## Purpose

The main purpose of the software and hardware that comprises the USB Autoscope system is troubleshooting of various electronic vehicle systems, such as ignition and timing system. The USB Autoscope is also very useful for engine mechanical diagnostics. The system is universal in nature and not tied to any particular vehicle system or brand. The usefulness of the system is not limited to just vehicles, but can also be used in the service and diagnosis of electrical machinery, other electrical devices, and electronic circuits and components.

The main modes

The USB Autoscope can be run in an analog oscilloscope or in a logic analyzer mode using the menu item "Start device". The analog mode provides on-screen display of the waveforms, but, compared with the logic analyzer mode, has a lower sampling rate. The logic analyzer mode provides a higher sampling rate of the signal and the output file waveform is also smaller, but its application is limited to only digital (two-level) circuits.

It may be advantageous to have the device start in a preset mode. To do so, the desired mode can be saved using the menu "Control => Save mode". In addition, the user can use already preset modes.
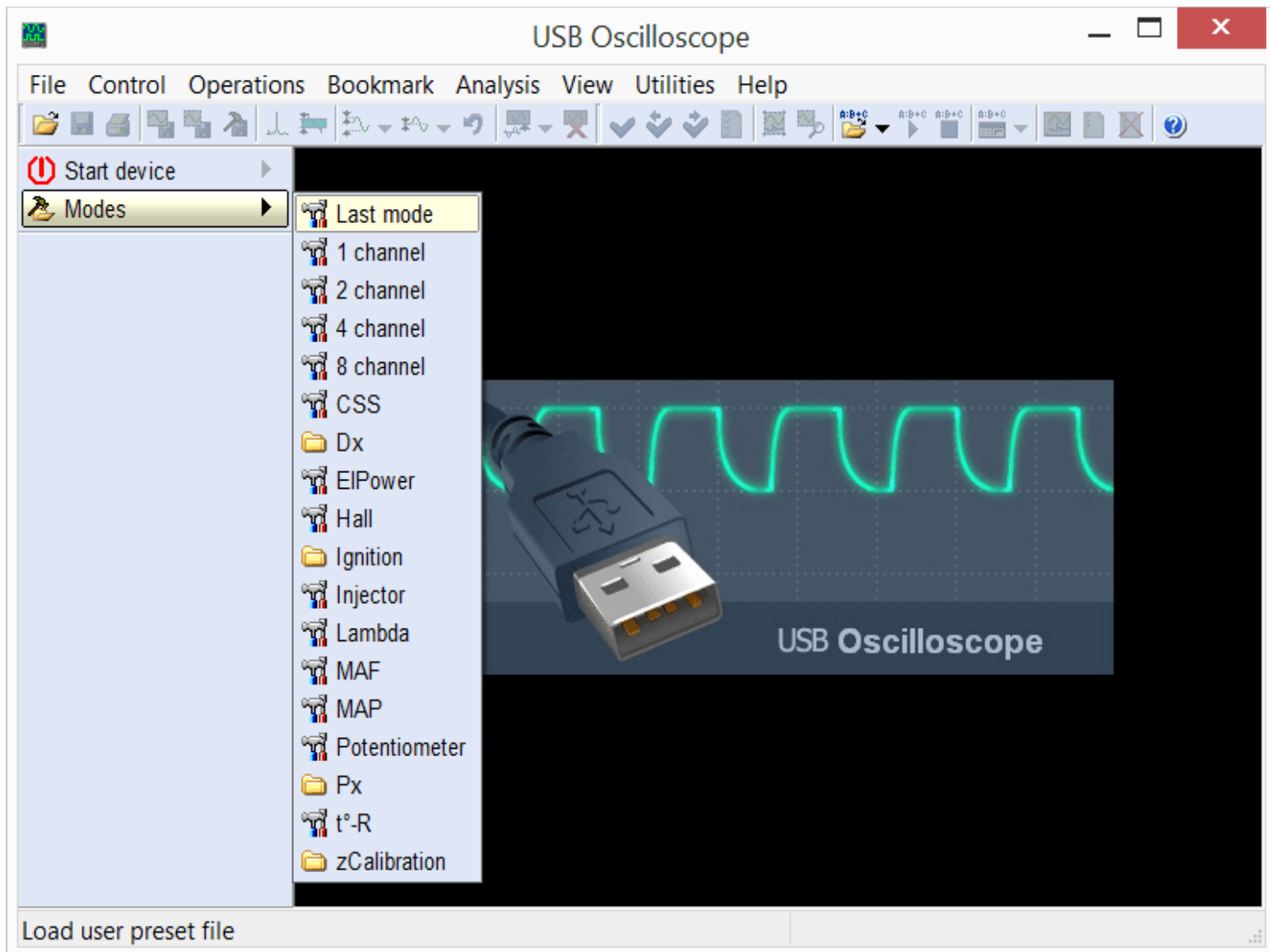
The menu item "Modes" makes it possible to use ready preset modes of the device as well as modes created by the user itself.

The available list of preset modes depends on which components were selected during installation.

