BioLogic

Getting Started with EC-Lab®:

Cyclic voltammetry

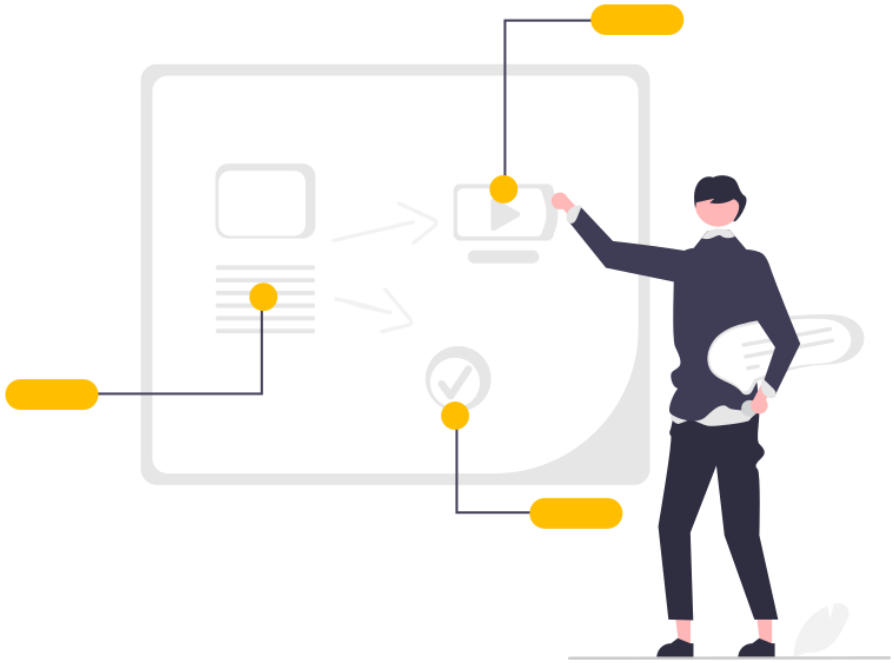
Getting Started EC-Lab: CV

V1

March 2024

Overview and quick access

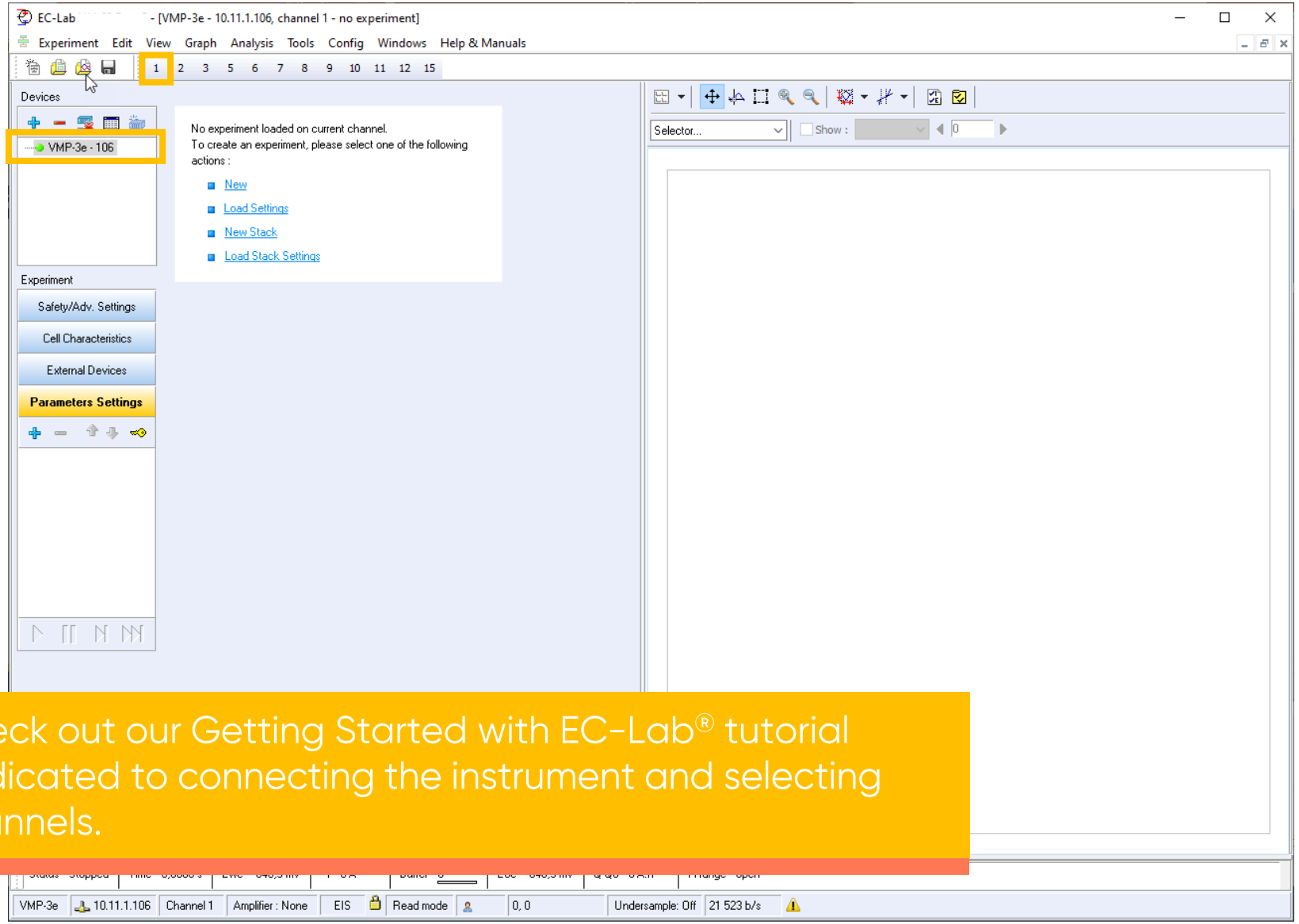
Note: Go back to this slide by clicking on the logo on the top left corner



Procedure

Step 0: Connect instrument and select channel

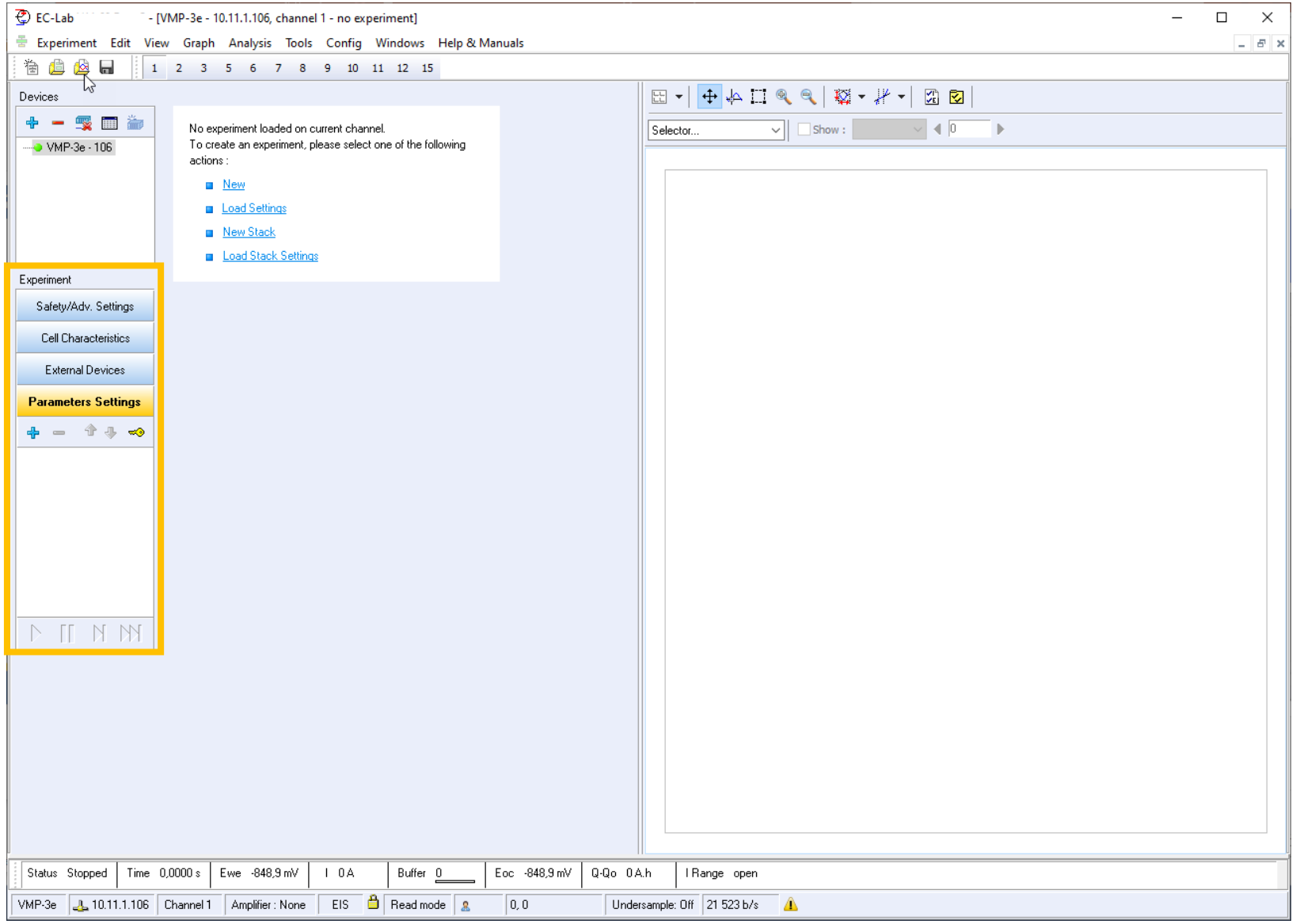
- Connect instrument and select channel



Check out our Getting Started with EC-Lab® tutorial dedicated to connecting the instrument and selecting channels.

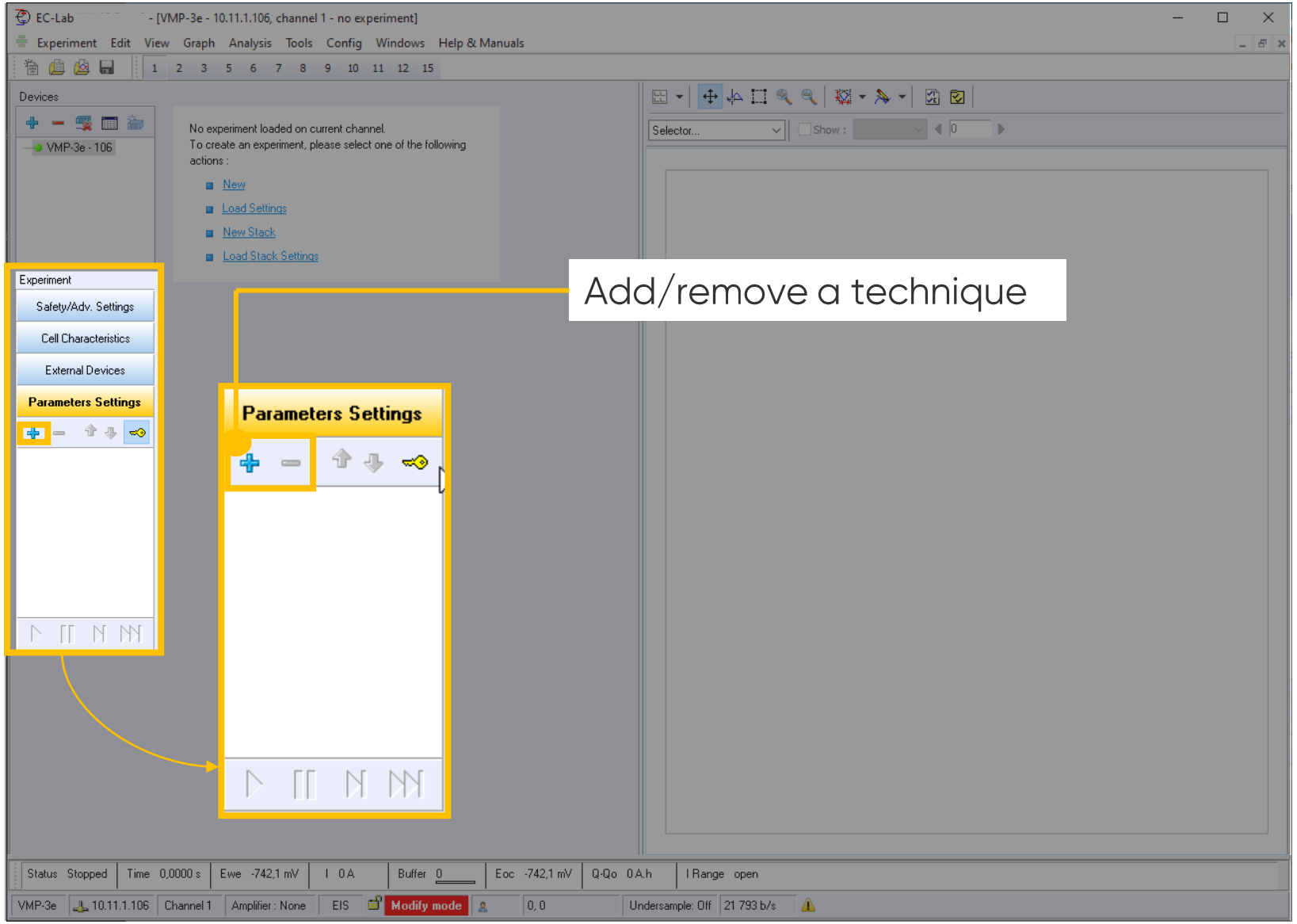
Step 0: Connect instrument and select channel

