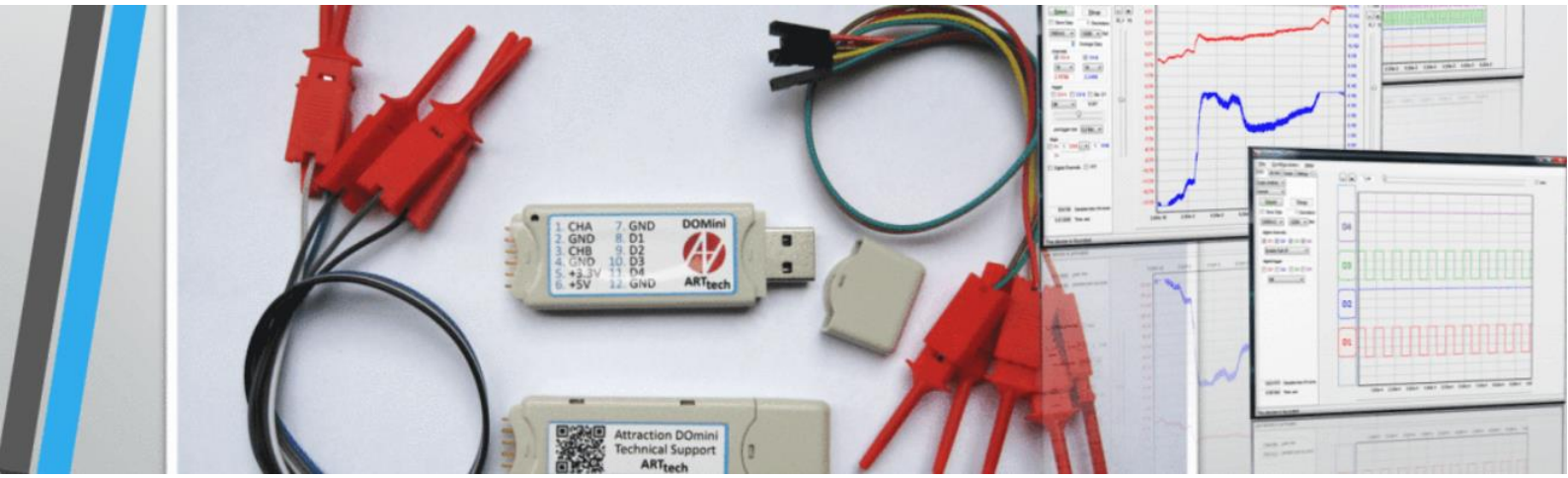
ArtTech Labs



Digital oscilloscope

Attraction DOmini

Control program

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1. Features

- 6 - measuring channels (2 analog + 4 digital)
- 4 - measurement modes (single, normal, auto, reader)
- Event trigger with data capture before the event
- Fourier analysis in real time
- The memory capacity is 26 400 measurements (logic analyzer up to 52 800)
- Number of measurements per second for analog channels from 5000 to 1 000 000
- Number of measurements per second for digital channels from 5000 to 12 000 000
- Available supply voltages + 3.3V and + 5V
- Calibrate sensors and create their own units
- Compatible with standard oscilloscope probe x1, x10
- The range of measured voltages CHA from -5 to + 5V (0-10V) and CHB from -15 to + 15V (0-30) with a probe x1
- ADC resolution - 10bit
- 4 digital inputs/outputs, PWM
- Digital interfaces: SPI, I2C, UART, 1-WIRE
- Supported modules: 16-bit ADC module, 22-bit ADC module, 12-bit DAC module, current monitor, optical module, DS18B20 temperature sensor.
- The program has a demo mode that allows you to see the operation of the oscilloscope.

2. Applying

- Time analysis of analog and digital signals
- Frequency analysis of signals (Fast Fourier Transform)
- Control of external devices using 4 I/O ports
- PWM signal generation from 3Hz to 10MHz
- Testing of chips with digital interfaces (SPI, I2C, UART, 1-WIRE)
- Use as a voltage source + 3.3V (up to 15mA) and + 5V (up to 50mA)
- Use as a data collection system (connection of various sensors: temperature sensors, moisture sensors, light, etc.)
- High-impedance detection of I/O ports (Z-state). Cannel CHA – 2.3V, cannel CHB – 1.8V (Z-state). Detection of line breaks, poor soldering, etc.
- Temperature measurement by a sensor DS18B20

Expansion modules

- Temperature measurement by a sensor DS18B20 (connect and measure)
- DAC MCP4921
- ADC MCP3550, AD7683
- Current monitor INA226

