memory (dds_settings.cfg).

Different waveforms have different frequency ranges.

Sine: 1 mHz ~ 20Mhz

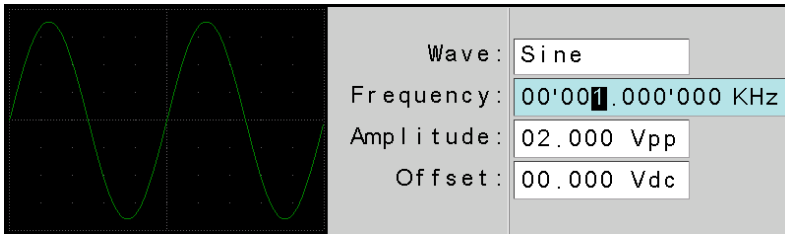
Square, triangle, full wave, half wave, gauss: 1mHz ~ 5Mhz

Sawtooth, sinC, noise, exponential, staircase: 1mHz ~ 1Mhz

DC: no frequency parameter.

5.1. Sine wave

Click the “Sine” button for a sine wave. At this time, you can set the parameters for the sine waveform.



Click the parameter or rotate the Rotary-3 to select it to be adjusted. An upper parameter is selected when the Rotary-3 is rotated clockwise, and a lower parameter is selected when rotated counterclockwise. The selected parameter is marked with a light blue color. Which digit of the parameter is desired to be set is selected with Rotary-2. The selected digit moves to the right when the Rotary-2 is rotated clockwise, and to the left when it is turned counterclockwise. After the digit is selected, the parameter setting is made by turning Rotary-1. When it is rotated clockwise, the parameter increases by the value of the selected digit (for example, if the tens digit is selected, the parameter setting is adjusted in ten steps). If it is rotated counterclockwise, the parameter value is decreased.

Digit selection and parameter setting can also be adjusted with the scroll button of the mouse, as an alternative to the one described above. Clicking the scroll button switches between parameter setting and digit setting. When the scroll is rotated, the selected digit or parameter is set.

Frequency setting:

“**Frequency**” parameter is set for frequency setting. In the sine wave, the frequency can be adjusted between 1 mHz and 20 MHz.

Amplitude setting:

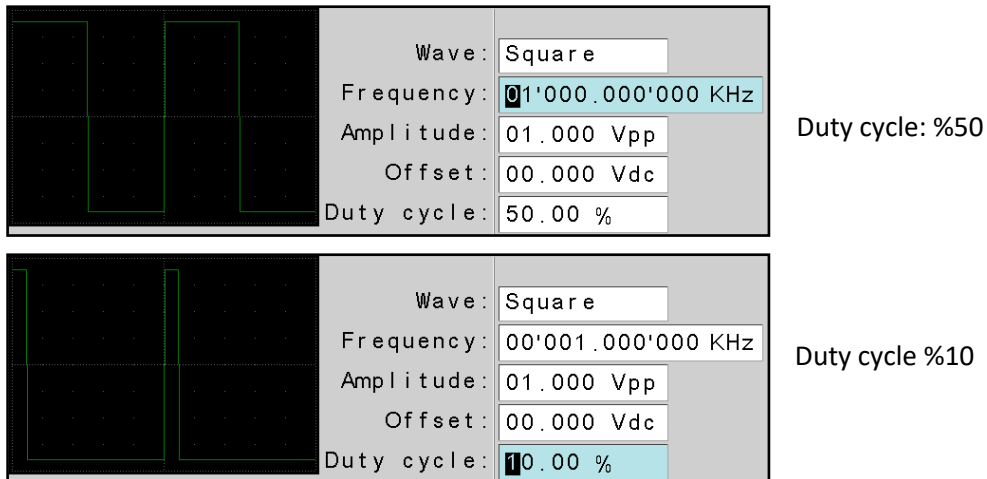
The “**Amplitude**” parameter is set for the amplitude setting. The amplitude can be adjusted between 0V and 10V (if the offset is 0V).

Offset setting:

“**Offset**” parameter is set for offset setting. The offset can be adjusted between -5V and +5V (if the amplitude is 0V).

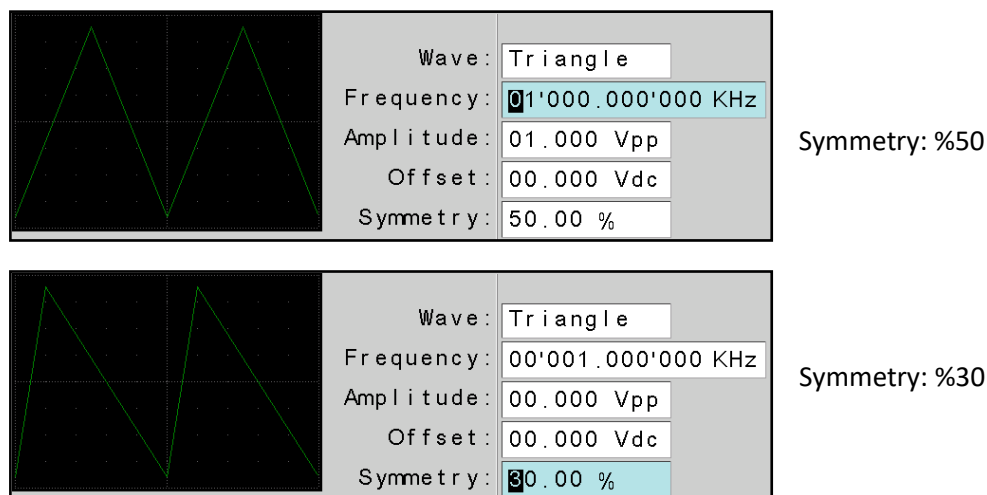
5.2. Square wave

Click the “**Square**” button for a square wave. At this time, you can set the parameters for the square waveform. For the adjustment methods, see the explanations in the "Sine wave" section. In the square wave form, the duty cycle is active. When the duty cycle value is changed, the waveform changes accordingly on the screen. Its adjustable range is between 5% and 95%.



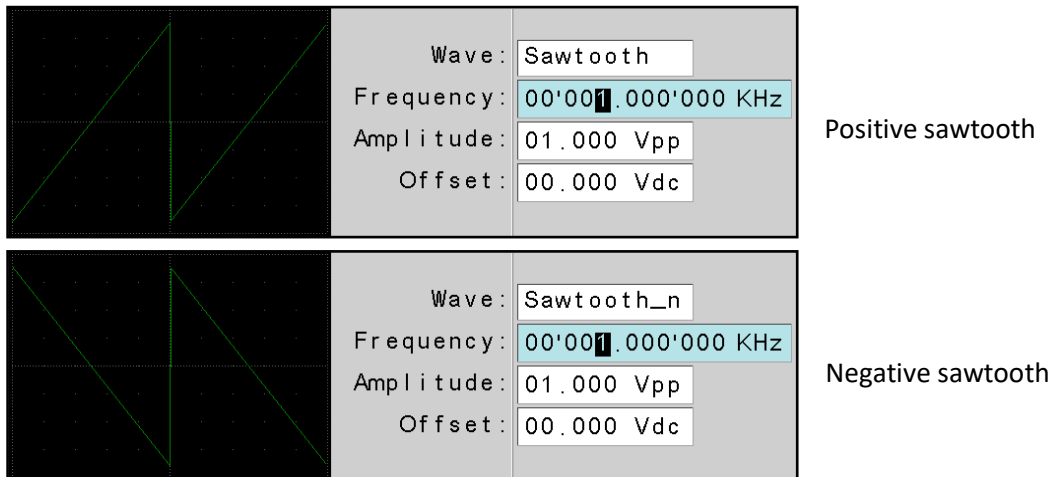
5.3. Triangle wave

Click the “**Triangle**” button for the triangle wave. At this time, you can set the parameters for the triangle waveform. For the adjustment methods, see the explanations in the “Sine wave” section. When the symmetry value is changed, the waveform changes accordingly on the screen. Its adjustable range is between 5% and 95%.



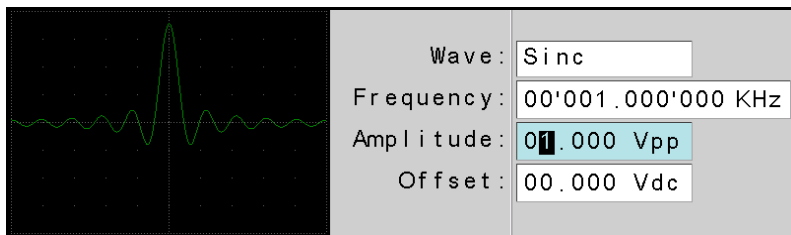
5.4. Sawtooth wave

There are two different forms of sawtooth wave, positive and negative. Click the **“Sawtooth”** button for a positive sawtooth wave. Click **“Sawtooth_n”** button for negative sawtooth wave. At this time, you can set the parameters for the sawtooth waveform. For the adjustment methods, see the explanations in the "Sine wave" section.



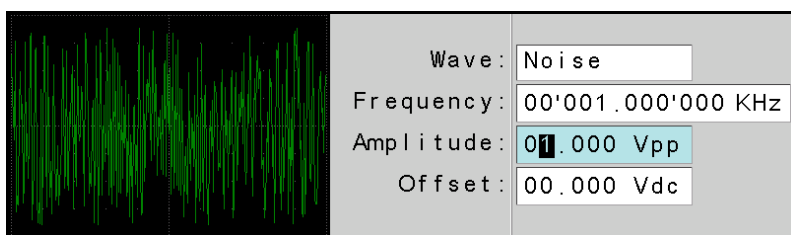
5.5. SinC wave

For the SinC wave, the **“SinC”** button is clicked. At this time, you can set the parameters for the sinC waveform. For the adjustment methods, see the explanations in the “Sine wave” section.



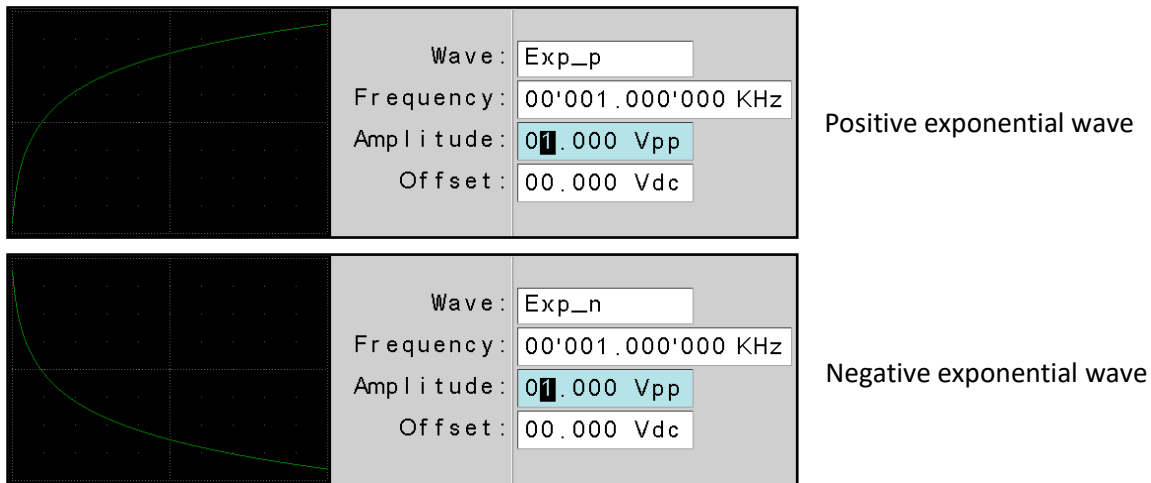
5.6. Noise signal

For the noise signal, the **“Noise”** button is clicked. At this time, you can set the parameters for the noise signal. For the adjustment methods, see the explanations in the “Sine wave” section.



