



**μCore**  
Electronics



# UCE-DSO210 DIGITAL OSCILLOSCOPE

## USER MANUAL

FATİH GENÇ  
UCORE ELECTRONICS  
[www.ucore-electronics.com](http://www.ucore-electronics.com)

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# 1. Introduction

UCE-DSO210 is a new design 2-Channel 10Msps Oscilloscope to perform electronics maintenance, electronic engineering tasks, etc.

## Features:

1. Display: 3.2 inch 320×240 pixel color LCD
2. Personalization: customization of display colors
3. Two channels with BNC Connectors
4. X-Y Mode
5. Analogue Band width: 2MHz
6. Maximum sampling rate: 10Msps 12-bit
7. Sampling depth: 8192 data
8. Input Impedance: 1MΩ
9. Vertical sensitivity: 50mV/div to 20V/div
10. Horizontal sensitivity: 1.25us/div to 500ms/div
11. Maximum input voltage: ±10V (X1 Probe), ±100V (X10 Probe)
12. Supply voltage: 5V (mini USB)
13. Trig modes: Run, single, Hold functions
14. Trigger functions: rising / falling edge, Triggering Cursor
15. Auto measurement: frequency, on time, off time, peak-to-peak voltage, mean voltage, RMS voltage
16. Test signal: 1KHz %50 duty-cycle square wave, 3.3Vpp
17. Cursor: differential measurement for time and voltage
18. FFT analyze: 512 points FFT analysis and THD calculation (input: CH-A)
19. Signal generator: sinus, sinC, square, triangle, sawteeth, arbitrary (0~3.3V, output: CH-A)
20. PC connection: no driver required (USB HID protocol)
21. PC software
22. Firmware upgrade (bootload)
23. Menu language: English

## Package List:

1. 1 pc UCE-DSO210 3.2" TFT Digital Oscilloscope
2. 2 pcs X1, X10 Probe
3. 1 pc touch pen
4. 1 pc USB cable

## 2. Turn on or turn off

To turn on the device, plug the USB cable into any USB socket whose output voltage is 5V. Energy sources such as computer, adapter and external power bank may be used as voltage source.

To turn off the device, disconnecting power supply will be sufficient.

Caution: You must remove probes from test points before turning off the device.



Figure 1. Main Menu image

## 3. Oscilloscope Mode

To enter the oscilloscope mode, press the 'DSO' icon in the 'Main Menu'. The overview of the oscilloscope mode is as shown in Figure 2.