- When the instrument and channel are selected, the user can set the experiment

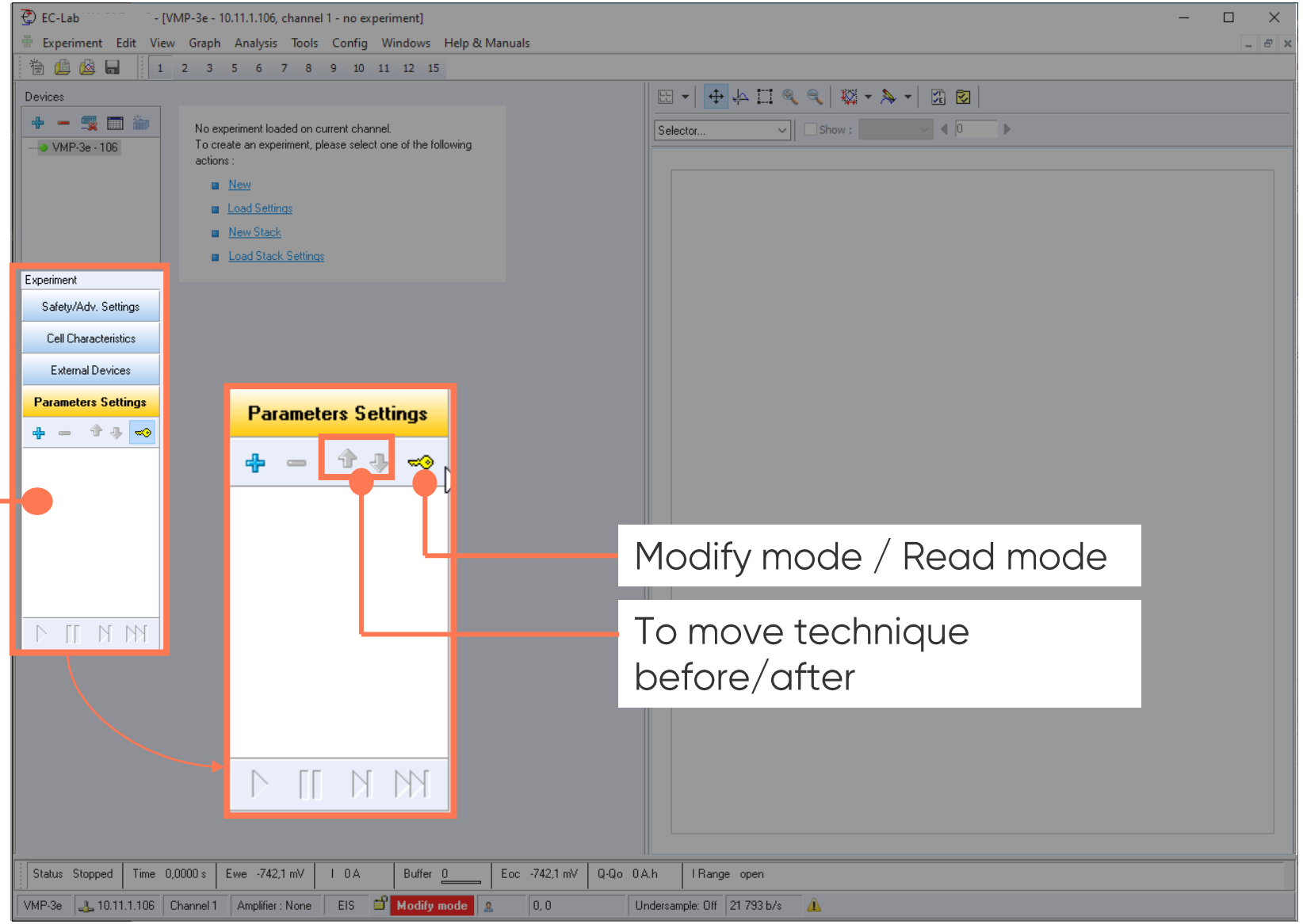


Step 1: Add CV technique

- Click on + to add a technique to the list



Step 1: Add CV technique

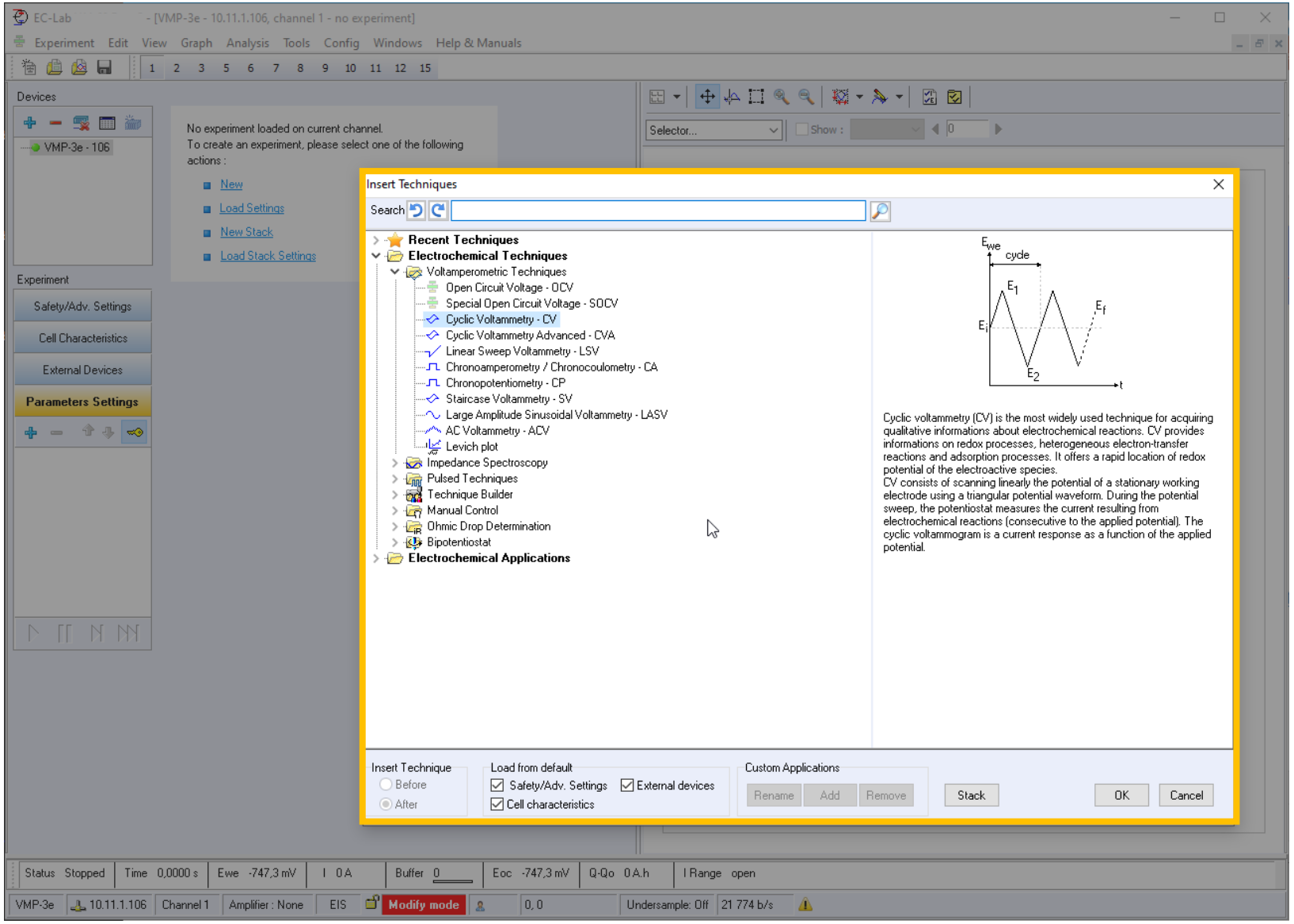


Step 1: Add CV technique

- Select Cyclic Voltammetry – CV technique

  It is in the Voltamperometric techniques folder

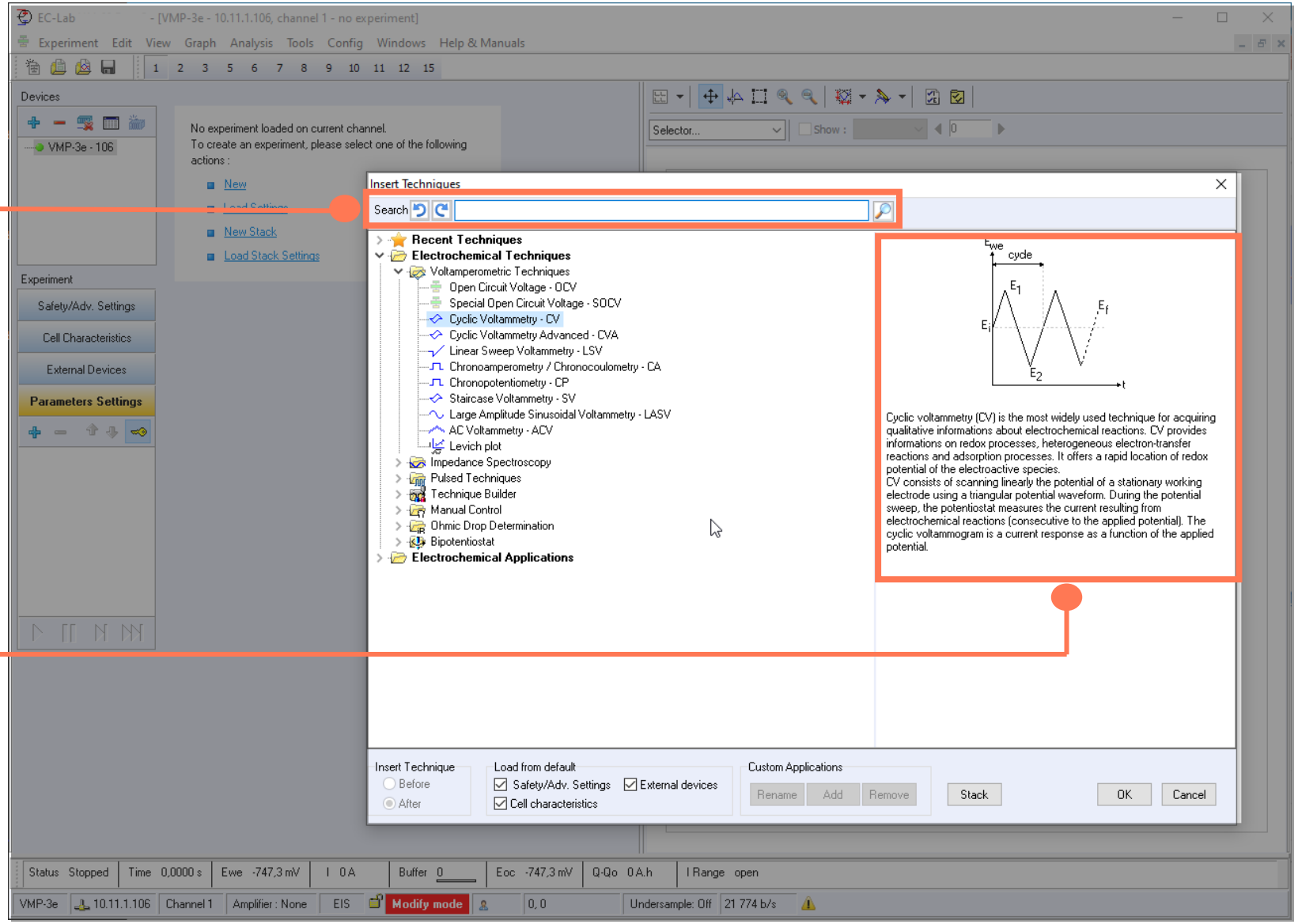
- Click on **OK** to validate



Step 1: Add CV technique

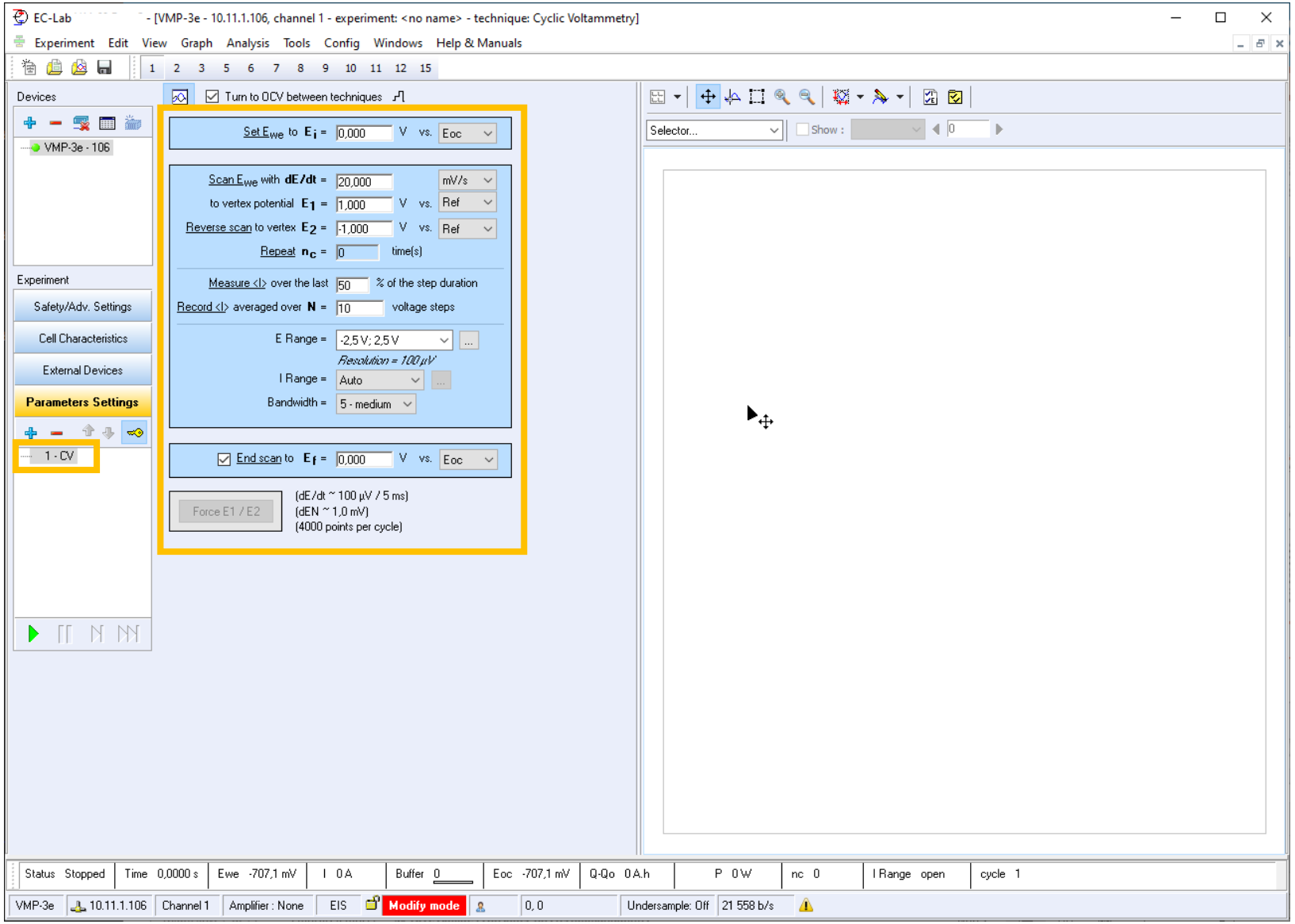
Search bar to quickly find the desired technique

Description of the settings technique and associated graph



Step 1: Add CV technique

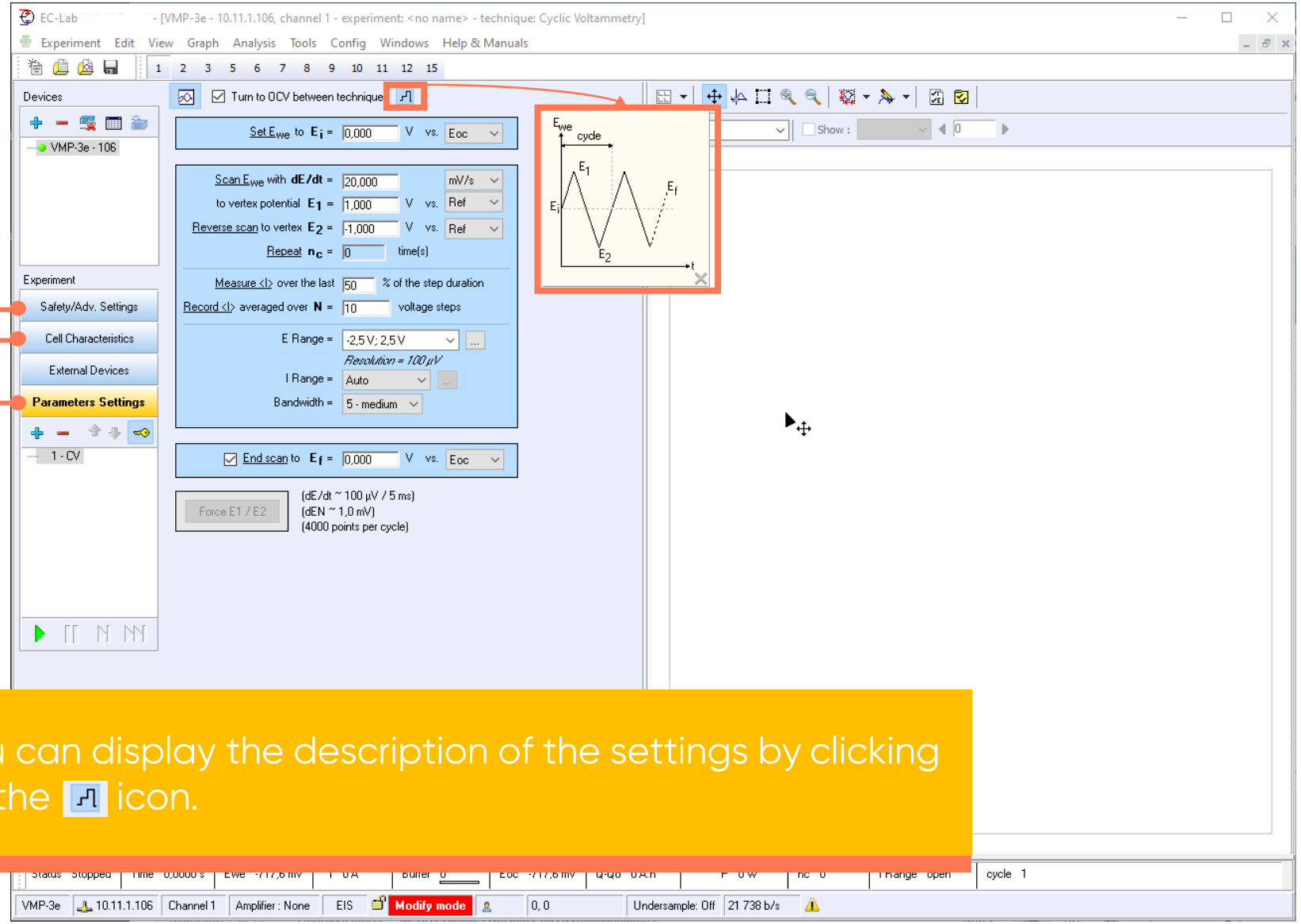
- CV technique is loaded in the technique list
- Corresponding CV parameter settings appear