•Analog oscilloscope mode

Designed for displaying and recording voltage waveforms in circuits of sensors and actuators of electrical and mechanical systems of the car.
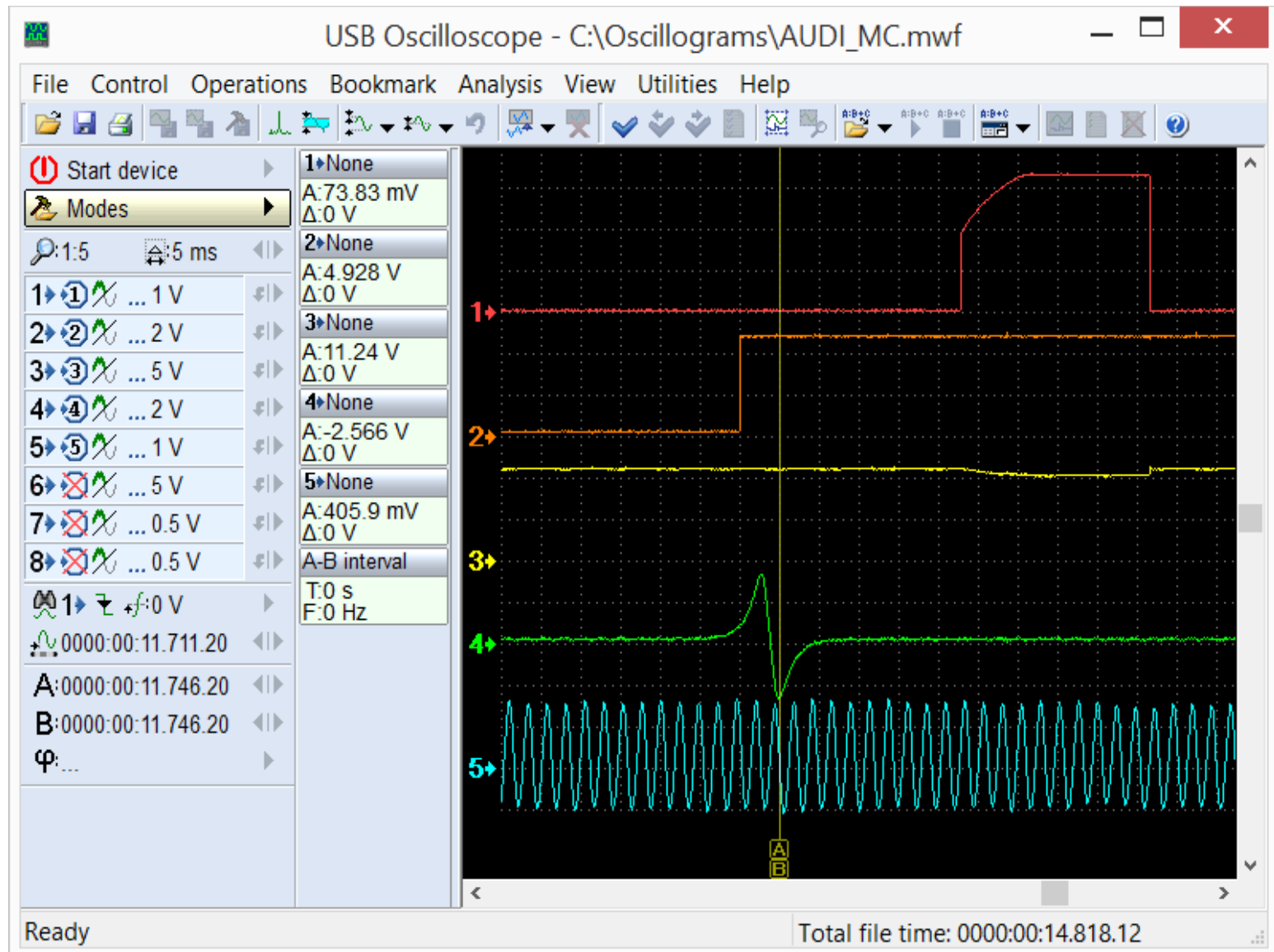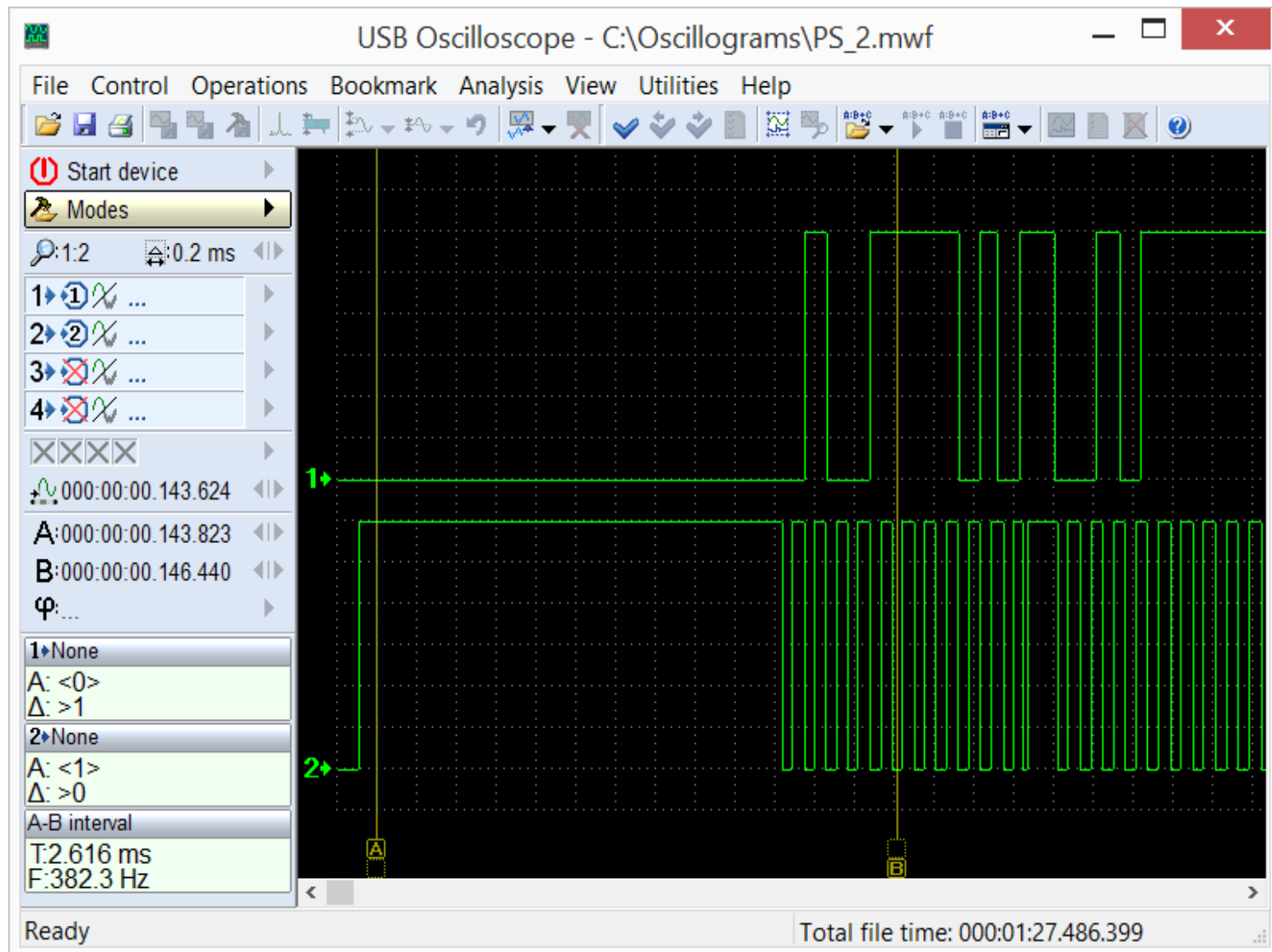