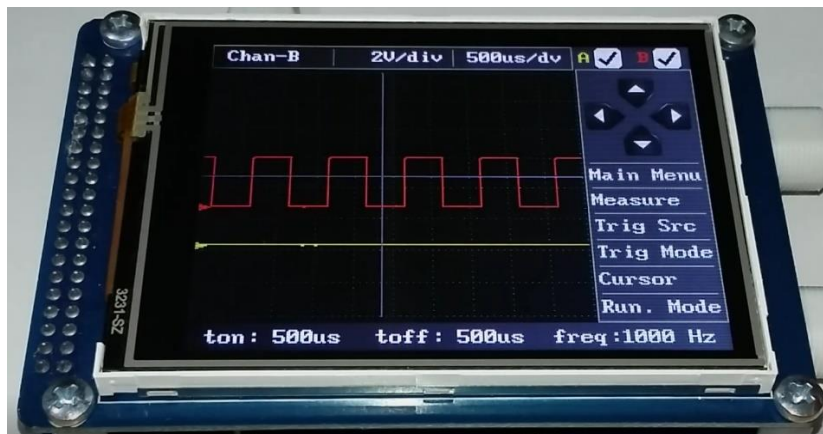


Figure 2. Oscilloscope Mode overview

### 3.1. Display Description

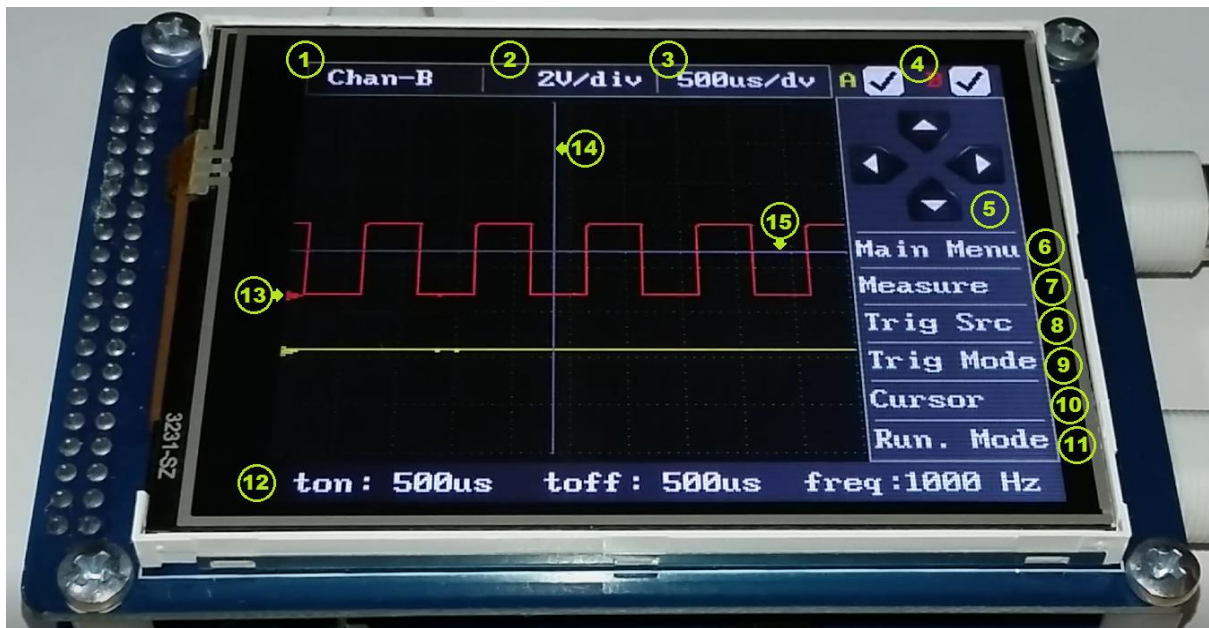


Figure 3. Oscilloscope mode display description

- 1) Channel selection: Select the channel whose vertical sensitivity is to be changed. Also, the measured values of the selected channel are shown in (12).
- 2) Vertical sensitivity: Set Volt/div of the channel selected in (1).
- 3) Horizontal sensitivity: Select sampling rate (Time/div).
- 4) Activation: Select channels required to show in display.
- 5) Four-way button: Set horizontal and vertical trigger levels (14, 15) in the oscilloscope mode. In cursor menu (10) will be used to precisely set positions of measurement cursors.
- 6) Main Menu: Return to the main menu.
- 7) Measure: Selecting measurement values desired to be shown in (12), as Time or voltage.
- 8) Trig Src: Selecting Trig source as A or B channel.
- 9) Trig Mode: Trigger is selected as rising edge or falling edge.
- 10) Cursor: To measure the time and voltage of the observed signal.
- 11) Run Mode: Setting Trig Mode as 'Run', 'Single' and 'Hold'.
- 12) The field to show measurements regarding the waveform.
- 13) This arrow mark at the beginning of each channel indicates ground level of that channel.
- 14) Indicates the horizontal trigger level.
- 15) Indicates the vertical trigger level.

## 3.2. Trig Source

To keep the observed signal stable on the display, the trigger source must be selected for that channel. Otherwise, it will be difficult to observe because the signal will be very moving on the display. To set the trigger source, the 'Trig Src' menu shown in figure 3 should be entered.

In Figure 4a, the trigger source is set to channel A, and interception occurs at the intersection of the horizontal (14) and vertical (15) triggering cursors. Since in Figure 4b, the trigger source is set to channel B interception occurs at channel B.

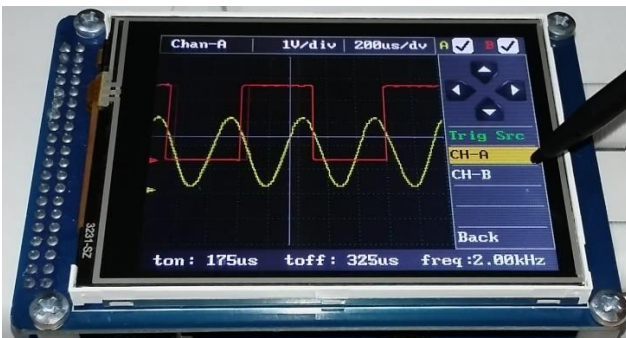


Figure 4a. Triggering setting for channel A.

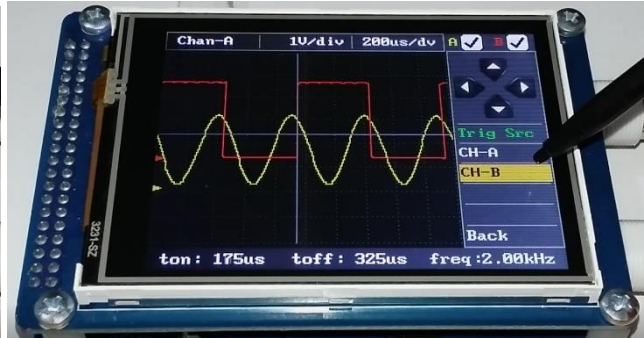


Figure 4b. Triggering setting for channel B.

## 3.3. Trig Modes

The triggering mode must be set in order to trigger on the rising and falling edge of the observed signal. In order to make this setting, 'Trig Mode' menu should be entered as shown at (9) in Figure 3.

Figure 5a shows the triggering of channel A on the rising edge. For this, 'Rising' has been selected in the 'Trig Mode' menu. Whereas in Figure 5b the A channel is triggered on the falling edge.

