elements
enabling technologies for Life Science

# EDR4 - Graphical User Interface and Basic Commands

Revision History

Date	Version	Description
24/04/2022	1.2	Updated to software version 1.0.19
07/05/2021	1.1	Updated to software version 1.0.9
14/04/2021	1.0	First version of document

Introduction

The default GUI is organized in multiple menus all embedded in a single window; however single menus can be removed from the main window and split in different windows to be placed where preferred on the screen.

Click on the "View" menu or "Analysis" menu to select which widgets should be shown or hidden.
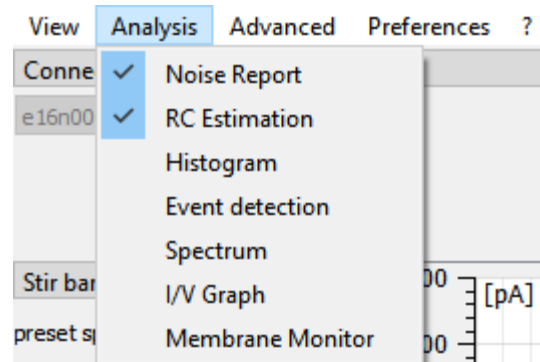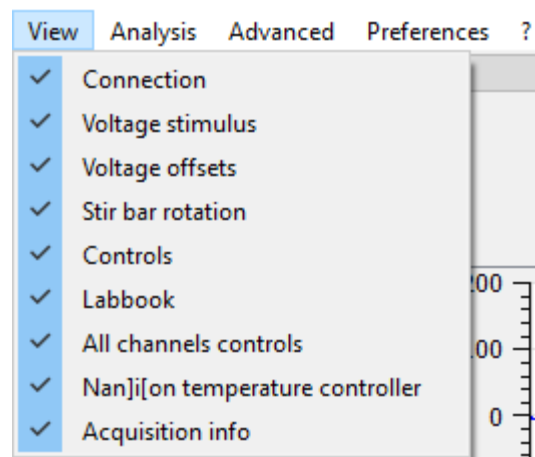
Current/voltage plots window

The central window of the Graphical User Interface displays the acquired input current channel (or channels for multichannel devices) and the control voltage in an oscilloscope-like fashion.

Vertical zoom and offset

The vertical zoom [image of zoom in/out buttons] controls let you interact with the current and voltage plots in terms of scale. The full trace button [image of full trace button] will try to rescale y-axis so that the data fits well the plot window.

The offset can be modified using the mouse scroll wheel.

The scale and offset are independent for all current channels and can be modified for each channel separately, but they can synchronized among plots of the same type by using the YAxis lock button [image of lock button].

The baseline tracking button [image of baseline tracking button] can be used to keep the current traces in the center of their y-axis. When it is pressed everytime the current trace reaches the end of the plot area the y-axis offset is updated so that the current trace is well centered.

Horizontal zoom

The horizontal scale is always synchronized among all plots. The zoom buttons [image of zoom buttons] increase and decrease the time scale of all channels.

Rectangular zoom

It is also possible to select a rectangular area to zoom manually. To do it simply left click in one corner of the rectangular area you want to zoom, drag the mouse cursor to the opposite corner of the area and finally release the left button of the mouse.
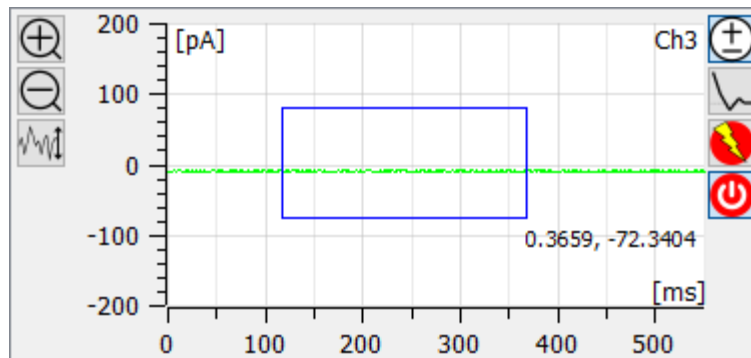
In order to zoom only along the x-axis or y-axis draw a thin rectangle, elongated along the horizontal or vertical axes respectively. When done properly the rectangle will become a horizontal or vertical line.
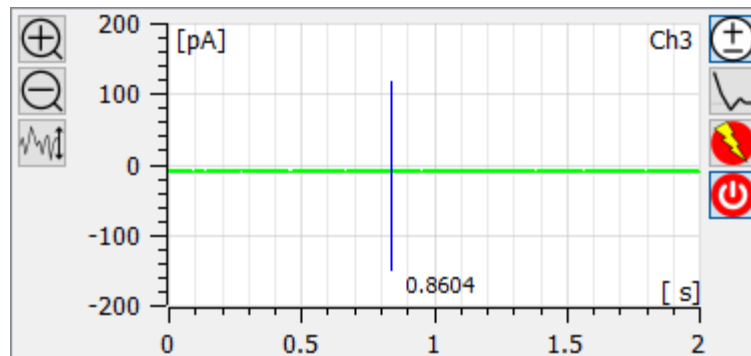
To go back to the previous zoom setting right click anywhere within the plot areas.