Example of the waveforms recorded in analog oscilloscope mode.

Allows to find faults in the high and low voltage circuits of ignition systems, malfunction of sensors and actuators of engine control systems, power circuits, generator, starter, battery, mechanical problems with the engine. Using appropriate sensors makes it possible to see the vacuum waveforms from intake manifolds, pressure in the cylinders, changes of pressure in the fuel rail of diesel engines, current of fuel injectors power control circuits, the current in the battery / starter circuits. A diagnosis as to the state of health of a particular circuit or component can be done by comparing the displayed waveforms / graphs to known good waveforms or the built in tools for automatic analysis can be used.

The analog oscilloscope mode can be started using the menu "Modes" or "Start device".

•Logic analyzer mode

Designed to monitor and record digital (two-level) signals using the input connector "Digital Inputs"[1].

Example of the waveforms recorded in the logic analyzer mode.

In this mode are shown only two levels, corresponding to the presence or absence of active signal in the circuit.

Logic analyzermodeis called from the menu Start device => Mode select => Logic analyzer mode", which will be available if during the program setup process the"Logic analyzer mode" component was selected.
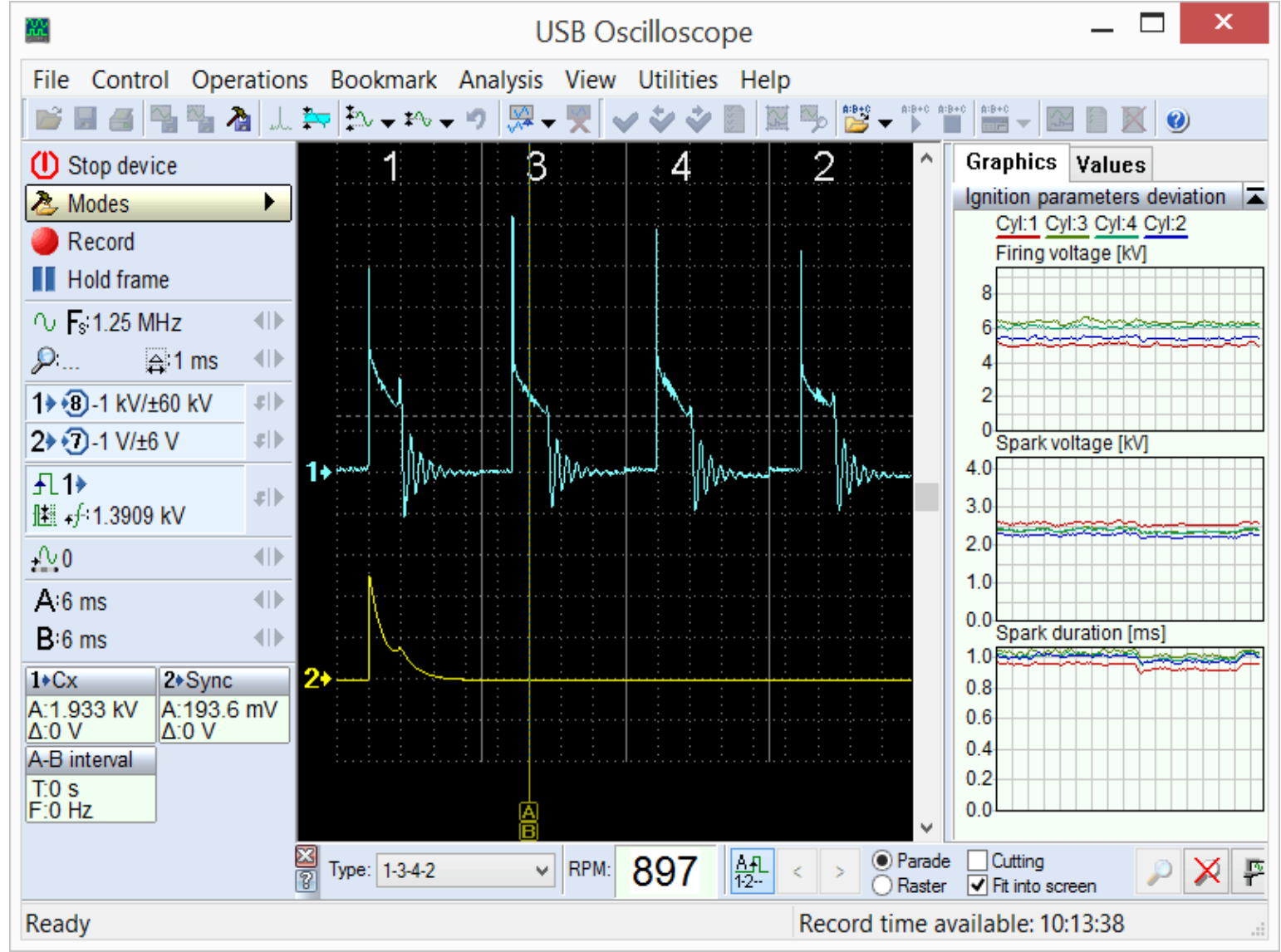
PlugIns