3. Interface of program

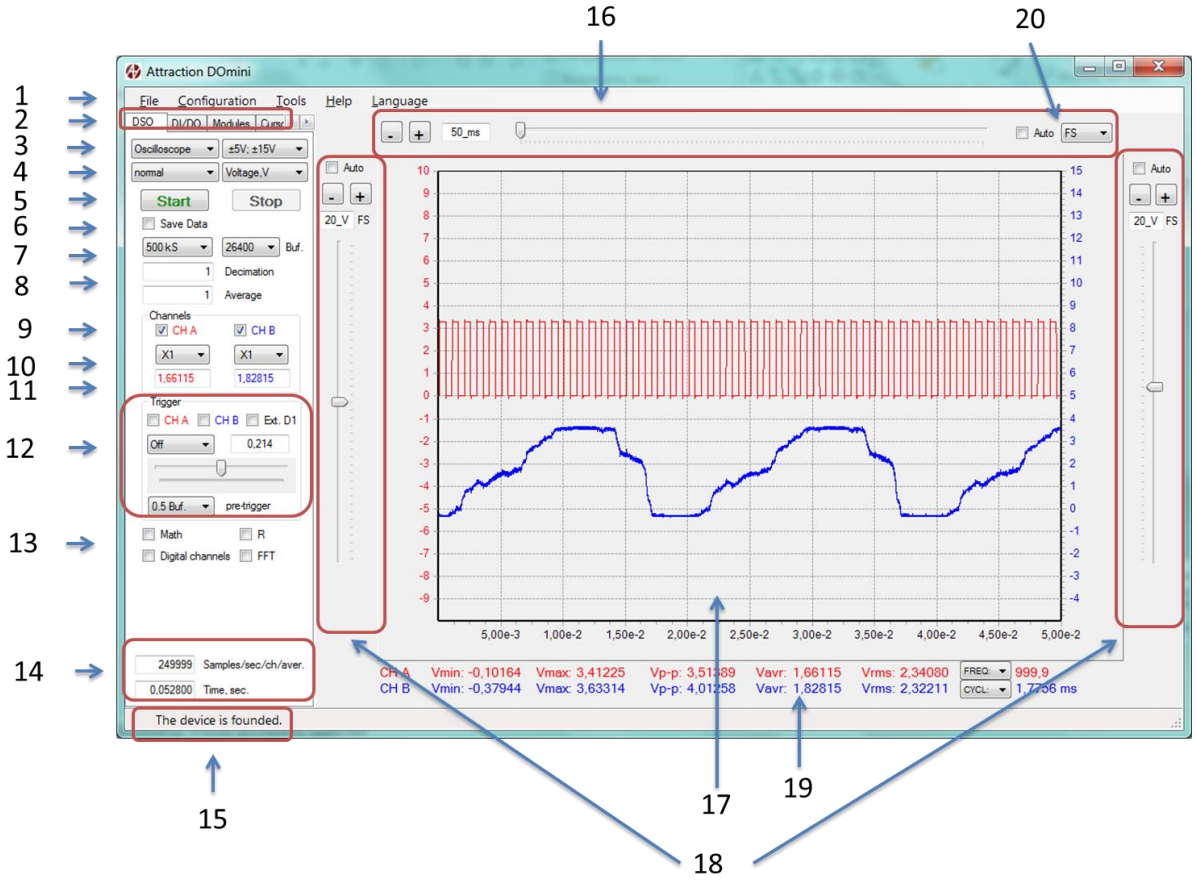


Fig.1. Oscilloscope.

1. Menu
2. Tabs of settings
3. Select Oscilloscope and Logic analyzer (input voltage range)
4. Regimes of oscilloscope
5. Start/Stop oscilloscope
6. Save data
7. Measuring speed, buffer size
8. Data averaging
9. Select channels
10. Probe divider (x1, x10)
11. Average values channels
12. Trigger
13. Additional options (Math, Digital channels, FFT, evaluation of resistance, X-Y mode)
14. Current speed and measurement time
15. Status device
16. Adjusting the Timeline
17. Waveform display field
18. Adjusting scale voltages
19. Auto measure function
20. Auto time scale: FS – full time scale, FREQ – auto frequency scale (auto selection of the optimal scale for signals).

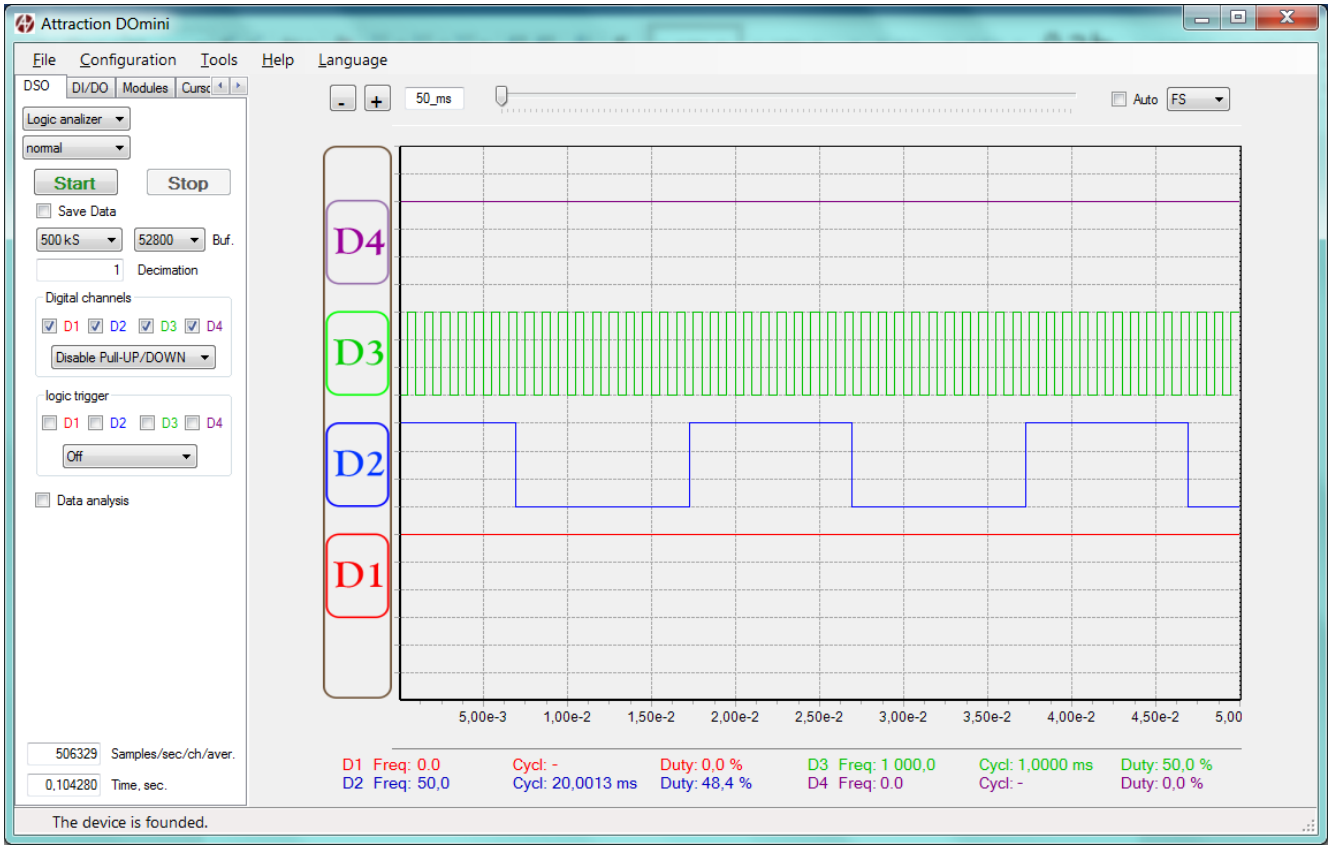


Fig.2a. Logic analyzer.