Step 1: Add CV technique

General parameters

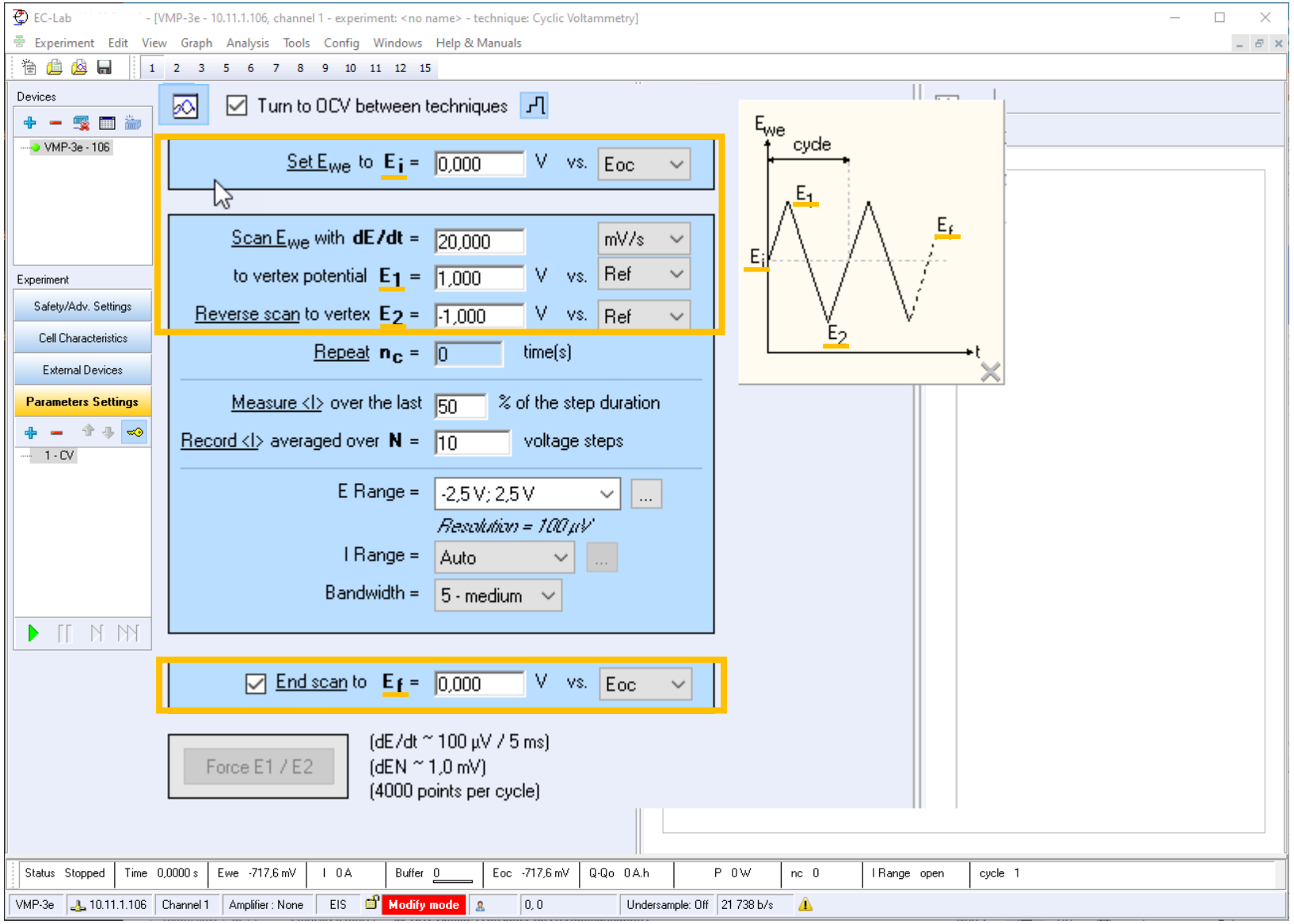
Technique parameters



You can display the description of the settings by clicking on the icon.

Step 2: Set CV parameters

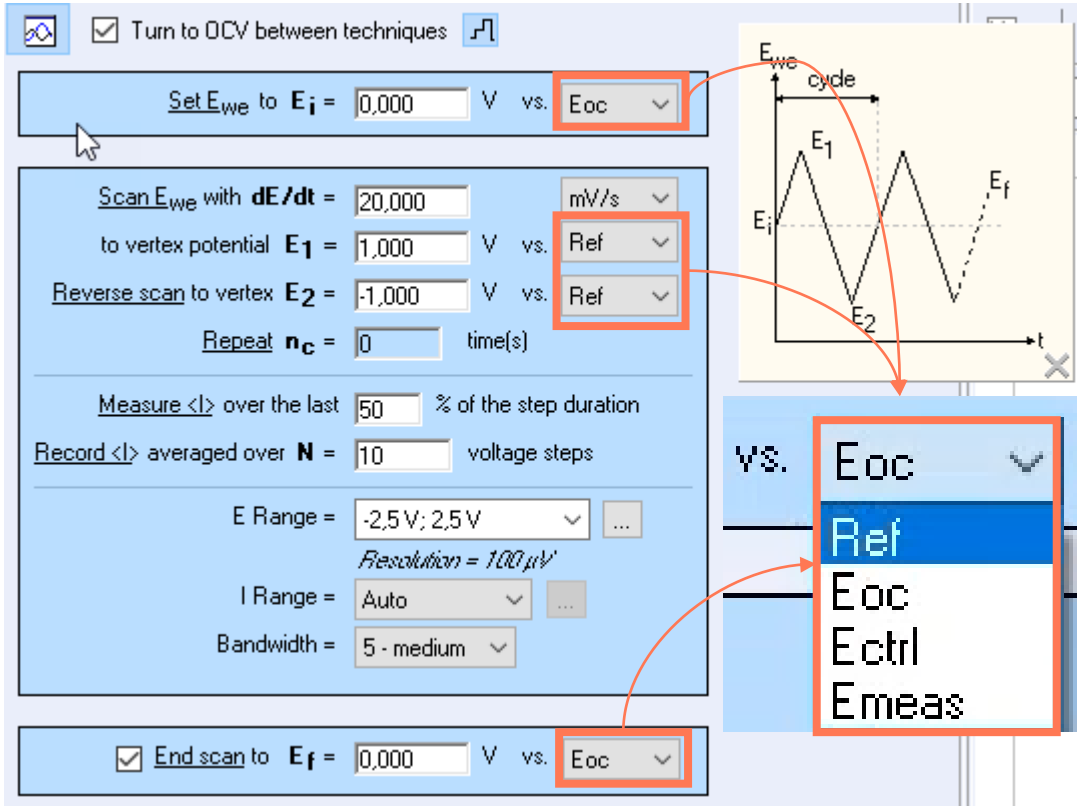
- Set E_i, dE/dt, E_1 and E_2 to define voltage ramp and voltage sweep
- The final voltage E_f can be defined



Step 2: Set CV parameters

Define E_i, E_1, E_2, E_f versus the voltage of:

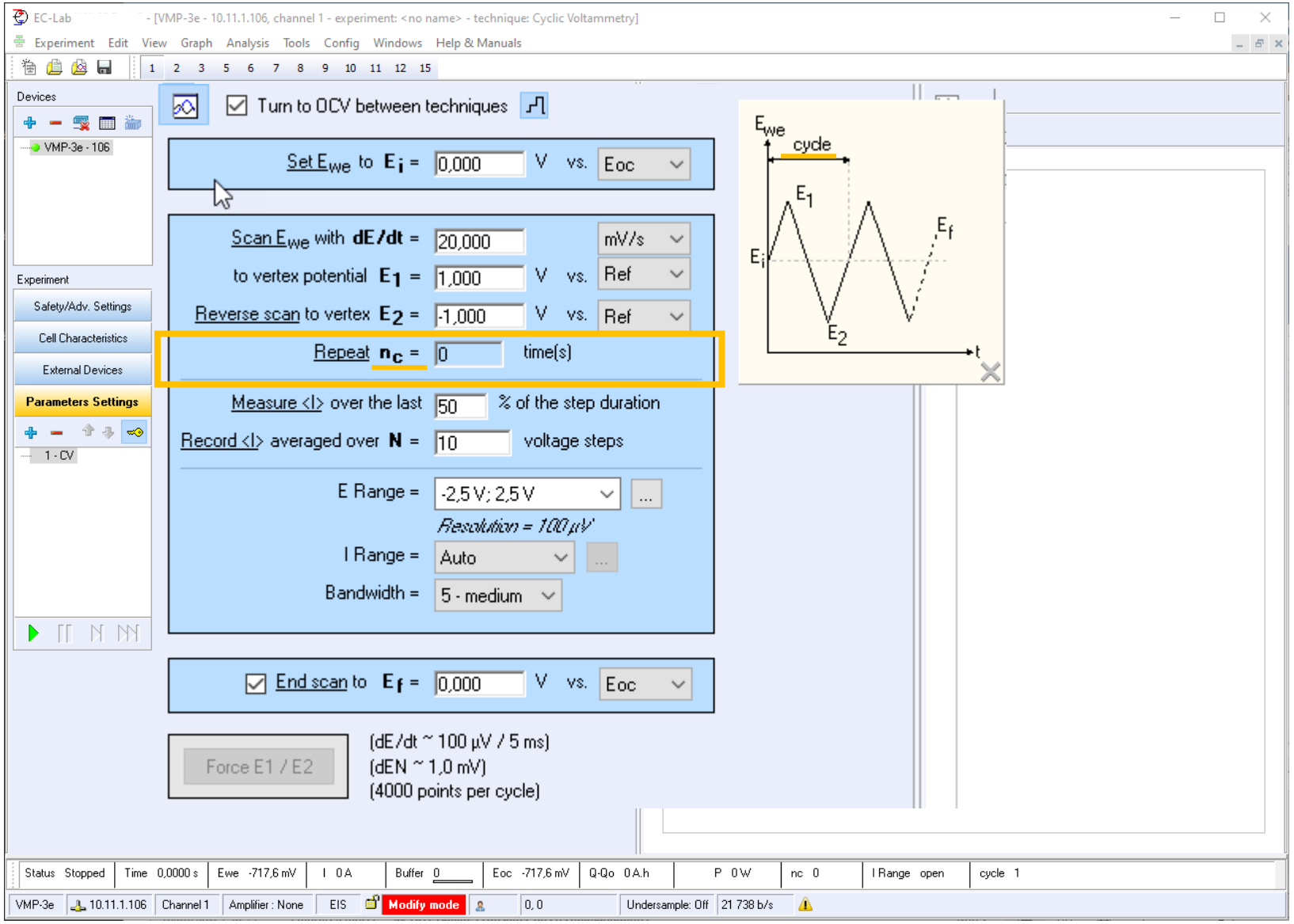
- **Ref:** the reference electrode
- **Eoc:** open circuit voltage
- **Ectrl:** the previous controlled voltage, if a technique is set before the CV
- **Emeas:** the previous measured voltage, if a technique is set before the CV



- Set E_i = 0 V vs. Eoc to avoid a current jump at the beginning of the CV.
- Set E_1 and E_2 vs. Ref as OCV may change. E_{Ref} is an absolute voltage value.