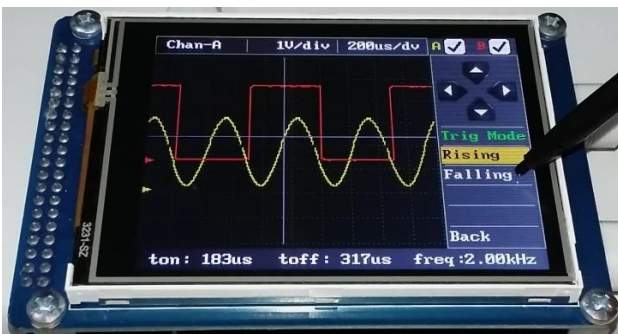


Figure 5a. Triggering on the rising edge (CH-A)

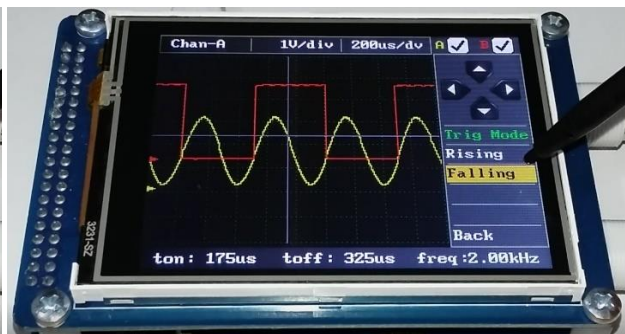


Figure 5b. Triggering on the falling edge (CH-A)



The triggering level of the captured signal may be changed with 'four-way button' (5).

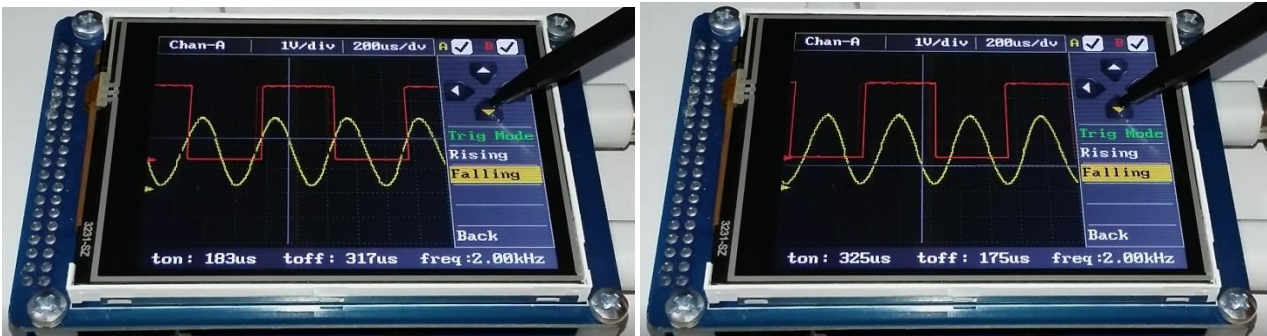


Figure 6. Trigger level setting

### 3.4. Vertical and Horizontal Sensitivity Setting

Vertical sensitivity setting is the setting corresponding to the voltage and horizontal sensitivity to the time setting. In order to observe signals in different frequencies and voltage levels, these settings need to be made properly. For signals with unknown frequency, the horizontal sensitivity will be increased from minimum level until becoming observable. The vertical sensitivity may be different for both channels, however the horizontal sensitivity corresponding to time is common.

Horizontal sensitivity can be set from **1.25 us/div** to **500 ms/div**. It is set from the menu (3) as shown in Figure 3.

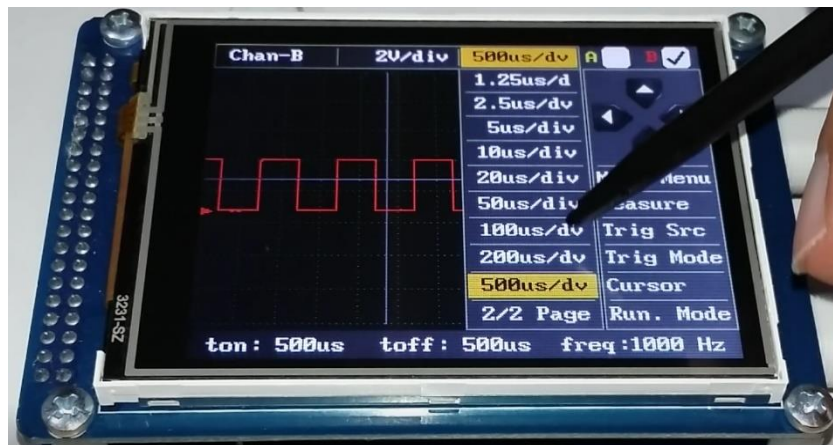


Figure 7. Horizontal sensitivity setting

Since vertical sensitivity may be set for each channel separately, initially the channel to be set will be selected at (1) in Figure 3. After channel selection is made, vertical sensitivity is set from the menu number (2). Vertical sensitivity can be set from **50 mV/div** to **20 V/div**.