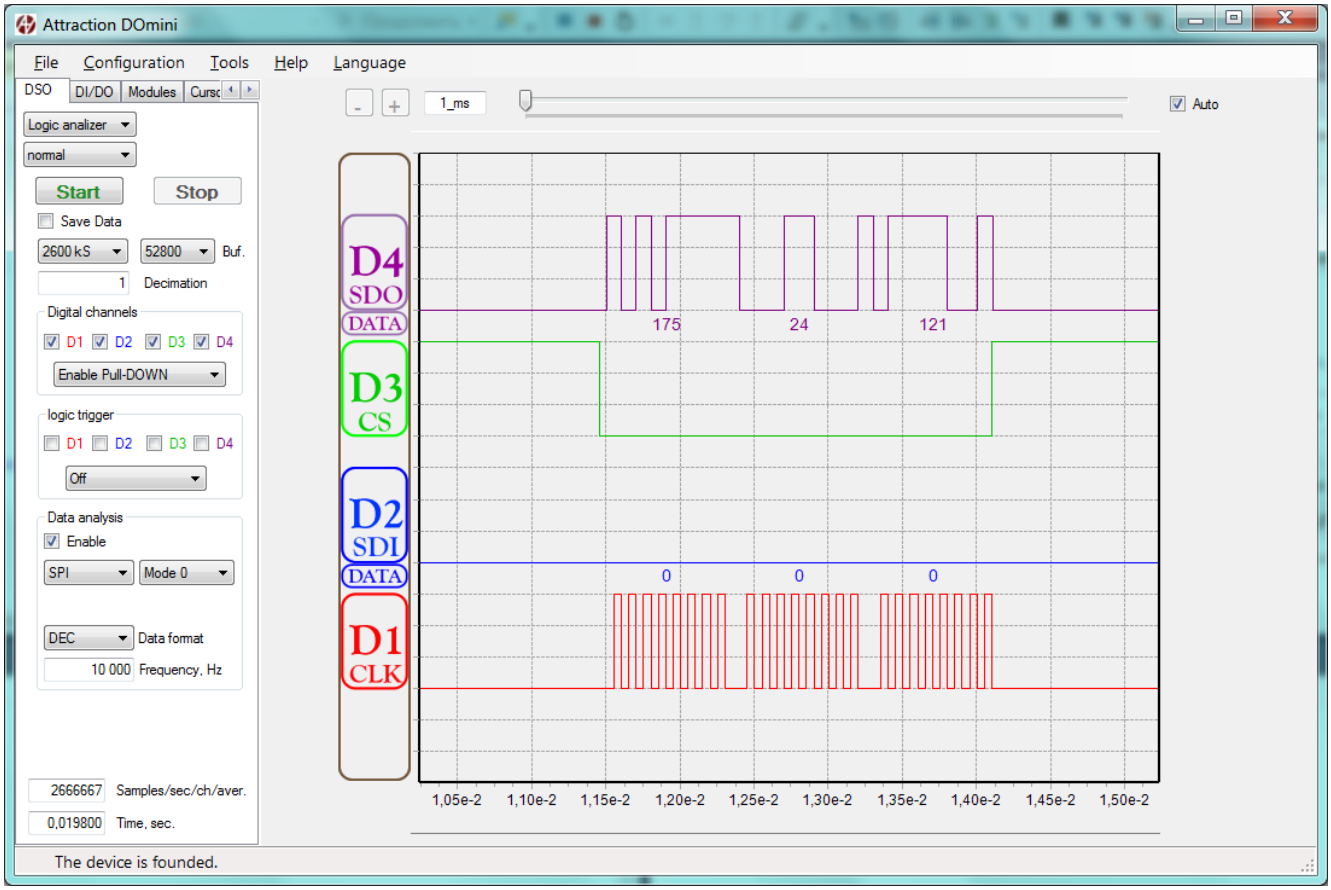


Fig.2b. Logic analyzer. Decoding of digital interface SPI.

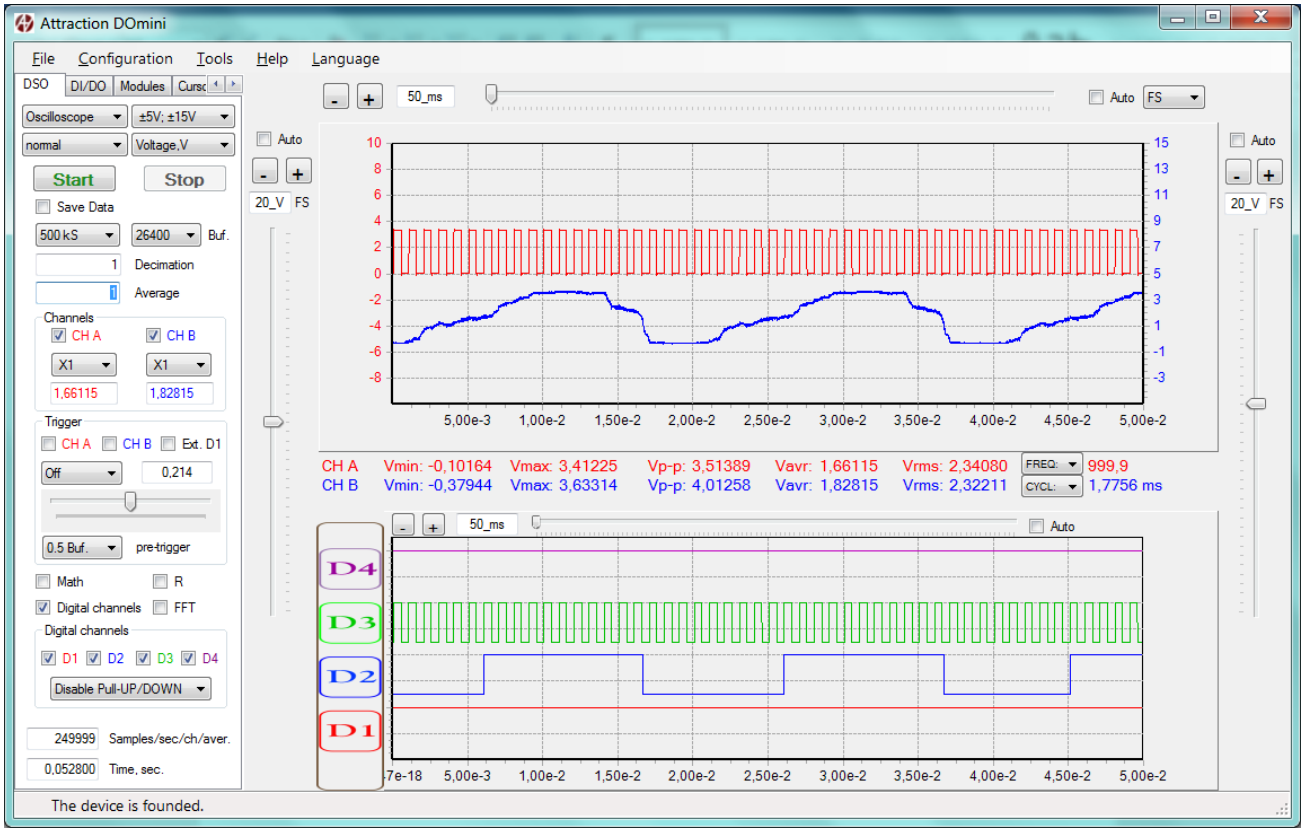


Fig.3. Combo mode. Oscilloscope + Logic analyzer. Enable Digital channels.

