

ElPower script

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1. Purpose

The ElPower script is designed for automatic analysis of the waveform of battery voltage and current graph in its chain. Allows to obtain a comprehensive understanding of the condition of the engine starting and charging system, get detailed information about the state of the battery, alternator, starter and other high-power electrical loads of the vehicle. Generates multiple tabs report, which shows the number of the measured and calculated characteristics of the system components, battery performance is evaluated consistency with the characteristics of the starter. Upon detection of the fault displays appropriate messages.

2. Recording the waveforms and starting the script

To obtain the current waveform from the battery circuit, a ± 1000 A current clamp with sensitivity of 1 mV/A and capable of measuring DC current is used. We recommend using the APPA 32 / APPA 36T / APPA 39T current clamp.

The quality of the report from the script is dependent on the quality of the waveform recording. The more detail, the more complete report.

Connection order

For USB Autoscope IV

- Connect to "-" terminal of the vehicle battery the black crocodile clip from the USB Autoscope IV power cord.
- The measuring adapter, using a small crocodile clip connect to the terminal "+" of the battery and connect to input №1 of the USB Autoscope IV.
- Connect the current transducer to input №4 of the USB Autoscope IV using PIN3-Banana adapter. Move the switch on the current transducer to the "600A 1mV/A (1000A 1mV/A)" setting.

For USB Autoscope III

- Connect oscilloscope probe to the input №1 of USB Autoscope III. Black «crocodile» clip connect to the terminal "-" of vehicle battery, lead of oscilloscope probe - to terminal "+".
- Connect the current transducer to input №2 of the USB Autoscope III using BNC-Banana adapter. Move the switch on the current transducer to the "600A 1mV/A (1000A 1mV/A)" setting.

For USB Autoscope II, USB Autoscope Lite and USB Autoscope I

- Connect oscilloscope probe to the input №5 of USB Autoscope II / USB Autoscope Lite / USB Autoscope I. Black «crocodile» clip connect to the terminal "-" of vehicle battery, lead of oscilloscope probe – to terminal "+".
- Connect the current transducer to input №2 of the Autoscope II / USB Autoscope Lite / USB Autoscope I using BNC-Banana adapter. Move the switch on the current transducer to the "600A 1mV/A (1000A 1mV/A)" setting.

For USB Autoscope

- Connect oscilloscope probe to the input №6 of USB Autoscope. Black «crocodile» clip connect to the terminal "-" of vehicle battery, lead of oscilloscope probe - to terminal "+".
- Connect the current transducer to input №2 of the USB Autoscope using BNC-Banana adapter. Move the switch on the current transducer to the "600A 1mV/A (1000A 1mV/A)" setting.

Waveforms recording

- In the USB Oscilloscope program choose "Mode => ElPower".
- Position the current transducer so the jaw surrounds all of the wires emanating from one of the battery terminals. Orient the current transducer so the "+" mark points in the direction of the current flow using the conventional theory of current flow.
- Perform zero calibration by turning the potentiometer on the current transducer body. Adjust until the signal from the current transducer is in the middle of the red zone on the oscilloscope screen (or press zero button).
- Start the waveform recording by pressing the "Start" button on the USB Oscilloscope screen.
- Close the jaws to embrace all the wires emanating from one of the battery terminals (jaw tightly).
- Turn the high beam headlights on for 3...5 seconds, then turn them off. In case of difficulty, instead of high beam headlights can be switched on turn signal lamps.
- Turn on the ignition.
- Wait a few seconds for the fuel pump to shut back off. If the vehicle is equipped with a diesel engine, wait for the glow plugs to shut off.
- Start the engine (If the engine does not start, continue cranking for 6 to 10 seconds).
- After 5 to 10 seconds, turn the high beam headlights back on for 3 to 5 seconds (or turn signal lamps).
- After another 3 to 5 seconds, turn off the ignition.
- Open the jaws. Close the jaws.
- Turn off the recording by clicking the "Stop" button on the USB Oscilloscope screen.
- If necessary, the recorded waveform can be saved using the "File => File save".