Maximize plot

The maximize button ⤢ makes a single current plot visible so that it covers the whole plotting area. When a plot is maximized the next ➡ and previous ⬅ buttons appear and can be used to quickly show the next or previous current plot maximized.
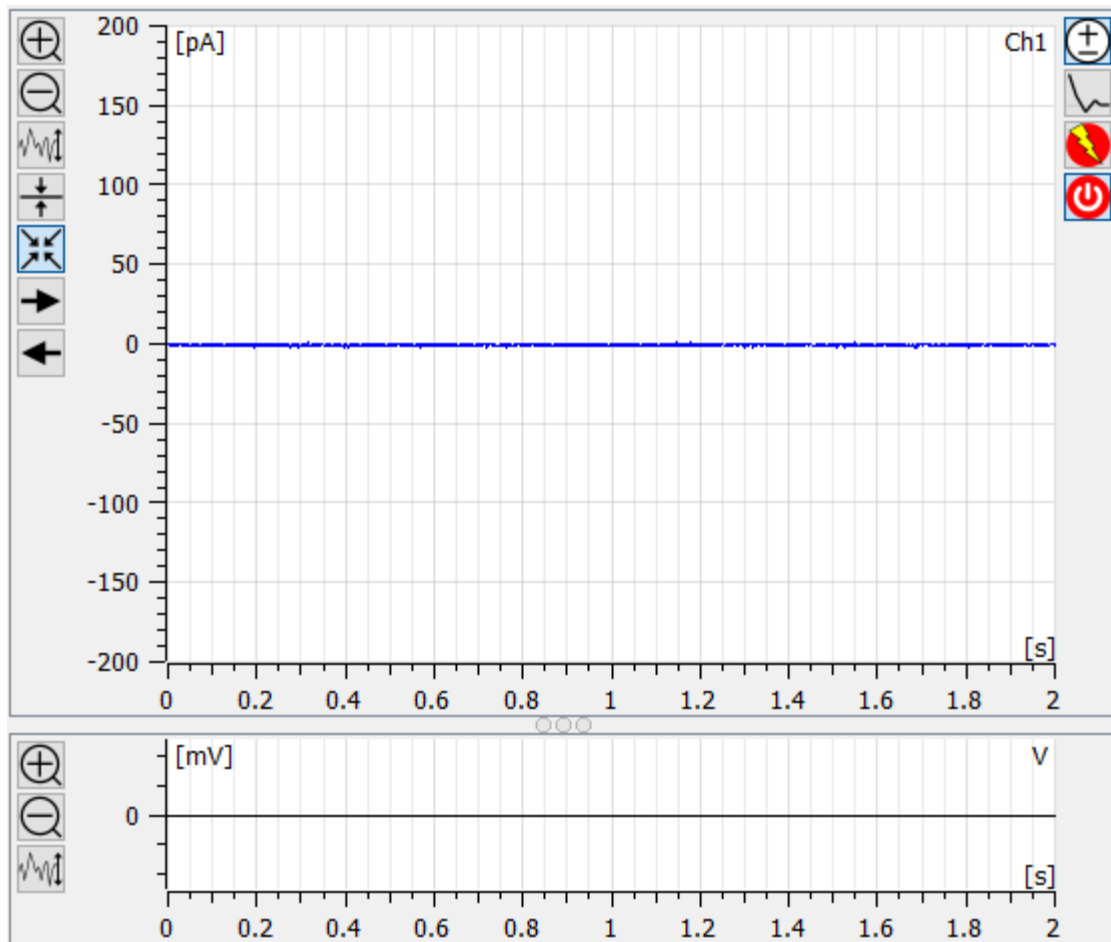
Visualization options

Check the Overlap button overlap in order to overlap all the current and voltage channels in a single plot.

