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VC-CC ePatch Features and Software

Alessandro Porro, PhD

Application Scientist at Elements srl

Overview

VC-CC ePATCH

the new mini amplifier for voltage clamp and current clamp experiments

EZ-Patch

the new acquisition software for ePatch devices

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Elements Patch Clamp Devices (Feb 2019)

ePatch 1st gen

- voltage clamp only
- already available on the market

ePatch 2nd gen

- voltage and current clamp
- work in progress

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Elements Patch Clamp Devices (Feb 2020)

ePatch 1st gen

- voltage clamp only
- already available on the market

ePatch 2nd gen

- voltage and current clamp
- ~~work in progress~~ Ready to work

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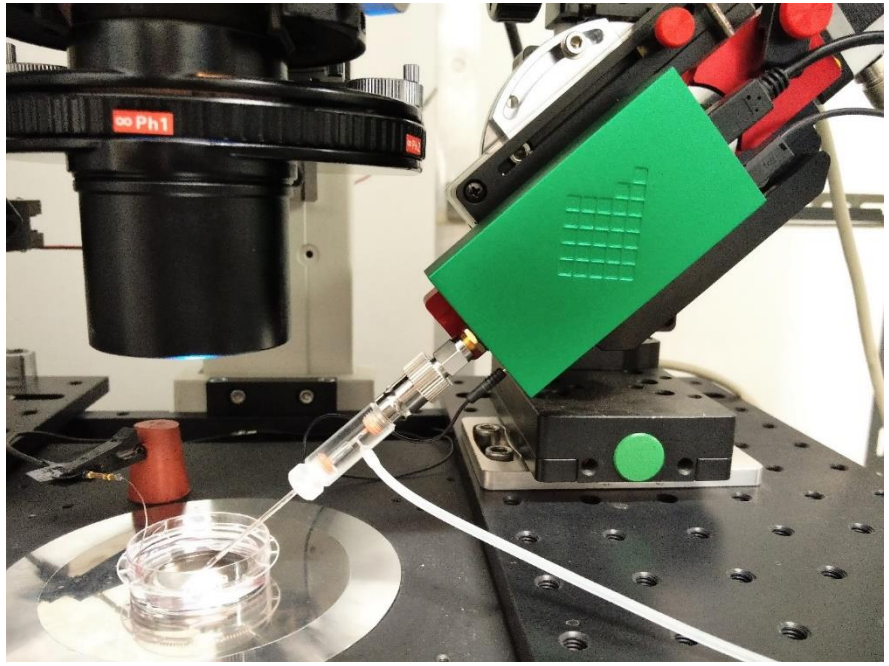
ePatch 2nd generation: the VC-CC ePatch

A tiny device for voltage clamp and current clamp recordings

Technical specifications (voltage-clamp):

- Open input noise (rms): 210fA @ 625Hz; 1.15pA @ 10 kHz; 8.1pA @ 100 kHz
- Current ranges: ±200pA (Gain 2.25GΩ), ±2nA (Gain 225MΩ), ±20nA (Gain 22.5MΩ), ±200nA (Gain 2.25MΩ)
- Voltage pulse generator range of ± 500 mV
- Digital filters: cutoff frequencies in the range between 62,5 Hz and 100 KHz
- Max sampling rate: 200 kS/s
- C-fast – C-slow – R-series – P/N compensations
- C-fast compensation range: 0-11 pF
- C Slow compensation ranges: C in 0 - 250 pF, τ in 0 - 2500µs
- R series correction ranges: R in 0 - 25 MΩ



Technical specifications (current-clamp):

- Noise (rms): 8µV @ 625Hz; 20µV @ 5 kHz; 110µV @ 10 kHz
- Current stimulus ranges: ±2.5nA (res. 0.2pA); ±100nA (res. 10pA)
- Voltage range: ±700 mV
- Pipette neutralization (0-31 pF range) and Bridge Balance compensation (0-40 MΩ range)
- True-zero current mode