Starting the ElPower script

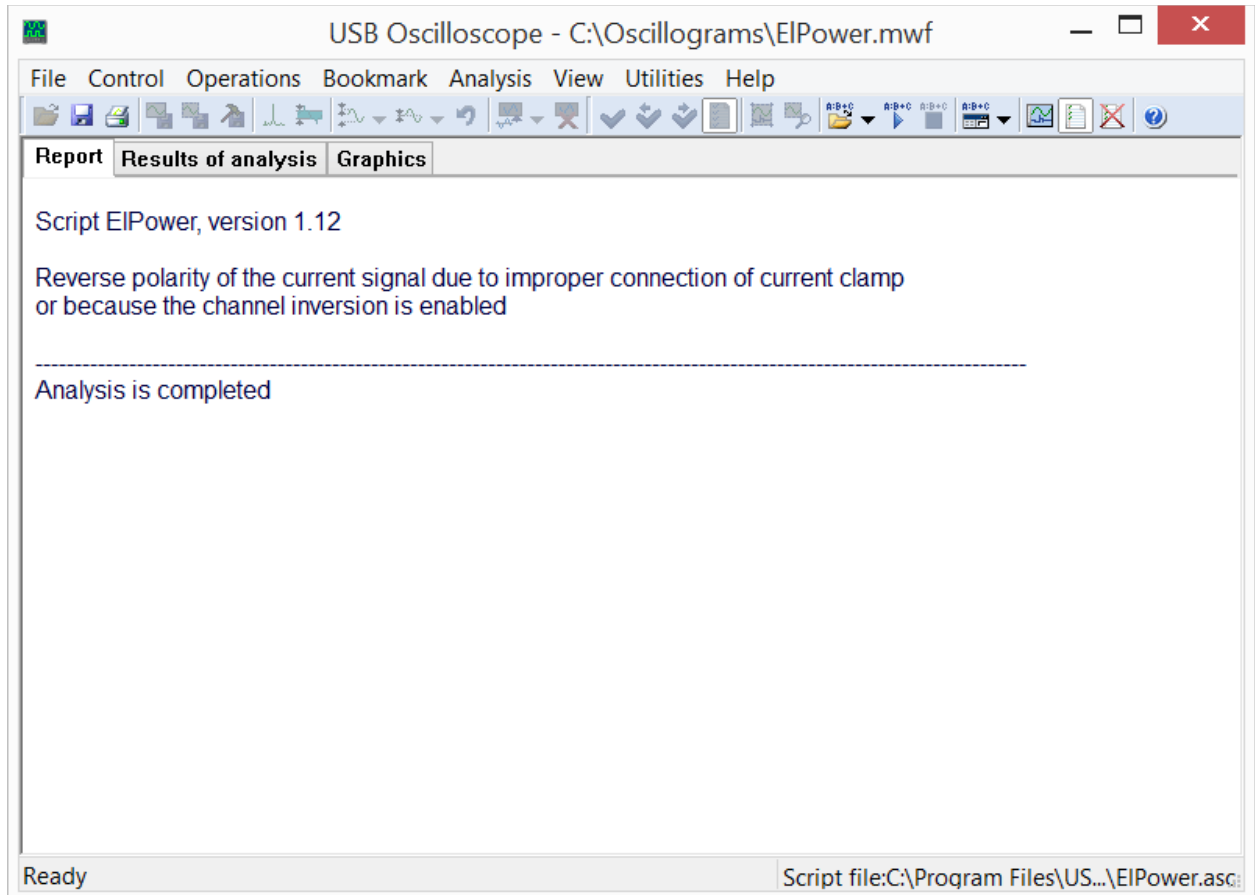
- Run the script signal analysis "ElPower". To do this choose the menu "Analysis => Execute Script".
- In the window "Please enter value(s)" choose / enter some values as follows:
- number of engine cylinders;
- battery starting current (usually stamped or written on top of the battery housing);
- standard of measurement (usually stamped or written on top of the battery housing);
- engine type...
- Press "OK".

Note that the script analyzes the entire file of recorded waveforms. It is also possible to select apart of the recording, the script will then analyze only the selected part.

3. Analysis results

3.1 The "Report" tab



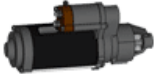
Displays the version of the script and, if needed, the error messages.



The tab "Report" of EIPower script report.