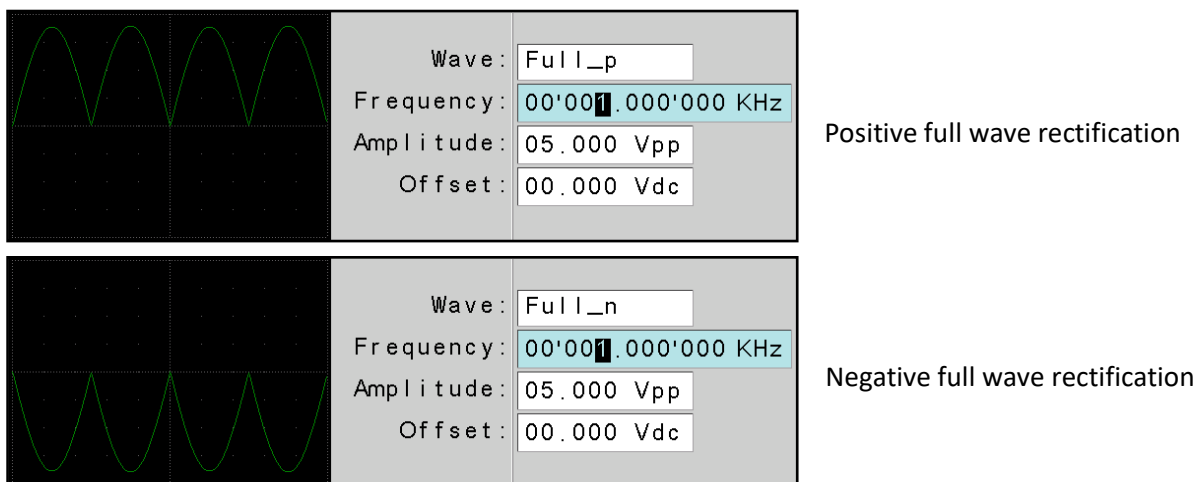
5.7. Exponential wave

There are two different forms of the exponential wave, positive and negative. For positive exponential wave, “Exp_p” button is clicked. For negative exponential wave, “Exp_n” button is clicked. At this time, you can set the parameters for the exponential waveform. For the adjustment methods, see the explanations in the “Sine wave” section.



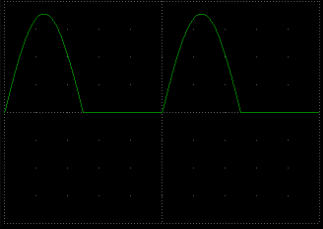
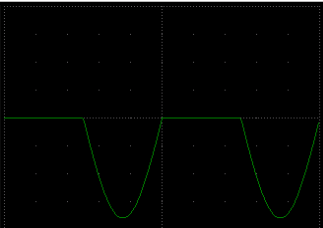
5.8. Full wave rectification

There are two different forms of full wave rectification, positive and negative. Click “Full_p” button for positive full wave rectification. Click “Full_n” button for negative full wave rectification. At this time, you can set the parameters for full wave rectification. For the adjustment methods, see the explanations in the “Sine wave” section.



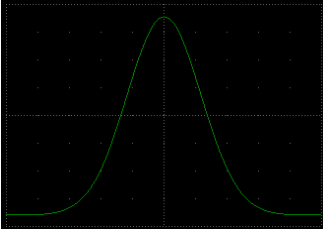
5.9. Half wave rectification

There are two different forms of half-wave rectification, positive and negative. Click “**Half_p**” button for positive half wave rectification. Click “**Half_n**” button for negative half wave rectification. At this time, you can set the parameters for half-wave rectification. For the adjustment methods, see the explanations in the “Sine wave” section.

	Wave: Half_p Frequency: 00'00'1.000'000 KHz Amplitude: 05.000 Vpp Offset: 00.000 Vdc	Positive half wave rectification
	Wave: Half_n Frequency: 00'00'1.000'000 KHz Amplitude: 05.000 Vpp Offset: 00.000 Vdc	Negative half wave rectification

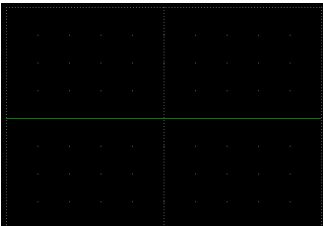
5.10. Gaussian wave

For Gaussian wave, “**Gauss**” button is clicked. At this time, you can set the parameters for the gaussian wave. For the adjustment methods, see the explanations in the “Sine wave” section.

	Wave: Gauss Frequency: 00'00'1.000'000 KHz Amplitude: 05.000 Vpp Offset: 00.000 Vdc
---	--

5.11. Direct voltage signal

Click the “**Direct**” button for the direct signal. With the direct signal, DC voltage is generated. It is adjusted with the offset parameter and voltage between -5V and +5V can be generated. For the adjustment methods, see the explanations in the “Sine wave” section.

	Wave: Direct Offset: 01.000 Vdc
---	------------------------------------

5.12. Staircase wave

Click the “Staircase” button for the staircase wave. At this time, you can set the parameters for the staircase wave. For the adjustment methods, see the explanations in the “Sine wave” section.



6. Short Circuit Finder Mode

One of the unique features of the UCE-DSO4200C is its ability to find the location of the short circuit. It is useful in finding short circuits in defective electronic boards. The menu is accessed by clicking the “SHORT CIRCUIT” icon in the “Main Menu”. Its general view is as in Figure 12.



Short circuit icon

SHORT CIRCUIT

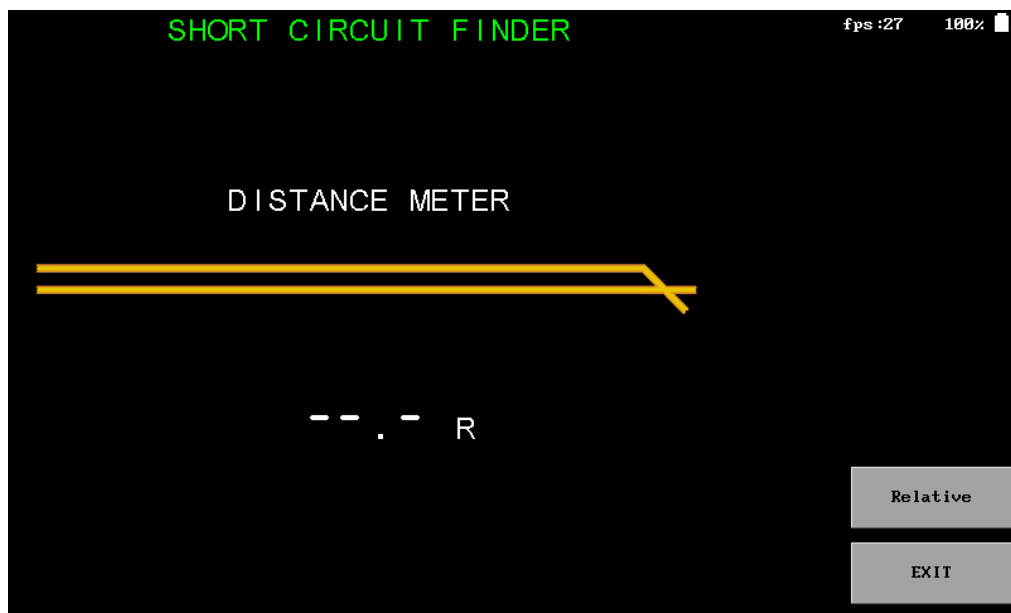
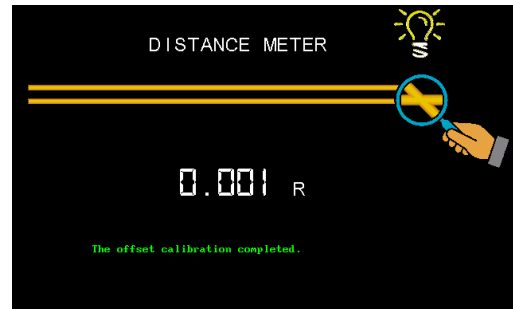
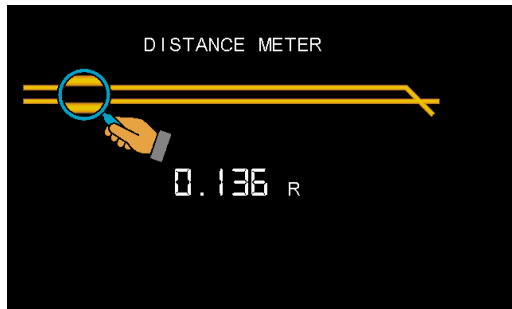
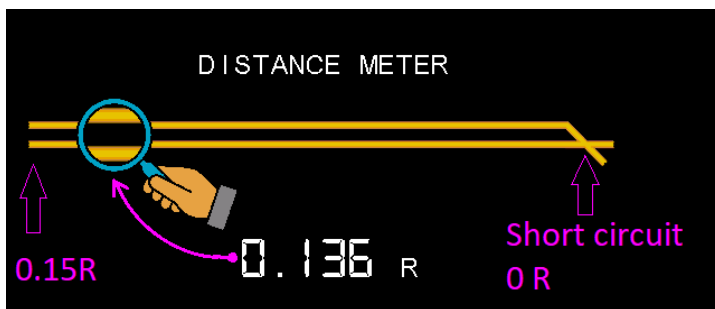


Figure 12. Short circuit finder mode overview

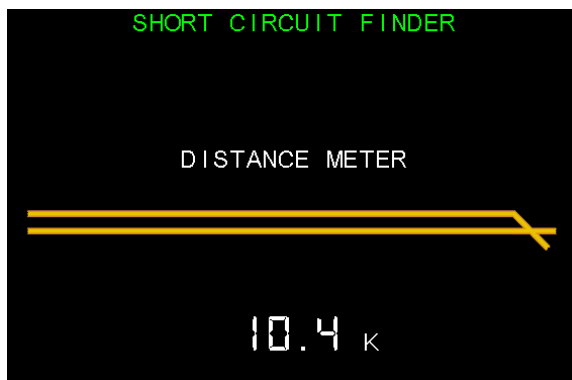
The menu is quite simple. In the middle of the screen there is an animation simulating the distance to the short circuit. There are 2 buttons at the bottom right. With the “EXIT” button, you return to the main menu.



In short-circuit mode, the measurement input is **Probe-1**. If 0.000R is not visible on the screen when the probe tips are short-circuited, the “**Relative**” button is clicked and the absolute value of the resistance value is taken. A message appears on the screen that the offset calibration is complete. The magnifying glass in the animation focuses where the short circuit is. The instrument is now ready for short circuit measurements. When the measured resistance value is below 0.15Ω, the magnifying glass is positioned on the line according to the resistance value. In addition, depending on the distance to the short circuit point, the buzzer makes an intermittent sound. At the short circuit point, the buzzer sounds continuously.



Note: Since low resistance values are measured here, it should be noted that contact resistance may affect the result while measuring.



If it is over 0.15Ω, the animation is not active, but the resistance measurement continues up to 100KΩ. It should be known that the measured resistance values are not as sensitive and accurate as a multimeter. Measurements are for reference only.

Since the resistance measurement is made at 0.2V test voltage, active components do not affect the measurement in the measurements on the electronic board. However, since the test voltage is 50Hz AC voltage, capacitors and inductances on the circuit may affect the measurement. The most accurate result is obtained with measurements made with discrete materials.

7. USB Disk

For USB connection feature, a cable connection must be provided between the USB port of the device and the computer. After the connection is established, it establishes a connection with the computer in **USB HID** protocol at the first power-on of the device. This connection provides control of the device via PC software. By clicking the “**USB DISK**” icon in the “**Main Menu**”, the device is connected to the computer as a USB Disk (USB HID connection is disconnected). On the computer, the device is listed in the “Devices and drives” section (Figure 13). Access to internal memory is provided via USB Disk. Thus, files can be transferred between the computer and the device. Click the “**EXIT**” button on the screen to terminate the USB Disk connection and return to the main menu. When returning to the main menu, a connection is established with the USB HID protocol again.