PlugIns are software plugins that may be used in the analog oscilloscope mode while displaying and analyzing waveforms from an analog input. They improve the visibility of displayed waveforms and can automatically perform analysis in real time. If necessary, the user can use provided documentation and tools to make their own PlugIns. Detailed information and examples can be found in the document "PluginsScriptPlugin.chm", which is installed in the program folder USB Oscilloscope, if during installation process components "Help files" and "Analyzer script / Panel Editor" were selected. For writing and

debugging panel code it is recommended to use the editor "ScriptEditor.exe", which is installed in the same folder.
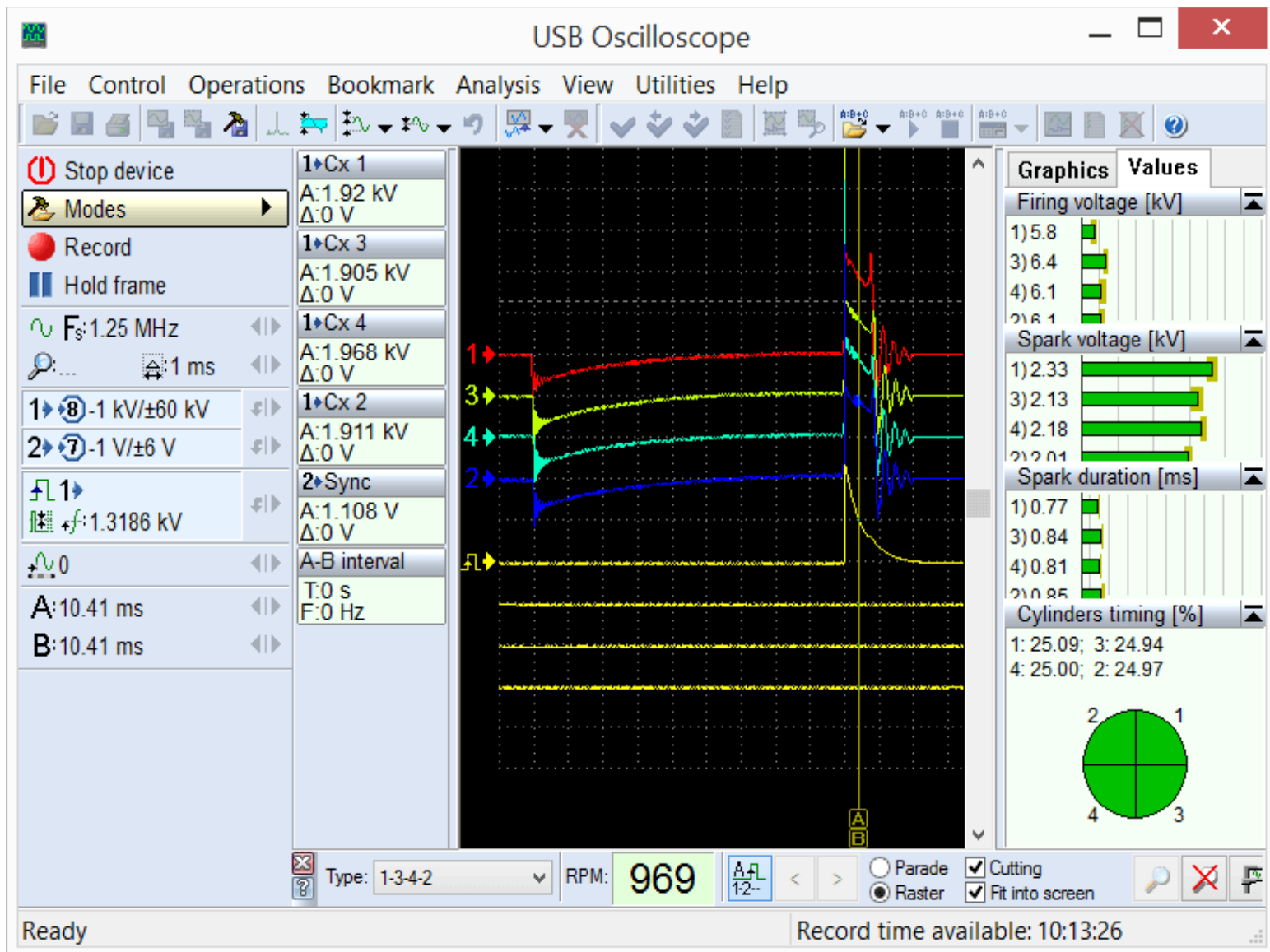
•PlugIn "Ignition diagnostic"

Intended to diagnose ignition systems using the voltage waveform in the secondary circuit. Displays voltage waveform in the high voltage circuit of the ignition system. The waveforms are displayed as "Parade" or "Raster".

PlugIn "Ignition diagnostic", mode "Ignition_Parade".
Called from menu "Modes => Ignition => Ignition_Parade".

In the "Ignition Parade" mode it is easy to discern voltage (amplitude) differences as differences in height of the voltage spikes. The "Raster" mode is best used to discern time differences such as spark burn time.

PlugIn "Ignition Diagnostic", mode "Raster".

Called from menu "Modes => Ignition => Ignition_Raster".