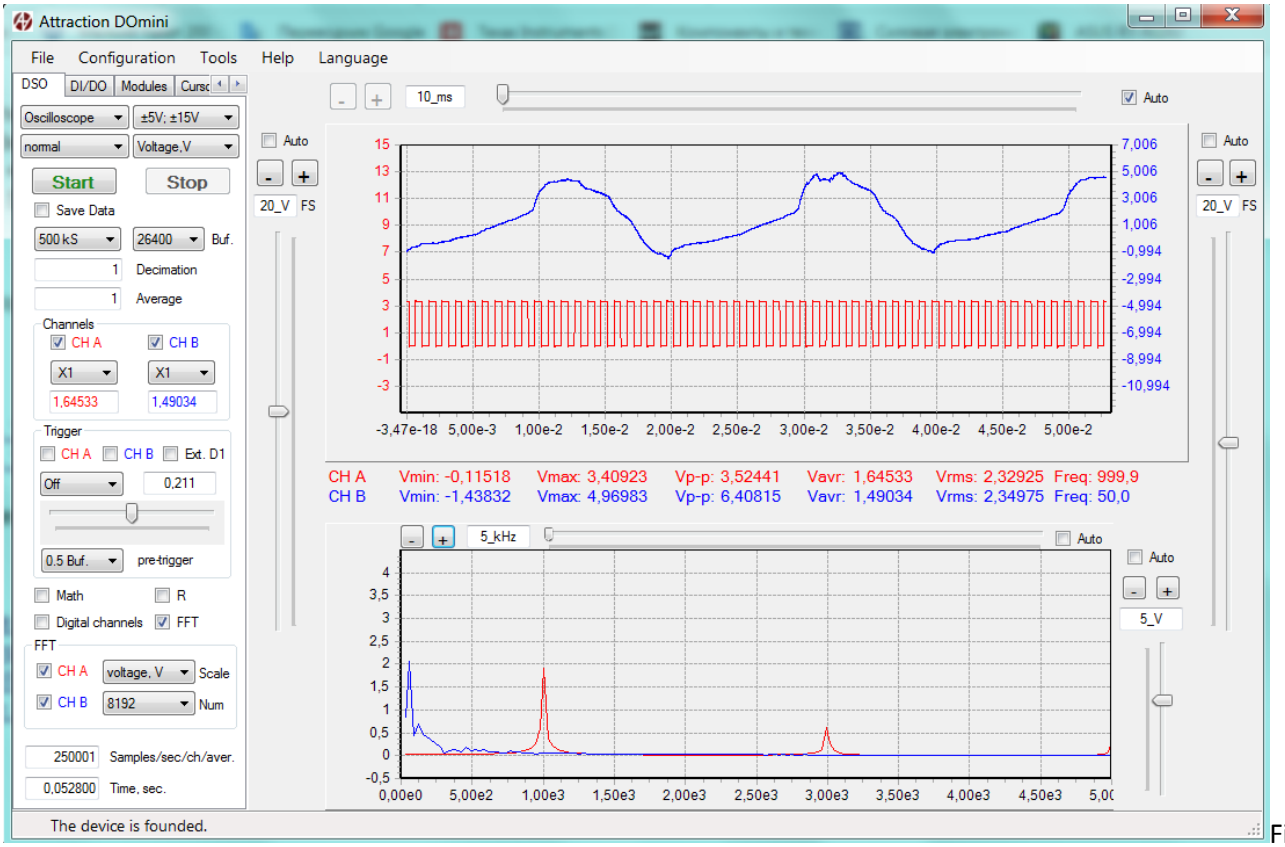


Fig. 4. FFT.

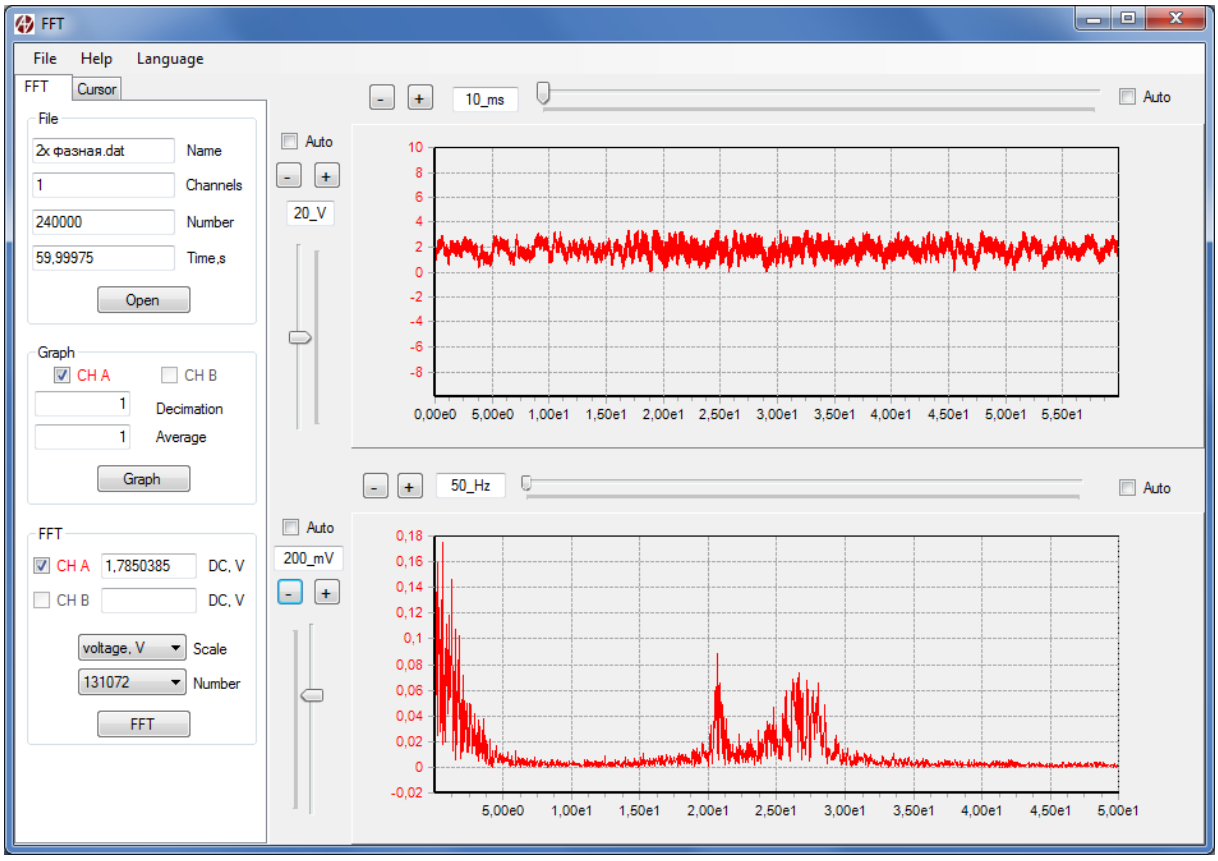


Fig. 5. FFT Tools. (Menu: Tools->FFT Analysis)

4. Tabs

DSO (digital oscilloscope) – Main tab. Oscilloscope operation modes (Oscilloscope, logic analyzer, additional options).

a. Oscilloscope.

4 oscilloscope operation modes: single, normal, auto, reader.

