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# EDA offline analyses

## Revision History

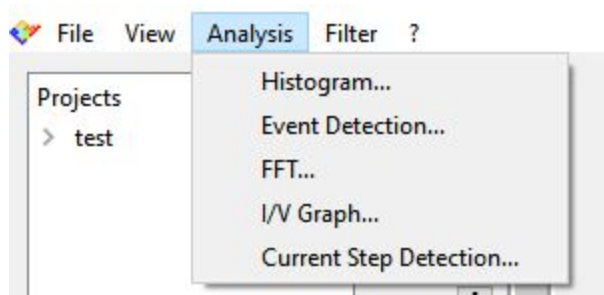
Date	Version	Description
07/11/2019	1.0	First version of document



## Analyses overview

EDA offers some predefined offline analyses selectable from the Analysis menu:

- Current histogram;
- Current events detection;
- Current spectrum;
- I/V graph;
- Current steps detection.



## New analyses requests

It is possible to suggest new analyses to be added in the next software releases.

To do so write to [support@elements-ic.com](mailto:support@elements-ic.com) and provide:

- A brief explanation of the analysis;
- A minimum set of specifications (e.g., parameters settable by the user, useful noise reductions or spurious data rejection, etc.);
- A sample recording with expected analysis result (e.g., obtained with Python, Matlab, etc.);
- If available, any useful reference is very welcome (e.g., reference to paper/book explaining the analysis, code/pseudocode, etc.).

## Analysis common features

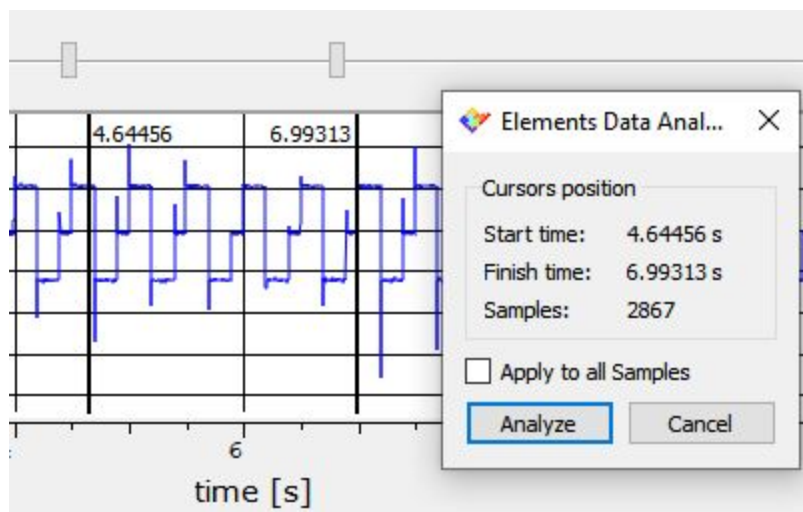
### Data selection

Before performing any analysis it is necessary to import a dataset as explained in the EDA Import and Export Data guide.

Once the data is loaded into EDA the cursors above the current plots can be used to select the portion of data to be analyzed. E.g., in the image below the data from 4.64456s to 6.99313s is selected.



After selecting any of the analyses the user will be asked whether the whole dataset should be analyzed or only the data in the interval defined by the cursors.