USB disk icon

USB DISK

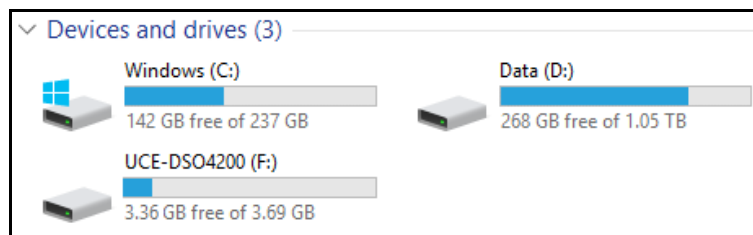


Figure 13. Devices and drives

8. File Browser

The file browser menu is the menu where the files in the internal memory are managed. Access to the menu is provided by clicking the “**FILE BROWSER**” icon in the “**Main Menu**”. Its general view is as in Figure 14.



File browser icon

FILE BROWSER

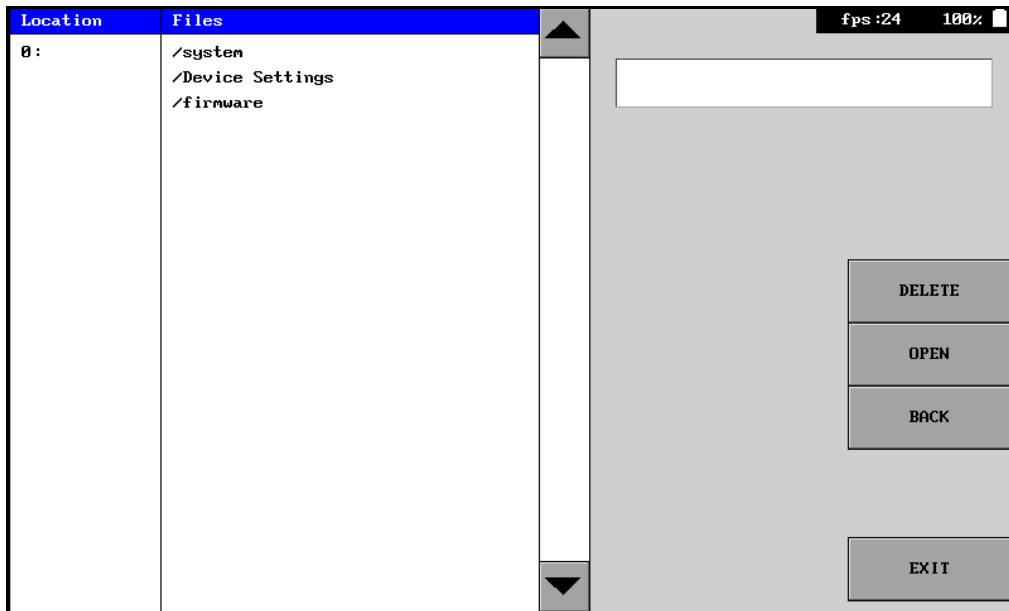


Figure 14. File view menu overview

At the top of the screen, there are two sections named “**Location**” and “**Files**”. Files are listed in the **Files** section and the location of these files is also listed in the **Location** section. The main disk directory is “**0:**”. Names starting with a slash “**/**” in the Files section represent folders.

There are some buttons on the right side of the screen. These buttons;

DELETE: Deletes the selected file or folder. However, the “**DELETE**” button must be clicked a second time to complete the deletion process.

OPEN: Opens the selected file or folder.

BACK: Returns back to the previous directory.

EXIT: Exits the file browser menu.

Selecting a file, folder or directory:

In order to process on a file, it must first be selected. There are different methods of selecting a file or folder.

- Clicking with the touch pen on one of the items listed in the **Files** menu.
- Left click on the item if the mouse is actively using it.
- Rotating the Rotary-2 encoder. Rotating clockwise selects the just below item, while rotating counterclockwise selects the just above item.

Location	Files
0:	ct_settings.cfg
/Device Setti	dds_settings.cfg
	dso_settings.cfg
	touch.cfg

File or folder selection

The listing in the **Location** section shows the location of the files. In the example below, the location of the files listed in the Files section is “0:/system/calibration/”.

There are two methods of selecting a directory;

- Clicking with the touch pen on one of the items listed in the **Location** menu.
- Left click on the item if the mouse is actively using it.

Location	Files
0:	beep.txt
/system	ct_cal.txt
/calibration	ddsamp.txt
	ddsoff.txt
	dsocha.txt
	dsochb.txt
	dsooff.txt

Directory selection

Open file or folder:

In order to process with an item, that item must first be selected. To open after it is selected;

- Clicking the “**OPEN**” button,
- Double-clicking if the mouse is actively used,
- Pressing the Rotary-2 button.

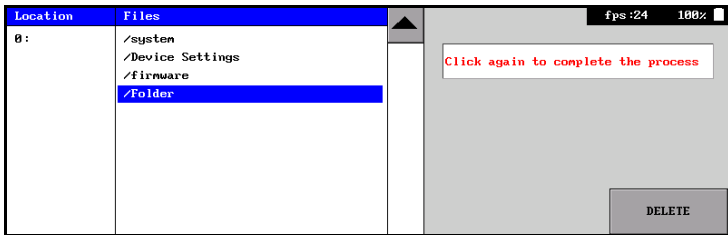
If the selected item is a folder, that folder is opened and the files under it are listed in the **Files** section and the name of the folder is added to the **Location** section. If it is a file in a supported format (txt, bmp, jpg, gif), the file is displayed.

Open directory:

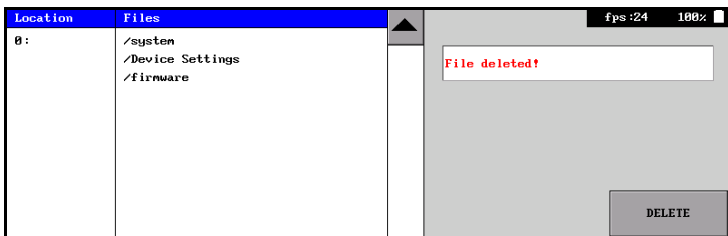
When the “**BACK**” button is clicked, the previous directory is accessed. But if one of the items listed in the **Location** section is selected and the “**OPEN**” button is clicked, that location can be opened quickly.

Delete a file or folder:

To delete an item, it must first be selected. Then click the “**DELETE**” button. The information that the “**DELETE**” button must be clicked again to complete the operation” is displayed on the screen.



Clicking the “**DELETE**” button a second time deletes the item.



Device Settings folder:

The “Device Settings” folder in the “0:” main directory is where the device settings files are saved.

- **ct_settings.cfg** file is in the curve tracer menu,
- **dds_settings.cfg** file is in the signal generator menu,
- **dso_settings.cfg** file is in the oscilloscope menu,
- **touch.cfg** screen touch,

Location	Files
0:	
/Device Setti	ct_settings.cfg dds_settings.cfg dso_settings.cfg touch.cfg

If these files are deleted, the device will load the factory default settings on first boot. If the screen touch file is deleted, screen calibration is requested at startup.

9. System Menu

The system menu contains system information about the device and is also where the instrument is calibrated. Access to the menu is provided by clicking the “**SYSTEM INFO**” icon in the “**Main Menu**”. Its general view is as in Figure 15.



System menu icon

SYSTEM INFO.

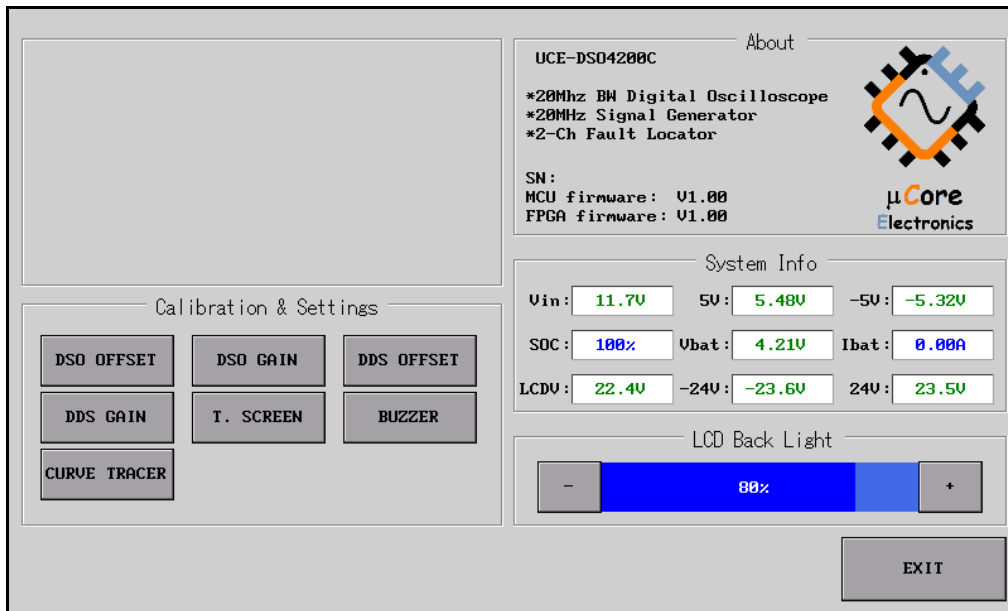


Figure 15. System menu overview

By clicking on the “**EXIT**” button at the bottom right, the main menu is returned.

The screen is basically divided into 5 zones.

- About
- System info
- LCD Back Light
- Calibration & Settings
- Calibration & Settings submenu (It appears blank at first. Submenu opens when selection is made from the Calibration & Settings menu.)

9.1. About

This is the section with information about the device. There is the serial number of the device and the firmware version information. Since the device is dual-processor, there are two firmware versions.

9.2. System info

It is the section that shows some analog data read on the motherboard. It contains information about system voltages and internal battery.

9.3. LCD Back Light

The backlight of the LCD can be adjusted here. By clicking the “+” and “-” buttons, the backlight intensity is adjusted between 25% and 100%. In addition, it can be changed by rotating the Rotary-3. When the “EXIT” button is clicked, the data is saved.

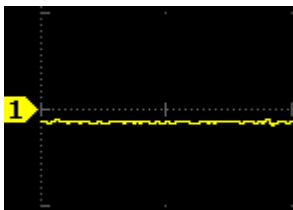
Note: If the battery charge drops below 20% while the device is running on battery, the backlight is automatically dimmed to reduce energy consumption. If the battery voltage drops below the critical level ($< 3.0V$), the backlight is completely turned off and the device stops working. In terms of battery health, the battery should be recharged as soon as possible.

9.4. Calibration & Settings

Here, calibration and some settings related to the device are made. Factors such as heat, dust and humidity reduce the performance of the device over time. In such cases, calibration can increase the performance of the device.