This PlugIn also calculates and displays the firing voltage, the spark voltage and the spark duration for each of the cylinders in the form of graphs or columns.

•PlugIn "Phase measurement"

This PlugIn is designed to test the engine mechanical timing and to measure the ignition timing using the pressure graph without combustion. Points out the allowable ranges of characteristic points and plots a graph of pressure vs. Crank angle. The actual position of the characteristic points depends on the relative position of the crank and camshaft.
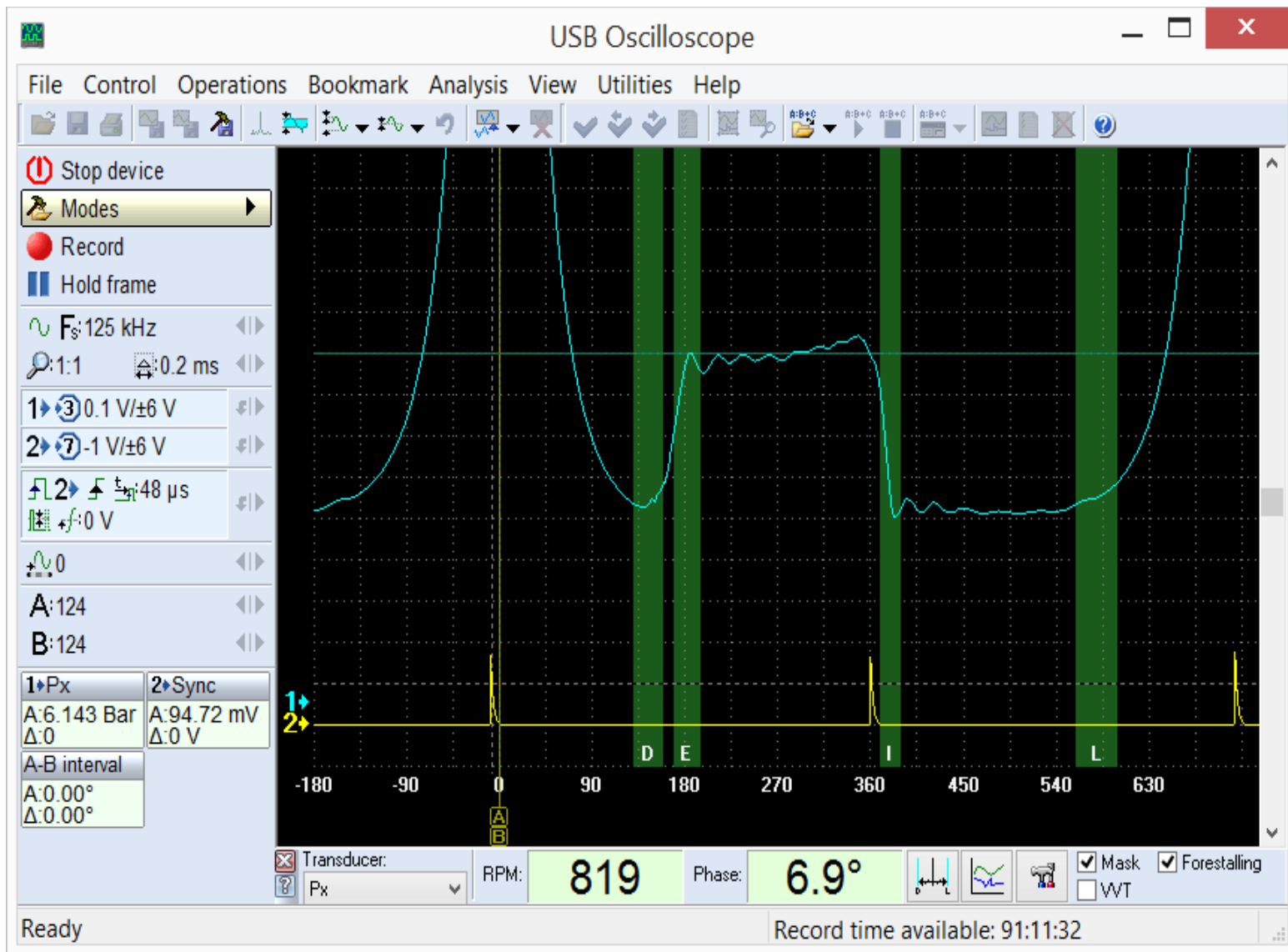
PlugIn "Phase measurement".

By comparing the actual position of the characteristic points of the graph with the allowable range it is possible to determine if the relative position of the crankshaft and camshaft are correct.

The PlugIn also displays the current value of ignition dwell angle relatively to the peak pressure in the cylinder. Because the software does not rely on existing timing marks to determine ignition timing, no errors due to inaccurate or missing marks will be introduced. In fact, the software can be used to gauge the relative accuracy of existing marks.

The PlugIn can be used to determine time or angle relationship between any pulsed signals, such as injection events for Diesel and gasoline engines and the relative position of the crankshaft.