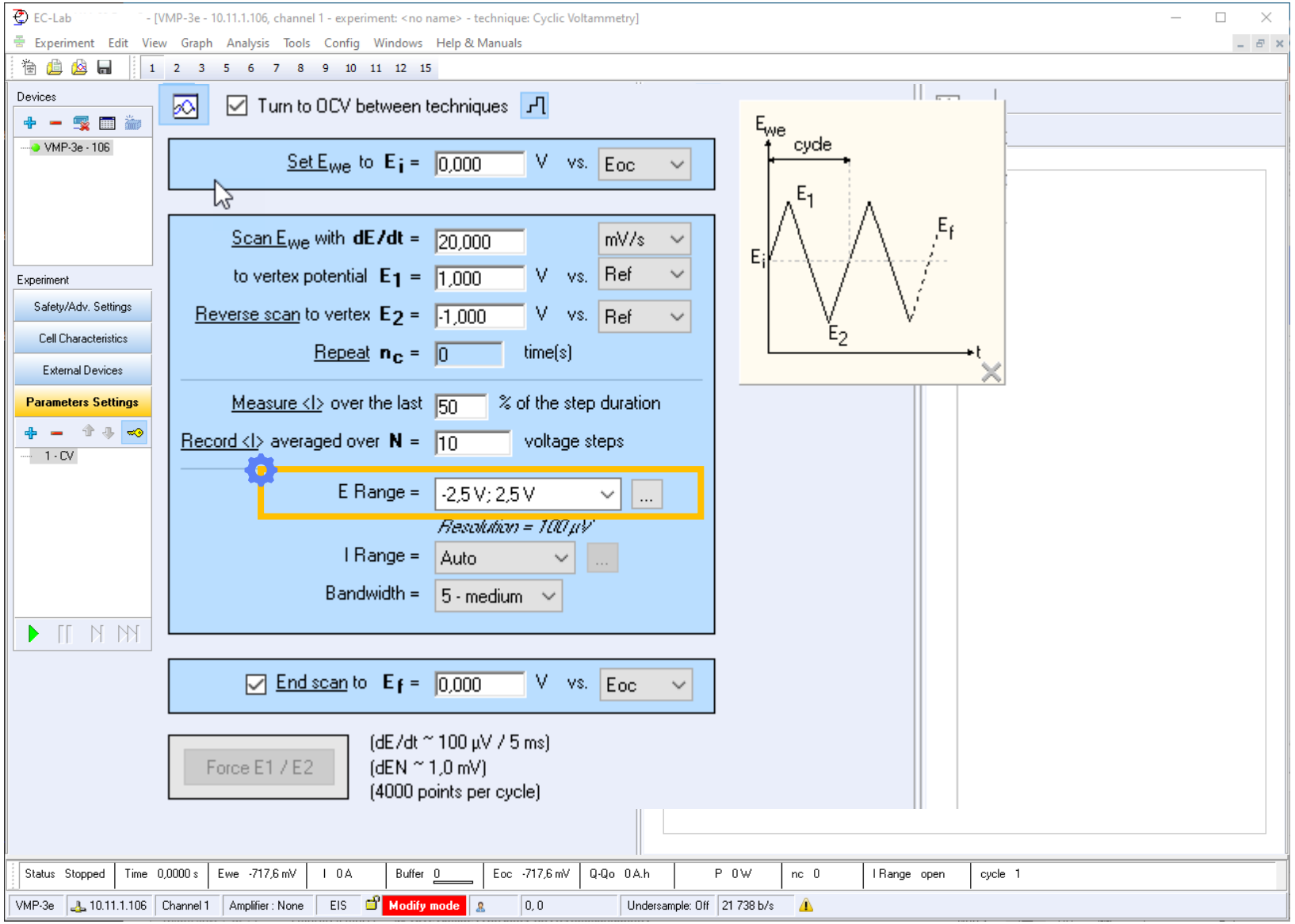
Step 2: Set CV parameters

- To perform several cycles, set Repeat n_c



Step 3: Optimize the measurement

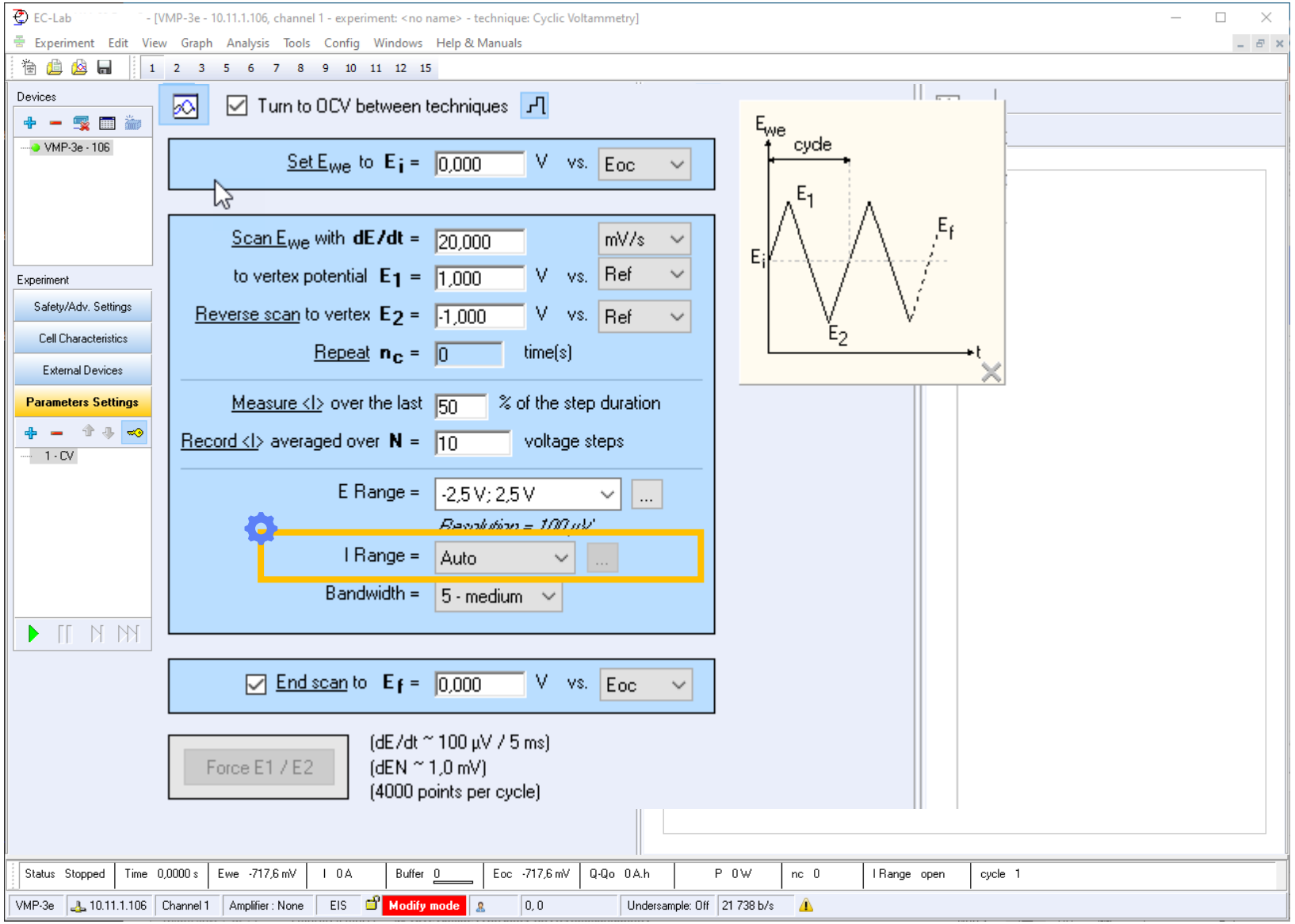
- E Range is the range of expected voltage
- E_i, E_1 and E_2 must be in the E Range



E Range has to be as narrow as possible, the resolution depends on it.

Step 3: Optimize the measurement

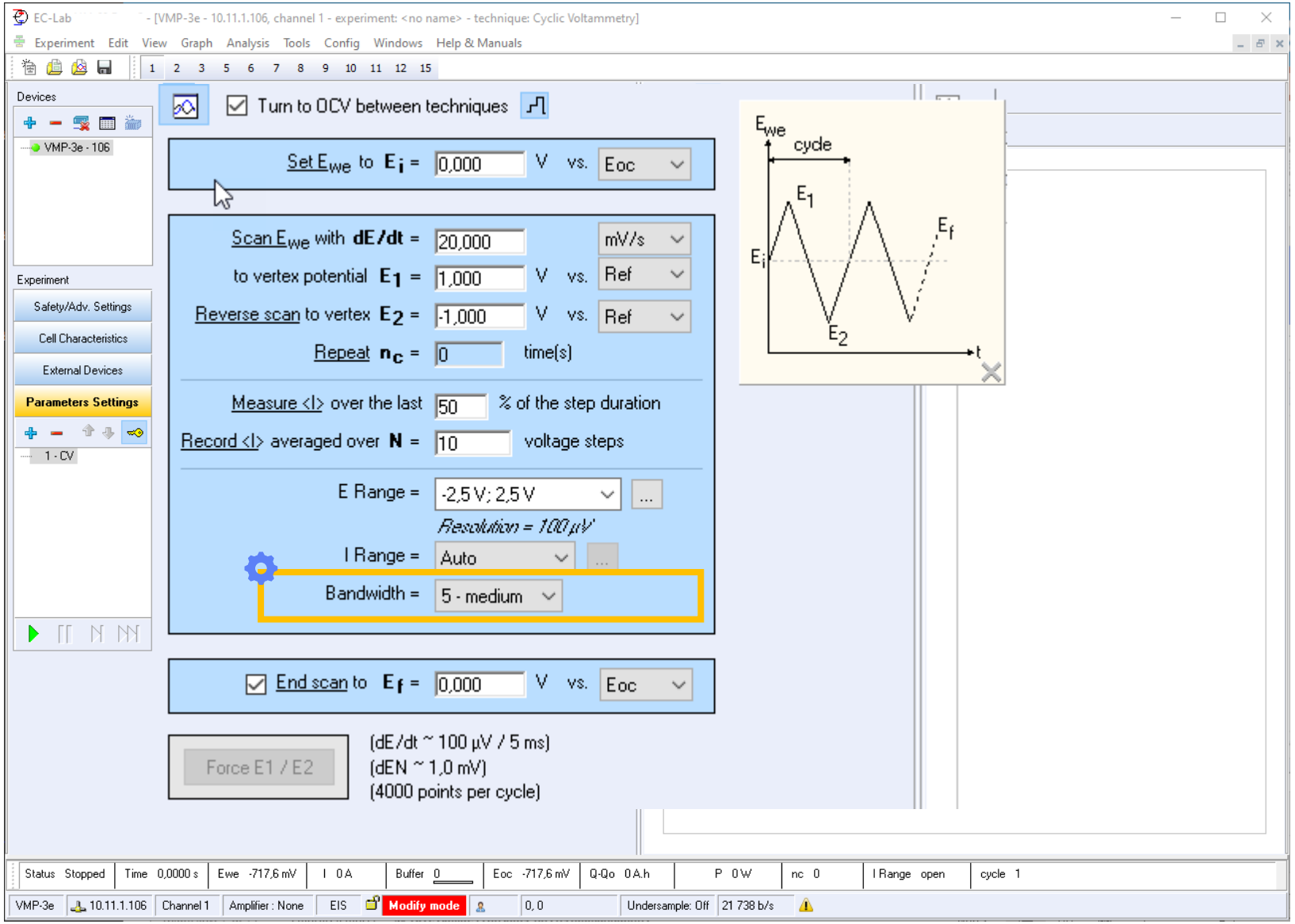
- I Range is the range of expected current
- Autorange is available



For high scan rates, it is recommended to set a fixed I Range because I Range shift duration may be no more negligible.

Step 3: Optimize the measurement

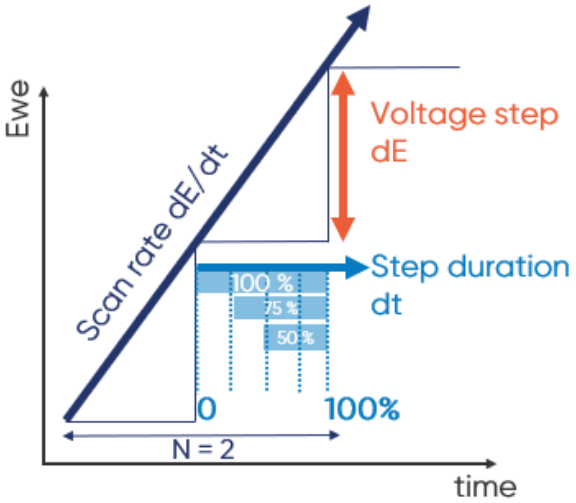
- Adjust bandwith to make sure that the potentiostat controls the cell in stable and fast way



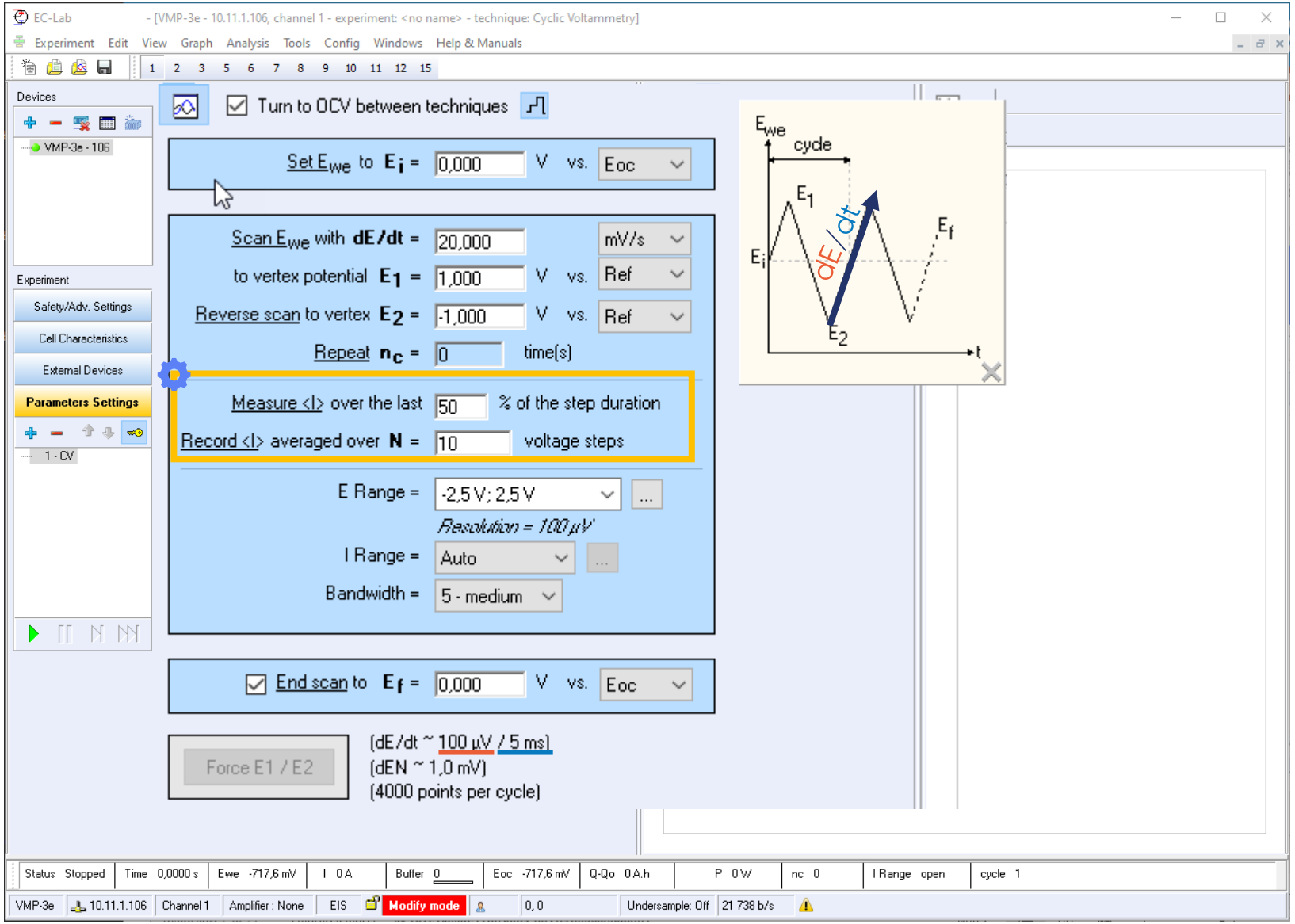
- Set fast bandwidth for high scan rate (200mV/s)
  - 7-fast for essential
  - 9-fast for premium

Step 3: Optimize the measurement

- Adjust current measurement and averaging



Note: dE is dependent on potential resolution

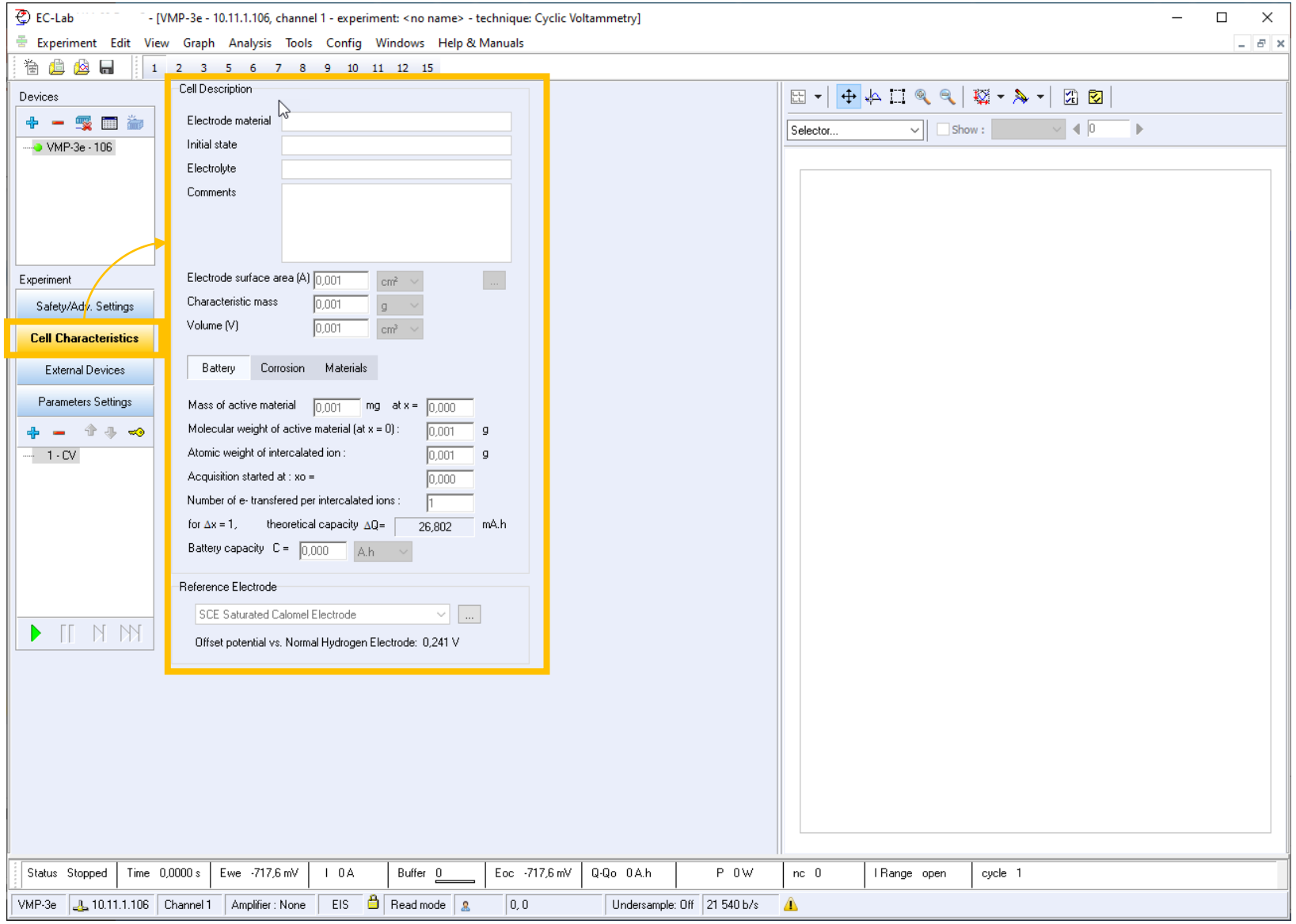


Set to 50% to cut first current value points corresponding to undesired capacitive response of the cell