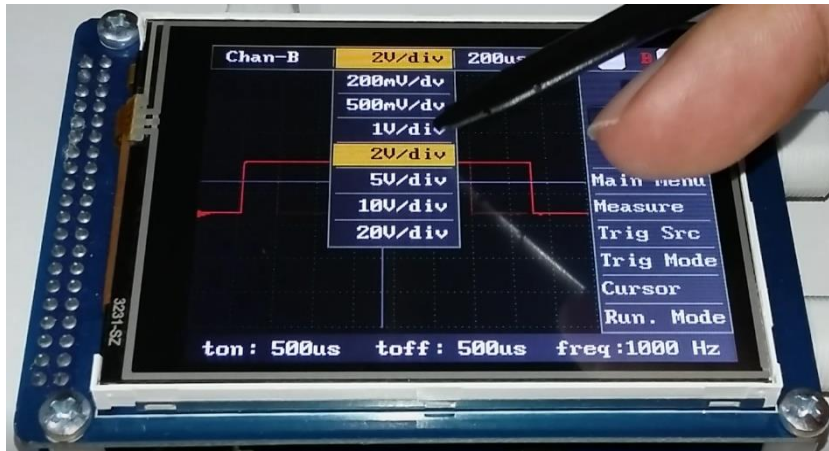


Figure 8. Vertical sensitivity setting

### 3.5. Cursor Function

The 'Cursor' menu is used to make measurements on the observed signal. There are four cursors, two for time measurement (t1 and t2) and two for voltage measurement (V1 and V2). To change the position of the cursors, the cursor to change the position will be selected first. Then the position of the cursor is set by touching on the display or by 'four-way button' (5). Measurement values are shown at (12) as time (delta T), voltage (delta V) and time dependent frequency.

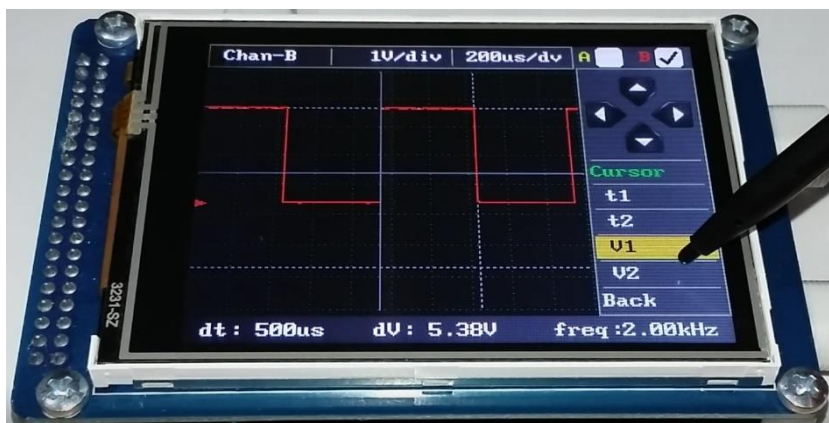


Figure 9. Measurement with cursor function



### 3.6. Auto Measurement

Some values of the signal are automatically calculated. Calculated values are collected in two categories.

- $T_{on}$ : The duration of the interval in which the signal is positive. If the level of the vertical trigger (15) is between the maximum and minimum values of the signal, it will be calculated as the time of the remaining portion above this level. If the trigger source (8) and the channel selection (1) belong to different channels, then the average of the maximum and minimum level is taken and the duration of the remaining time above this part is measured.
- $T_{off}$ : The inverse of  $t_{on}$  time. That is, the time remaining below vertical triggering (15) level. The measurement strategy in  $T_{on}$  time is also valid here.
- Freq: Frequency of the signal.
- $V_{pp}$ : Peak-to-peak voltage is the difference between the maximum and the minimum amplitudes of a waveform.
- $V_{rms}$ : The RMS value of the sampled signal.
- $V_{mean}$ : The mean value of the sampled signal.

The time values calculated for B channel (1) in Figure 10a are shown at (12). And also, voltage values are shown for B channel in Figure 10b.

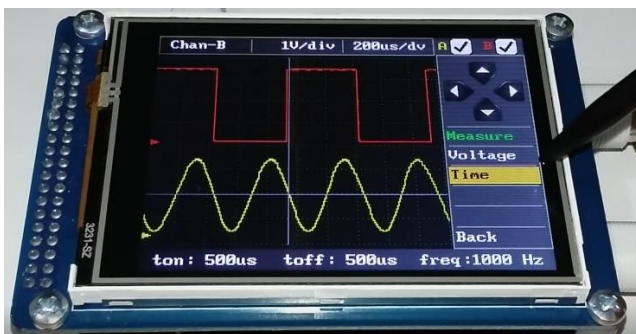


Figure 10a. Auto measurement for time. (CH-B)