- 2 analog cannels
- Sampling buffer depth: 26400 bytes
- Analog bandwidth: 0 - 280KHz
- CHA from -5 to + 5V (0-10V) and CHB from -15 to + 15V (0-30) with a probe x1
- Event trigger with data capture before the event
- FFT in real time

b. Logic analyzer

- 4 digital cannels
- Event trigger (rise, fall)
- Maximum real-time sampling rate: 12Msps
- Sampling buffer depth: 52800 bytes.

Description of oscilloscope modes:

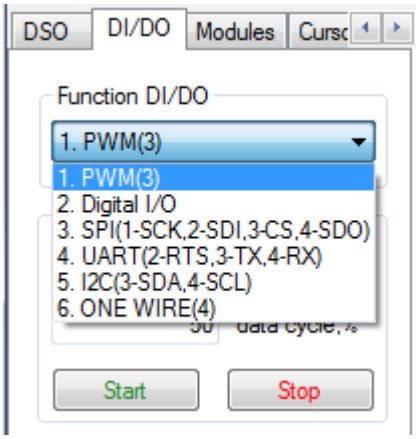
Single – a one oscillogram is read and the measurement process is completed.

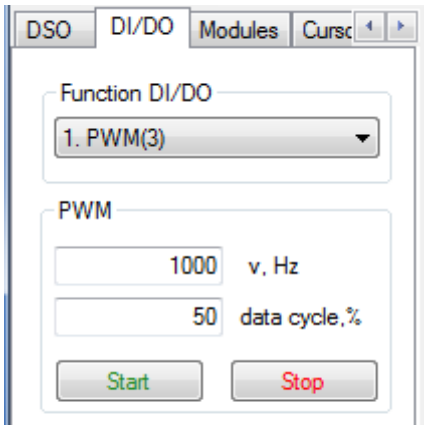
Normal – The oscillograms are continuously read one after another. When a trigger is set, the device waits for the event to occur, then reads one oscillogram and starts the process again. Until the triggering condition is met, the data will not be displayed.

Auto – The oscillograms are continuously read one after another. When the trigger is set, the device waits for the event to occur for some time T, even if the trigger condition is not executed osciloscope displayed the oscillogram. In this mode, in contrast to the normal mode, the oscillogram are always displayed on the screen, even if the trigger condition is not met.

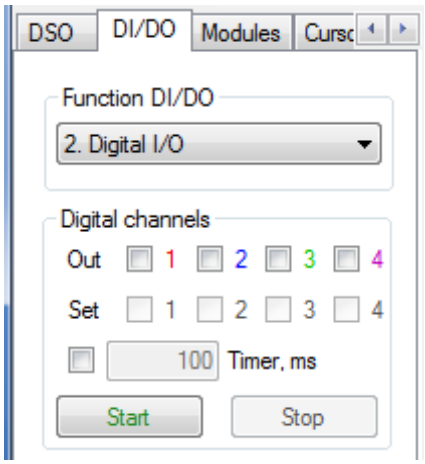
Reader – the data is read by a continuous stream.

Tab DI/DO (digital input/output) – I/O regimes: digital I/O, PWM, SPI, UART, I^2C, 1-WIRE.



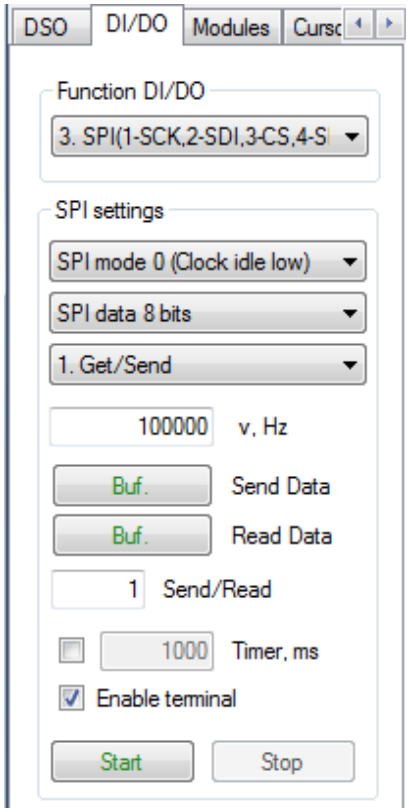


2. PWM
It is used to generate an pulse-width modulation signal (PWM). The minimum frequency is 3Hz, the maximum frequency is 10 MHz. The control step is 1Hz. The duty cycle is from 0 to 100 in 1% increments.



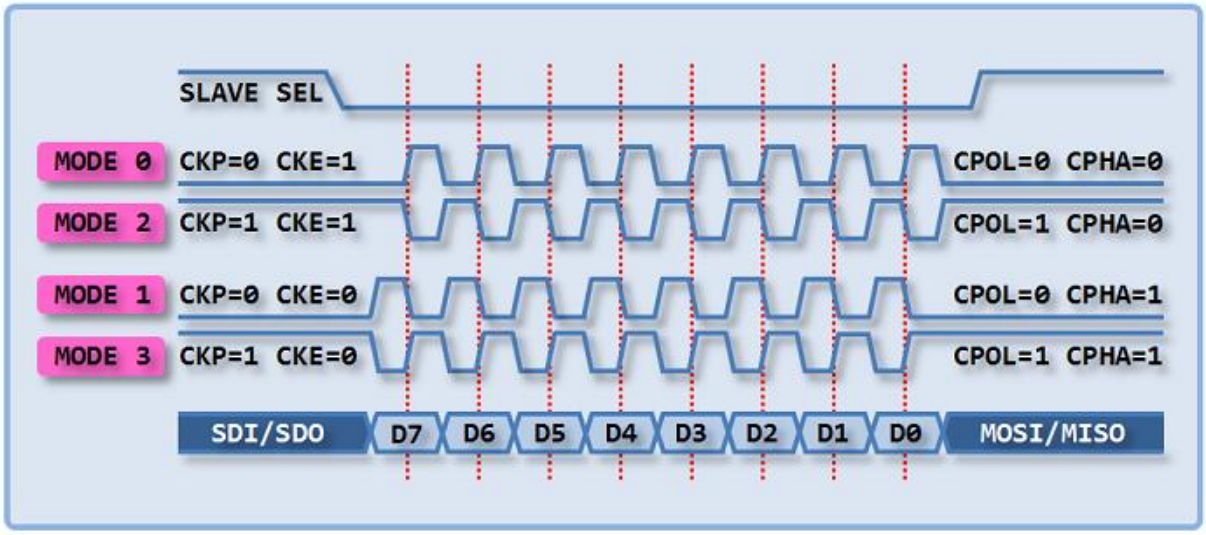
1. Digital I/O

It is used to establish a high or low logic signal on the D1, D2, D3, D4 ports. Setting the Out check box adjusts the outputs to the output, and setting the Set checkbox sets a high logical state. The timer (Timer toggle) is used to automatically change the logical state of the terminals after a specified period of time.