Notice that the voltage vertical scale is on the right side. To change zoom use the vertical zoom controls placed on the right side and to change Vc offset use the mouse scroll wheel once the mouse position is in the right side of the window:
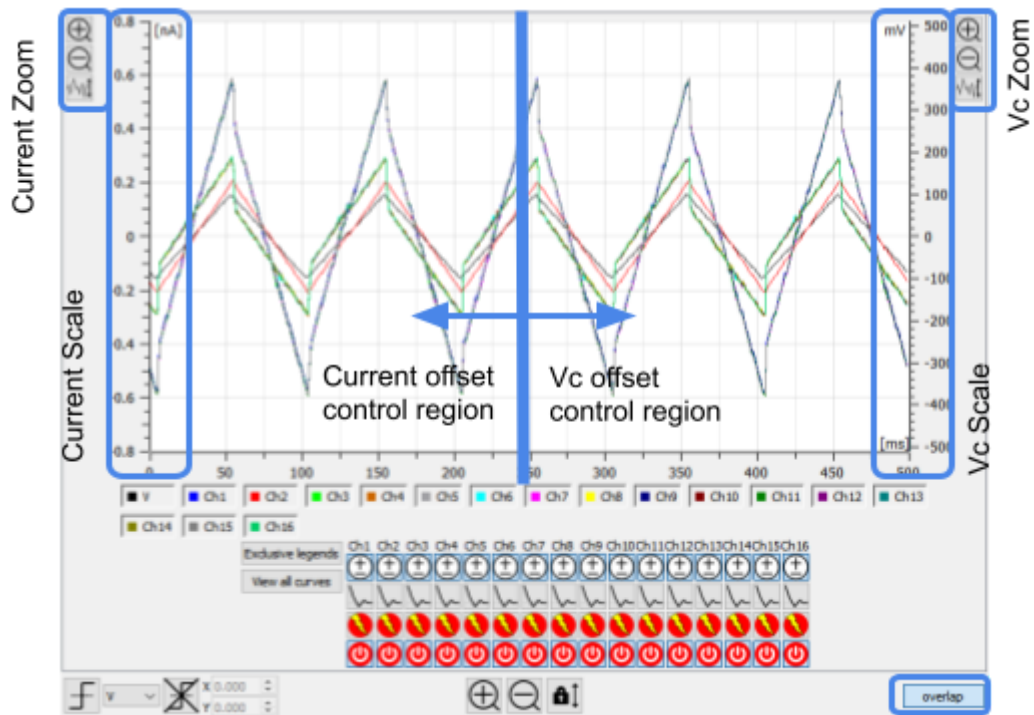
In order to change the color of traces or to switch between dark and light mode select Plot from the Preferences menu.
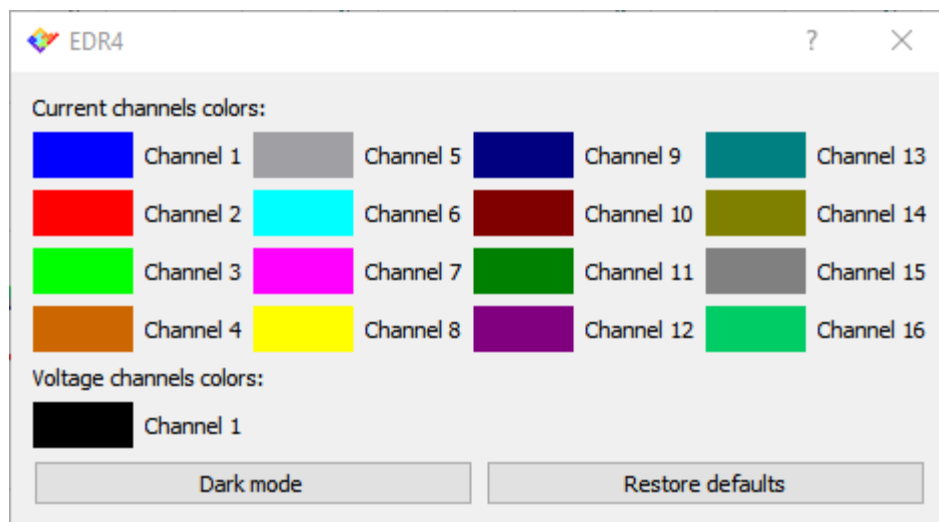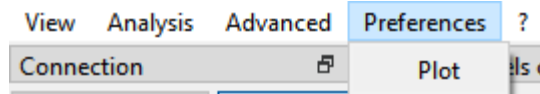
Displayed data trigger

When the trigger button is pressed the mouse cursor will change and resemble the trigger icon. In this condition click in any plot to set a triggering point that will be marked by two dashed lines on the triggered plot: now the plot will refresh so that the selected trace crosses the triggering point with a rising edge.
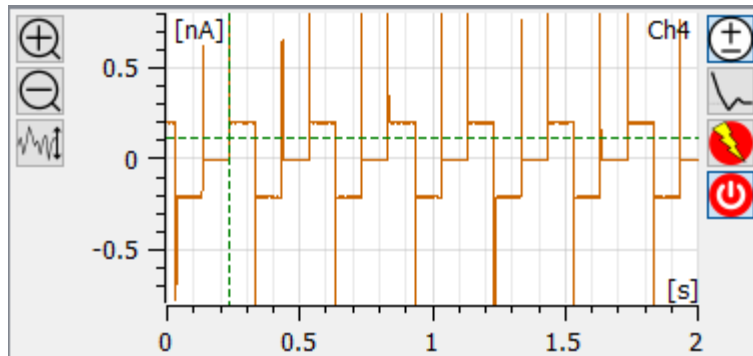
Use the right button to set the triggering point in order to set a falling edge trigger.
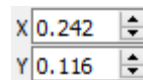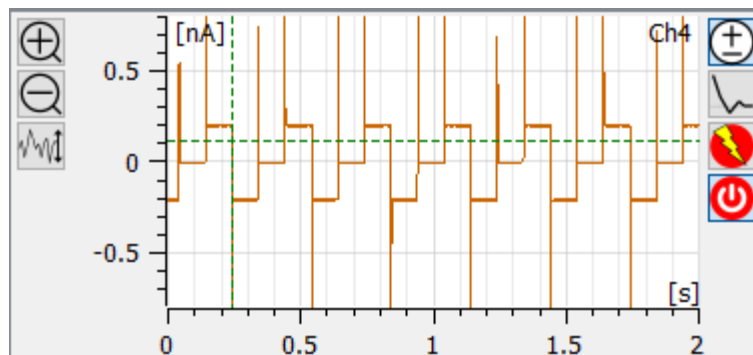
Once a triggering point is set the trigger location controls will be enabled: using these controls the triggering point position can be fine tuned.