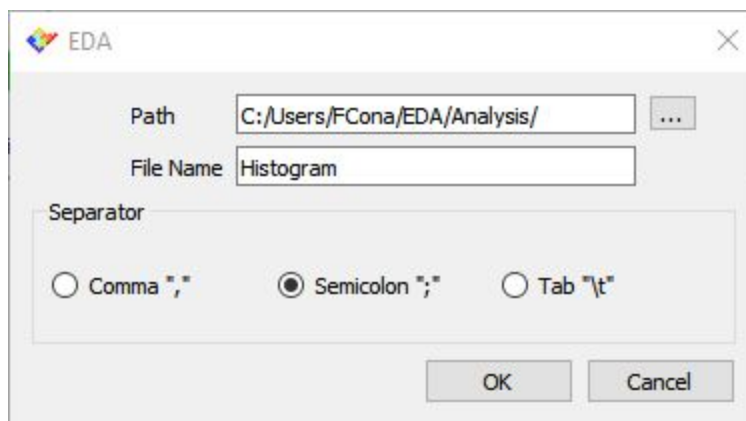


## Analysis zoom

All the graphical reports of the analyses can be zoomed by selecting a rectangular area to be zoomed: left click in a corner of the area to zoom, drag the mouse cursor to the opposite corner of the area and finally release the left button. To zoom back right click in any point of the plotting area.

## Analysis export

All analyses results can be exported to .csv files. In order to do so, click the Export button that is located in the upper right corner of the analysis window. In the window that will open browse for a location to save the .csv file, select a filename and select the value separator (the comma may create conflicts in some applications depending on your local machine configuration).





## Analyses description

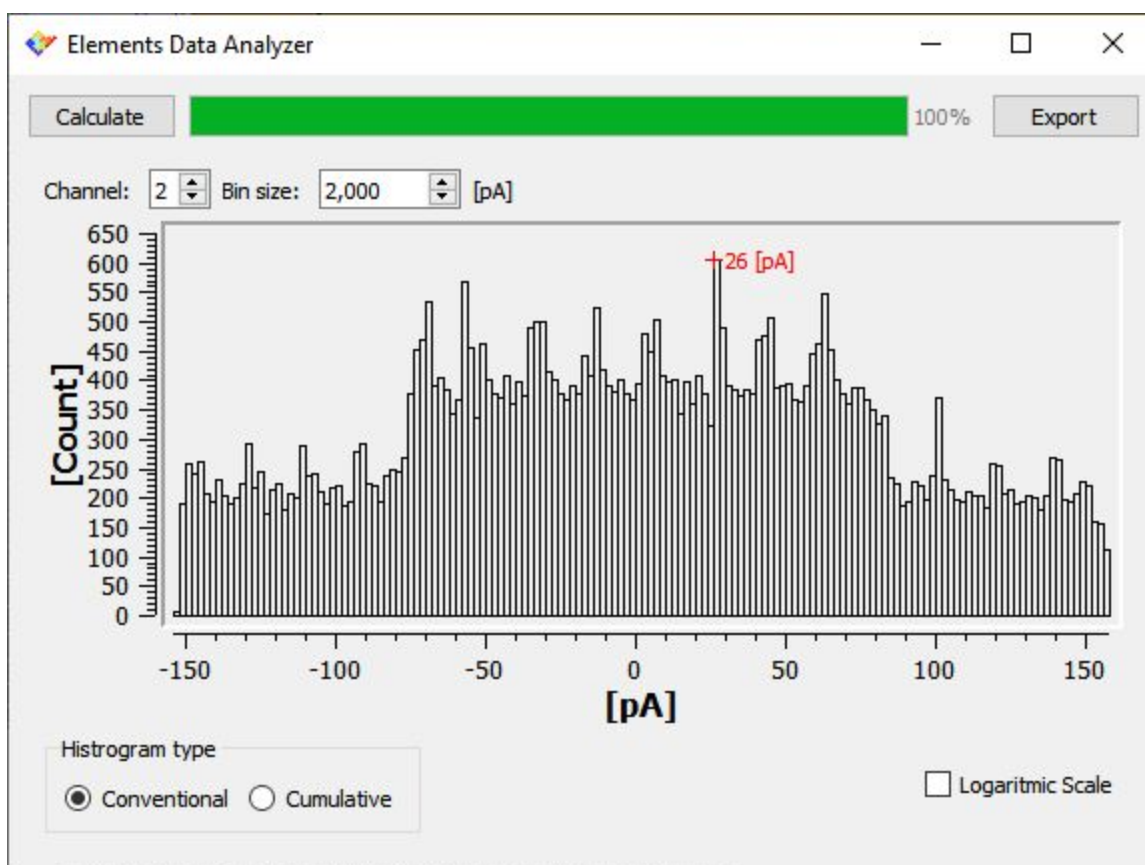
### Current histogram

To compute a current histogram select Histogram from the Analysis menu.