The PlugIn is called from the menu "Modes => Px => Px / Px+Longer" for Px transducer or "Modes => Px => Px35″ / Px35+Longer" for Px35 transducer.
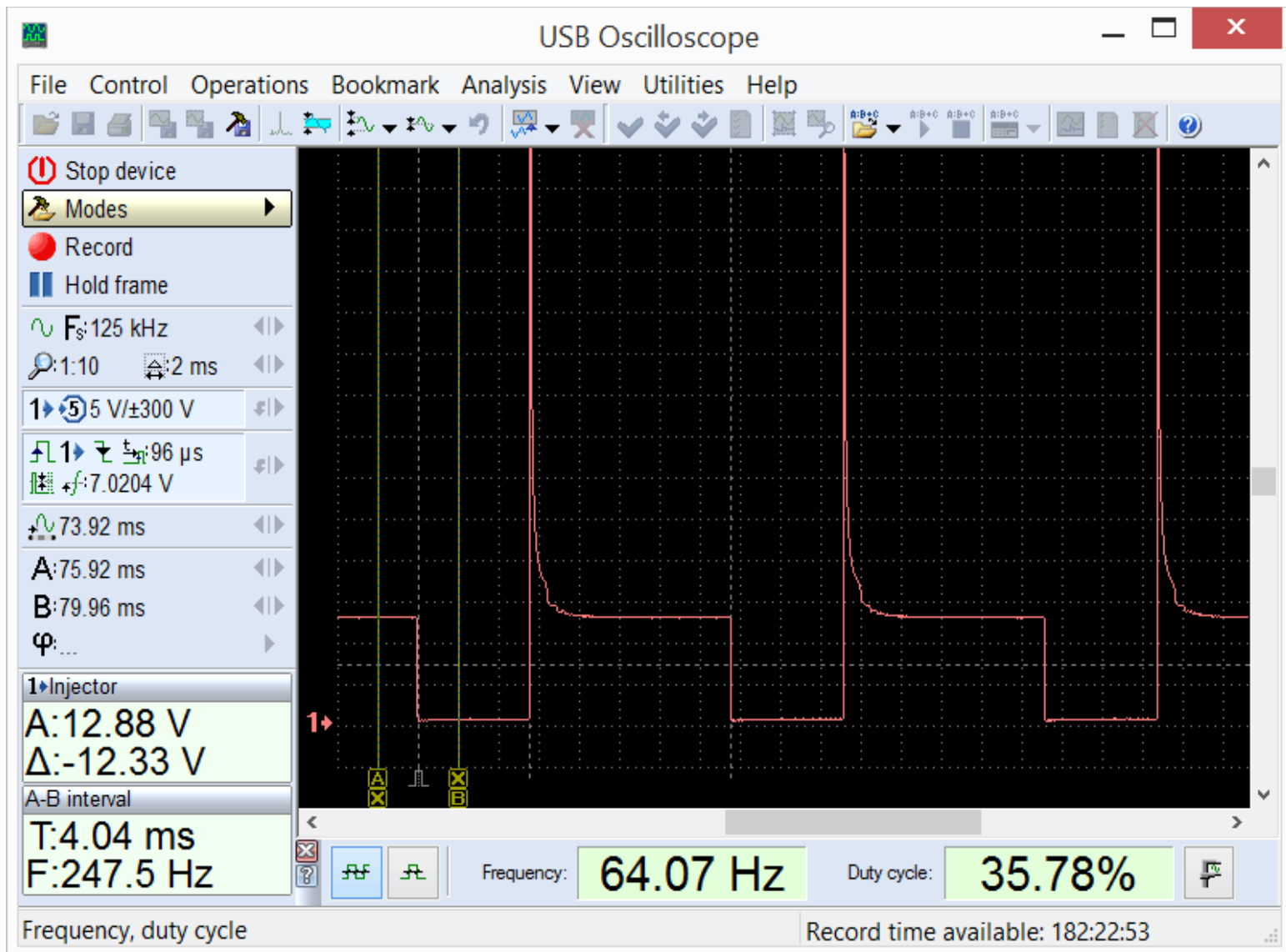
•PlugIn "Time parameters"

Depending on the selected measurements mode, calculates and displays the current duty cycle and frequency of a periodic signal, or pulse width.
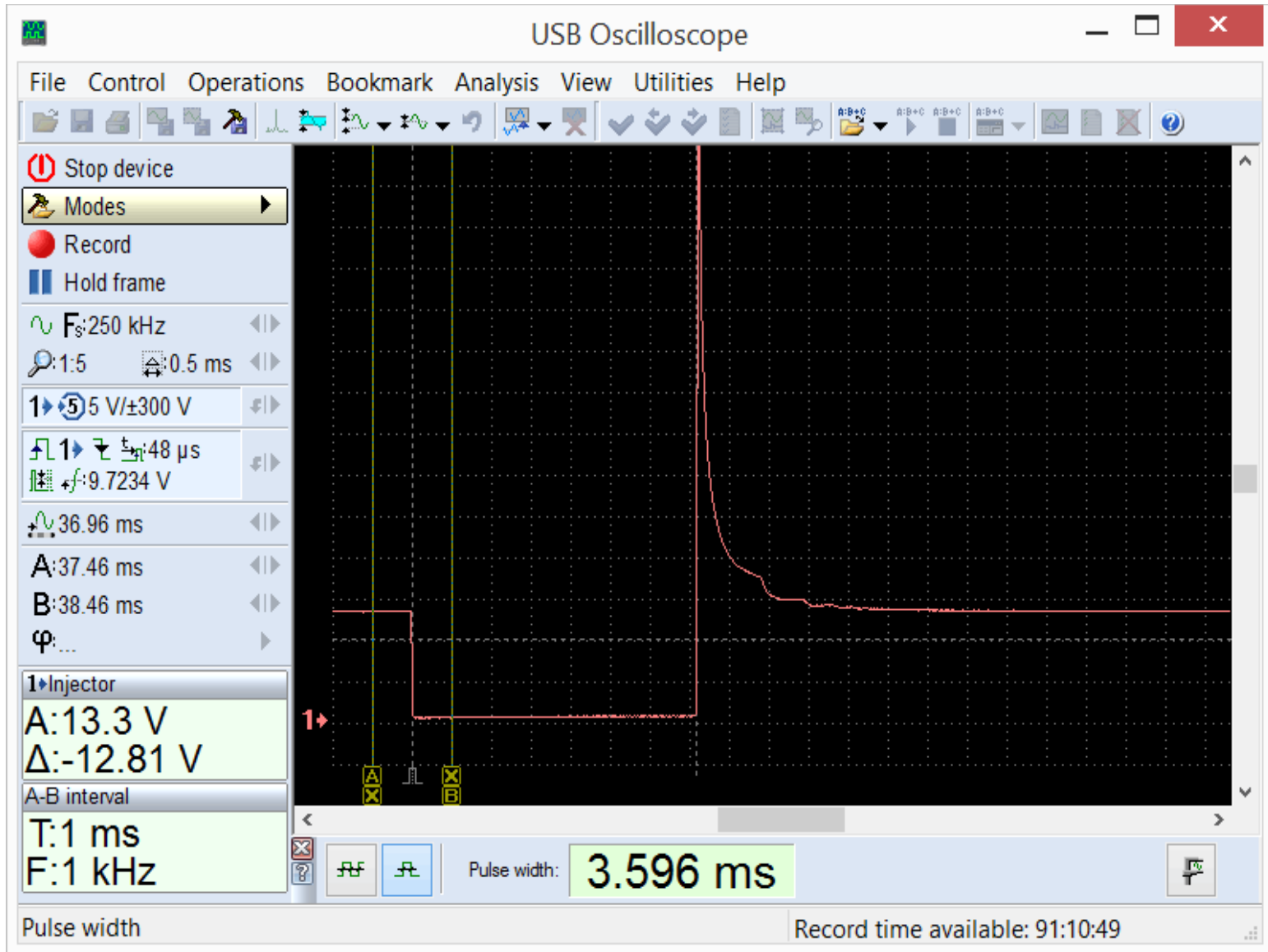
PlugIn "Time parameters", mode "Pulse Width".
Selected using the menu "Modes => Injector".