Use the remove triggers button to disable the triggering function.

Setting a second triggering point will disable a previously set triggering point.

If the trace does not cross the triggering point the plots will stop refreshing. This condition will persist until the trace finally crosses the triggering point or the triggering point is changed, moved or disabled.

In overlapped visualization the triggering channel control will be enabled and allow to select which channel should be triggered.

Single channel buttons

On the right side of current plots a list of buttons is available, depending on the particular Elements device (not all of these buttons are available for all devices).
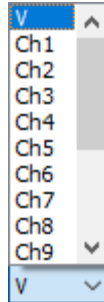

If one of these buttons is not available it means that the device being used does not implement the corresponding feature.
These buttons affect only the current channel they refer to, and they can be used to:

Select channel for voltage protocol

Pressing this button will select/deselect a channel for voltage protocols application (all channels are selected by default: button pressed). This feature allows the application of a voltage protocol on a subset of the available channels while leaving the other channels alone.

Selected channel

Deselected channel
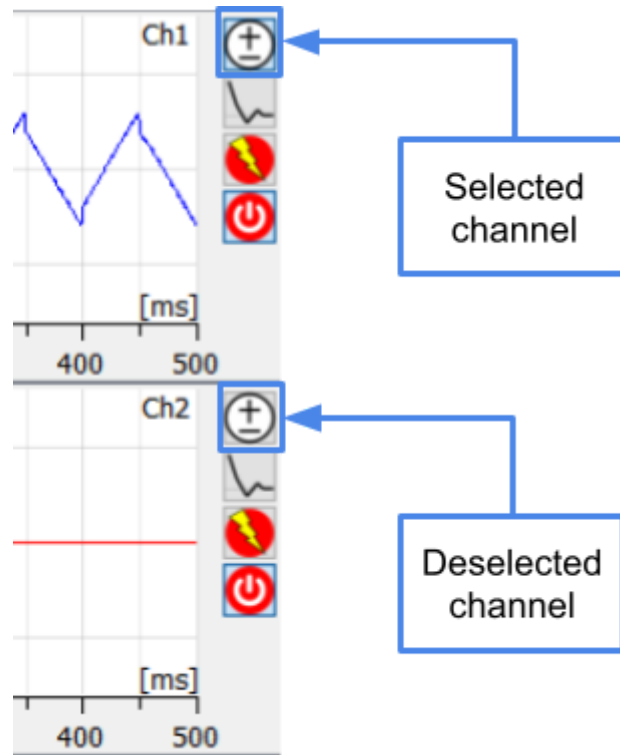
Digital offset compensation

Pressing this button will activate/deactivate the digital offset compensation procedure on a channel (by default digital offset compensation procedures are deactivated: button released). The digital offset compensation modifies the voltage applied to the device under test in order to compensate for electrode voltage offset. This way, when the user applies 0 V the actual potential applied on the DUT is slightly different so that the net current flowing is as close to 0 as possible.

Compensate channel
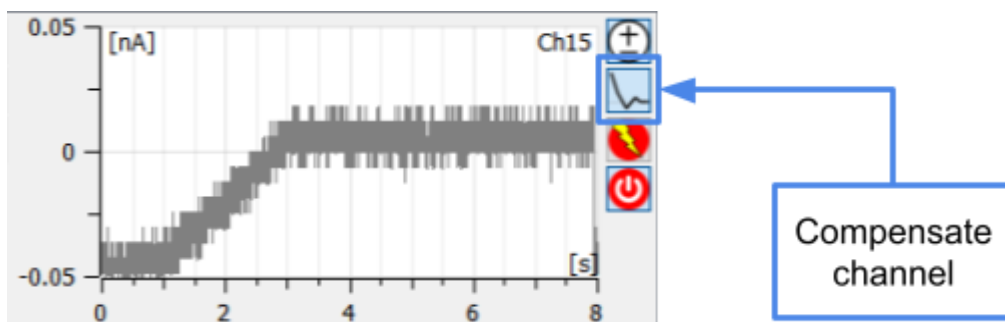
Zap

This button applies a zap to a channel. The zap applies -1V for 100ms and is typically used to break the lipid bilayer when it is badly formed, e.g. because of a clog.