In the window that will open select the current channel you want to apply the analysis to (for multichannel devices) and the histogram bin size, i.e. the width of each bar of the histogram: increasing the bin size reduces the resolution and the variance of the histogram.

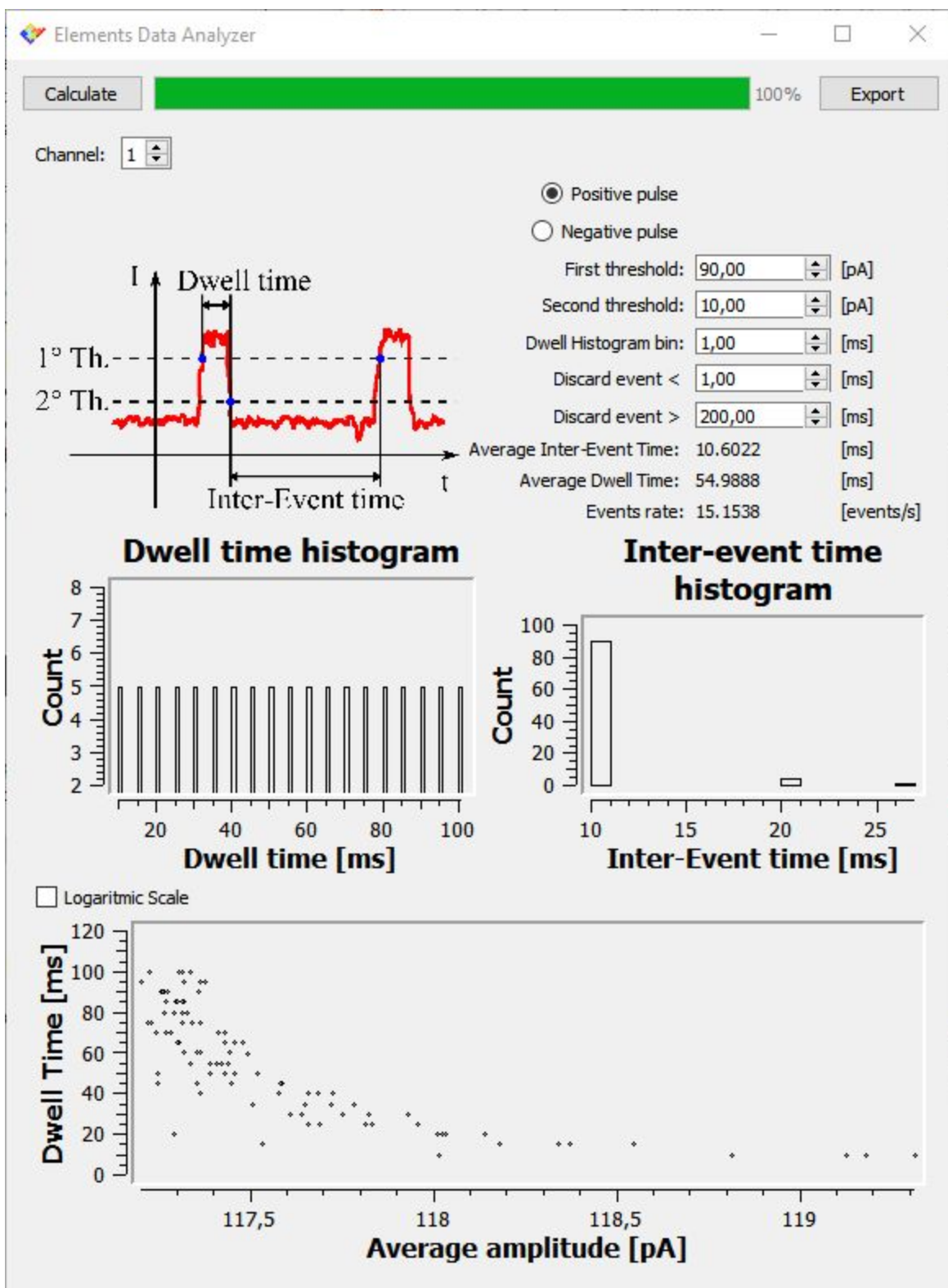
Click Calculate to actually perform the analysis.