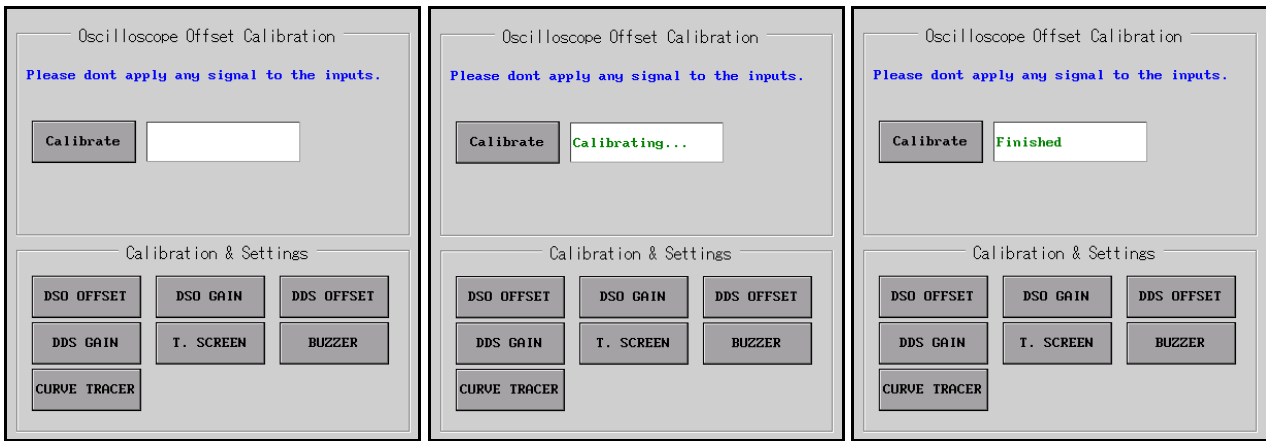
DSO OFFSET calibration:

When there is no signal at the input in the oscilloscope mode (or when the probe tips are short-circuited), if the signal is not at zero volts, then an offset calibration should be performed.



Offset shift in negative direction in CH-1

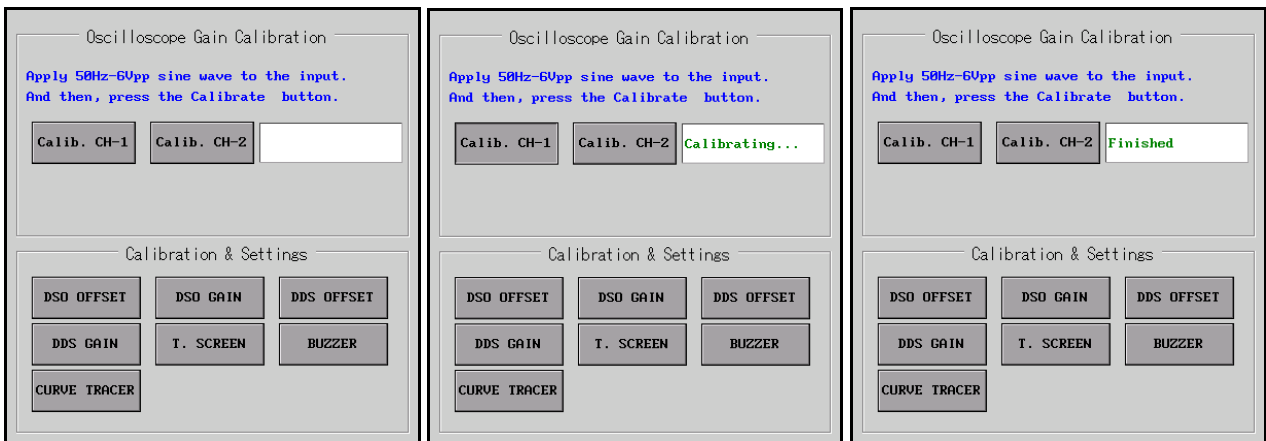
For this, the “**DSO OFFSET**” button is clicked. In the calibration submenu at the top, text appears stating that no signal should be applied to the input. If probes are attached to the oscilloscope inputs (CH-1 and CH-2) while performing the offset calibration, the probes must also be removed. Then click on the “**Calibrate**” button in the submenu. At the end of this process, an information message that the calibration is finished appears in the information window next to the button.



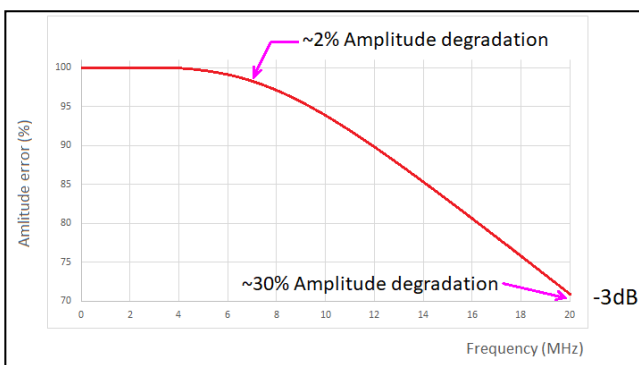
DSO GAIN calibration:

Gain calibration is done to increase the measurement accuracy of the oscilloscope. To calibrate, first click the “DSO GAIN” button. After the 50Hz-6Vpp sine reference signal is applied to the input in the submenu, an information message indicating that the calibration process should be performed is displayed.

There are two buttons in the submenu. To calibrate Channel 1, apply the reference signal to the CH-1 input and click the “Calib. CH-1” button. Then, the reference signal is applied to the CH-2 input and the calibration process is completed by clicking the “Calib. CH-2” button.



Important note: As the frequency of the measured signal increases, the amplitude weakens. While

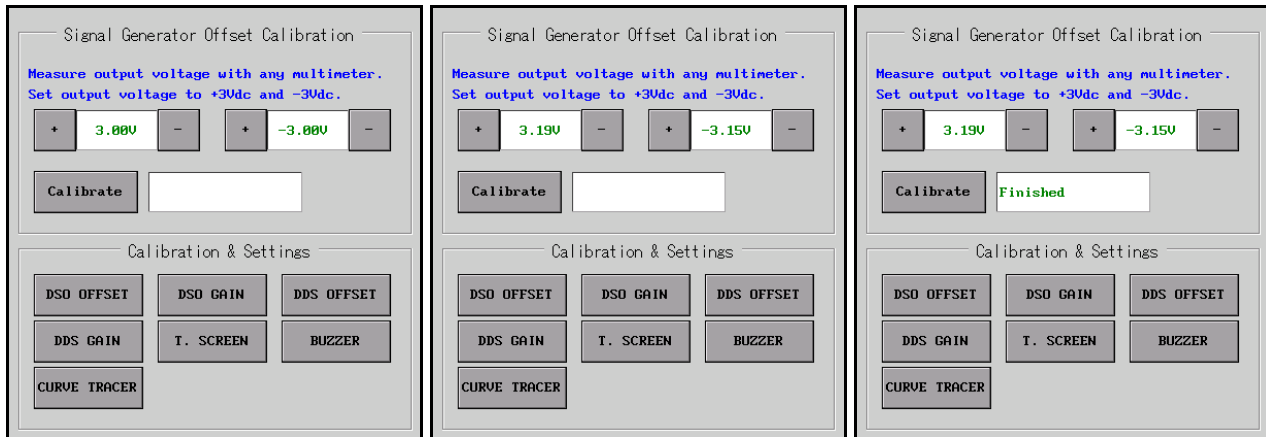


determining the bandwidth of the oscilloscopes, the frequency value at which the measured signal power is weakened by -3dB is taken as a basis. Expressed in terms of voltage, this corresponds to about 30% attenuation. A 20 MHz oscilloscope is generally guaranteed to have less than 30% attenuation at 20 MHz. To achieve voltage accuracy better than 2% on the UCE-DSO4200C, the frequency of the signal applied to the inputs must be less than 7 MHz.

DDS OFFSET calibration:

This calibration is done for the offset adjustment of the signal generator. To calibrate, first click the “**DDS OFFSET**” button. In the submenu, an information message appears that the signal generator output (GEN) should be measured with a multimeter.

In the submenu, there are two parameter settings as +3Vdc and -3Vdc. The left parameter is adjusted until the voltage measured on the multimeter (DC range) is **+3.00V**. Then the right parameter is adjusted so that the output is **-3.00V**. After the adjustment process is completed, the calibration process is completed by clicking the “**Calibrate**” button.



The parameter can be adjusted in three different ways.

- By clicking the “+” and “-” buttons next to the parameters.
- By turning Rotary-1 for +3V and Rotary-2 for -3V (Clockwise turn increases the value, counterclockwise decreases the value).
- If the mouse is active, when the cursor is placed on the parameter to be adjusted, the parameter is marked with a red frame. In this case, the parameter can be adjusted by turning the scroll.



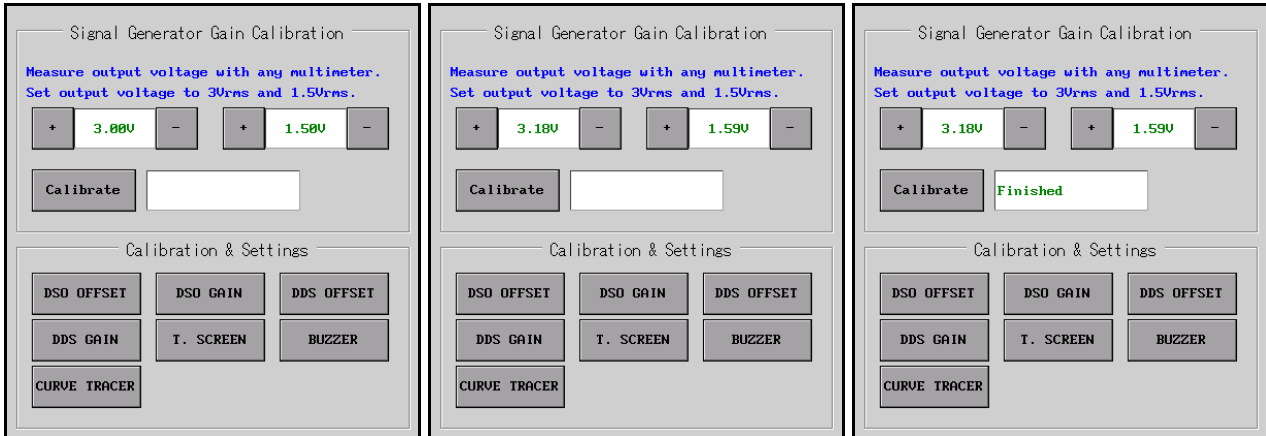
DDS GAIN calibration:

This calibration is done for the gain adjustment of the signal generator. To calibrate, first click on the “**DDS GAIN**” button. In the submenu, an information message appears that the signal generator output (GEN) should be measured with a multimeter.

There are two parameter settings in the submenu as 3Vrms and 1.5Vrms. The parameter on the left is adjusted until the voltage measured on the multimeter (AC range) is **3.00Vrms**. Then the right parameter is adjusted so that the output is **1.50Vrms**. After the adjustment process is completed, the calibration process is completed by clicking the “**Calibrate**” button. The fact that the multimeter to be used in the calibration has TRUE RMS will make the calibration more successful.

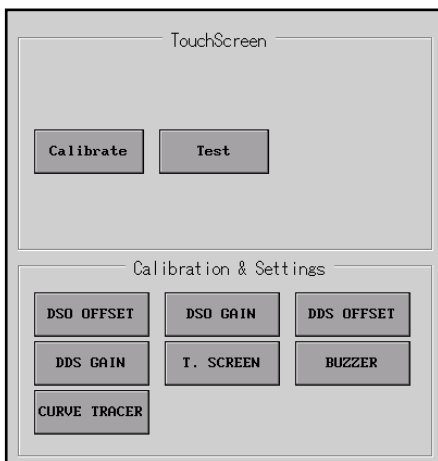
The parameter can be adjusted in three different ways.

- By clicking the “+” and “-” buttons next to the parameters.
- By turning Rotary-1 for 3Vrms and Rotary-2 for 1.5Vrms (Clockwise turn increases the value, counterclockwise decreases the value).
- If the mouse is active, when the cursor is placed on the parameter to be adjusted, the parameter is marked with a red frame. In this case, the parameter can be adjusted by turning the scroll.