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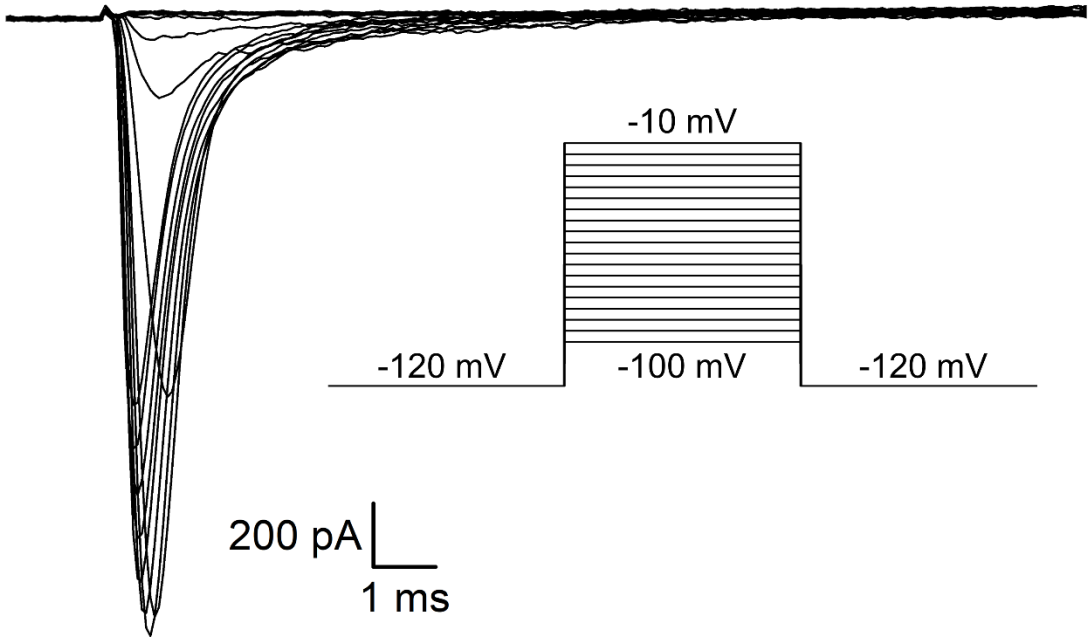
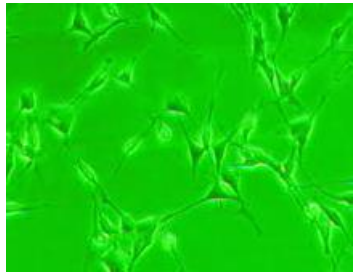
VC - ePatch: case study

Whole-cell voltage clamp recording of Na_v 1.5 channel overexpressed in HEK cells