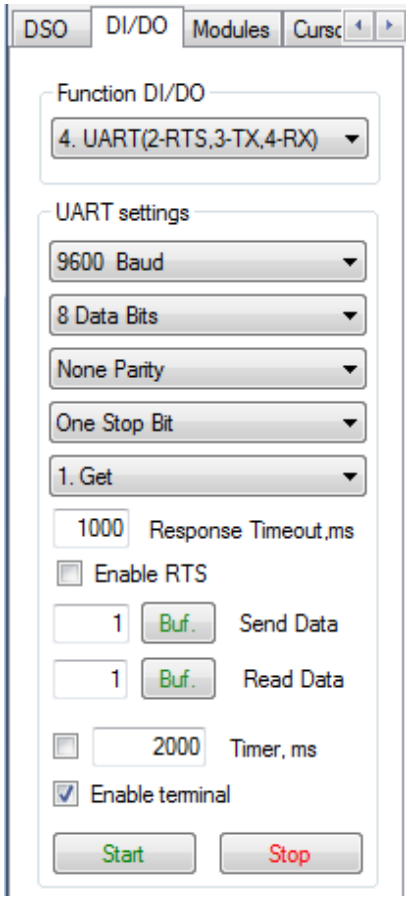


3. SPI

It is used to communicate with devices (ADC, DAC, various sensors, etc.). The following figure shows the configurations of the SPI modes. The minimum frequency is 100Hz, the maximum frequency is 10 MHz. The control step is 1Hz. The information for sending is recorded in the table that appears when you click the Buff button. The number of sent and read data is indicated in the corresponding fields. The information is read by clicking on the Buf button. In addition, the information sent and received is output to the terminal. To send and receive information after a specified period of time, a timer is used.

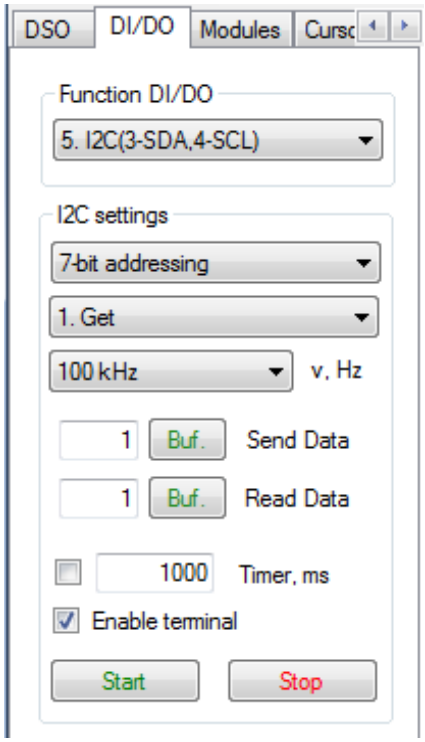


Regimes SPI.



3. UART

It is used to communicate with devices (ADC, DAC, various sensors, etc.).



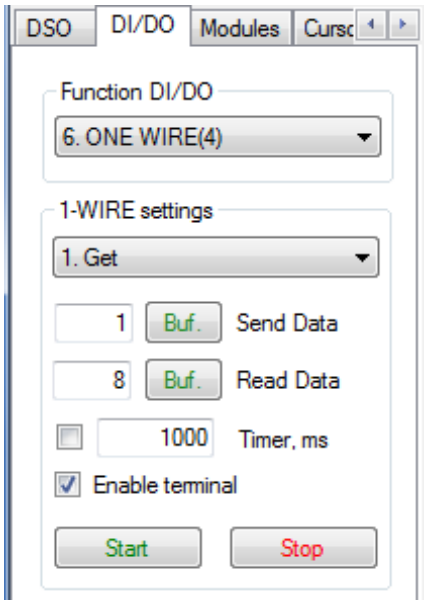
3. I²C

It is used to communicate with devices (ADC, DAC, various sensors, etc.).

Example of communication with EEPROM M24512.

E2 = 0, E1 = 1, E0 = 0 (164 и 165 the device address for writing and reading, respectively).

- Write 1 byte to address 0: send 4 bytes of Tx: 164, 0, 0, 123.
- Write 2 bytes at address 5: send 5 bytes Tx: 164, 0, 5, 123, 124.
- Read data from the current address: send 1 byte Tx: 165; count N bytes.
- Reading data at address 5: send 4 bytes Tx: 164, 0, 5, 165; count N bytes.



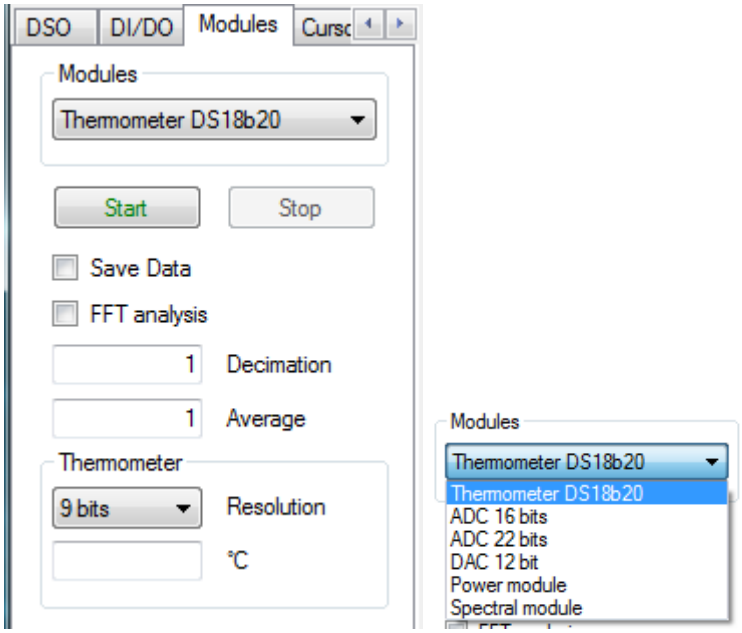
3. 1-WIRE

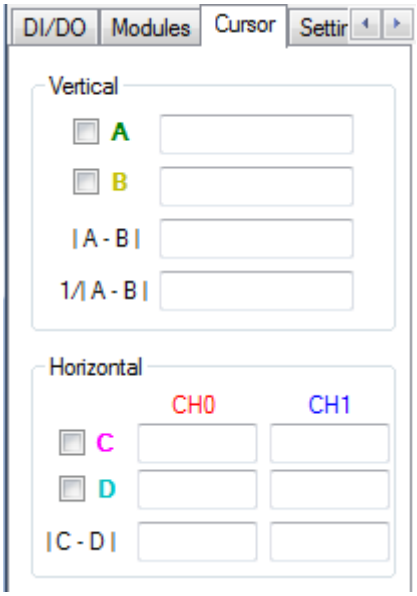
Used to communicate with devices (ADC, DAC, various sensors, etc.).