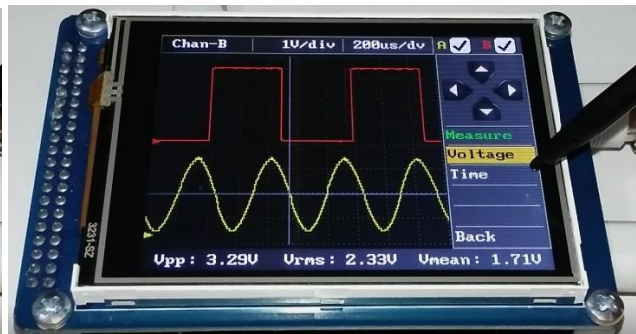


Figure 10b. Auto measurement for frequency (CH-B)

Figure 11 shows the measurement values in case of changing channel selection in (1) as A and B.

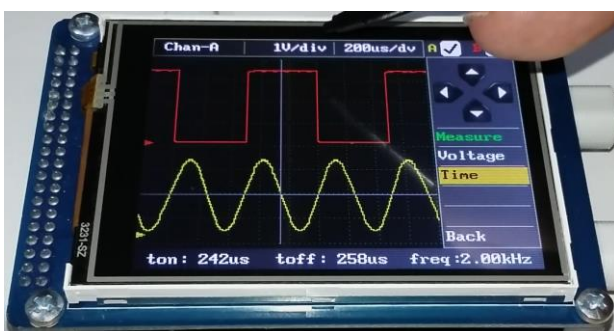


Figure 11a. Auto measurement for time (CH-A)

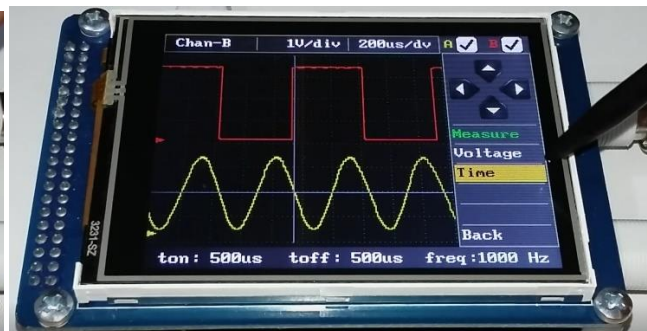


Figure 11b. Auto measurement for time (CH-B)

## 3.7. Operating Mode

The triggering requirement of the oscilloscope defined in the operating mode.

- **Running:** Determines wave form even if it cannot define triggering requirement in this operating 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 operating 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.
- **Hold:** When this button is pressed in any moment, the last signal in the display is frozen.

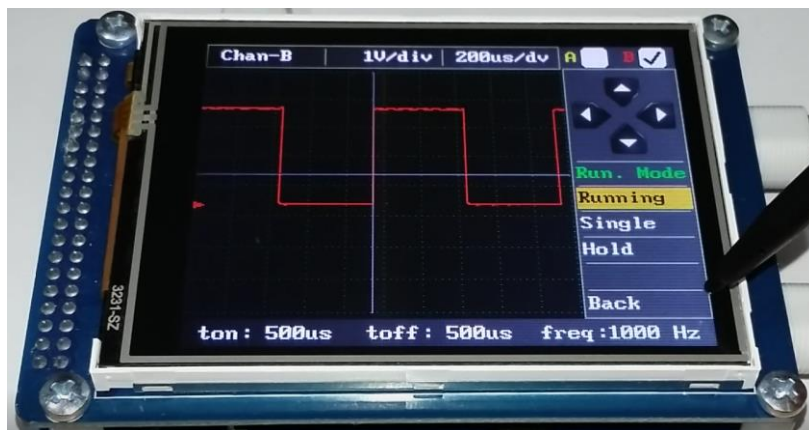


Figure 12. Operating mode

## 4. XY Operating Mode

The XY mode plots one channel against another on the screen. The XY mode is useful to show the phase relationship between periodic signals and for plotting the I-V (current-voltage) character of electronic components.

Electronic components can be characterized by applying a current-limited AC sine wave voltage, and plotting the resulting current flow (I) and voltage drop (V) on the oscilloscope in X-Y display mode.

While, the current flow causes a vertical trace deflection in the display, the voltage causes a horizontal trace deflection. The trace that appears on the display gives an analog signature for the component.

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.

The signature of a resistance is a line with a slope of 0 to 90 degrees. The capacitance signature is a circle or an ellipse. The diode is a combination of 2 or 3 lines at an angle close to 90 degrees.