Touch screen calibration:

When there is a problem with the screen touch, it can be recalibrated or the performance of the touch can be tested before calibrating. Clicking on the “**T. SCREEN**” button opens the submenu related to the screen touch. Clicking on the “**Test**” button in the submenu opens a screen on which drawings can be made. Here, it is decided whether there is a need for calibration by touching the screen and observing the response of the screen. The response of the screen to touch is different than the capacitive screens. Touching with fingers does not give good results on resistive type screens. For this reason, it is recommended to use a touch pen. If the pen is not to be used, good results can also be obtained by touching it with a fingernail. Touching with light pressure may cause erroneous operations. It should not be forgotten that since the resistive panels are mechanical in nature, it is necessary to press with a little pressure.



If you want the screen to be recalibrated, click the “**Calibrate**” button. 5 boxes appear on a white screen with 2 second intervals. The center of the box is kept pressed with the help of a pencil until the next box appears on the screen. If the calibration was successful when the box in the center of the screen is touched in the last step, an information message about this will appear on the screen and the calibration screen will be exited.

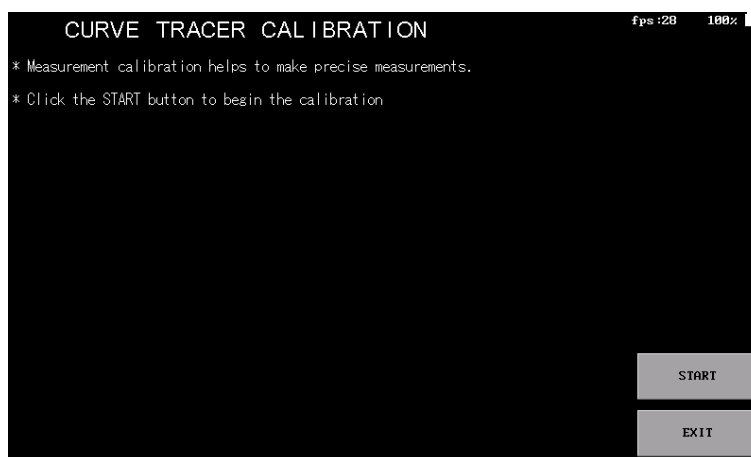
Buzzer setting:

When the “**BUZZER**” button is clicked, the submenu for the buzzer-related settings is opened. There are 4 different buttons in the submenu. Two of them are the test button. Buzzer has two different tones. The “**Low Freq**” and “**High Freq**” buttons can be used to test low and high frequency tones. The other two buttons are the settings for the buzzer to make a sound on touches or not. When the “**Buzzer ON**” button is clicked, the buzzer is set to sound when the buttons are touched or the rotary encoders are rotated. When the “**Buzzer OFF**” button is clicked, the buzzer's sound is turned off.

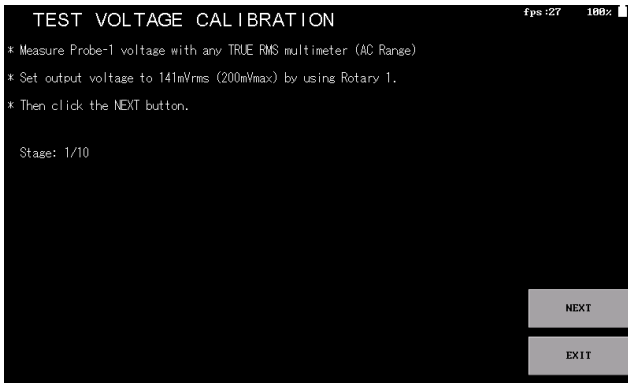


Curve Tracer calibration:

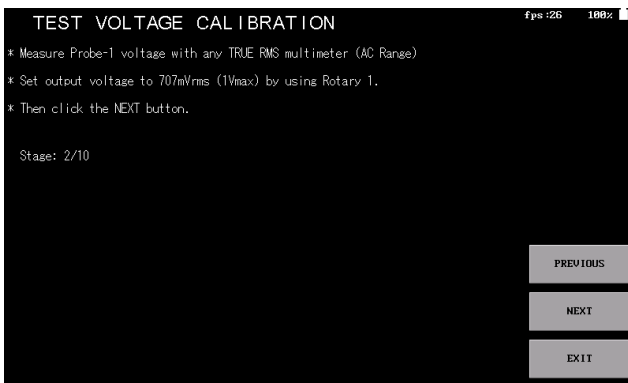
In the Tracer menu, an impedance curve should be formed as a horizontal (0 degrees) line when the probes are idle, and a vertical (90 degrees) line when short circuited. Also, the size of the horizontal and vertical lines must be 8 squares (end to end). If there is a deflection in these values, the performance of the device can be increased by calibrating. Click the “**CURVE TRACER**” button to enter the calibration menu.



The calibration process consists of 10 steps. Click the “**START**” button to start.



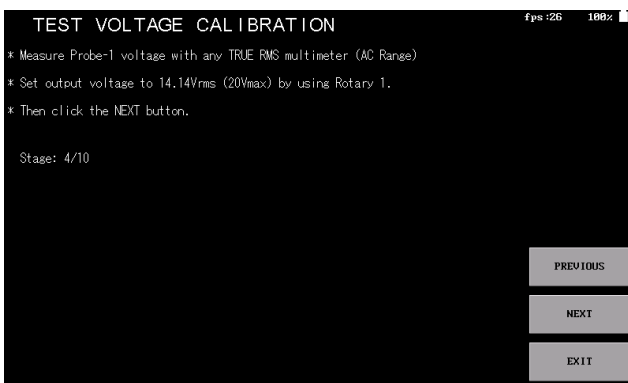
In the first stage, it is requested to measure the Probe-1 input with a multimeter and set the output voltage to **141mVrms**. A multimeter with TRUE RMS feature is connected to the Probe-1 and the measurement is made in AC range. Rotate the Rotary-1 (clockwise to increase, counterclockwise to decrease) until the multimeter reads 141mVrms. If the mouse is actively used, adjustment can also be made by turning the scroll. After the adjustment is made, the “**NEXT**” button is clicked to proceed to the next step.



In the second stage, the output voltage is adjusted as **707mVrms**, similar to the previous one, and then the “**NEXT**” button is clicked. If there is a need to make corrections in the previous level, the “**PREVIOUS**” button is clicked.



In the 3rd stage, the output voltage is adjusted to **1.41Vrms** and then the “**NEXT**” button is clicked to proceed to the next stage.



In the 4th stage, the output voltage is set to **14.14Vrms** and then the “**NEXT**” button is clicked to proceed to the next stage.



In the 5th stage, the gain adjustment is made automatically. This step may take some time to complete. When the stage is completed, the “NEXT” button becomes active. Clicking the button will move to the next step.



In the 6th step, offset adjustment is made automatically. When the stage is completed, the “NEXT” button becomes active. Clicking the button will move to the next step.



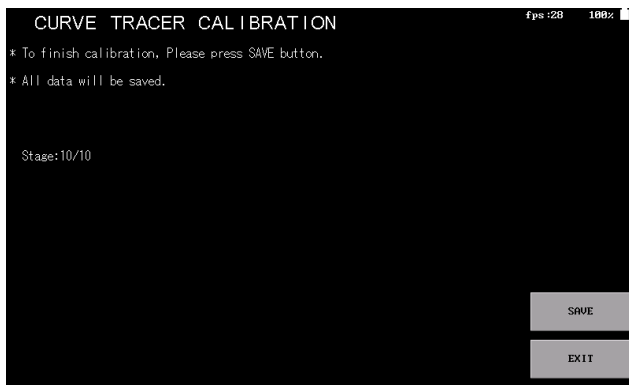
In the 7th stage, the open circuit impedance adjustment is made automatically. When the stage is completed, the “NEXT” button becomes active. Clicking the button will move to the next step.



In the 8th step, probe calibration is performed. The probes of the device are connected to the probe-1 input and the terminals are short-circuited. When short-circuited, the impedance value is seen and the “NEXT” button becomes active. Clicking the button will move to the next step.

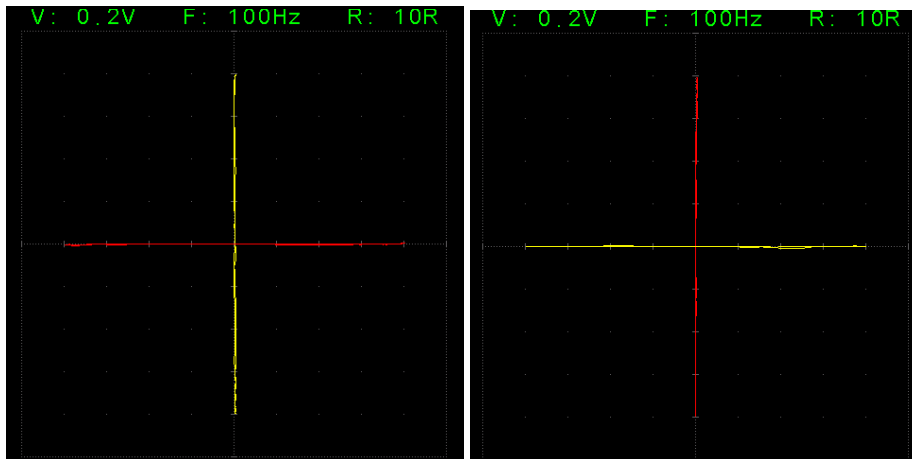


In the 9th step, probe calibration is performed. The probes of the device are connected to the probe-2 input and the terminals are short-circuited. When short-circuited, the impedance value is seen and the **“NEXT”** button becomes active. Clicking the button will move to the next step.



In the 10th and last stage, the calibration data is saved to the disk. By clicking the **“SAVE”** button, the data is saved and the calibration is completed. Click the **“EXIT”** button to exit the menu.

Whether the calibration is done correctly or not can be checked from the curve tracer menu. It is especially recommended that the test be performed at the 10R range. Calibration is successful if Probe-1 and Probe-2 channels are open and short-circuit curves look like below.



10. PC Program

Control of three modes of UCE-DSO4200C can be done with PC program (PC_DSO4200.exe). There are vertically arranged tabs on the left side of the screen (Figure 16).

- Oscilloscope,
- Signal Generator,
- Curve Tracer,
- About.

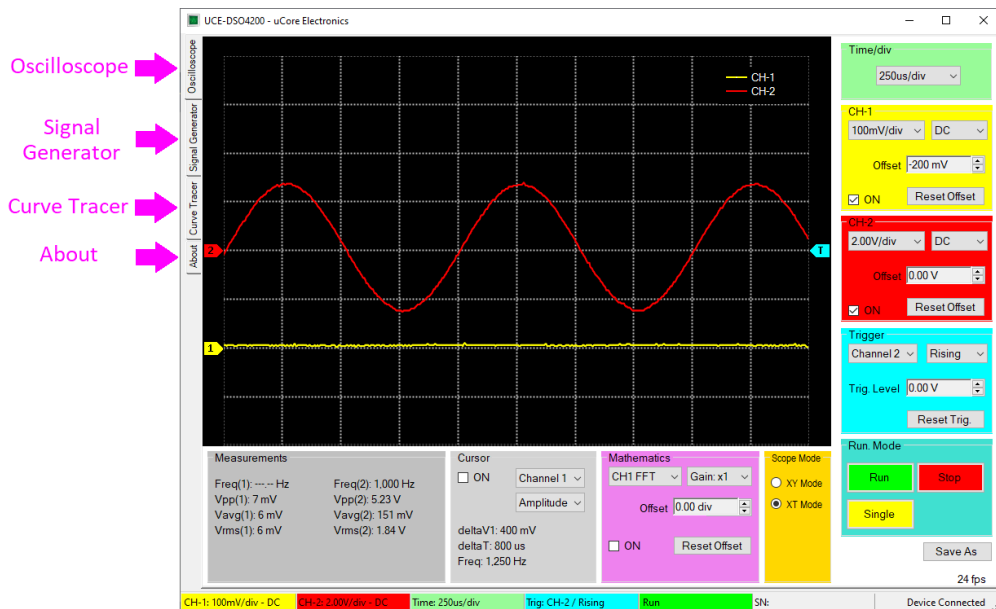
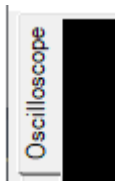


Figure 16. PC program (Oscilloscope menu active)

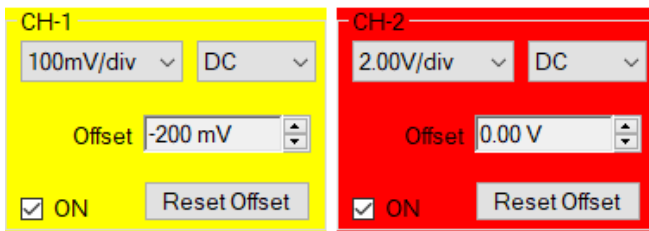
In this section, the use of the PC program will be briefly discussed. The functions are explained in detail in the device usage.