This analysis can optionally visualize the cumulative histogram or set a logarithmic scale.



### Current event detection

To detect current events select Event detection from the Analysis menu.





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In the window that will open select the current channel you want to apply the analysis to (for multichannel devices) and select if you want to identify positive or negative events. Set the remaining analysis parameters in order to correctly detect the events you are interested in and reject spurious events.

Click Calculate to actually perform the analysis. This analysis will identify as events those intervals that comply with the following rules:

- The event starts when the current passes the First threshold with a rising edge (or falling edge for negative pulses detection);
- The event ends when the current passes the Second threshold with a falling edge (or rising edge for positive pulses detection);
- Events outside the duration range defined are rejected.

The analysis result will include the following:

- A histogram of the duration of the detected events (dwell time histogram);
- A histogram of the duration of the intervals between consecutive events (inter-event time histogram);
- A time/amplitude scatter plot that shows the relation between the duration and the mean amplitude of each event;
- A report including the average inter event time histogram, the average event duration and the average events rate.

This analysis can optionally visualize the histogram in a logarithmic scale.

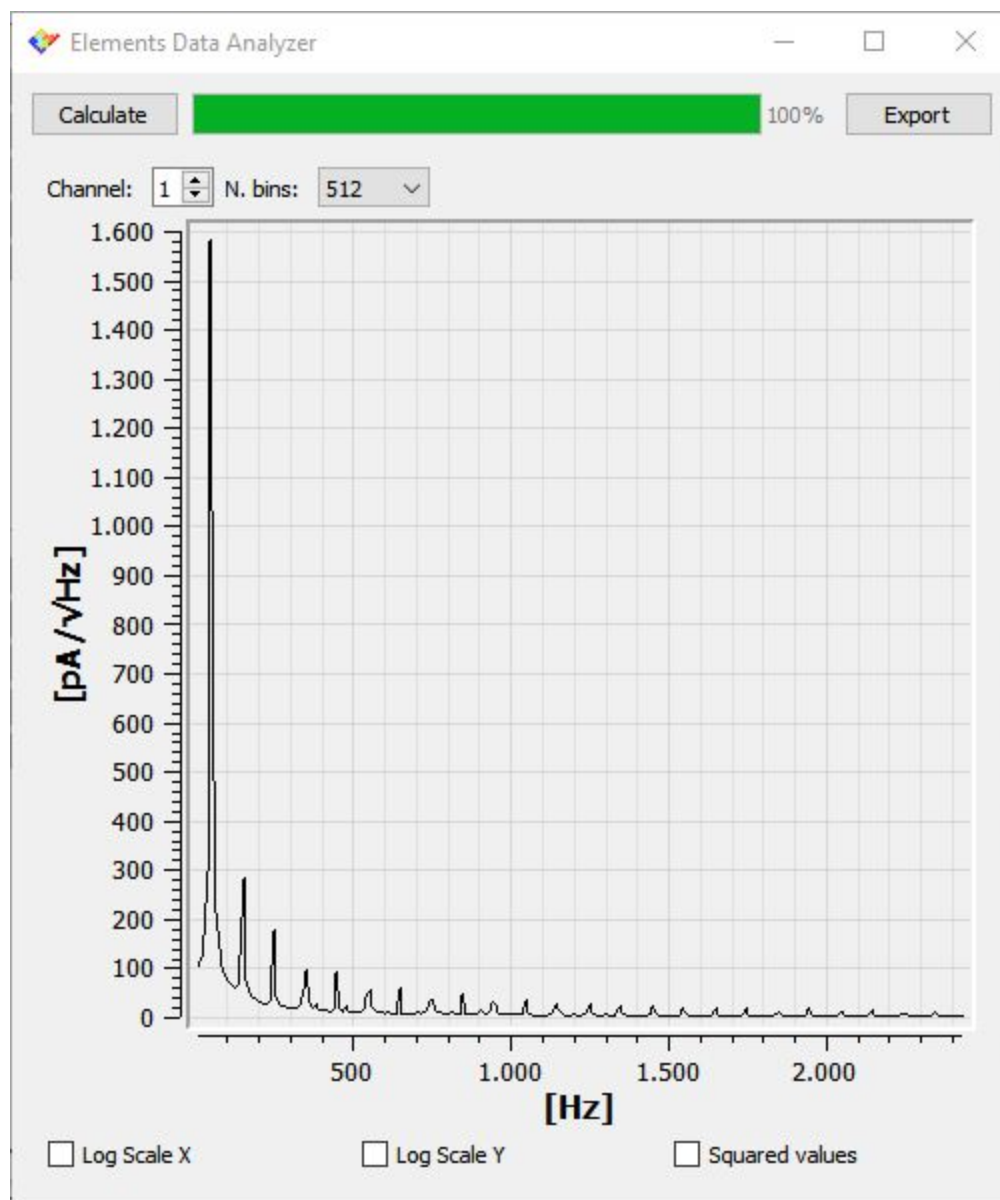
## Current spectrum

To compute a current spectrum select FFT from the Analysis menu.

In the window that will open select the current channel you want to apply the analysis to (for multichannel devices) and the number of frequency bins, i.e. the number of points between 0Hz and SR/2: increasing the number of bins increases the resolution and the variance of the spectrum.


Click Calculate to actually perform the analysis. The spectrum is computed by computing the FFT over windows of  $2 \cdot N$  bins current samples, keeping only the first half of the spectrum, and finally taking the root mean square of the modulus of the computed FFTs.

This analysis can optionally visualize the power spectrum or set logarithmic axis.