3.2 The "Results of analysis" tab

In the USB Oscilloscope program in the tab "Results of analysis" EIPower script will display some measured as well as calculated characteristics of the battery, the engine starting, and the charging system.

Component	Parameters and Ranges	Measured/Calculated Values
Battery 	Initial voltage (12.2...12.7)	11.8 V
	Charge level (50...100)	10 %
	Voltage under load (9...10)	8.55 V
	Measured starting current EN (440...500)	442 A
	Percentage from specified starting current 540 EN (85...105)	82 %
Alternator 	Maximum voltage (13.8...15)	12.19 V
	Continuous charging voltage (13.8...14.8)	12.08 V
	Voltage ripple (20...80)	424 mV
	Current of one phase is missing	!!!
Starter 	Solenoid current (10...35)	30.4 A
	Solenoid transit time (10...45)	25 ms
	Current peak	456 A
	Required battery starting current EN (270...770)	480 A

The tab "Results of analysis" of EIPower script report, the alternator is broken.

Names of the system elements are shown in the first column of the table. In the second column names are grouped parameters related thereto, to the right of them in brackets is shown the range of their nominal values. The third column shows the values of the measured and calculated parameters.

The results are grouped in the following order.

Battery

- **Initial voltage** – measured battery voltage at the start of measurement. For best results, the battery should be fully charged and the vehicle should be allowed to rest for one hour before testing.
- **Charge level** – calculated on the basis of the initial voltage. For best results, the battery should be fully charged and the vehicle should be allowed to rest for one hour before testing.
- **Voltage under load** – actual voltage under load at the time of the peak current consumption, which is while the engine is being cranked. The voltage under load should not drop below 9 V. Less than 7 V can cause hard starting and various malfunction problems with the on board electronics.
- **Measured starting current** – estimated maximum amount of current that can provide battery undervoltage provided in the normal range. Range of nominal values calculated based on the characteristics of the starter.
- **Percentage from specified starting current** – displays the ratio of the battery current capacity compared to the rating on the battery top. If the value is less than 50%, the battery is typically bad.

Alternator

- **Maximum voltage** – maximum battery voltage seen. Voltage more than 16 V can cause various malfunction problems with the on board electronics.
- **Continuous charging voltage.** If the charging voltage is below 13.8 V, incomplete charging can occur. If the voltage is above 15 V, damage to the battery and possibly to the vehicle electronics can occur.

The reason for the low charging voltage can be a generator malfunction or higher than normal current consumption in the vehicle. For example, some diesel engine control units cycles the glow plugs after engine start for a few minutes. Total current consumption, thus, can exceed the maximum current capacity of the generator.

- **Voltage ripple** – larger values may indicate a problem with the diode bridge or stator of the generator.
- **Current of one phase is missing.** This message appears when one phase of the generator is not working.

Starter

- **Solenoid current** – total current of pull-in and hold-in windings of the starter solenoid. (This measurement is done before the starter main contact is closed).
- **Solenoid transit time** – time from the solenoid is turned on and until the power contacts close.

Increased time and / or large variances of this measurement may indicate a sticking solenoid or armature.

- **Current peak** – the largest current value seen, as the starter is engaged.
- **Required battery starting current** – the calculated value of current in the starter circuit while keeping the voltage drop within nominal limits. The margins (shown in parentheses) are calculated based on the number of cylinders and the engine type. (Engine displacement is not considered).

If the calculated value of the nominal peak current is near the lower limit, the starter cables may be of insufficient thickness, a bad contact in the starter circuit, or too much electrical resistance in the starter. If this value is near the upper limit – then use of a larger battery is recommended.