10.1. Oscilloscope menu

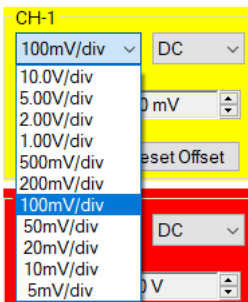
Click the “Oscilloscope” tab on the left to open the oscilloscope menu.



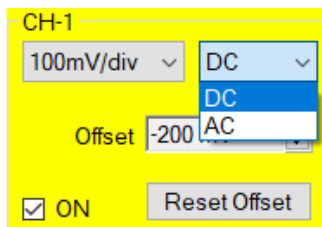
When the oscilloscope menu is opened, the device also switches to oscilloscope mode and simultaneously the data is reflected in the graphics area. As shown below, channel-1 is set in the yellow section, while channel-2 is set in the red colored section.



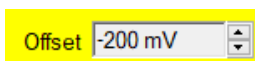
To set the vertical scale of the channel, click on the parameter to open the scale list and click on the desired value.



It is possible to adjust the coupling in a similar way. It is selected by clicking the parameter and clicking the desired coupling from the list.



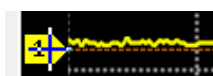
The offset is adjusted in two different ways. It can be adjusted by clicking the up and down arrows next to the offset parameter below, or it can be adjusted quickly by holding the GND reference of the channel with the mouse cursor and dragging it up and down. When the mouse cursor is over the channel GND reference, the shape of the cursor becomes "+".



Adjustment with the arrow buttons next to the offset parameter.



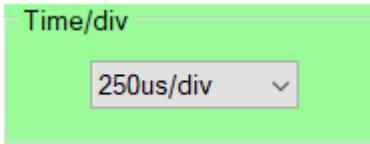
When the mouse is over it, the cursor appears in the "+" form



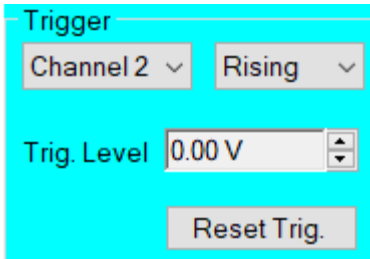
The reference level is displayed as a horizontal dashed line when dragged.

When the **"Reset Offset"** button is clicked, the offset is set to 0V.

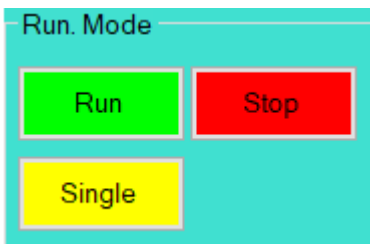
To activate the channel, **ON** is checked (unchecked to make it passive).



The horizontal time base is set in this section. When the parameter is clicked, the desired value is selected from the drop-down list.



In the trigger section; settings such as the channel where the trigger will be made, the trigger edge, the trigger level is made. The trigger level can be adjusted by clicking the up-down arrows next to the “**Trig. Level**” parameter. Similar to the offset adjustment, the trigger reference (**1**) can be adjusted by dragging it with the mouse. When the “**Reset Trig.**”



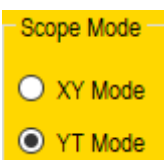
button is clicked, the trigger level is set to 0V.

The operating mode is detailed in the device usage. See section 3.5 for detailed information. It is possible to select three different operating modes by clicking the buttons here. In **Stop** operation, the position of the displayed waveform in the buffer is visible at the top of the screen. By holding down the left mouse button and dragging the green box, it is possible to see the sampled but not displayed data on the screen.

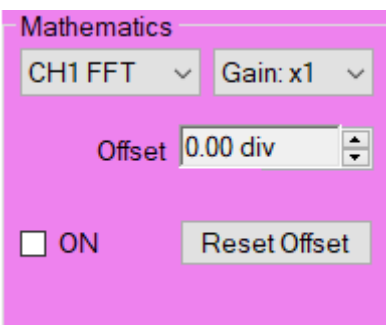


Measurements	
Freq(1): --- Hz	Freq(2): 1.000 Hz
Vpp(1): 7 mV	Vpp(2): 5.23 V
Vavg(1): 6 mV	Vavg(2): 151 mV
Vrms(1): 6 mV	Vrms(2): 1.84 V

Automatic measurement values of channels are displayed in this field. The values marked with (1) are the data of channel-1, the values marked with (2) are the data of channel-2.



It is the selection of the time base mode described in section 3.6.

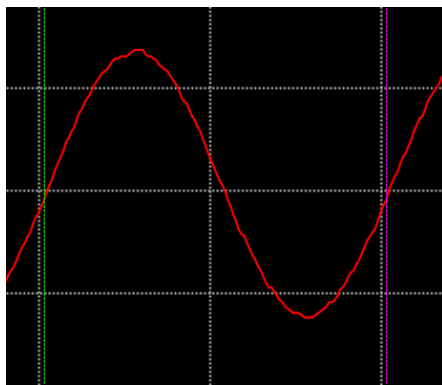


The “**ON**” checkbox is marked to activate the Mathematics menu. At the top, the mathematical operation is selected and the gain adjustment is made. The “**Offset**” parameter can be adjusted to position the math channel on the screen. Parameter setting is made as +4 and -4 div. When the “**Reset Offset**” button is clicked, the offset value is set to 0 div.

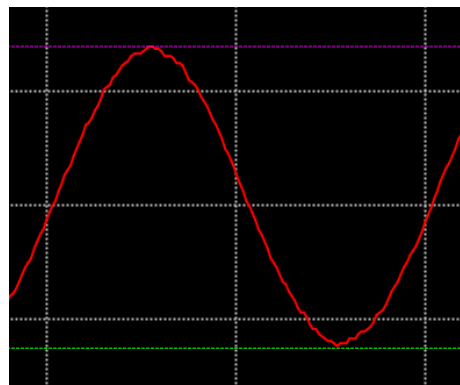


Manual measurement of waveforms is also available in the PC program, similar to the instrument. The “ON” checkbox is marked to activate the measurement. If it is desired to measure on the Y axis, the second parameter is selected as “Amplitude”. In this case, horizontal cursors are active. The cursors are in two different colors, green and magenta. While holding down the left button and dragging, the green cursor moves, while holding down the right button and dragging, the magenta cursor moves vertically. The voltage difference between the two cursors is seen at the bottom as **deltaV2** (deltaV1 if measuring for Channel 1). Since CH-1 and

CH-2 may have different volt/div values, the channel where the measurement is made (Channel 1 or Channel 2) should be selected in the upper parameter. If it is desired to measure in the X axis, the second parameter is selected as “Time” (channel selection does not affect). In this case, vertical cursors are enabled. While dragging with the left button, the green cursor is moved horizontally, while dragging with the right button, the magenta cursor is moved horizontally. The time difference between the two cursors is shown below as **deltaT**. The frequency value for this time period is displayed as **Freq**.



X-axis measurement



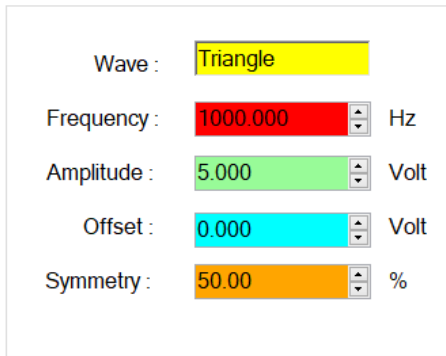
Y-axis measurement

10.2. Signal generator

Click the “Signal Generator” tab on the left to open the signal generator menu. It has an interface that is very similar to the design on the device. There is a preview of the signal at the top, the signal buttons at the bottom and the parameter settings at the top right.



General information about the signal generator is explained in Chapter 5.



The parameter is set in three different ways.

- With the up-down arrows next to it,
- Entering numbers from the numeric keypad in the parameter field and then clicking **Enter**,
- By scrolling the mouse cursor over the parameter.

While changing the parameter, the generated signal is updated instantly.

10.3. Curve tracer

Click on the “**Curve Tracer**” tab on the left to open the curve tracer menu.



The screen consists of two parts. On the left is the V-I impedance curve and on the right is the menu area. The menu area consists of two tabs, “**Basic Mode**” and “**Advanced Mode**” (Figure 17).

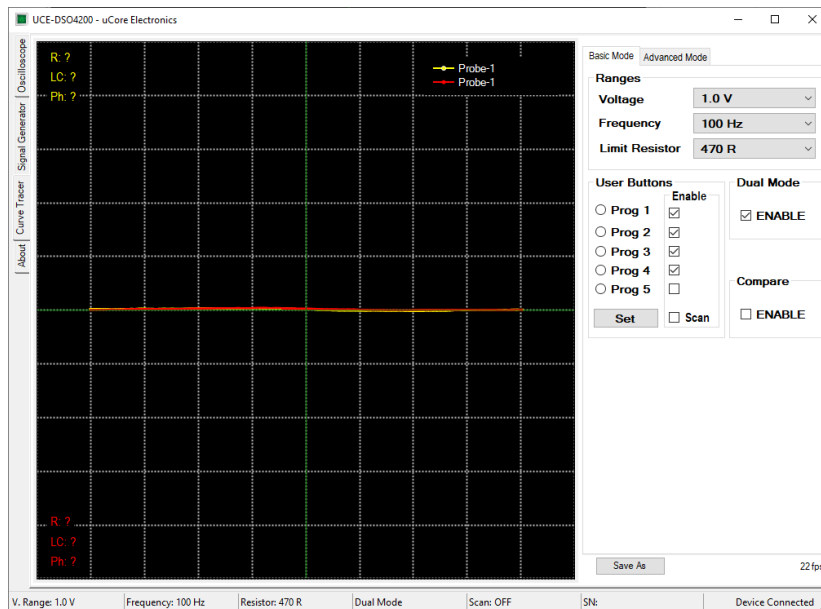
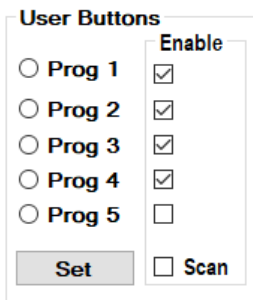


Figure 17. Curve tracer overview

Basic Mode: It is the menu where basic settings such as test voltage, test frequency and source resistance are made. In addition, scanning mode and dual channel operating mode settings are also made in this menu (Figure 17).

Dual Mode: It allows simultaneous use of Probe-1 (yellow color) and Probe-2 (red color) channels. If a single channel is used, only Probe-1 is active.

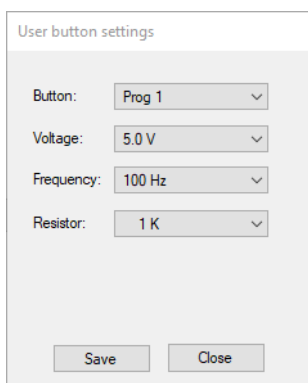
Compare: Compares the similarity between two channels. DUAL mode must be active for comparison.