In the mode "Pulse width" for example, the pulse parameters of the fuel injector can be measured.

PlugIn "Time parameters", mode "Frequency, duty cycle".
*Selected using the menu "Control => Time parameters".*

In the mode "Frequency, duty cycle", PlugIn displays the current duty cycle and pulse frequency. This can be useful in the analysis of signals with a pulse width modulation (PWM),which are found in some actuators control circuits, as well as some sensors with two-level output signal.

The measured values can also be viewed as graphs.
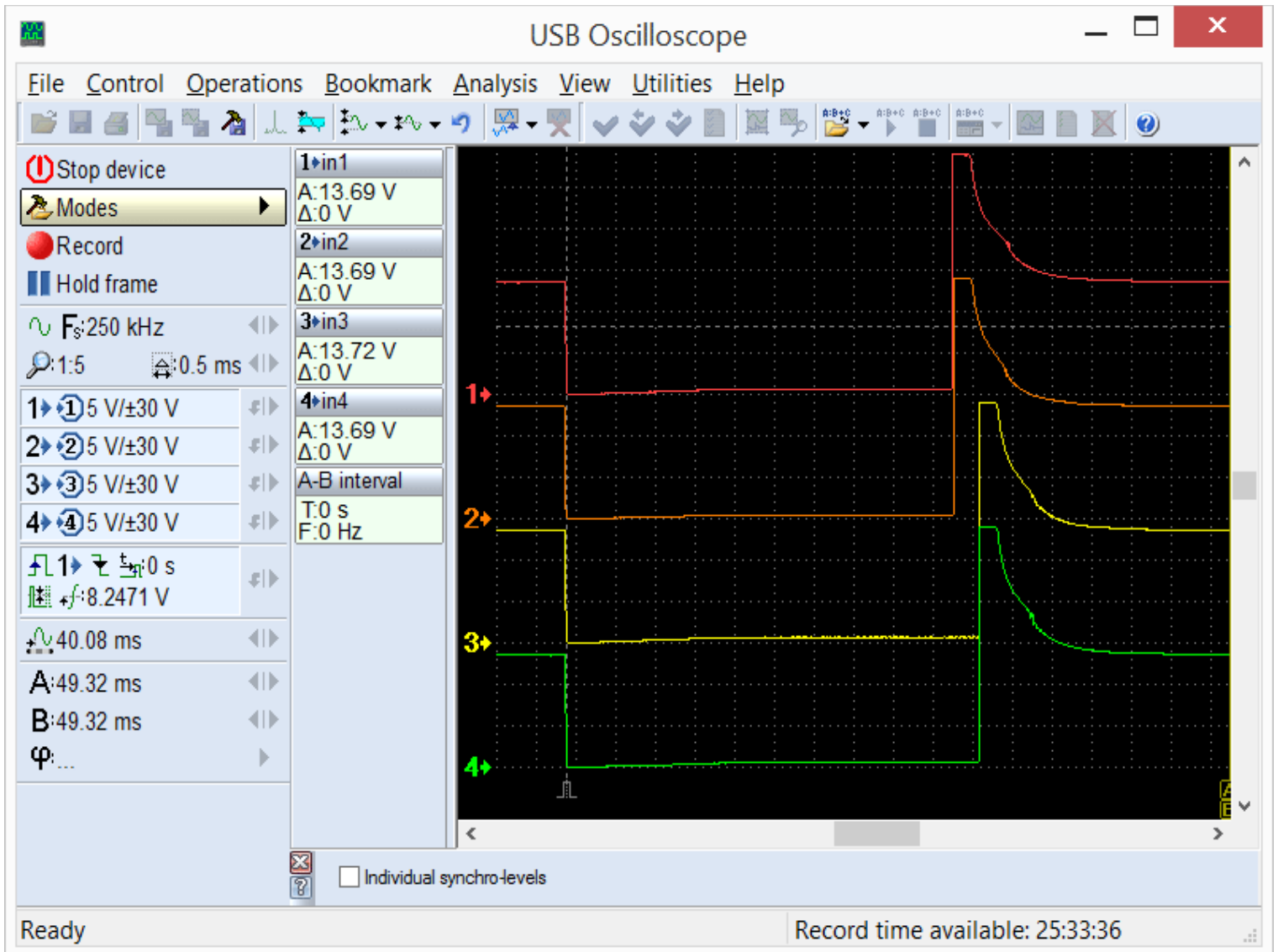
•PlugIn "Synchronize all channels"