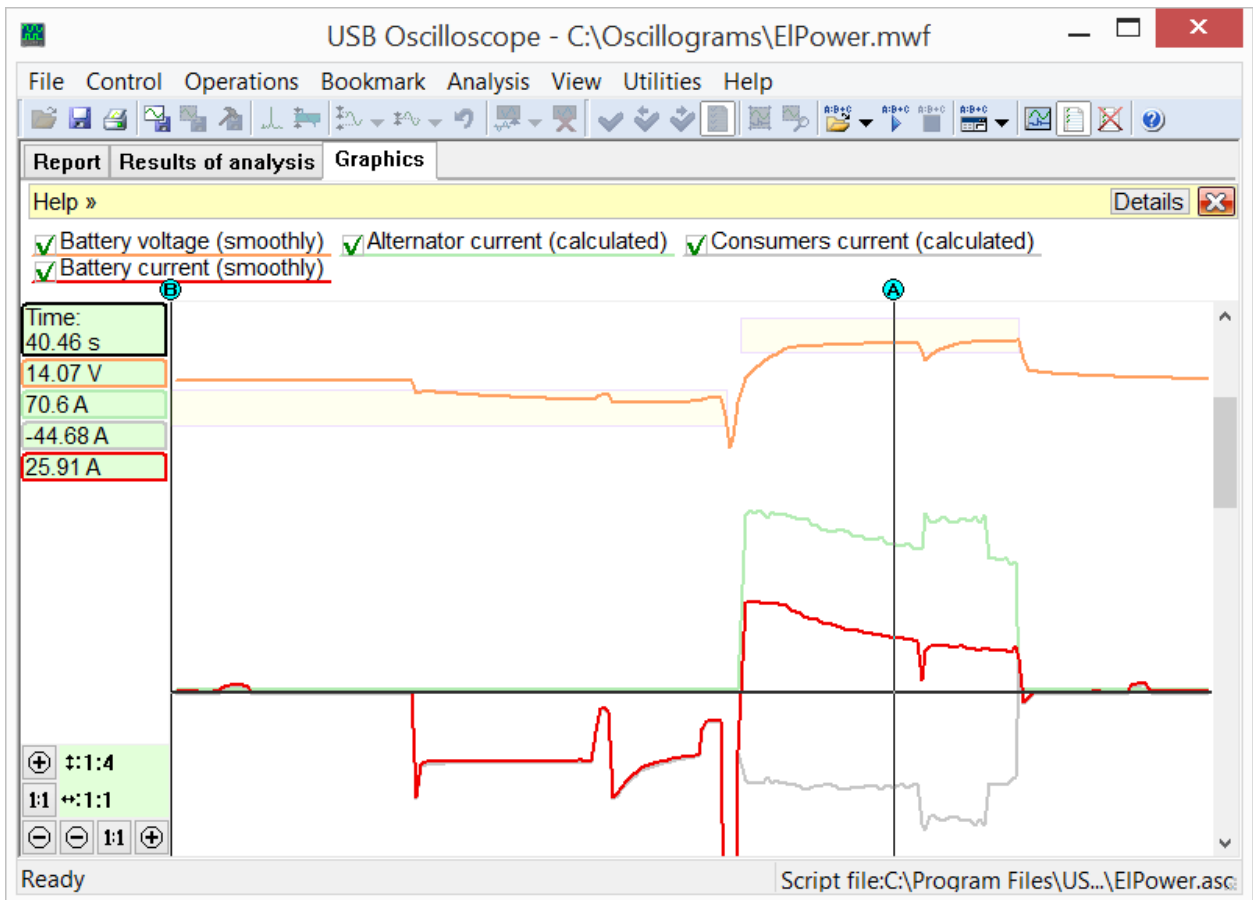
- **Starter current drop outs** occur due to wear of the brushes and / or the commutator bars. This failure creates significant interference in the vehicle electrical system and can lead to malfunction of the electronics or even make starting the engine very difficult.

Glow plugs

- **Total peak current of all glow plugs** – the peak current consumed from the battery, during the initial energizing of the glow plugs.
- **Glow plug on time** – time from turn on and until turn off.
- **Probable number of faulty glow plugs** – estimated number of "blown" glow plugs.

3.3 The "Graphics" tab

Shows the smoothed graphs of the measured battery voltage and current, it is also possible to perform the additional measurements in manual mode.