Prog 1-5: There are 5 programmable user buttons. Selected voltage, frequency and limit resistor combinations are stored in the memory.

Scan: Scans user buttons at regular intervals. By removing the tick next to the stage that is undesirable to be scanned, it is canceled.

Set: Programs user buttons. Clicking the button opens a new window. Voltage, frequency, resistance combinations are created in the window that opens. Then the button to be saved at the top is selected and the settings are saved by clicking the “Save” button. Click the “Close” button to close the window.



Save As: When this button is clicked, the impedance graph is saved to the computer in picture format (bmp, jpg, png, gif) (Figure 17).

Advanced Mode: It is the menu where operations related to the database are made (Figure 18).

Comparison tests are performed within a certain tolerance and this variable can be set by the user in this menu in percent. The result of the comparison is reported visually and audibly by the program. If the audible warning is not preferred, this feature can be turned off by the user from this menu.

In this menu, a database can be created for different electronic boards. The impedance curve of each point on the PCB is recorded. These records are matched with the visual image of the PCB to see which impedance curve is at which coordinate when testing the same board in the future. Thus, a very fast test is provided.

In order to use this feature, this mode must be activated first. When “Enable Database Mode” is checked, “Database Mode” is accessed.

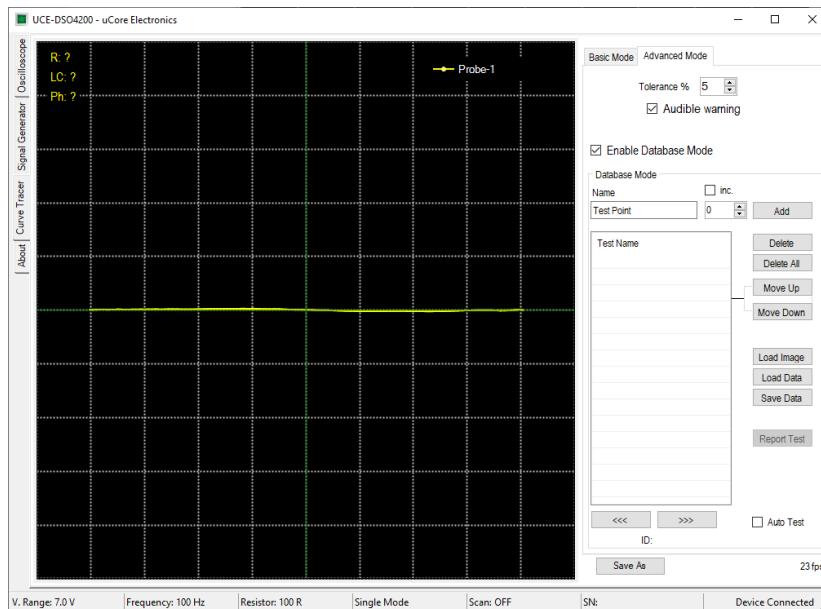


Figure 18. Advanced mode

There are many buttons in this section. These buttons;

Add: Adds a new test point to the database list.

Delete: Deletes the test point selected in the list.

Delete All: Deletes the entire list.

Move Up: Moves the selected test point up one position.

Move Down: Moves the selected test point down one position.

Load Image: Opens a new window to load the visual of the electronic board to be tested.

Load Data: Loads a database saved on disk to the list.

Save Data: Saves the created database on disk.

>>>: Selects the next test point.

<<<: Selects the previous test point.

There are also two checkboxes in this section.

Inc.: This check box adds an incremental number to the end of the test name. Thus, a different test name is created each time when the **Add** button is clicked.

Auto Test: This check box is selected to start the comparison test from the database.

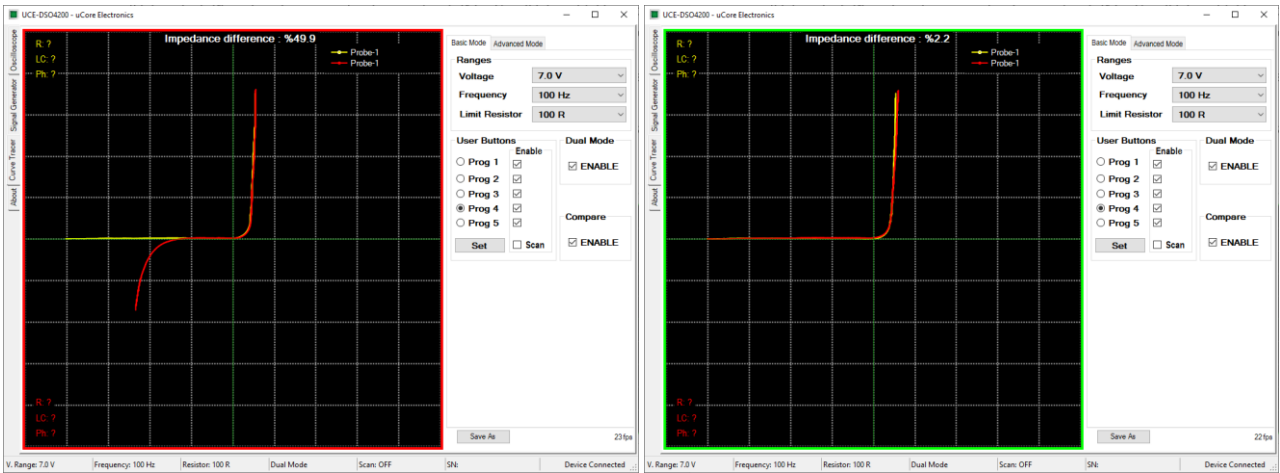


Figure 19. Two channel comparison in Dual Mode

When “**Compare**” is active, the comparison algorithm is also active. The impedance curve in both channels is compared with the algorithm. As a result of the comparison, a percentage value called “**Impedance difference**” is calculated. If this value exceeds the tolerance value (Figure 18) set in the “**Advanced Mode**” tab, the comparison will fail and a red frame will appear around the graphics area. If the comparison is successful, a green frame is formed (Figure 19).

If the “**Audible warning**” checkbox in the “**Advanced Mode**” tab is checked, it gives a different sound warning in case of success and failure as a result of the comparison.

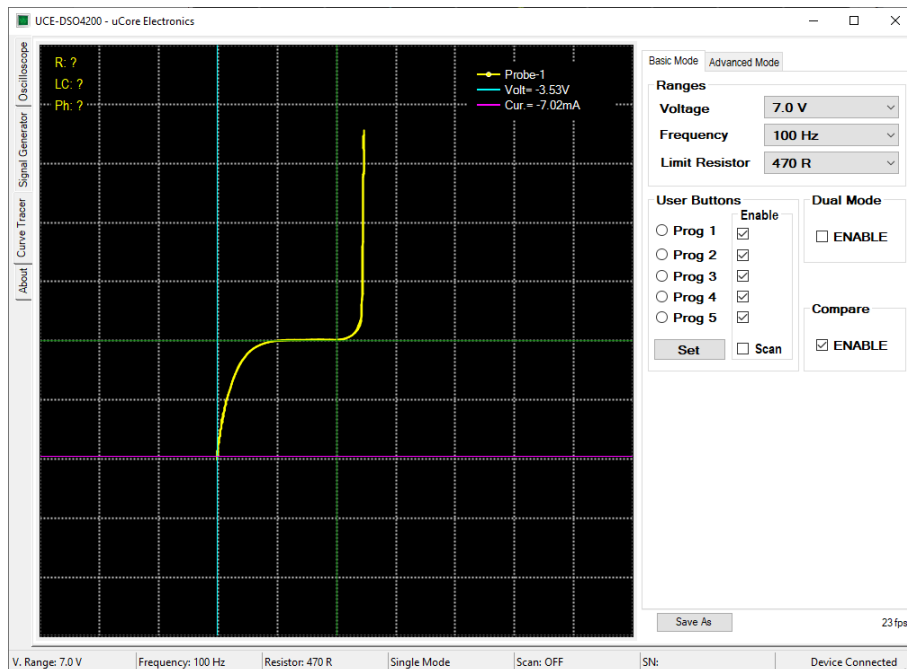


Figure 20. Analysis with Cursor

Cursor analysis becomes active when left-clicking anywhere on the graphics area. Two cursors appear on the graph. The vertical one is for the voltage and the horizontal one is the current. The current and voltage values at the intersection of the two cursors are seen in the upper right of the graph. With this feature, precise measurements can be made on the impedance curve. Cursors and measurement values become inactive when changing the test stage or right-clicking.

10.3.1. Creating a database

In the “Advanced Mode” tab, the “Enable Database Mode” checkbox is checked to activate the database mode. The first thing to do when creating a database is to load the electronic board image. To do this, click the “Load Image” button. On the page that opens (Figure 20), the image of the electronic board to be recorded is loaded by clicking the “Load” button.

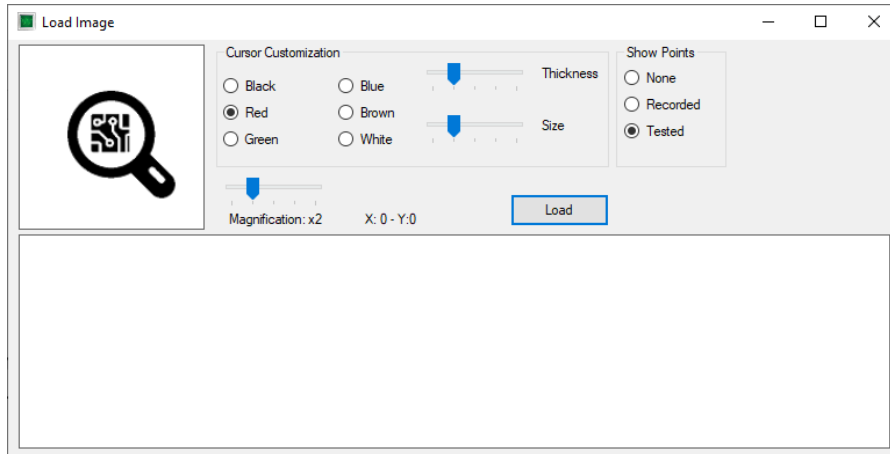


Figure 20. Overview of the Load Image window

On this window, cursor customization can be done. Depending on the color and density of the PCB, the color, size and thickness of the cursor can be changed by the user. There is also a magnifying screen. The position of the cursor on the PCB is seen more clearly in this area (Figure 21).

There are 3 features in the **Show Points** section.

- **None:** does not show any data on the image.
- **Recorded:** Shows all recorded points on the image.
- **Tested:** Marks the points according to the result of the test during the auto-test. The points that pass the test are marked in green, and those that fail the test are marked in red.

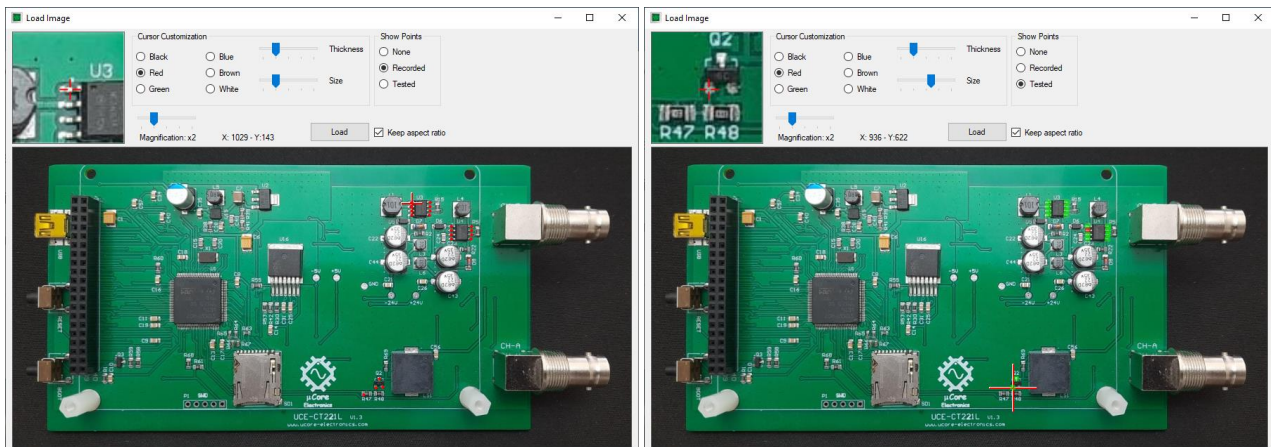


Figure 21. Load Image window (display of recorded and tested points)

Before starting the database creation, an electrical connection must be established between the GND point of the electronic board to be registered and the black probe at the Probe-1 input.