Designed to work with time-spaced signals from different channels of the oscilloscope, for example, to view the injector waveforms of the gasoline injectors.
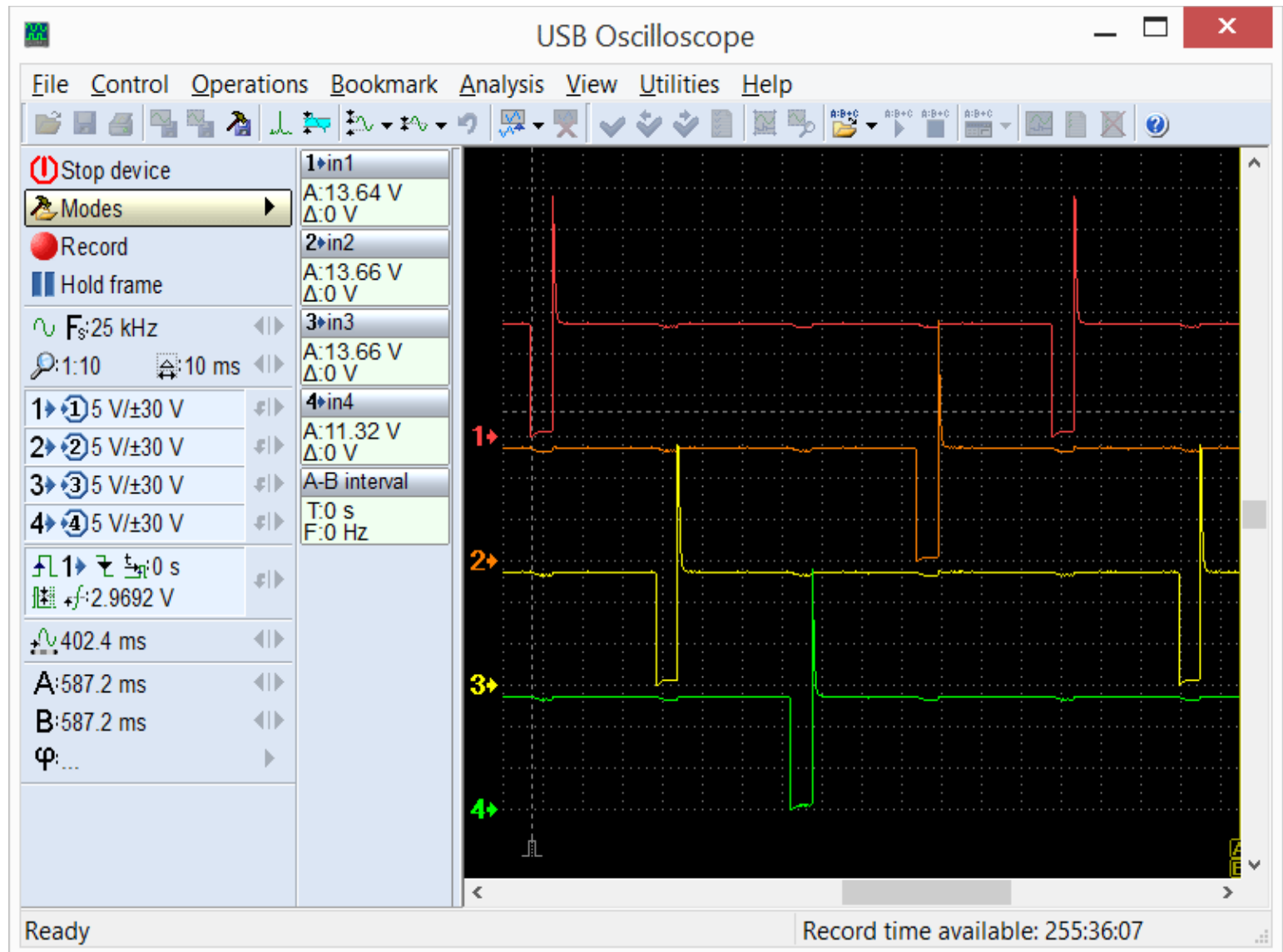
In modern engine control systems, the injectors are usually fired or controlled sequentially, in the firing order. For this reason, comparing the waveform from one injector to another can be difficult.

The PlugIn displays the waveforms from the different channels in a raster format that makes it simple to compare their shape and duration.

USB Oscilloscope

File   Control   Operations   Bookmark   Analysis   View   Utilities   Help

Stop device
Modes
Record
Hold frame
Fs:250 kHz
1:5   0.5 ms
1 1 5 V/±30 V
2 2 5 V/±30 V
3 3 5 V/±30 V
4 4 5 V/±30 V
1   0 s
8.2471 V
40.08 ms
A:49.32 ms
B:49.32 ms
φ:...

1 in1
A:13.69 V
Δ:0 V
2 in2
A:13.69 V
Δ:0 V
3 in3
A:13.72 V
Δ:0 V
4 in4
A:13.69 V
Δ:0 V
A-B interval
T:0 s
F:0 Hz

Individual synchro-levels

Ready   Record time available: 25:33:36

The PlugIn "Synchronize all channels" shows the time-spaced pulses lined up vertically so that they may be visually compared.

This mode may be useful in a number of scenarios. For example, to compare the waveform from the cam and the crank sensor to each other. This will work even if the time difference varies such as with variable valve timing.

PlugIn is called from the menu "Control => Synchronize all channels" when using the oscilloscope in 2 or 4 channel analog mode. Synchronization must be activated and, if necessary, set up manually using the sync settings panel.

[1]   USB Autoscope will be equipped with "Digital Inputs" connector according to the user request.