Switch off channel
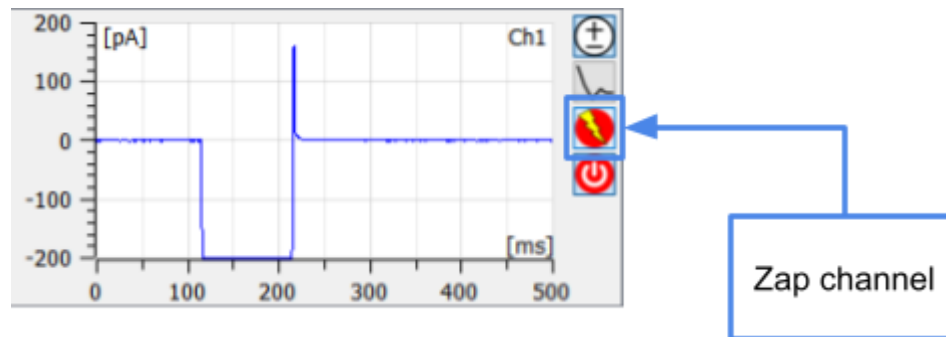

Pressing this button will switch on/off a channel (all channels are switched on by default: button pressed). Switching off a channel is useful to neglect irrelevant data, such as data coming from a broken bilayer, and concentrate on more meaningful data. Switched off channels are easily

recognizable because the corresponding switch on button turns to a warning icon and their trace is identically 0.

Note also that in order to minimize cross-talk with the switched off channels (recall that a common use case is for broken bilayer, which means very low resistances and thus very high currents), voltage protocols are not applied on switched off channels and their current offset is continuously digitally compensated.

Moreover, data from switched off channels is not recorded during data saving.

All channels controls

Multichannel devices provide the option to apply most of the controls described above to all of the channels at once. This can be done by using the buttons in the "All channels controls" widget, also in this case not all of these buttons are available for all devices
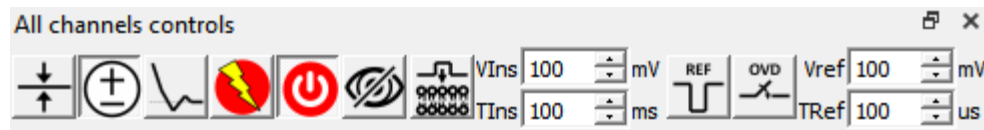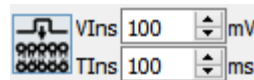
Hide switched off channels

The hide button makes switched off channels invisible, so that the other plots can be rearranged and resized to make better use of the available area.

Insertion Pulse

These controls apply an insertion pulse.

The insertion pulse is a rectangular voltage pulse applied to all channels on top of the currently applied voltage protocol. It is commonly used to increase the chances of ionic channels into lipid bilayers. In order to use it, set the amplitude and duration of the pulse and click the button.

Reference Pulse and Override Reference Pulse

The "All channels controls" widget also hosts controls to apply a reference pulse and a control to override the reference pulse switch.
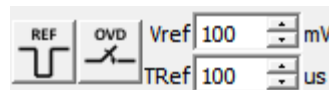
The reference pulse is a rectangular voltage pulse applied to all channels. This voltage pulse is applied by the external DAC, the voltage value is editable by modifying the spinbox Vref and the temporal duration of this pulse is editable by modifying the spinbox Tref. This can be applied by pressing the enter key on the spinboxes or by clicking the button "Ref". It is commonly used to apply very fast pulses, in the range of us. If the override button is checked Vref voltage is continuously applied on all channels.

Acquisition info widget
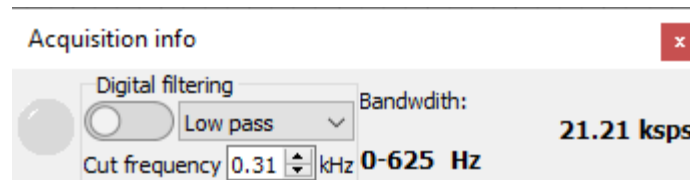
The acquisition info widget reports some runtime information about the data being acquired.

On the left is the saturation LED, which will blink anytime one of the current channels is saturating the selected current range.

The digital filter controls can be used to filter the acquired data with low pass or high pass digital filter (4th order butterworth). The filter cut-off frequency can be set in the range [SR/100, SR/4], where SR is the selected sampling rate. The range is limited to ensure that the filter does not become numerically unstable.

When the filter is enabled filtered data is used for real time visualization, recording and analyses, so original data is lost.

On the right of the widget is displayed the current amount of data acquired in terms of samples per second.

Device controls

The Controls menu contains all the device settings controls in a modular fashion. The features availability depends on the particular Elements device connected. In any case this section allows users to set Current Range and the Sampling Rate.