N = 10 voltage steps allows to get smoother data

Step 4: Set general parameters

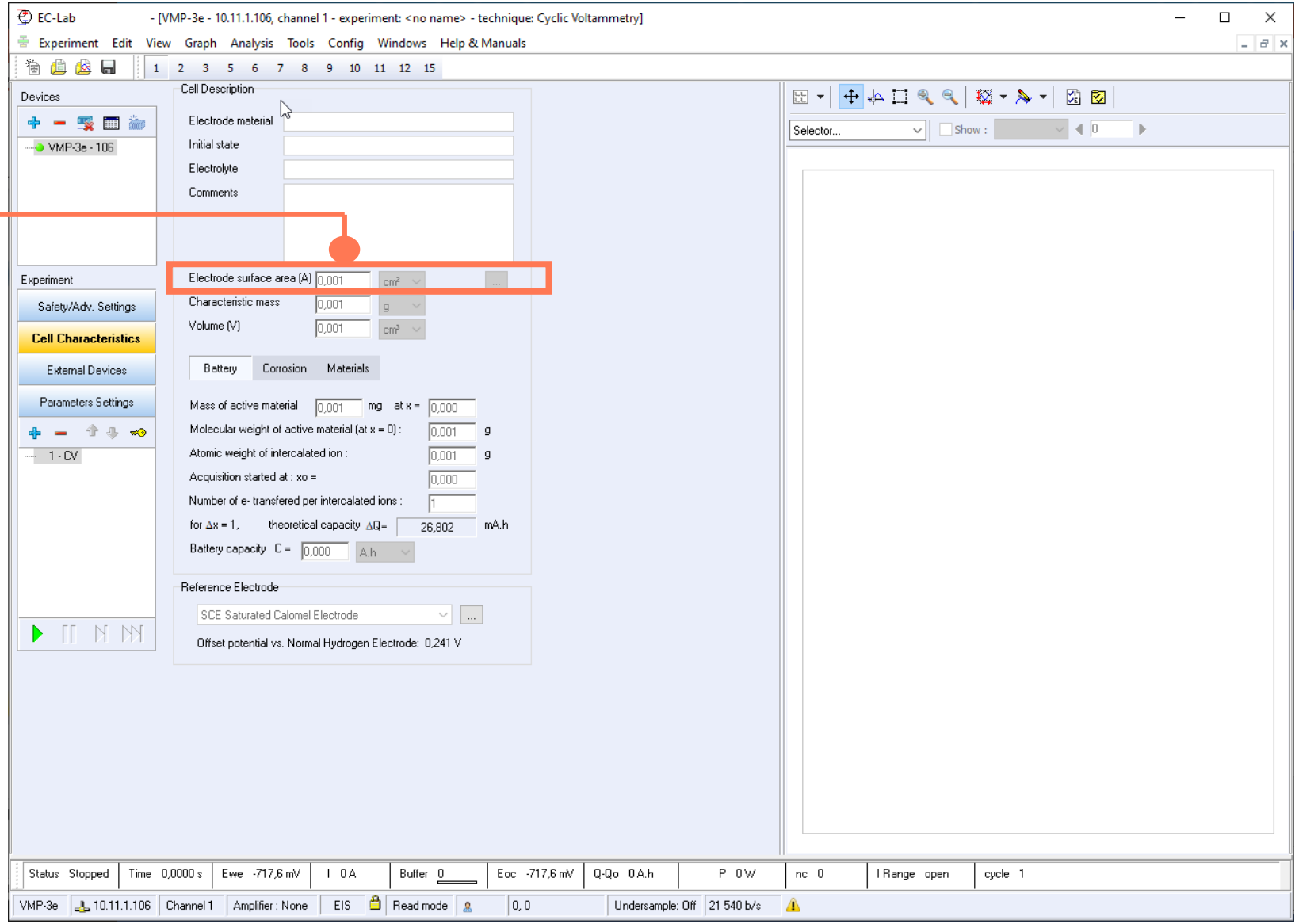
- Add information and comments about the cell



Note: All this information are store in the data file

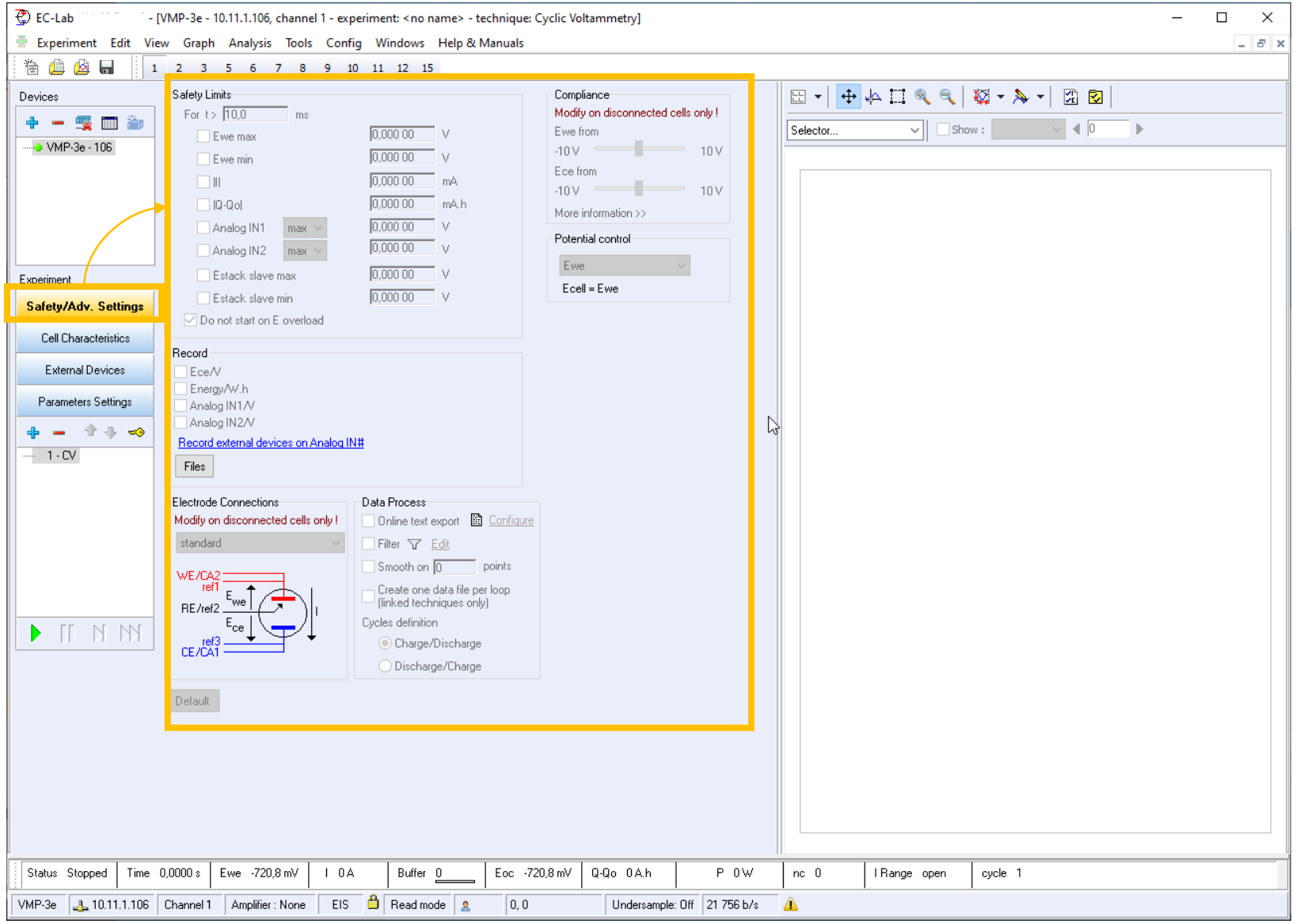
Step 4: Set general parameters

Electrode surface area must be set if the user want to work with current density (mA/cm2) instead of current (mA)



Step 4: Set general parameters

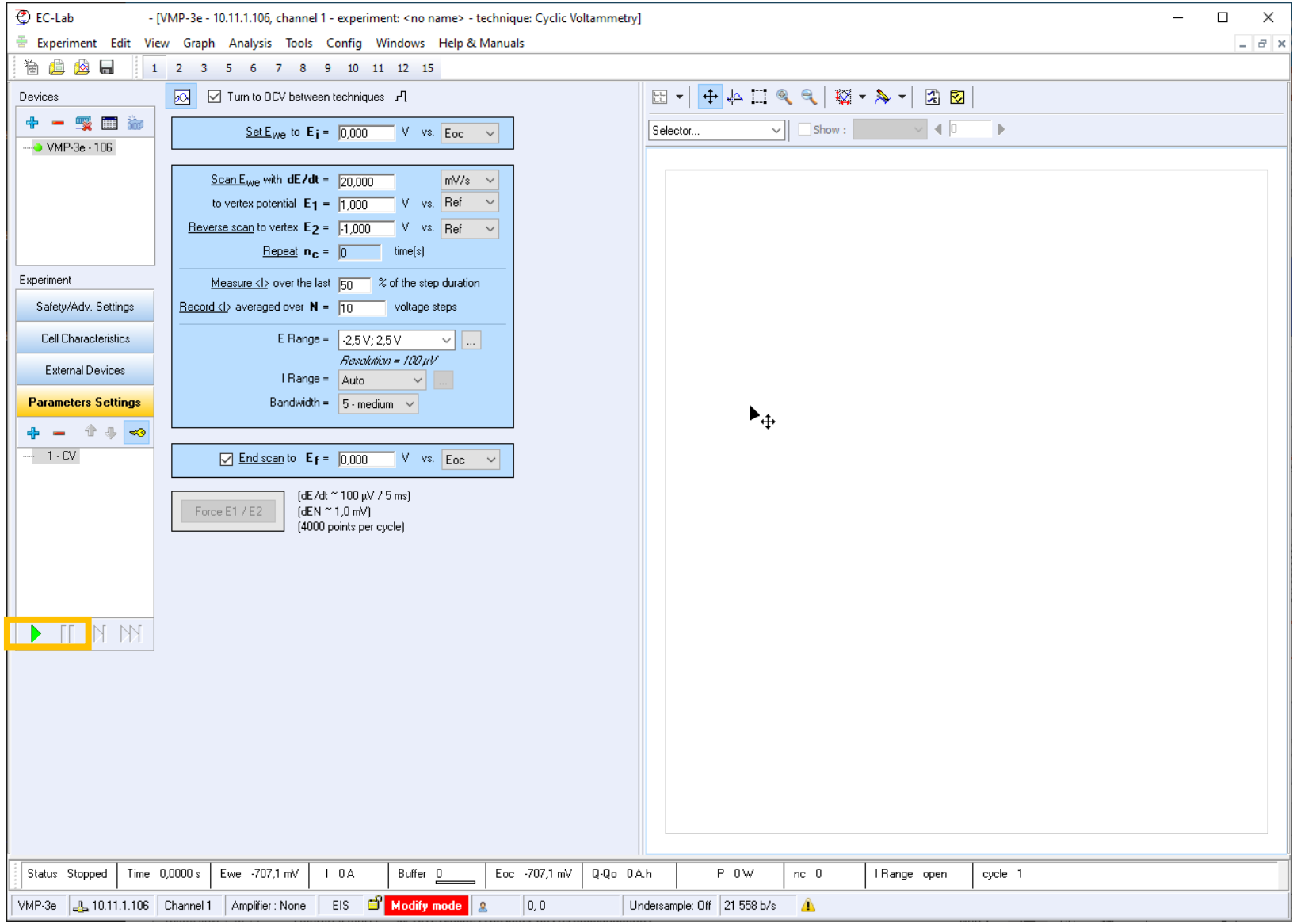
- Safety and Advanced Settings are available here



Note: This window is different for the Essential and Premium instruments

Step 5: Launch the measurement

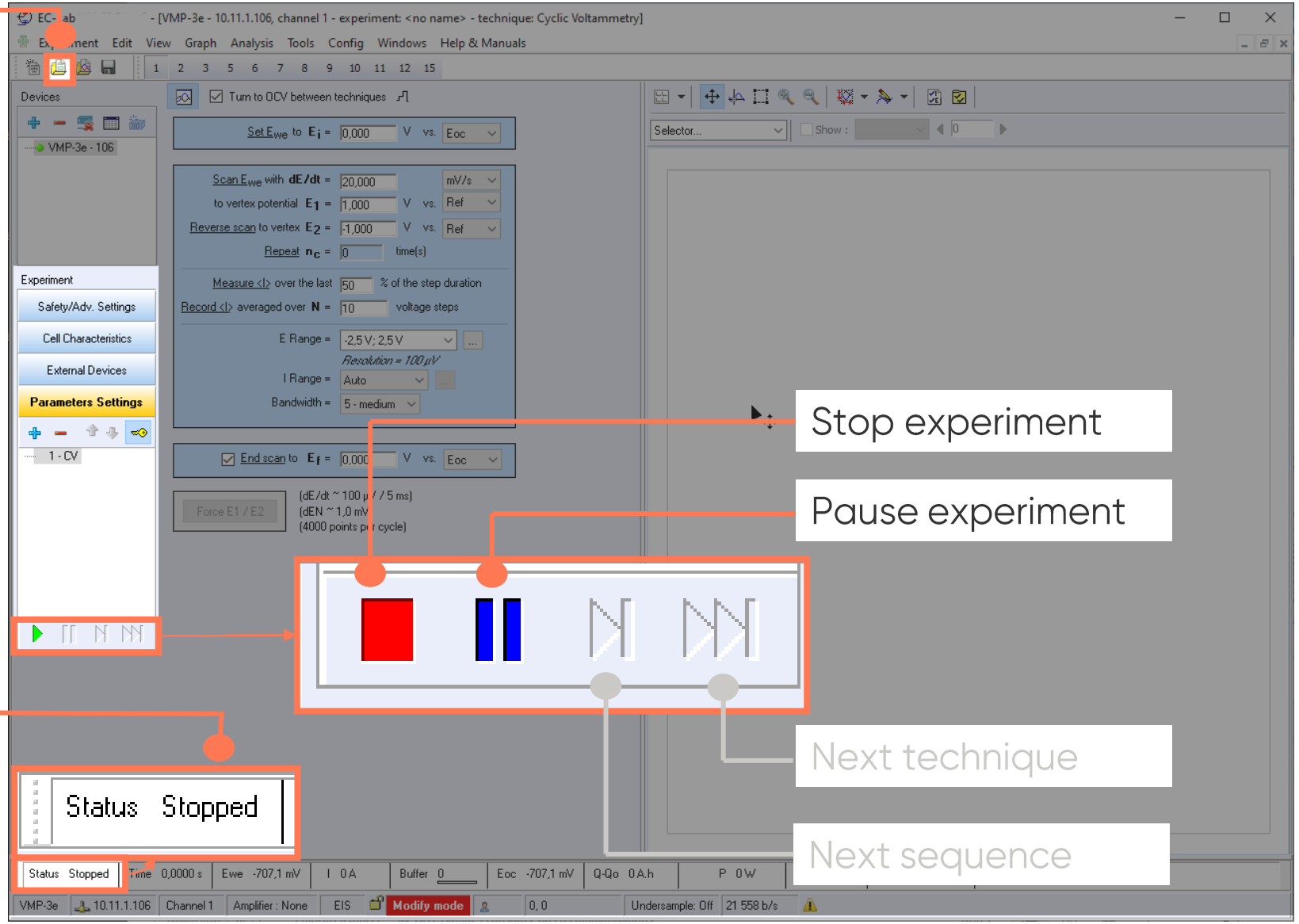
- Click on ▷ to launch experiment



Note: All the settings may be changed during the experiment (Modify on the fly) except I Range, E Range and bandwidth