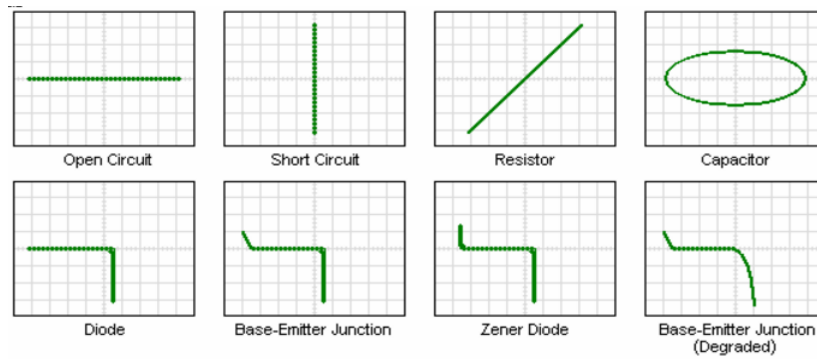


Figure 13. Component characteristics in XY mode (horizontal trace voltage, vertical trace current)

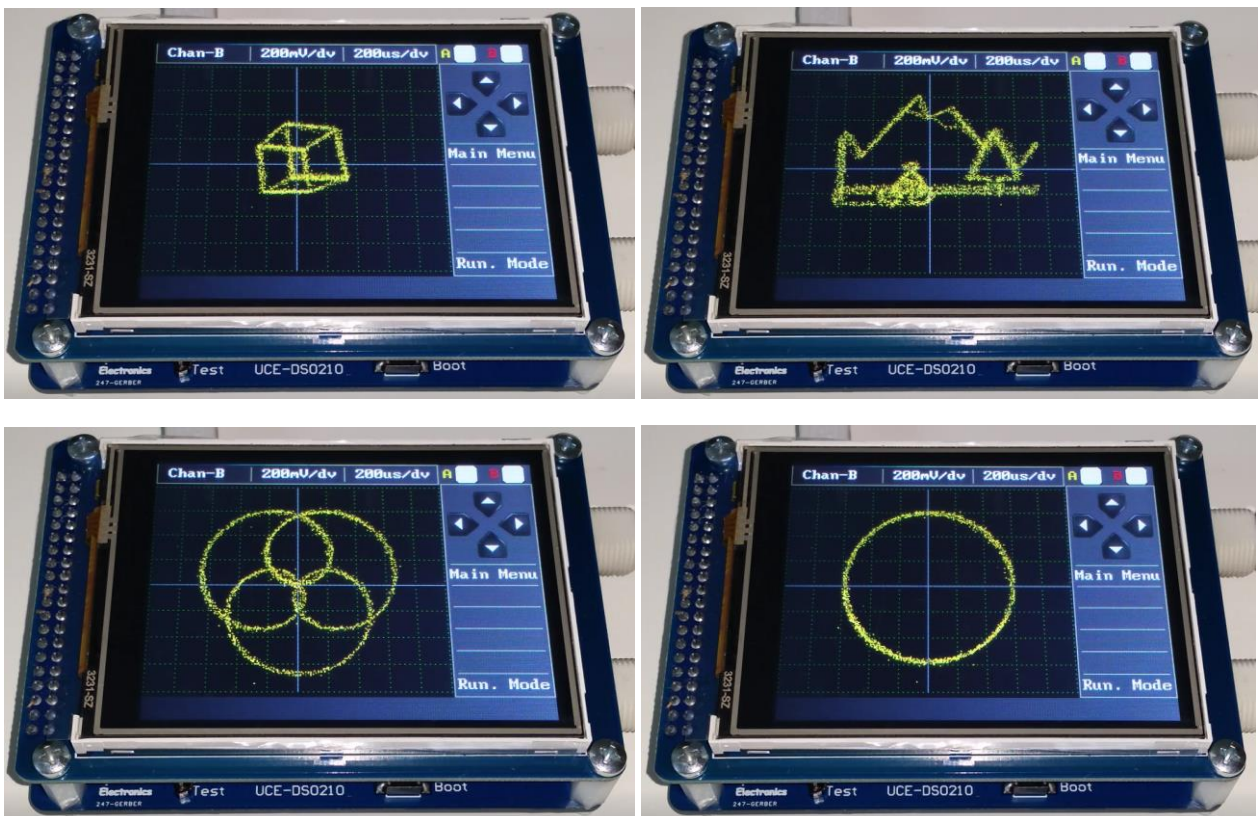


Figure 14. XY mode examples

## 5. FFT Analyze Mode

Fast-Fourier-Transform (FFT), is a transformation used to simply convert any signal in the time domain into frequency domain. In other words, the Fourier transformation is a sinusoidal decomposition of a sign. It separates harmonic components by determining periodic signals in complex ones.

In FFT analysis, the oscilloscope works as a single channel. FFT analysis result of the signal applied through channel A will be seen in channel B. The automatically calculated signal frequency and total harmonic distortion (THD) are shown at (12).



For more accurate calculation, the signal to be analyzed will be sampled in order to take 512 data during 3 periods. Frequency of the signal is calculated in this analysis and sampling rate is automatically adjusted. The frequency of the signal must be constant for this analysis to work correctly. When the accuracy of the calculations is confirmed, the color of the THD result turns green.

The 'Auto Mode' checkbox must be checked on the 'FFT settings' page in the 'Settings' menu in order to perform analysis in automatic mode. When operating in FFT analysis mode with automatic mode, the horizontal sensitivity section (3) is disabled and called as 'Auto' (Figure 15).