For example, the following image shows a device reading data in the ±200 pA range and sampling data at 1.25 kHz.
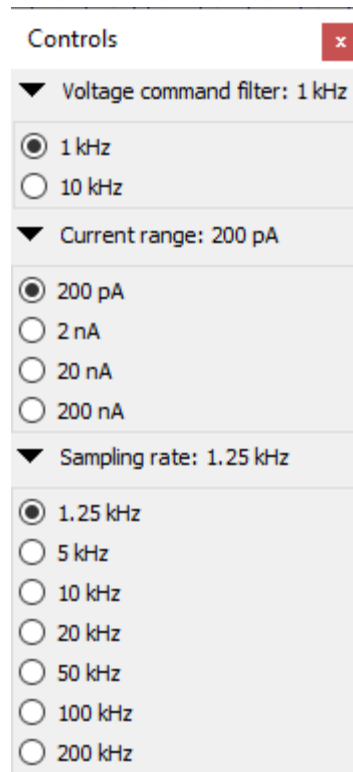
Voltage command filter

The Voltage command filter control (when present) lets the user set the bandwidth at the output of the Vc circuity generator. By default the lowest bandwidth is selected, so the bandwidth of the voltage stimuli is limited to few tens of Hz up to some kHz depending on the particular device.

It is recommended to reduce the bandwidth when a constant or slow changing voltage is applied, in order to reduce the RMS noise on the current measurement.

On the other hand, it is better to increase the voltage bandwidth when using a voltage protocol with high bandwidth components. This is especially important when performing Resistance or Capacitance estimations, since the filtering may affect the estimation significantly.

Voltage stimulus

The Voltage stimulus widget contains a complete set of parametric voltage stimulus protocols. For each voltage protocol the different parameters represented in figure can be set (see device specific guides for the complete list of voltage protocols available for each device and the "Voltage Protocols" guide for further details).
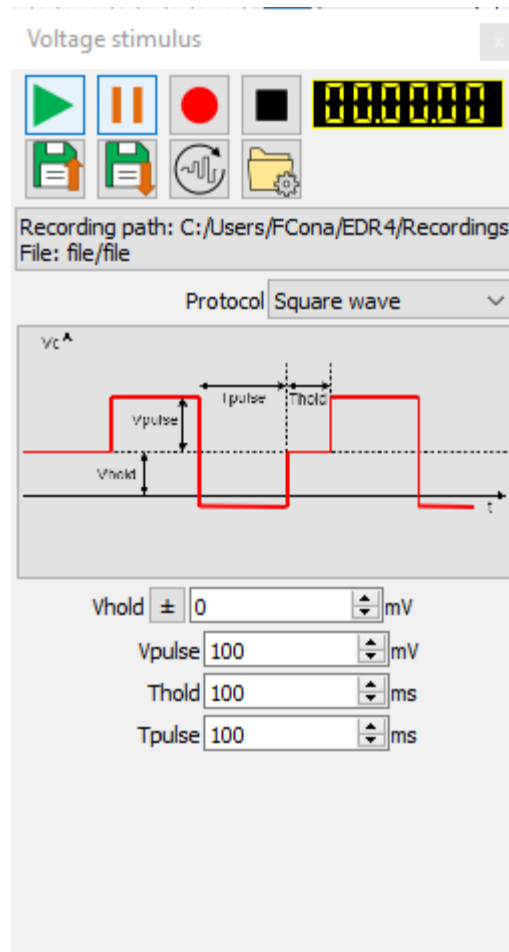
Recording

The voltage stimulus widget hosts also the controls for recording the acquired data. More info on this on the "Record, display and read data" guide.

Compensations

The compensations widget contains:

- a spinbox to select the channel to be compensated;
- a switch to activate the Cfast compensation for the selected channel;
- a knob to set the cFast compensation value.
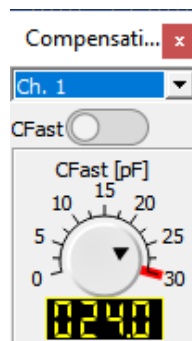
To activate the compensation on a single channel it is necessary to select the channel and switch the button "on". Different values of compensation can be applied to different channels but among the options it is possible to select "all channels" and apply the same compensation at the same time to all channels.
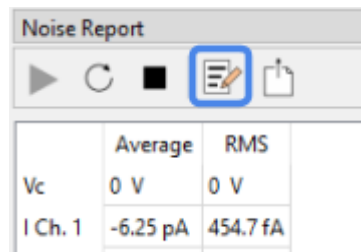
LabBook

Users can add any comment to a lab book .txt file while the experiment is running, such as experimental details or when any important event occurs during the recording. To add a note just write it in the editable field and press enter. The lab book .txt file will be saved in the default path "C:\Users\<USERNAME>\EDR4\Labbooks", which is easily accessible by clicking on the lower left button that contains the name of the file.