Step 5: Launch the measurement

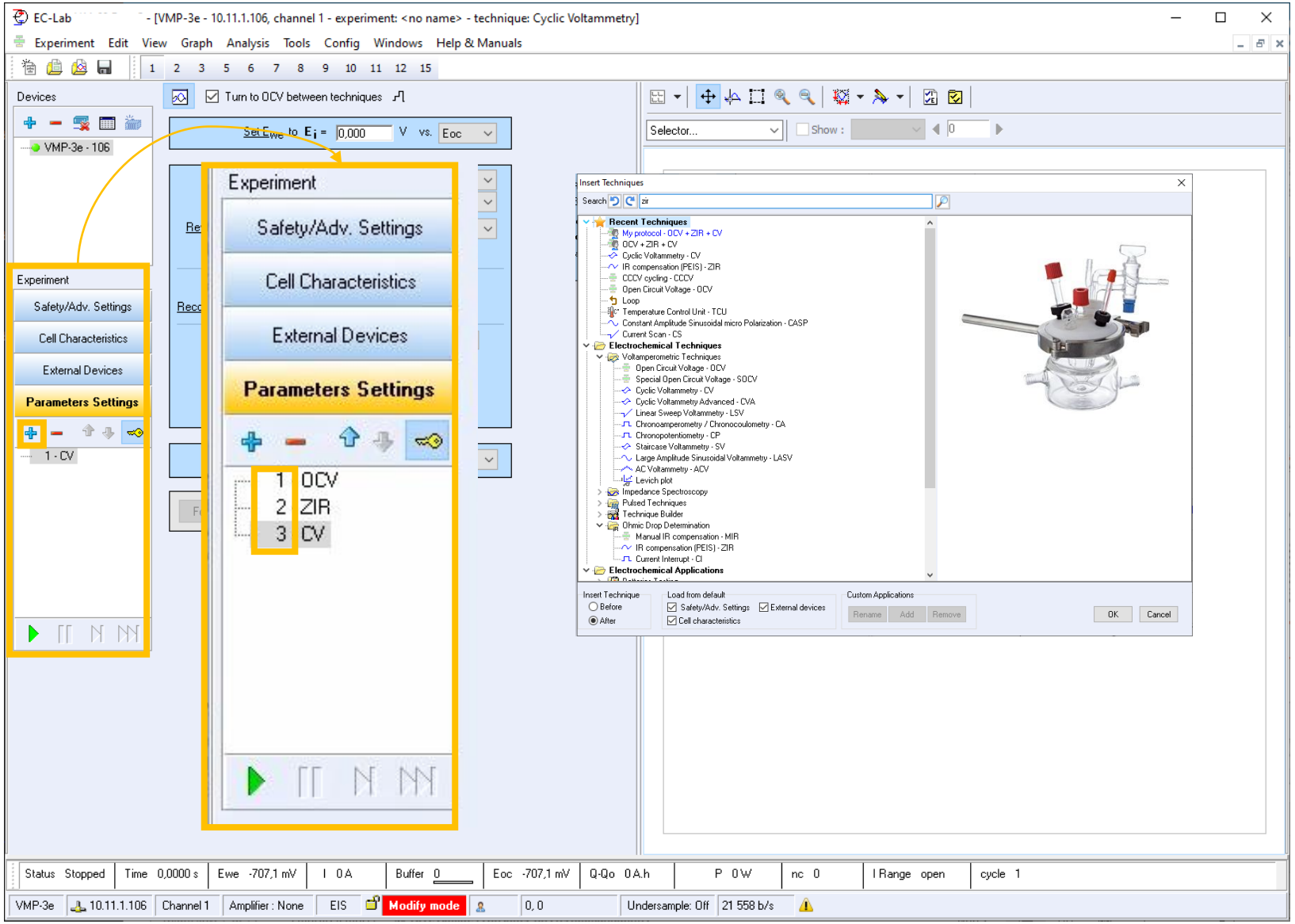
Load techniques with same settings using a .mps files created when launching the experiment



Status of experiment is displayed (Stopped, Paused, Relax...)

Step 6: Add additional experiments

- Click on + button to add more techniques
- Order of execution appears in the technique list

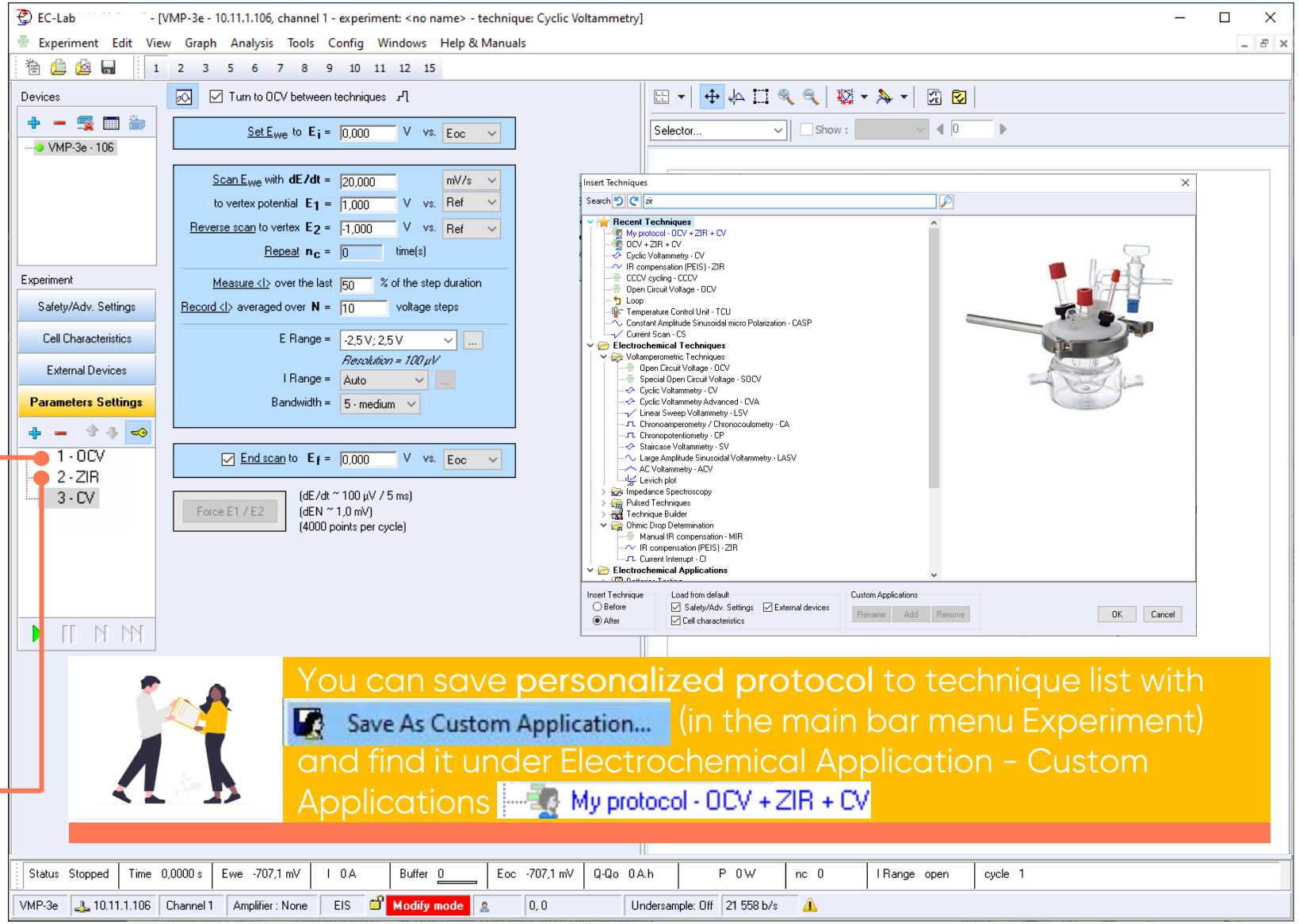


Step 6: Add additional experiments

Can be used as a waiting time for equilibration of the electrochemical cell

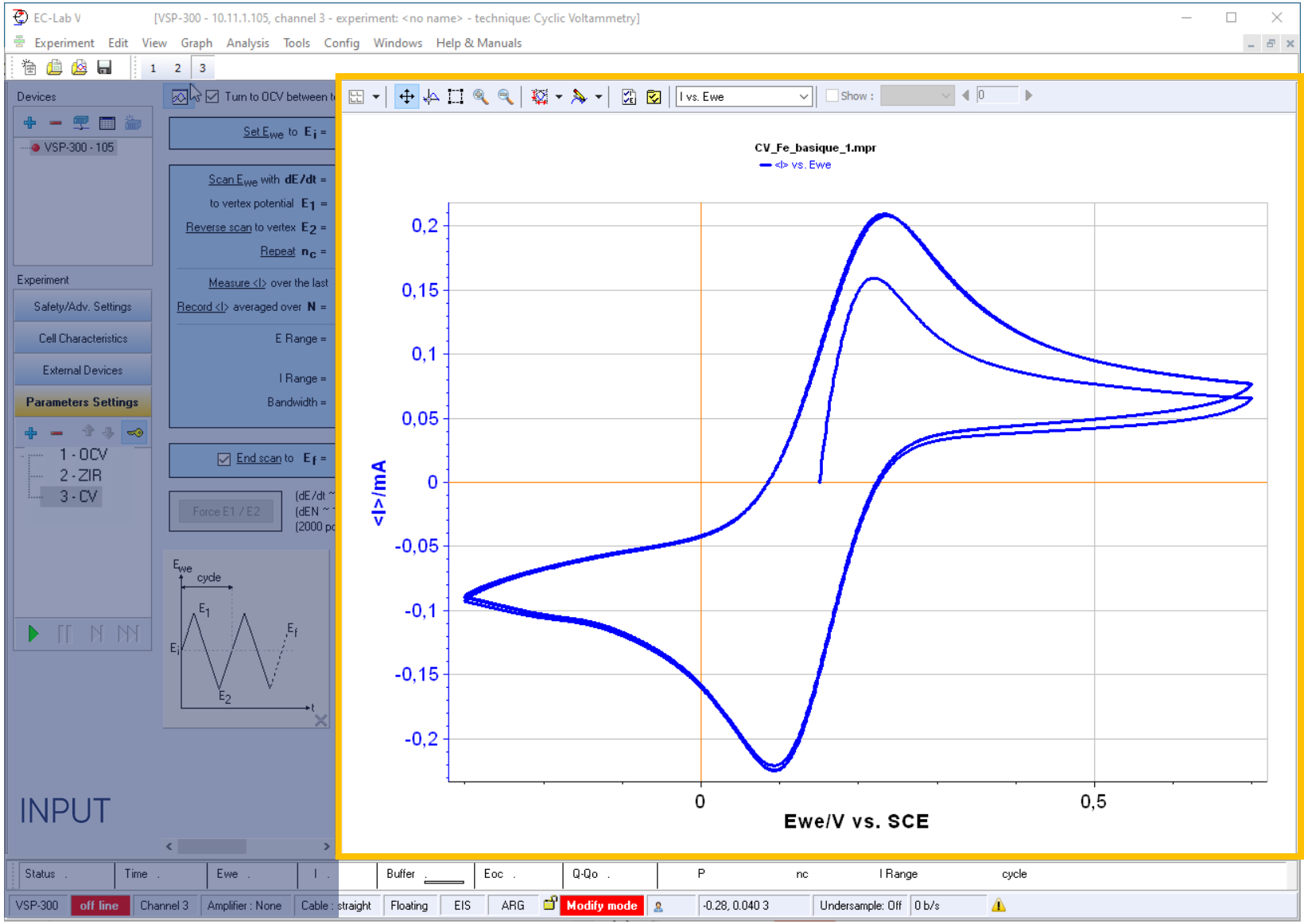
Note: CA or CVA technique can be used to set a conditioning period before starting voltage ramp

Can be used to determine and compensate ohmic drop



Step 7: Read the graph

- Graphic is displayed in real time
- Data are saved in .mpr file

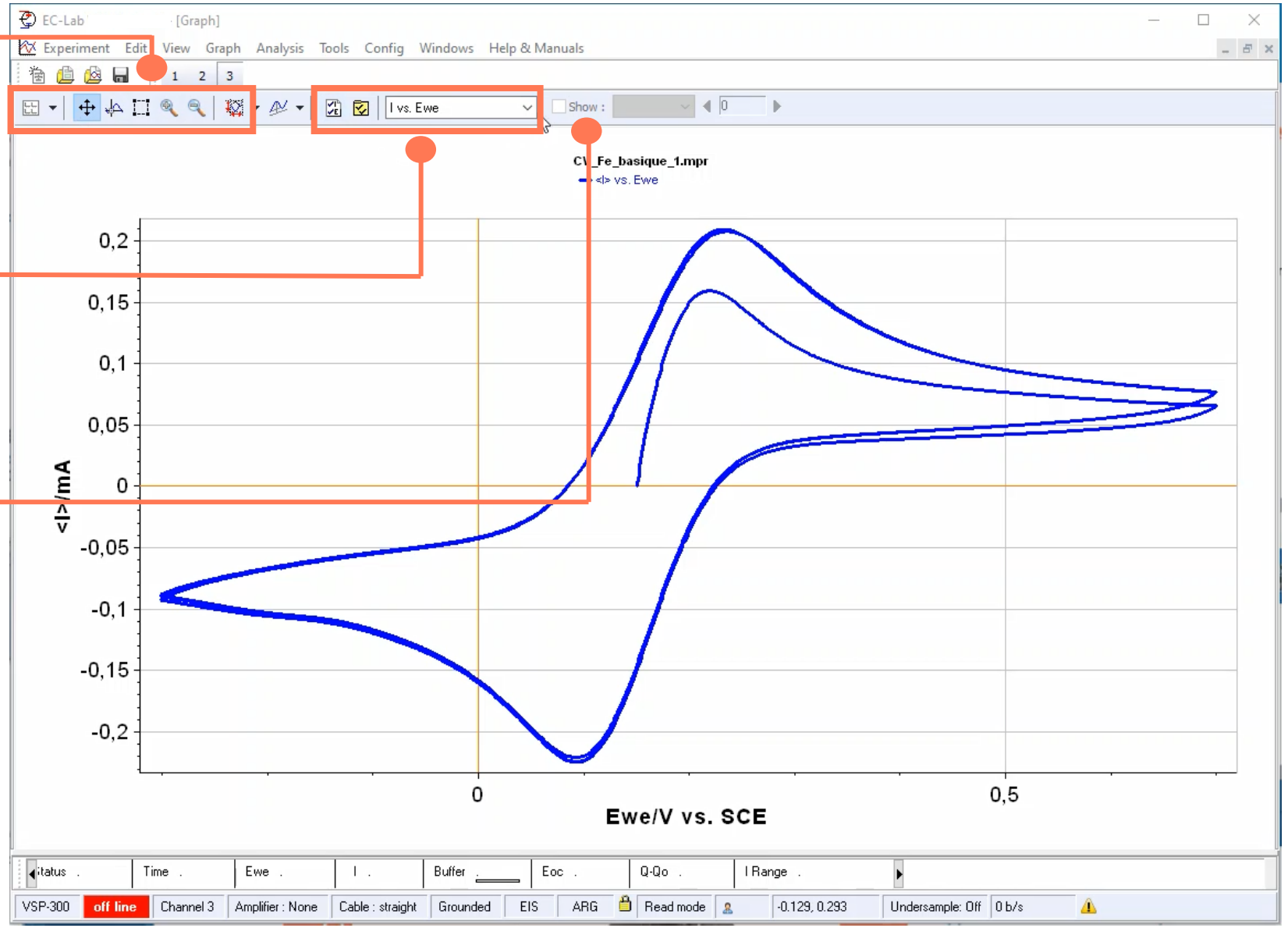


Step 7: Read the graph

Browse though the graph
(Filter, Scroll, Cursor, Selection, Zoom +, Zoom –, Autoscale)