Example of DS18B20 sensor connection.

- Reading a notepad (SCRATCHPAD): send 2 bytes Tx: 204, 190; count 9 bytes.
- Recording Notepad (SCRATCHPAD): Send 5 bytes of Tx: 204, 78, 0, 0, 31 (the last 3 bytes of data to write).
- Read ROM (unique number): send 1 byte Tx: 51; count 8 bytes.
- Start the temperature conversion: send 2 bytes Tx: 204, 68.
- Read the temperature measurement result from the scratchpad (SCRATCHPAD): send 2 bytes Tx: 204, 190; count 9 bytes (the first 2 bytes of the ADC temperature code).

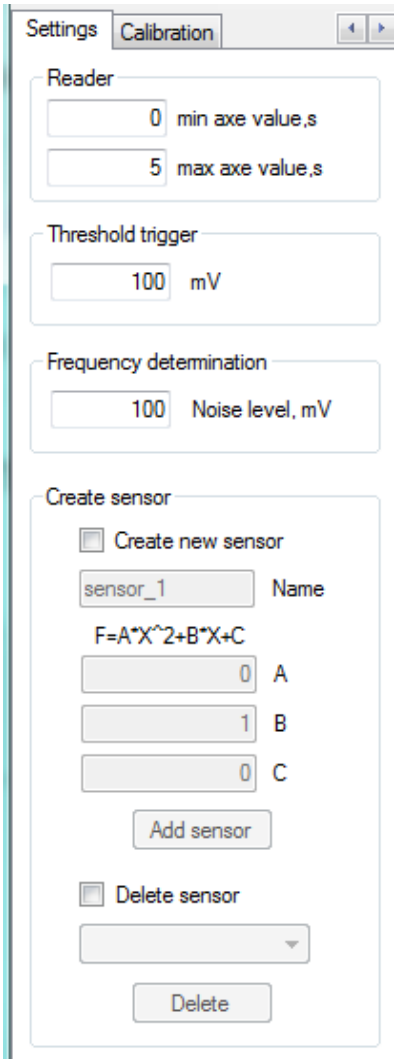
Tab Modules - is intended to connect additional modules to the oscilloscope: 16-bit ADC module, 22-bit ADC module, 12-bit DAC module, current monitor, optical module, thermometer DS18b20.





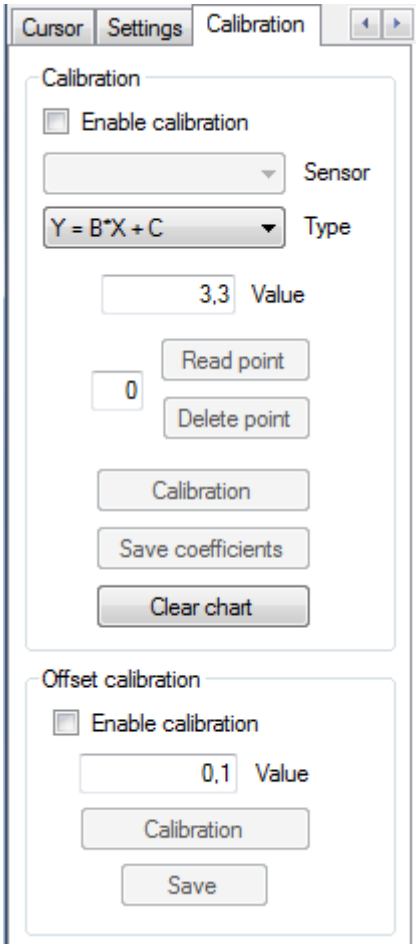
Tab Cursors - It is intended for measurement of amplitudes, periods, frequencies, times of measured signals with the help of horizontal and vertical cursors.

Tab Settings



- Reader - Adjusting the parameters of the graphic field for the mode of the oscilloscope reader.
- Threshold trigger - Decrease in noise sensitivity of a signal when a trigger is triggered.
- Frequency determination - reduction in signal noise sensitivity when determining the signal frequency
- Create sensors (Add new sensor or delete sensor).

Tab Calibration – calibration of sensors (full calibration and offset calibration).



5. Create a new sensor.

To add a new sensor, go to the Settings tab, specify a name and specify the coefficients that define your dependence (F (X) = AX2 + BX + C or F (X) = BX + C, X is the ADC code. (The ADC code can be obtained by selecting type of the sensor Data)) and click the Add sensor button. Then the message about adding a sensor will appear. After that you can use the new sensor (added to the list of sensors).

6. Algorithm of calibration

Calibration is available for newly registered sensors (built-in sensors are not calibrated for this algorithm)

1) Connect your sensor or calibration signal to the oscilloscope;

2) Select the sensor to calibrate CHA, CHB, or both, set the voltage range, select the frequency of the reading (calibration takes place at the selected frequency) (Oscillating tab);

3) Go to the Calibration tab;

4) Check the "Enable calibration" box.

5) If necessary, clear the graphic field by clicking the "Clear chart" button.

6) Select the type of calibration (F (X) = AX2 + BX + C or F (X) = BX + C)

7) Set the calibration point;

8) Send a calibration signal to the oscilloscope (change the sensor reading);

9) Press the "Read points" button. Points are displayed on the chart display field. Measured points can be deleted by pressing the "Delete point" button;

10) Repeat steps 6-9 at least 3 times (allowable number of calibration points 3 <= N <= 100) (for two parametric calibration (F (X) = BX + C) minimum number of measurements 2);

11) Press the "Calibration" button (calibration factors are calculated and the graph is plotted). In case of correct interpolation of measured points, go to step 12 (saving coefficients). The coefficients are automatically applied to the new measured data;

12) Save the coefficients by clicking the "Save coefficients" button (by default, it is suggested to save the coefficients in the coefficients.xls file in the **C:\ArtTech\Oscil_DOmini\calibration** folder). When the program starts, the coefficients are loaded from this file. If you saved the coefficients elsewhere, these coefficients can be downloaded from the **Configuration-> Open coefficients** menu. If you do not save the coefficients, then the coefficients will be lost the next time you start the program.

Calibration offset

It is used to offset measured data (one-point calibration).
1) Give a calibration signal to the input of the oscilloscope.
2) Set the calibration value.
3) To start calibration, press the calibration offset button.
4) To save the calibration data, press the "Save offset" button.

7. Restore Factory Calibration Coefficients

In case of spoiling of coefficients after calibration or other reasons, files with factory coefficients can be found in the folder **C:\ArtTech\Oscil_DOmini\recovery** and replace the files in the following folder **C:\ArtTech\Oscil_DOmini\calibration**.