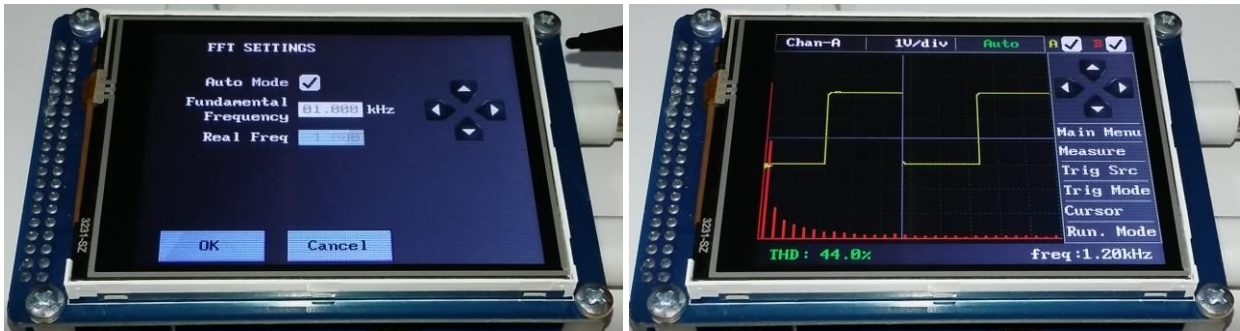


Figure 15. Square wave FFT analysis in automated mode

Sometimes it may not be possible to measure the frequency of some signals (e.g. SPWM, modified sine, etc.). In such cases, it cannot be possible to perform FFT analysis in automatic mode. If the fundamental frequency of the wave is known, the 'Auto Mode' check box is removed from the 'FFT settings' menu and the frequency input is activated. The fundamental frequency of the signal is entered into the 'Fundamental Frequency' section. Below of this section, it can be seen what the set frequency actually would be. As the frequency rises, any deviations may occur between the desired frequency and the actual frequency. The frequency range that can be entered from **20 Hz** to **50 kHz**. In this analysis mode, the horizontal sensitivity section (3) calls 'Fixed' as in (Figure 16).

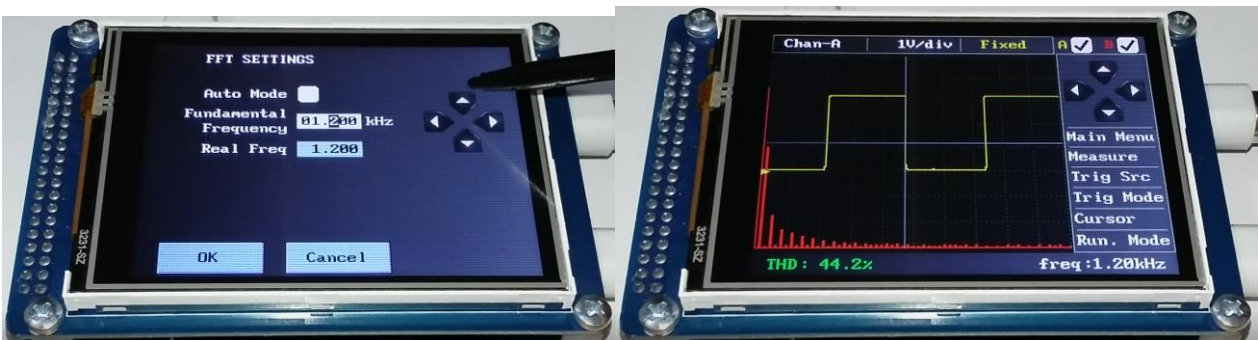


Figure 16. Fixed mode FFT analysis

The amplitude of the harmonic components in FFT analysis, is the same as the vertical sensitivity. The frequency/div ratio is six times as the frequency of the signal. In the example of Figure 16, the frequency/div value is  $1.2 \text{ kHz} * 6 = 7.2 \text{ kHz / div}$ . The number of harmonics shown in the FFT analysis is **60**.

## 6. Signal Generator

64-point data signals are produced by 12-bit 1-Msps DAC on the oscilloscope. When the 'Signal Generator' button is clicked in the main menu (Figure 1), the following menu is displayed (Figure 17). In that menu, there are some edit boxes where the offset voltage, amplitude and frequency can be set. In order to change the value which you need, click on it. The value will be marked in a frame. Desired value is set by using 'four direction arrow'. When the values are changed, the signal to be generated is refreshed in the graphic. Below the frequency box, it can be seen what the set frequency actually would be. As the frequency rises, any deviations may occur between the desired frequency and the actual frequency. The frequency range allowed to be entered is from **1 Hz** to **59999 Hz**. When the setting is finished, the 'OK' button is pressed to start the signal production. The signal output is over the CH-A connector. The impedance of the signal generator is **50  $\Omega$** .