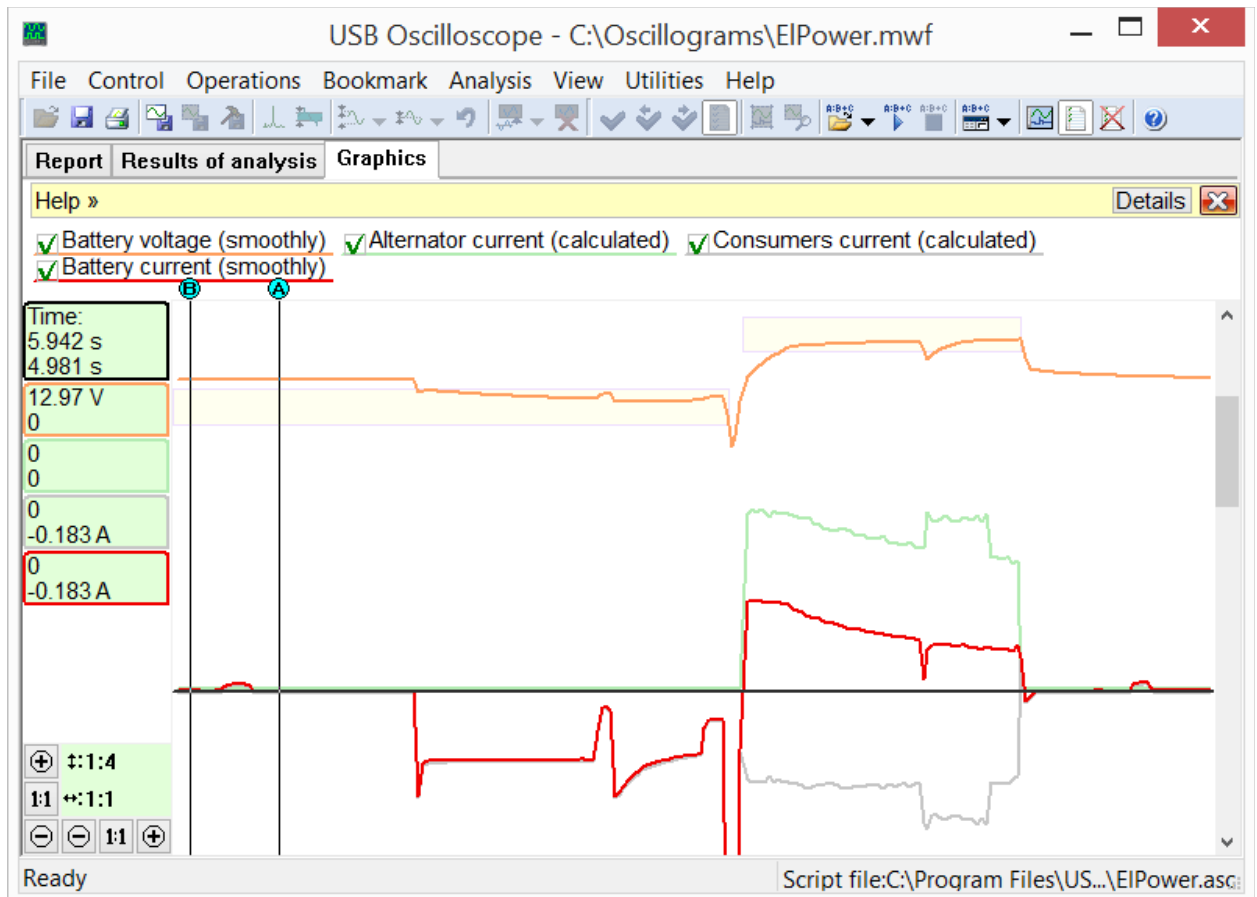


The tab "Graphics" of EIPower script report.

In addition, here presented graphs of calculated (estimated) alternator current and onboard consumption.

4. Parasitic draw measurement

Allowable parasitic draw is ~ 100 mA. For the actual value, be sure to consult service information. It is possible to measure the parasitic draw immediately after opening and closing the jaws of the current transducer. To do this, measurement marker B should be set to a point immediately before the opening of the jaws and marker A - after closing. Then read the value of the current difference between the points indicated by markers A and B, which is displayed in the bottom line of the measurement display of graphic "Battery current". The opening and closing of the jaws are usually clearly visible on the current graph.



The measuring of parasitic draw, which value in this case is ~ 180 mA.

Analogically, may be estimated the value of current, consumed onboard at the end of the record.

Do note that some electronic components may not be turned off for more than one hour after the ignition is switched off.

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