After the PCB image is loaded, the database creation can be started. First, the point to be measured is marked by clicking on the PCB image (Figure 21). Then, by touching the same point on the board with the probe and the impedance curve appears on the chart, it is added to the list by clicking the “**Add**” button (Figure 22). If no test point is selected in the list, the new point is added to the end of the list. If a new record is added by selecting a point from the list, then it is added below the selected point. Thus, new data can be added between the points in the list later.

If the name of a point in the list is desired to be changed, that point is selected first and then the “**F2**” key is pressed. The name of the test point can now be changed.

If there are incorrect or undesired test points, they can be deleted from the list with the “**Delete**” button. Or, if you want to change the order in the list, “**Move Up**” and “**Move Down**” buttons can be used. The item can also be shifted by drag and drop method.

When the list is completed, the **Save Data** button is clicked and recorded to the disk. The extension of the recorded file is “**uce4**” and does not include the board image. Therefore, it must be stored together with the image of the board.

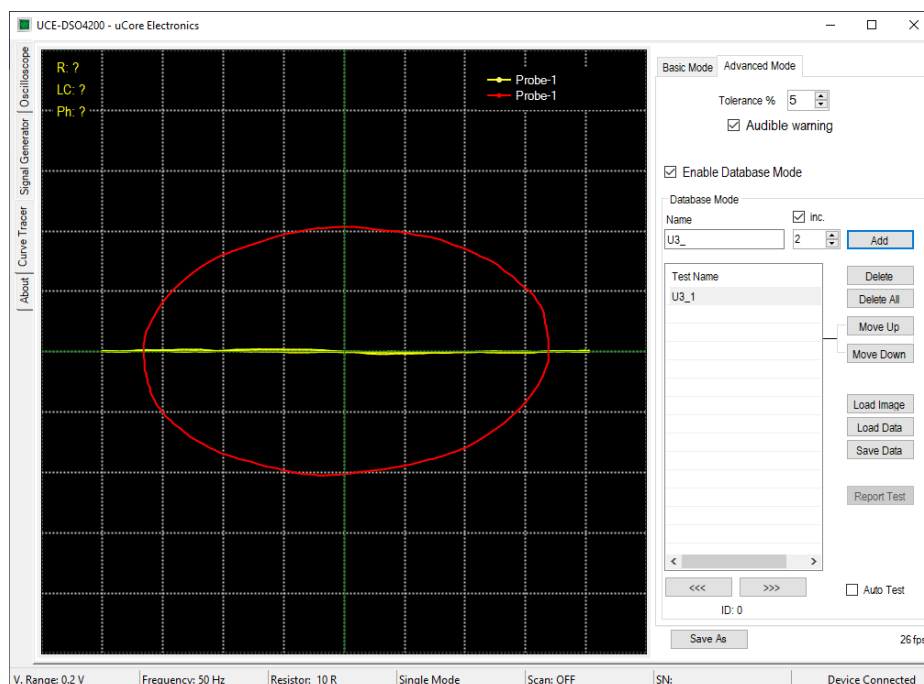


Figure 22. Creating a database

10.3.2. Comparison from database

In the “**Advanced Mode**” tab, the “**Enable Database Mode**” checkbox is checked to activate the database mode. Then click the “**Load Image**” button. In the window that opens, the image of the electronic board to be tested is loaded by clicking the “**Load**” button. Then, by clicking the “**Load Data**” button in the main window, the digital data of the electronic board is loaded into the list. When the points in the list are clicked, the position on the board and the impedance curve can be seen in the program. In Figure 23, when the point recorded with the name U3_1 is clicked on the list, its position on the board image can be seen. The red colored curve in the graph is the impedance curve for this point. The yellow curve is the impedance curve read from the Probe-1 input.

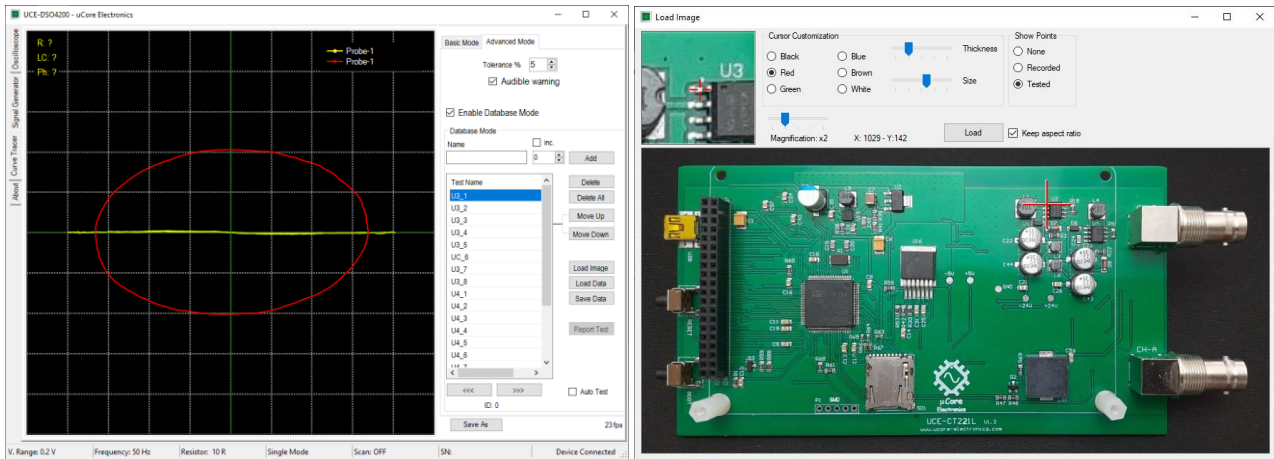


Figure 23. Comparison from database

When the “**Auto Test**” checkbox is checked, it switches to auto-test mode. From which point the test is desired, that point is selected by clicking on the list. Testing can now begin. When measuring with a probe on the real board, in the coordinate shown on the board image, impedance curves are compared by the algorithm. Both impedances can be observed on the chart. In addition, the impedance difference between the two data is also seen as a percentage at the top of the graph. If this value does not exceed the tolerance limit, the test passes, an audible warning sounds and a green frame is formed around the graph (Figure 24). Upon termination of the measurement, the next point is automatically moved. If the impedance difference exceeds the tolerance limit, the test fails and the color of the frame around the graph becomes red, giving a warning with a different tone. In this case, the next point is not automatically passed. In this case, the next point is not automatically moved. Clicking on the “>>>” button moves to the next point. When the test is terminated or finished, the “**Report Test**” button becomes active. Clicking on it generates the report of the test. You can find the details of the test steps in this file in pdf format.

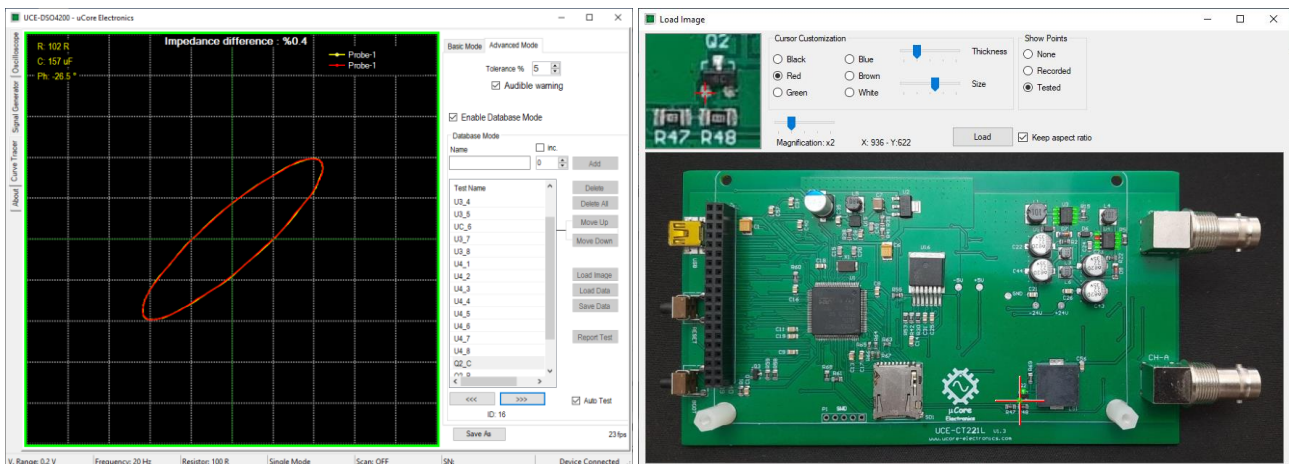


Figure 24. Auto-test mode

There may be some differences in the impedance curves caused by the production of electronic materials. Therefore, comparisons are made within tolerance. Another important factor affecting the impedance is the probe impedance. The same probes should be used when creating a database and testing afterwards. The difference in probe impedance can affect the curve. Also, in the database test, the GND point of the board should be the same as the reference point when creating it.

10.4. About tab

Click the “**About**” tab on the left to open the about menu.

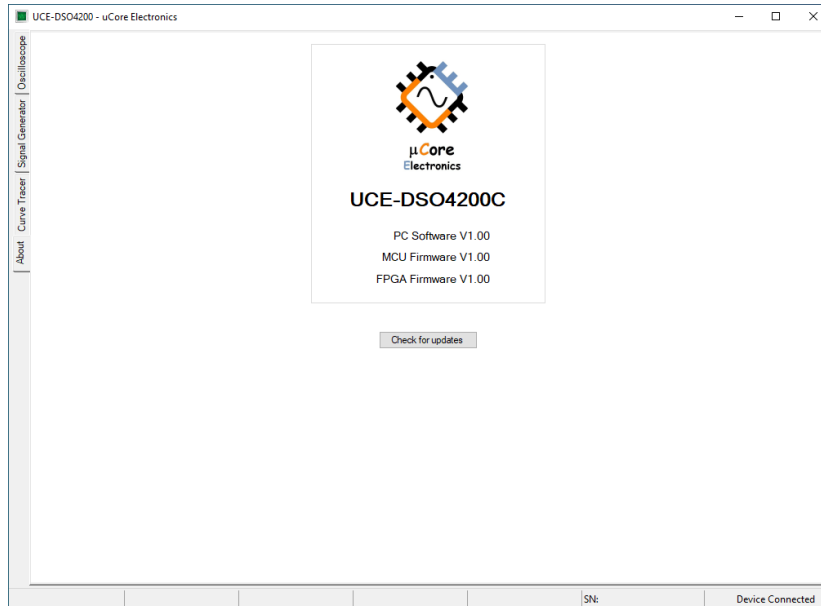


Figure 25. About tab overview

This is the section with information about the device and the PC program. It contains version information of device and PC program software. There is also a “**Check for updates**” button on the page. When the button is clicked, it is checked whether there is a software update related to the system. If new software is available, the download buttons are activated and related files are downloaded. The files are available in the “**downloads**” folder.