## I/V graph

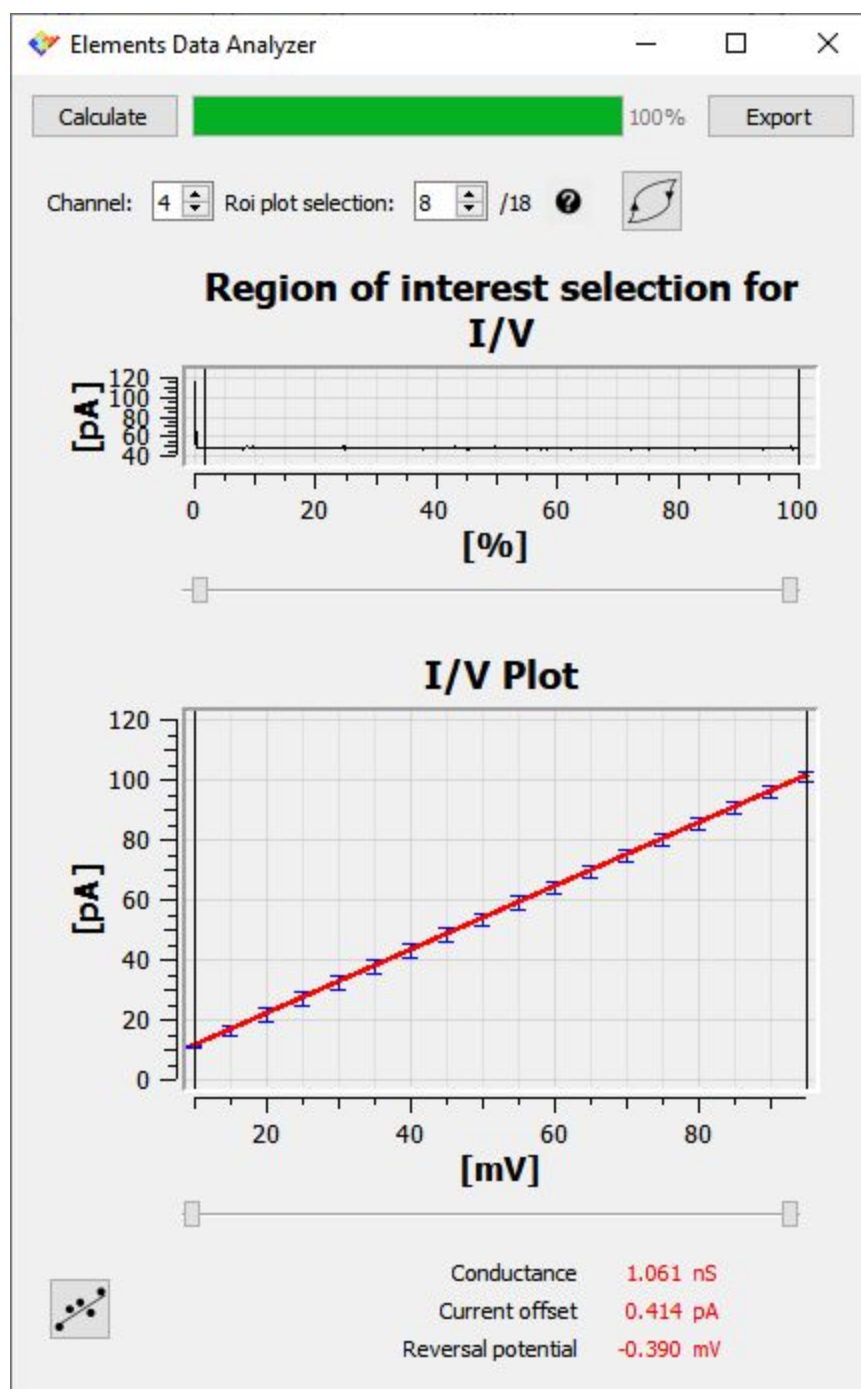
To compute an I/V graph select I/V graph from the Analysis menu.

In the window that will open select the current channel you want to apply the analysis to (for multichannel devices). It is possible to use the cursors under the Region of interest selection plot to reduce the interval over which the current statistics are computed, e.g., by moving slightly to the right the leftmost cursor it is possible to neglect capacitive peaks usually located at the beginning of voltage steps (move the mouse over the help icon  for more information).






Click Calculate to actually perform the analysis. The analysis will compute the current mean value and standard deviation over each interval in which the voltage is constant, taking into account the limits set with the Region of interest plot.








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In case the hysteresis button  is pressed intervals with the same voltage value are treated separately if they belong to a rising sequence or to a falling sequence.

Clicking the linear fit button  a linear fit of the I/V graph will be performed including only the points within the interval identified by the cursors below the I/V graph plot. Performing the linear fit provides also a brief report including the estimated conductance, the current offset and the reverse potential.

## Current steps detection

To detect current steps select Current steps detection from the Analysis menu.

In the window that will open select the current channel you want to apply the analysis to (for multichannel devices) and the minimum amplitude and duration of the current steps to be identified.

Click Calculate to actually perform the analysis. The analysis will identify current steps as intervals in which the current changes less than the minimum step amplitude. Changes greater than the minimum current step threshold are rejected if their duration is smaller than the minimum step duration.

The analysis result will include the following:

- A graphical representation of the identified steps (green line) superimposed to the raw signal for quick visual confirmation of the result;
- A histogram of the steps amplitude (current steps amplitude histogram);
- A histogram of the steps duration (current steps duration histogram);
- A report including the number of different current values identified, the average current steps amplitude and the average current steps duration.