Figure 17. Signal Generator main display

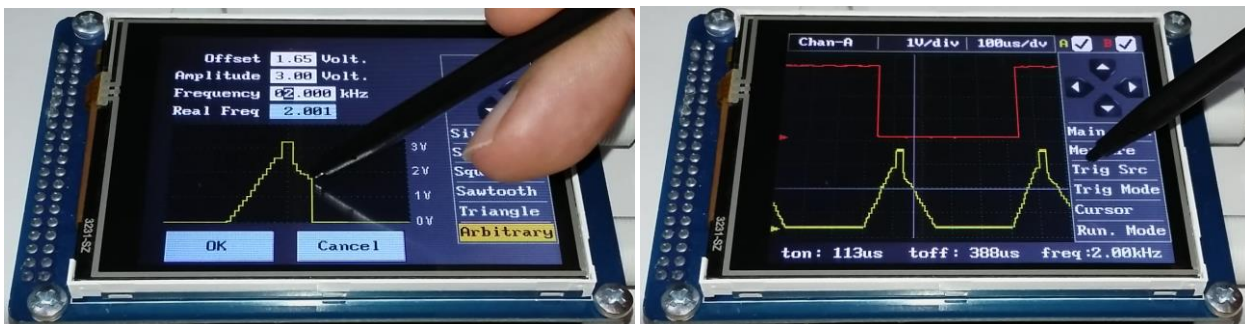


Figure 18. Arbitrary signal generation

On the right side of the display, there is a list of signal types that can be generated. In addition to the production of some basic signals (sinus, square, triangle, saw), a special signal, SinC function, may also be produced. In the arbitrary mode, it is also possible to produce special waveforms drawn on the graph with pen. This drawn waveform is kept in memory so that the device can be used again in the next boot. The signal must be generated by pressing the 'OK' button in order to store the signal data in the memory. If the drawing is canceled by pressing the 'Cancel' button, it will not be stored in the memory.



## 7. Settings Menu

Press 'Settings' (Figure 1) button in the main menu in order to enter setup menu. Settings regarding oscilloscope will be done in this menu.

- Screen Calibration: Calibration of touch panel
- ADC Calibration: Calibration of the sampling circuit
- FFT: Settings related to FFT analysis
- Set Colors: Color personalization

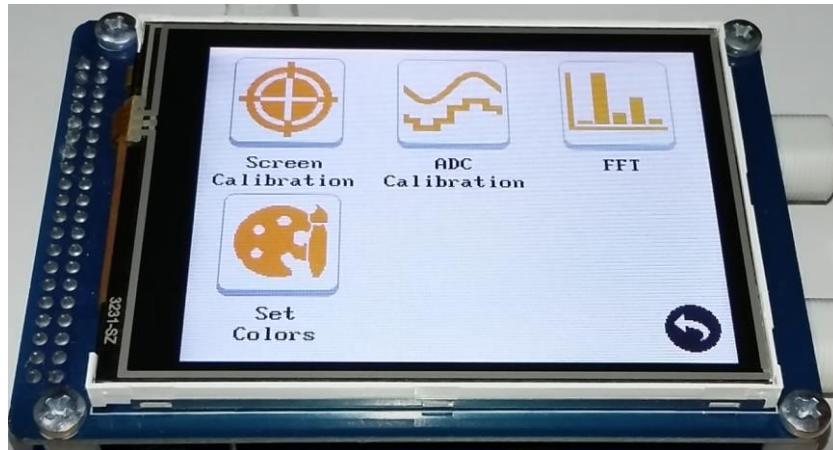


Figure 19. Setup Menu

### 7.1. Screen Calibration

When a more precise touch is needed, you may do touch panel calibration. To do this click 'Screen Calibration' and pass to the following display. Press in the middle of crosshair icon on the display with the pen. After four points, if the calibration is successful, the 'smiley face' symbol appears on the display and the program returns to settings menu. If the calibration is unsuccessful, the program prompts you to go back and repeat calibration.

Tip: Use medium touches instead of soft ones during calibration.



Figure 20. Screen Calibration

## 7.2. ADC Calibration

For a better signal sampling, a correct ADC calibration is necessary. Probes connected to both channels are connected to GND terminal for this (Figure 21). If the calibration parameters are stable within the specified limits touch anywhere on the display to complete the calibration and return to settings menu.



Figure 21. ADC calibration

## 7.3. FFT Setting

Settings for FFT analysis are made in this menu. The settings in this menu have already been described under the heading 'FFT Analyze Mode'.

## 7.4. Color Setting

The optimum color combination was chosen for the oscilloscope design. But it is also possible to personalize these colors. When the 'Set Colors' button on the Settings menu is clicked, we see the following display (Figure 22). In order to change predefined colors on the left side of display click on it. The new color is determined by clicking on the color palette on the right side. Once the color personalization is completed, click 'Save & Exit' button to save the colors and exit. If you want to restore the color combination to its original state, click the 'Default' button and click the 'Save & Exit' button to save.

There are **800** different colors on the color scale.



Figure 22. Color setting