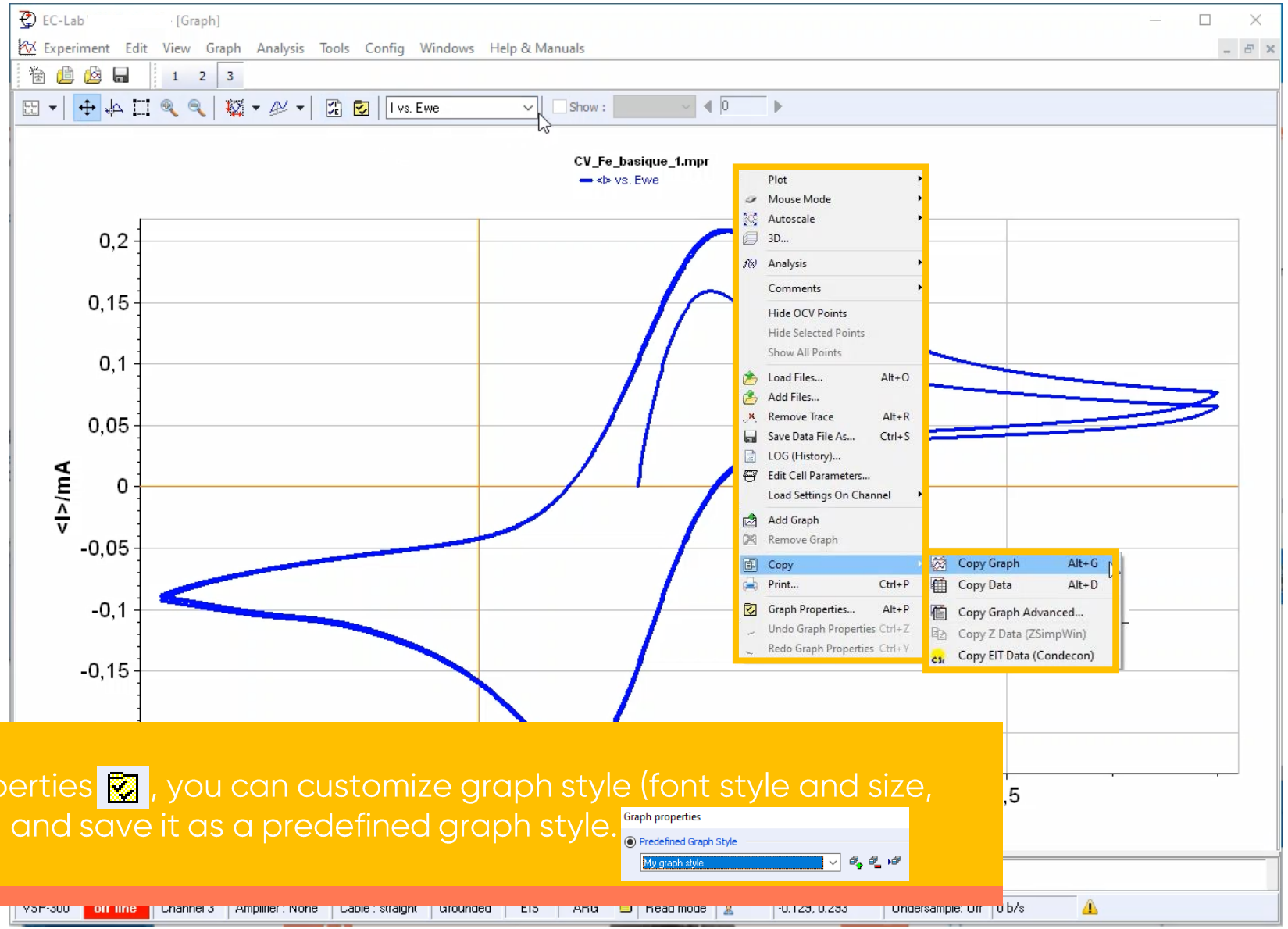
Modify the graph
(Selector, graphic properties, representations)

Show only selected cycle



Step 7: Read the graph

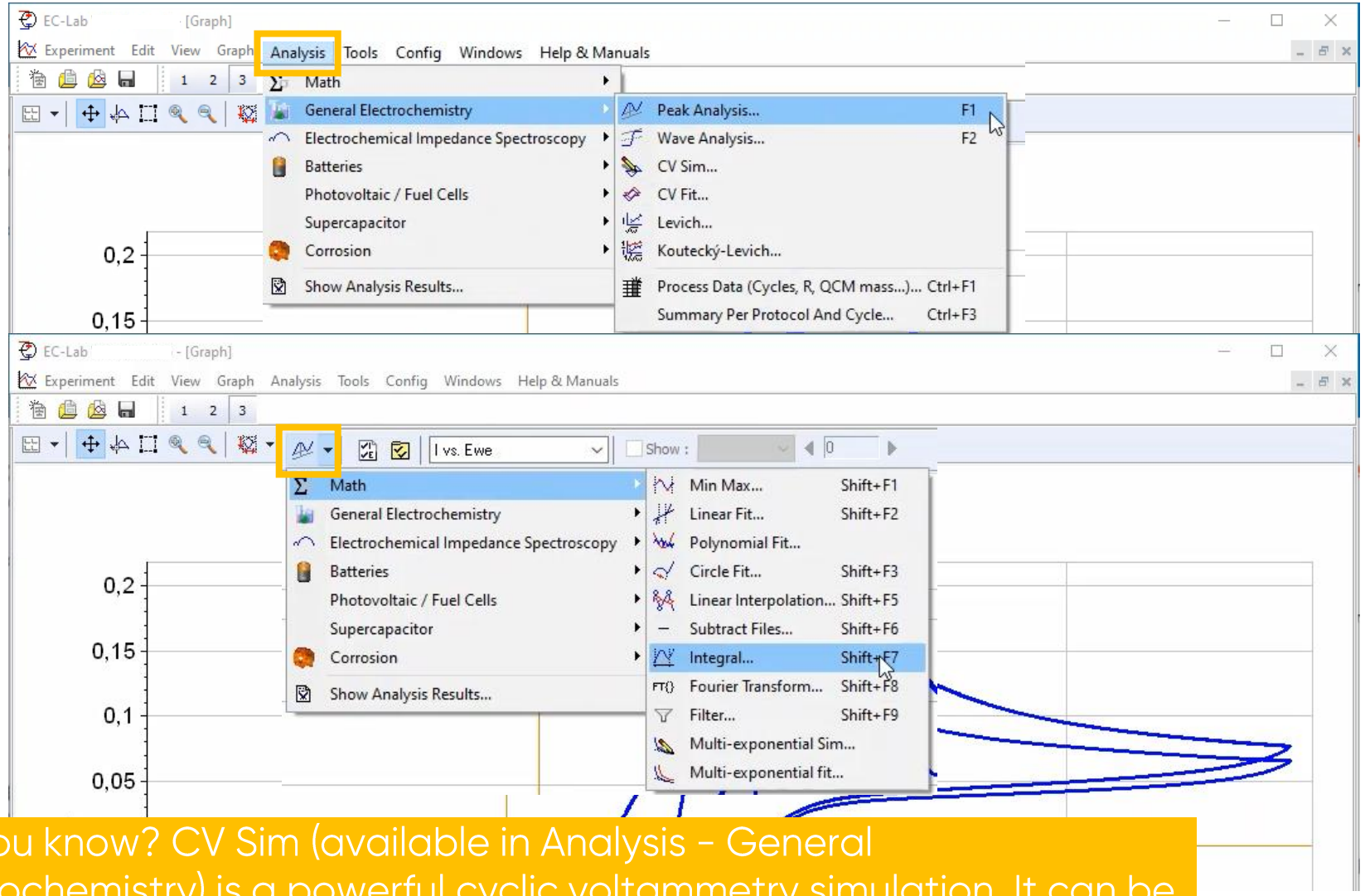
- Copy graph as a picture with a right click on the graph



In graph properties , you can customize graph style (font style and size, traces, grid...) and save it as a predefined graph style.

Step 8: Analyse the data

- Analyse the CV
  - Math
  - General Electrochemistry



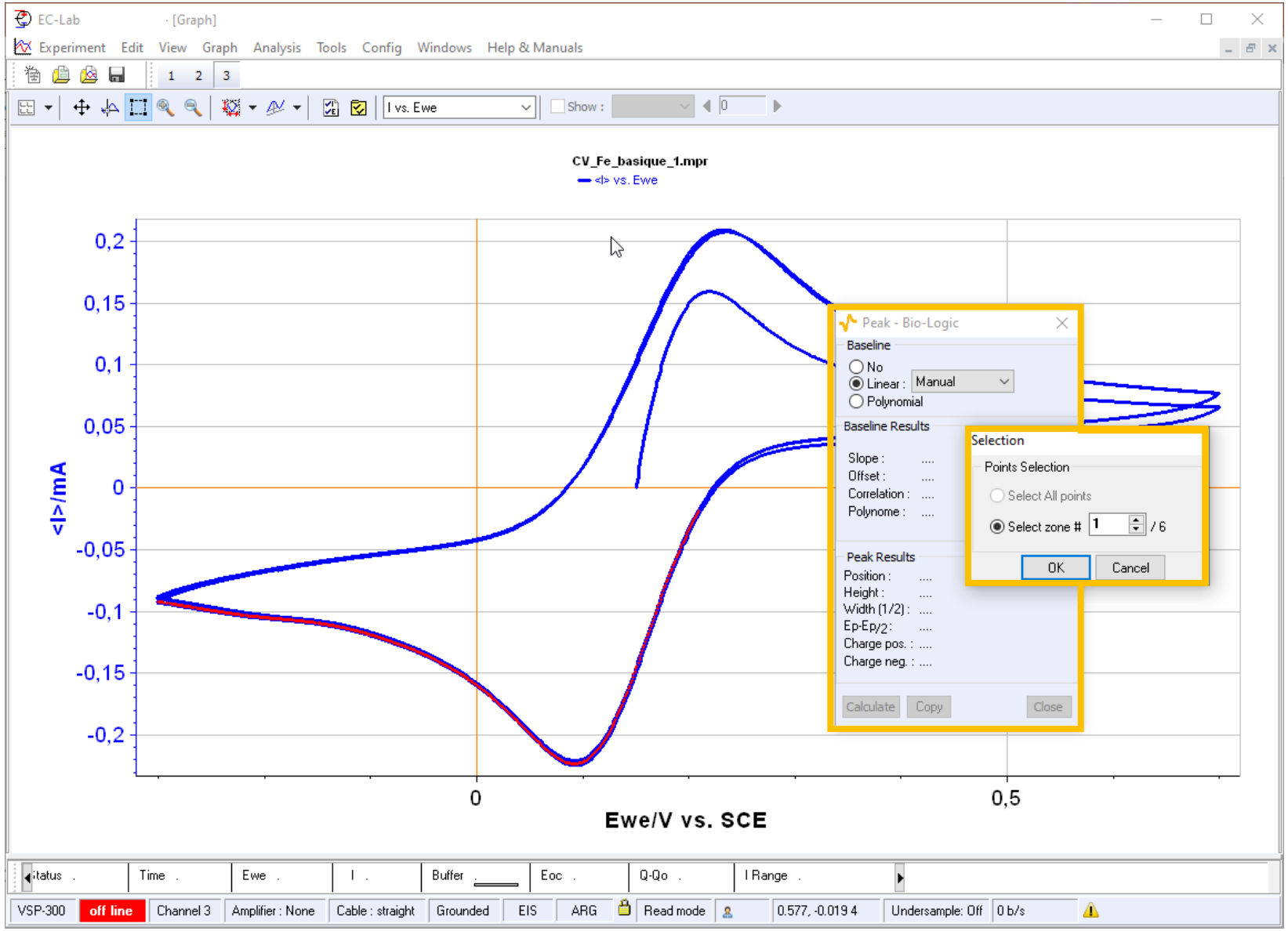
Note: Analysis is available either in the main tool bar or as a shorcut in the graph bar or with F6

Did you know? CV Sim (available in Analysis - General Electrochemistry) is a powerful cyclic voltammetry simulation. It can be used as a learning tool.

Step 8: Analyse the data

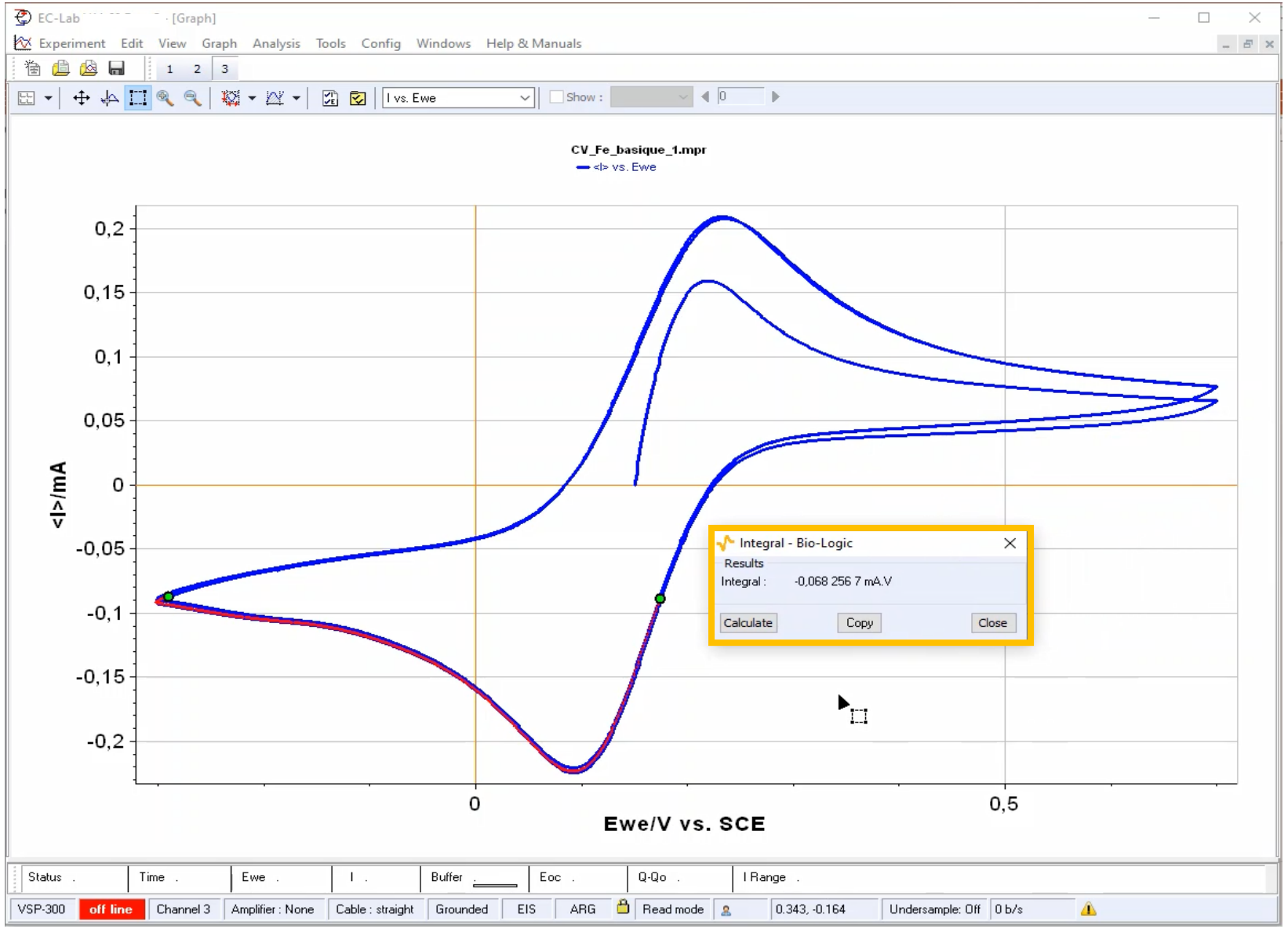
- Peak analysis
  - Select the peak on the graph
  - Click on calculate
  - Select zone (if needed) and click on ok