The lab book used during the last session is loaded by default every time EDR4 connects to a new device. A new lab book can be started by clicking the "New labbook" button.
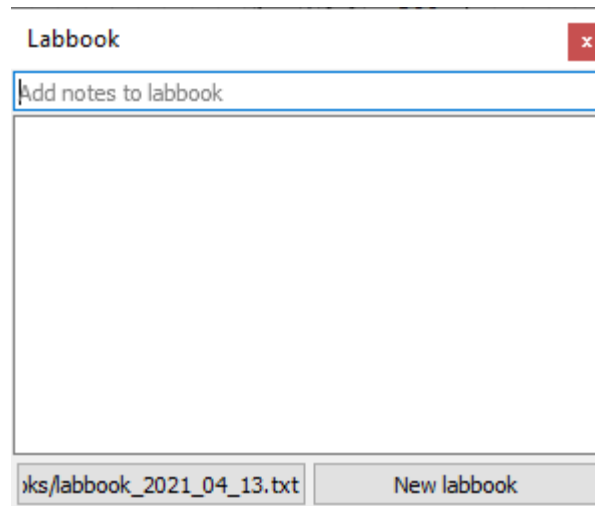
Online analyses results can be also noted to the lab book by clicking on the proper button.

Lab book notes taken during a recording will also be saved in a separate lab book into the save path folder.
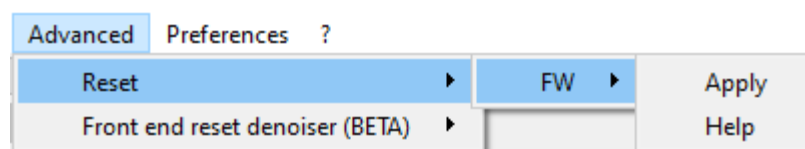
Online Analyses

Each online analysis has its own widget that can be shown, hidden, moved around or docked as any other widget. More info on specific analyses can be found in the "Online Analyses" guide.
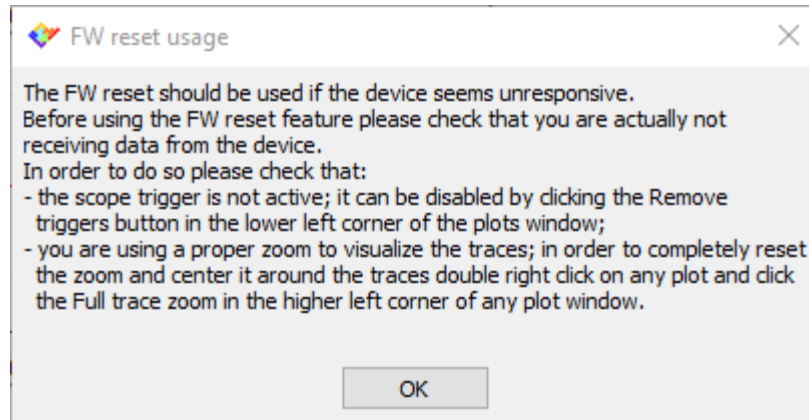
Advanced menu

The advanced menu contains features that are not commonly used.

Firmware reset

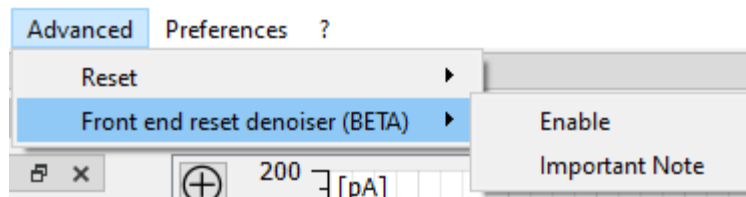The firmware reset can be used to restore the device functionality if it seems unresponsive. More information on this is available by clicking the Help button.

Front end reset denoiser

This feature provides a way to eliminate the influence of the capacitive front end resets. Currently this feature is released in BETA version. More information on this is available by clicking the Important Note button.

Front end reset denoiser: BETA version important note ✕

This feature aims at erasing the noise due to the reset of the capacitive front end.

Capacitive front ends, such as the ones used in almost all of Elements devices, need to be resetted periodically to discharge the capacitors in the front end. This discharge can affect the acquired currents, giving rise to a periodic noise around 10kHz or 40kHz, depending on the current range.

This new feature learns this noise and removes it digitally from the acquired signals in real time. The algorithm is not trained to learn specifically the front end reset waveform, so it will eventually erase any signal component at the very same frequency.
Notice however, that it does not act as a filter, it doesn't simply drill some holes at specific frequencies: for a signal to be learnt and removed from the algorithm it has to be an almost perfectly periodic waveform, exactly at the reset frequency, not even a few Hz off, otherwise it will remain untouched.

The current version of the algorithm has a known issue that appears when a command is issued to the device when sampling at high sampling rates, causing a bit of sample loss: in these cases the learned noise gets desynchronized and so the noise is added back for a short while (0.5-1s), until the algorithm re-learns the noise waveform and removes it again.
In order to avoid this inconvenient it is suggested to configure the current range, sampling rate, voltage protocol and so on beforehand, so that when you are recording you don't need to issue any command.