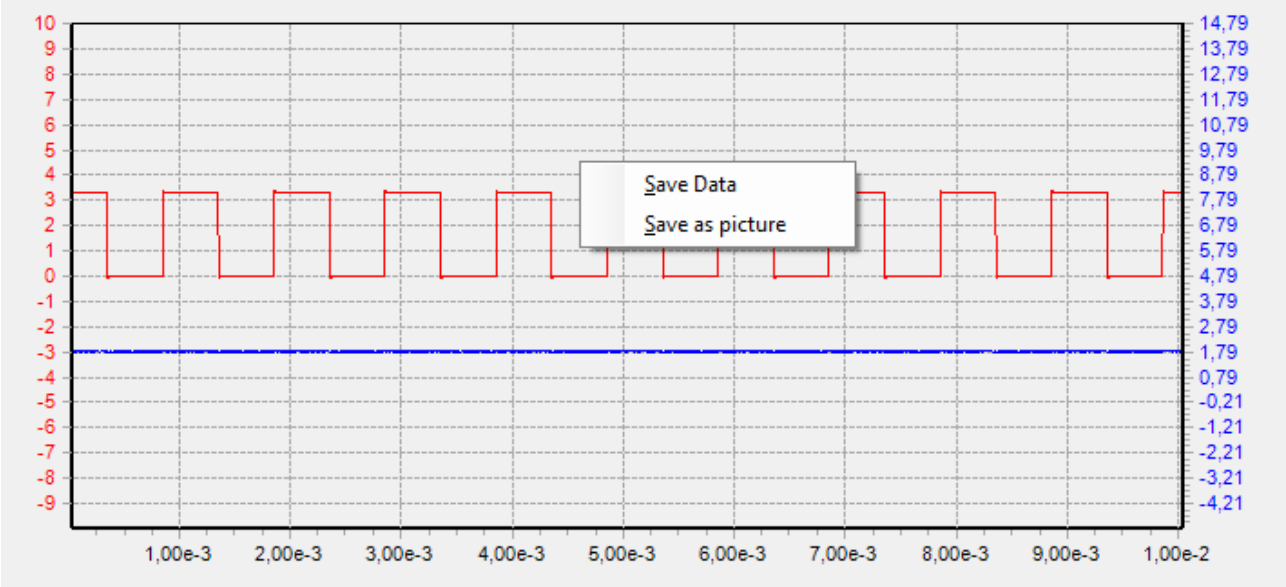
8. Saving/reading device configuration

Saving or loading device settings: Configuration menu -> Open configuration/Save configuration. The working folder path: **C: \ArtTech\Oscil_DOmini\configuration**. When you run the program, the configuration is automatically downloaded from the following **C:\ArtTech\Oscil_DOmini\configuration\configuration.xls** file.

9. Saving data

1) To save data before starting the measurement, you must check the "Save Data" field. The program suggests saving the data in the following way: **C:\ArtTech\Oscil_DOmini\data**. After stopping the measurement process, the check mark is removed automatically. To save data, the following formats are available: xls, txt, dat. By default.

2) Click the middle mouse button and save data.

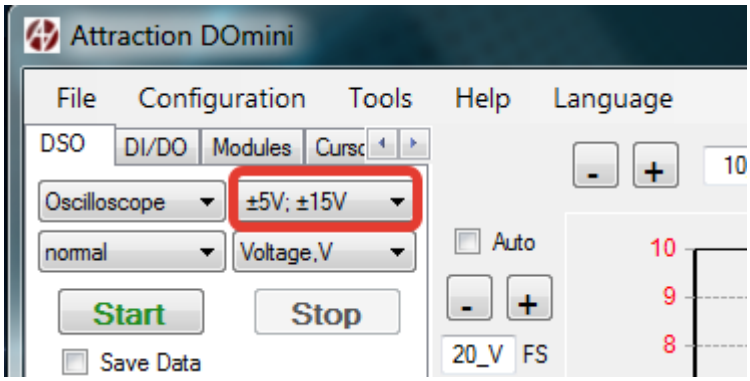


10. Viewing saved data

Opening the file to view the data: **File -> Open data**. To view the data, the following file formats are available: xls, txt, dat.

11. Determining the state of I / O ports, breaks, poor soldering.

To determine the state, it is necessary to turn on the oscilloscope in differential measurement mode (mode - + 5V; - + 15V - enabled by default).



With the probes disconnected, the oscilloscope shows voltages for the CHA + 2.3 V channel and for the CHB + 1.8 V channel. When the probe is connected to a port configured for input or not activated (z-state of the port), the voltages on the channels will not change (CHA = + 2.3V CHB = + 1.8V). If it is configured for output,

then there will be either 0 (low logical state of the port) or the supply voltage of the chip (high logical state of the port). Similarly, it is possible to determine the break on the line and not the soldering of electronic components (the initial voltage on the oscilloscope will not change). Using this function allows you to quickly find the damaged lines, not soldered components, to determine the state of the ports of microcontrollers.

12. Oscilloscope connector

Верхний ряд	**1. CHA**	**2. GND**	**3. CHB**	**4. GND**	**5. +3.3V**	**6. +5V**
Нижний ряд	7. GND	8. D1	9. D2	10. D3	11. D4	12. GND

1. CHA - the analog channel of the oscilloscope
2. GND - ground
3. CHB - the analog channel of the oscilloscope
4. GND - ground
5. + 3.3V - power supply 15 mA
6. + 5V - power supply 50 mA
7. GND - ground
8. D1 - the digital channel of the oscilloscope (SPI-SCK)
9. D2 - the digital channel of the oscilloscope (SPI-SDI), (UART-RTS)
10. D3 - digital channel of the oscilloscope (SPI-CS), (I2C-SDA), (UART-TX), (PWM)
11. D4 - digital channel of the oscilloscope (SPI-SDO), (I2C-SCL), (UART-RX), (1-WIRE)
12. GND – ground

13. Oscilloscope Features

Channels	2 – analog, 4 – digital
Regimes	single, normal, auto, reader
Analog channels	
Maximum real-time sampling rate, Sa/s	1 000 000
Bandwidth, kHz	0-280
ADC resolution, bit	10
Sampling buffer depth, sempels	26 400
Input voltage range, V	CHA +/-5B, 0-10V (probe 1X) CHB +/-15B, 0-30V (probe 1X)
Input impedance, MOhm	>1
Digital channels	
Maximum real-time sampling rate, Sa/s.	12 000 000
Sampling buffer depth, sempels	52 800
Input voltage range, V	0-3.3 or 0-5
Output impedance, Ohm	300
Power pins	
power supply, V	+3.3 and +5
Output impedance, Ohm	10 (+5V), 33 (+3.3V)
Max Current, mA	3.3V – 15 5V - 30
Operating parameters	
Interface with PC	USB 2.0, full-speed
power, V	+5B from USB
Working temperature, °C	from 0 to +40
Storage temperature, °C	from -20 to +50
Dimensions, mm	71x23x8.7
Software	
operating system	Windows Xp, Vista, 7, 8, 10 Android 4.0 or later