Note: For details on baseline options, refer to EC-Lab Analysis and Data Process manual



Step 8: Analyse the data

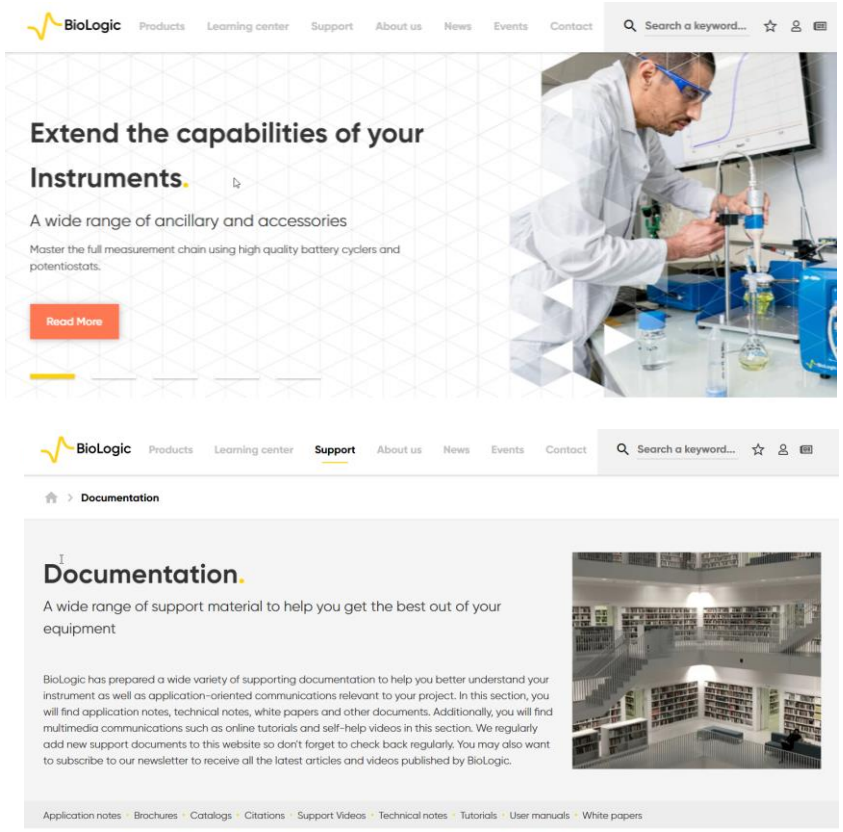
- Integral
  - Select the area of interest on the graph
  - Click on calculate
  - Select zone (if needed)



Find out more

For supplementary information

Visit our website!



www.biologic.net

- Documentation list
  - What is CV? A comprehensive guide to Cyclic Voltammetry (article)
  - EC-Lab Techniques and Applications (manual)
  - EC-Lab Analysis and Data Process (manual)

Did you know? **Free update of EC-Lab®** are available on our website.

Need help?

Contact us!

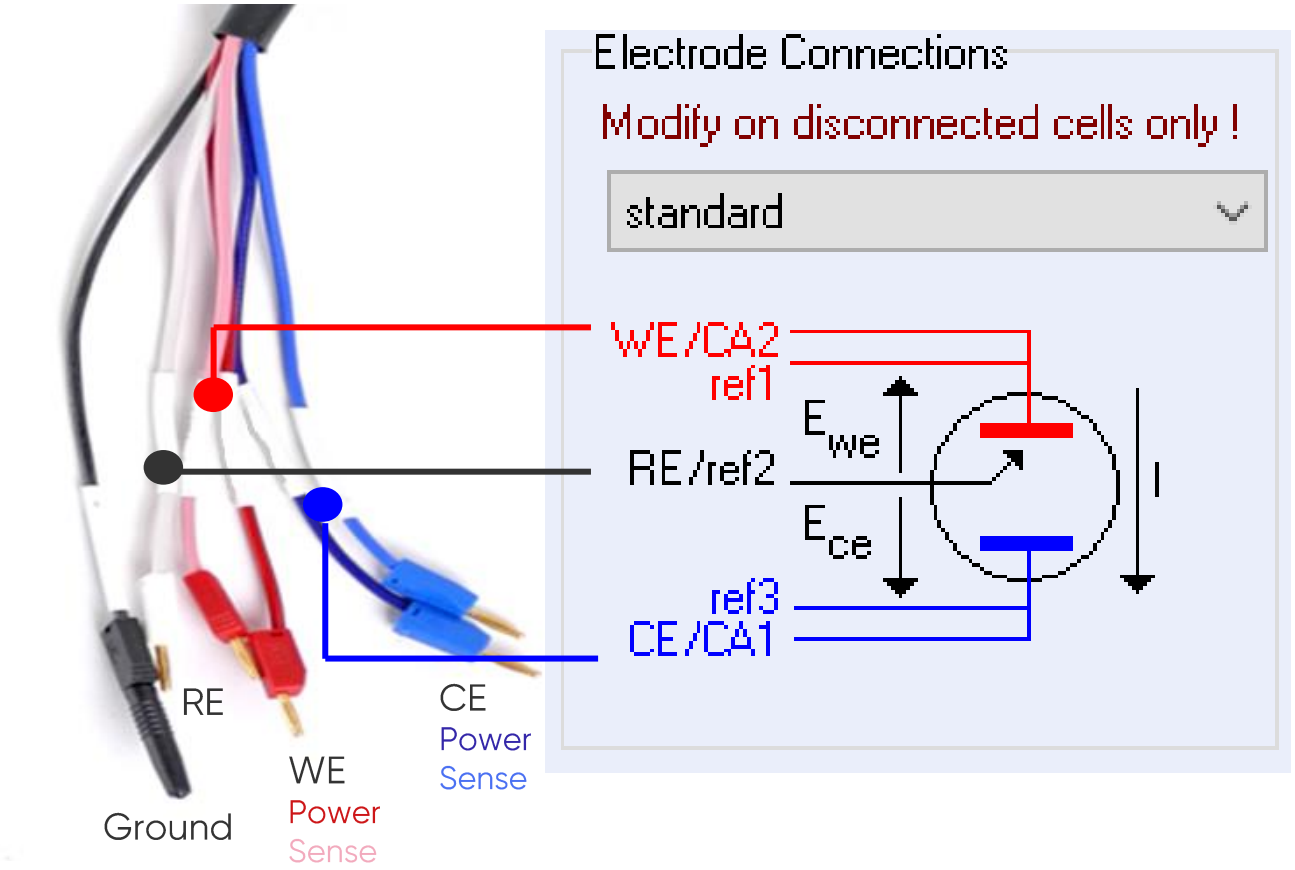
Contact - BioLogic

- Helpful information to provide when contacting support center:
  - Serial number of the instrument (located on the rear panel of the device)
  - Software and hardware version you are currently using (on the Help menu, About on EC-Lab)
  - Operating system on the connected computer
  - Connection mode (Ethernet, LAN, USB) between computer and instrument

FAQ

- How do I connect potentiostat to the cell?
- How do I select correct bandwidth?
- What is the difference between compliance and control voltage?
- If I do some modifications on the fly on the experiment parameters, how can I remember what I have done?

How do I connect potentiostat to the cell?



- In standard electrode connections mode:
  - Working Electrode (WE)

  Connect power and sense
  - Reference Electrode (RE)
  - Counter Electrode (CE)

  Connect power and sense

Note: For other connection modes, refer to Connection to the cell (article) or Technical Note #09 and #11, or the Installation and Configuration Manual.

How do I select correct bandwidth?

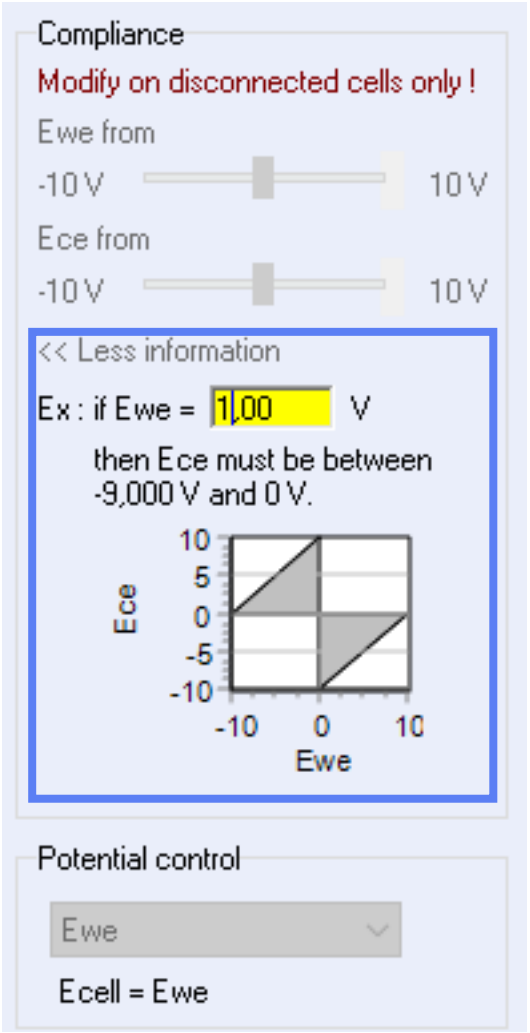
- To quickly verify if the correct bandwidth is selected (no oscillation and stable measurement), you can follow these steps:
  - Change the Bandwidth factor. Start with a lower value. If decreasing the bandwidth factor does not work, try to increase it. The faster, the better.
  - For potentio-dynamic measurements carried out at high scan rates, fast bandwidths must be set.
  - The hardware ohmic drop compensation slows down the regulation loop, so in some cases, you may need to decrease the bandwidth.
  - For Premium range potentiostats, adjust bandwidths 7, 8, 9 first. Then, if the measurement still shows signs of oscillation try the advanced bandwidths 1 to 6.

Note: To go further, refer to Get more from your potentiostat, Understanding bandwidth & its effect on measurements (articles), Application Note #04, Technical Notes #35

What is the difference between compliance and control voltage?

- Compliance is the voltage between WE and CE
- Control voltage is the voltage between WE and RE

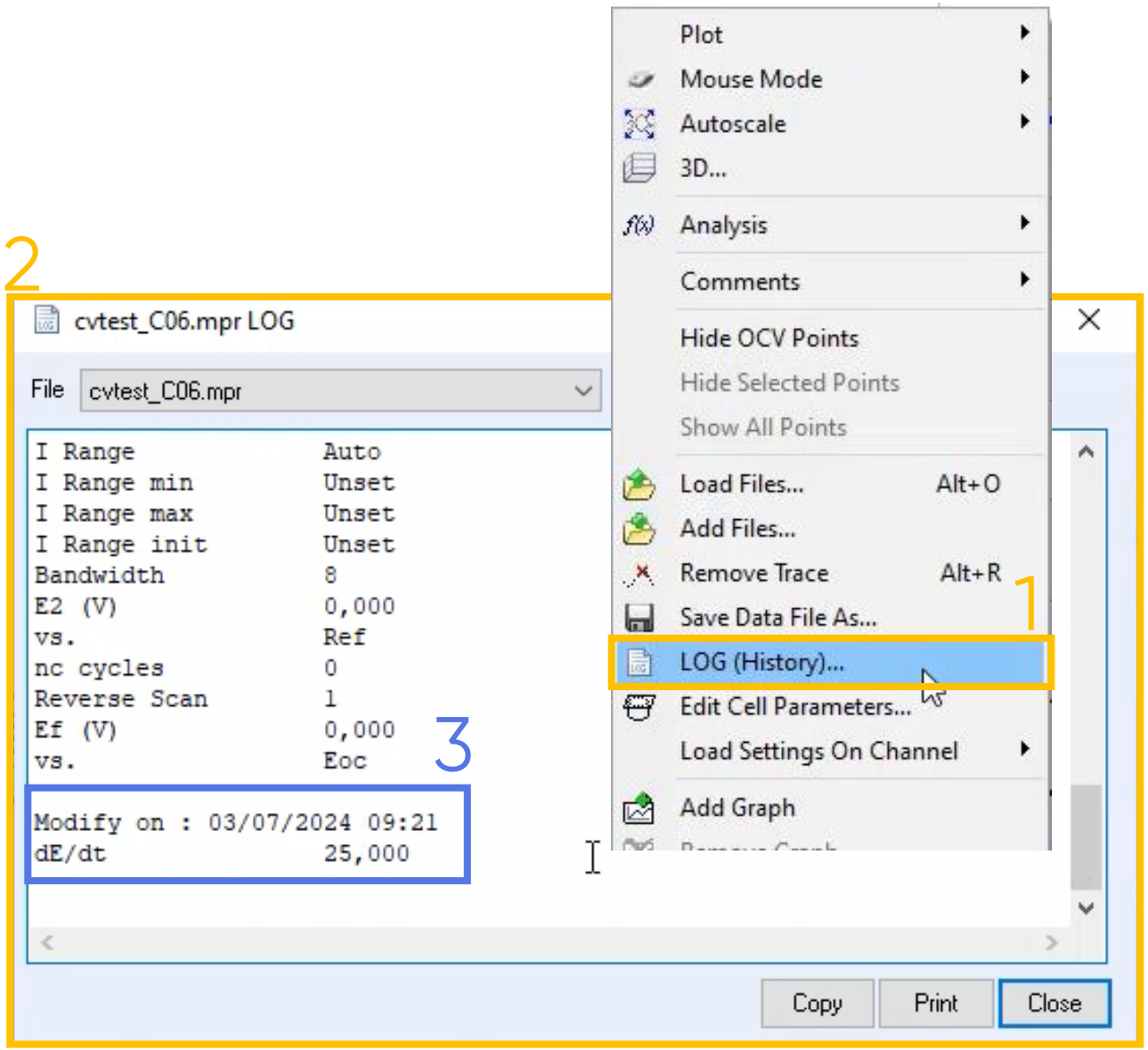
- Verify the desired voltage to apply matches with the compliance.
  - For Premium: compliance = ±12 V
  - For Essential: compliance = 20 V adjustable from ±10 V, between [-20 ; 20] V



Note: Compliance is adjustable only on essential instrument in Safety/Adv Settings.

If I modify-on-the-fly the experiment parameters, how can I remember what I have done?

- Each experiment is associated with a LOG file (right click on the graph), which is the memory of an experiment
- This file contains the mark of all the change parameters happening during the experiment



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Thank you for choosing us!