<div align="center">

[OK]

</div>
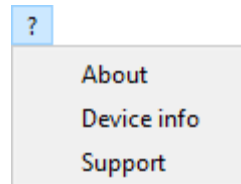
The "?" menu

The "?" menu gives access to some information about the software or the device.

About

The About window will show some general information about the software.

Device Info

The Device Info window shows detailed information about the device currently connected (or the selected device if the connect button has not been pressed yet), such as the device ID (which is the device Serial Number), the device version and the firmware version.

This information is very useful especially when requiring support, so the bottom button will conveniently copy the information to the clipboard, so that it can be pasted in an email.
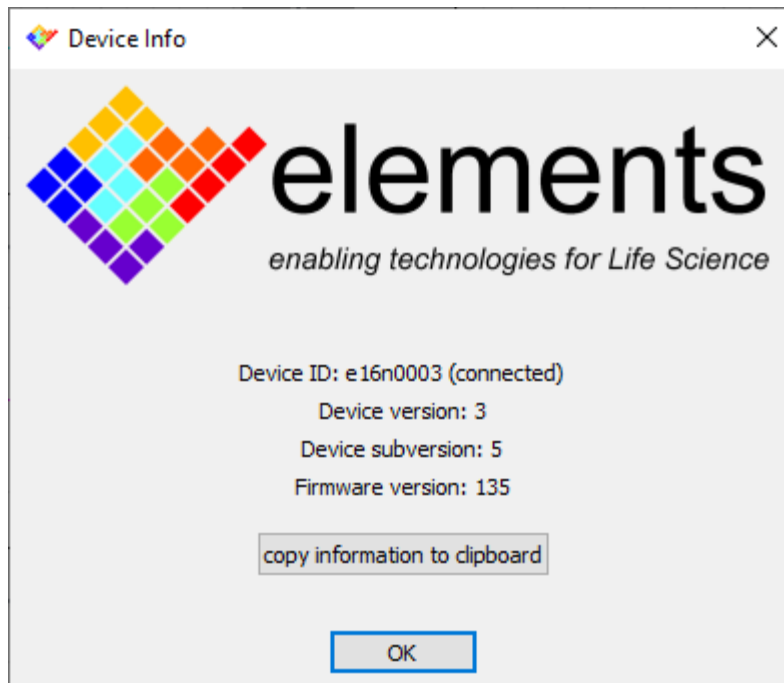
Support

The support window contains information on how to contact the technical support and what kind of information you should provide to make the support service more efficient.
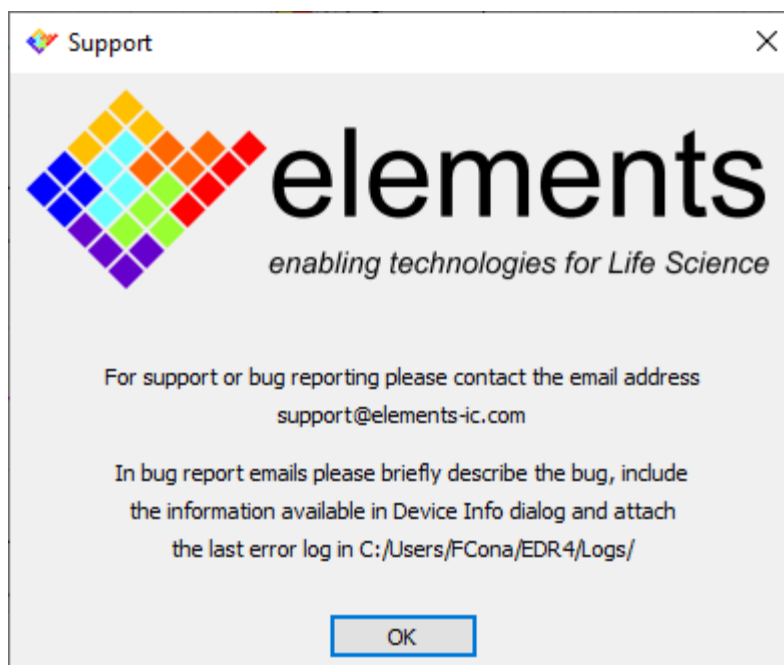
Shortcuts

The software offers some shortcuts to help scientists control the software more efficiently while performing their experiments.

Below is a list of the currently available shortcuts:

+	Increase current scale (x2)
-	Decrease current scale (/2)
CTRL +	Increase time scale (x2)
CTRL -	Decrease time scale (/2)
SHIFT +	Increase voltage scale (x2)
SHIFT -	Decrease voltage scale (/2)
CTRL R	Reset the x axis and y axis to the initial zoom
CTRL ArrowUp	Increase holding voltage by 10mV
CTRL ArrowDown	Decrease holding voltage by 10mV
CTRL X	Start protocol X (X in 0, 1, … , 9)
ENTER/RETURN	Start currently selected voltage protocol
SHIFT ENTER/RETURN	Start currently selected voltage protocol and start recording