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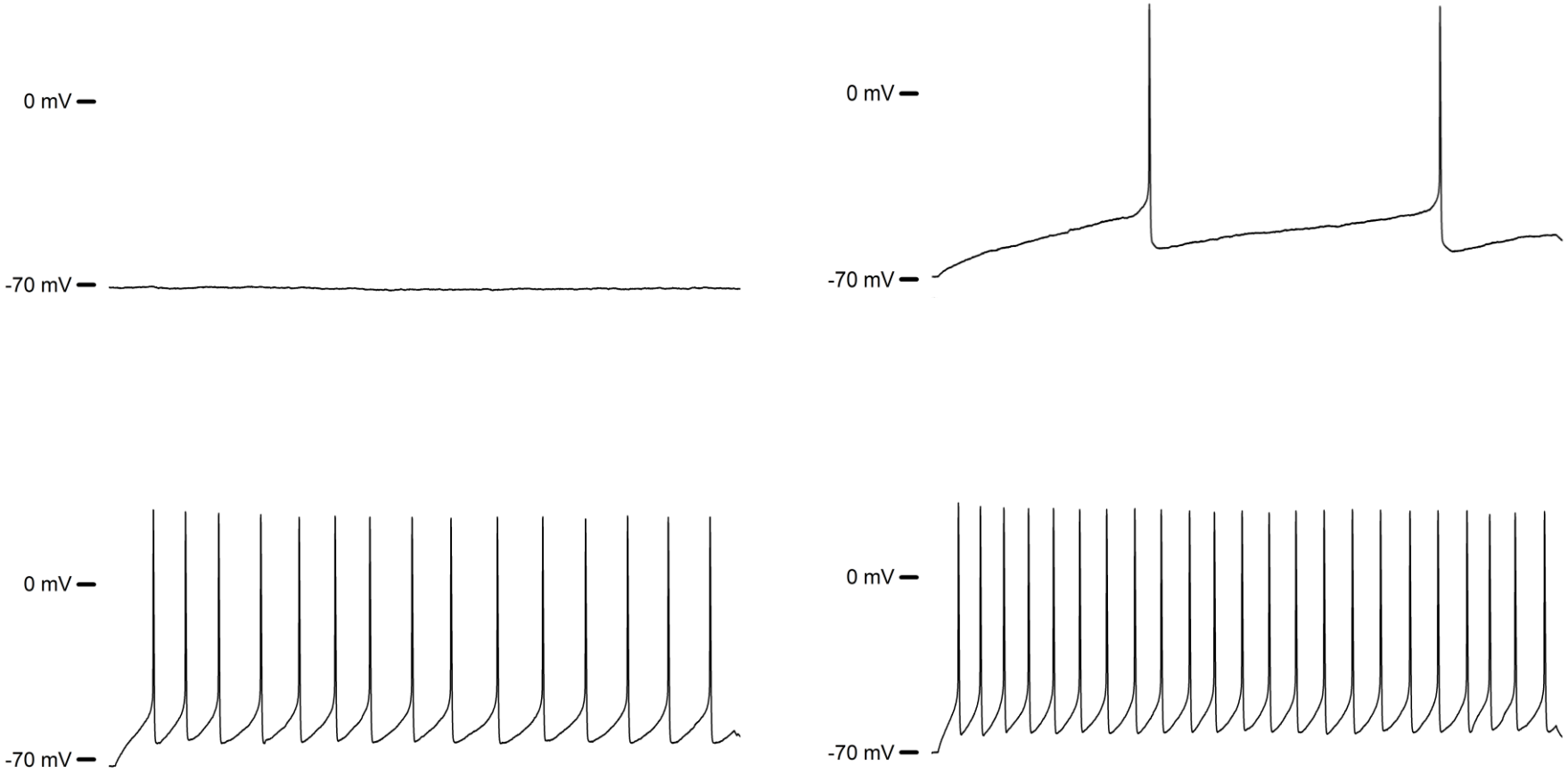
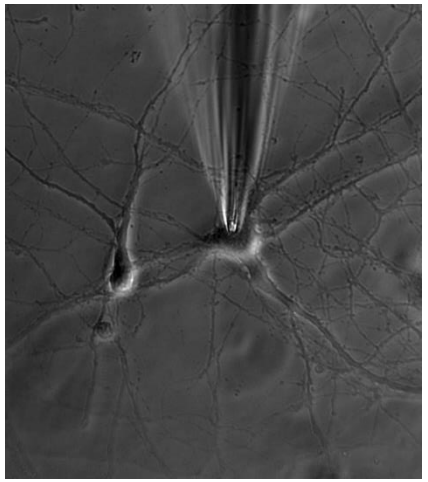
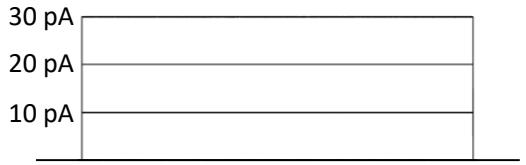
VC-CC ePatch: case study

Whole-cell current clamp recording of isolated rat cortical neurons







Data courtesy of Dr. A. Binda and Prof. I. Rivolta, Milano-Bicocca University, Italy

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EZ-Patch software

The new interface designed and developed for the ePatch devices

EZ-Patch software

The new graphical interface designed and developed for the ePatch devices

Features:

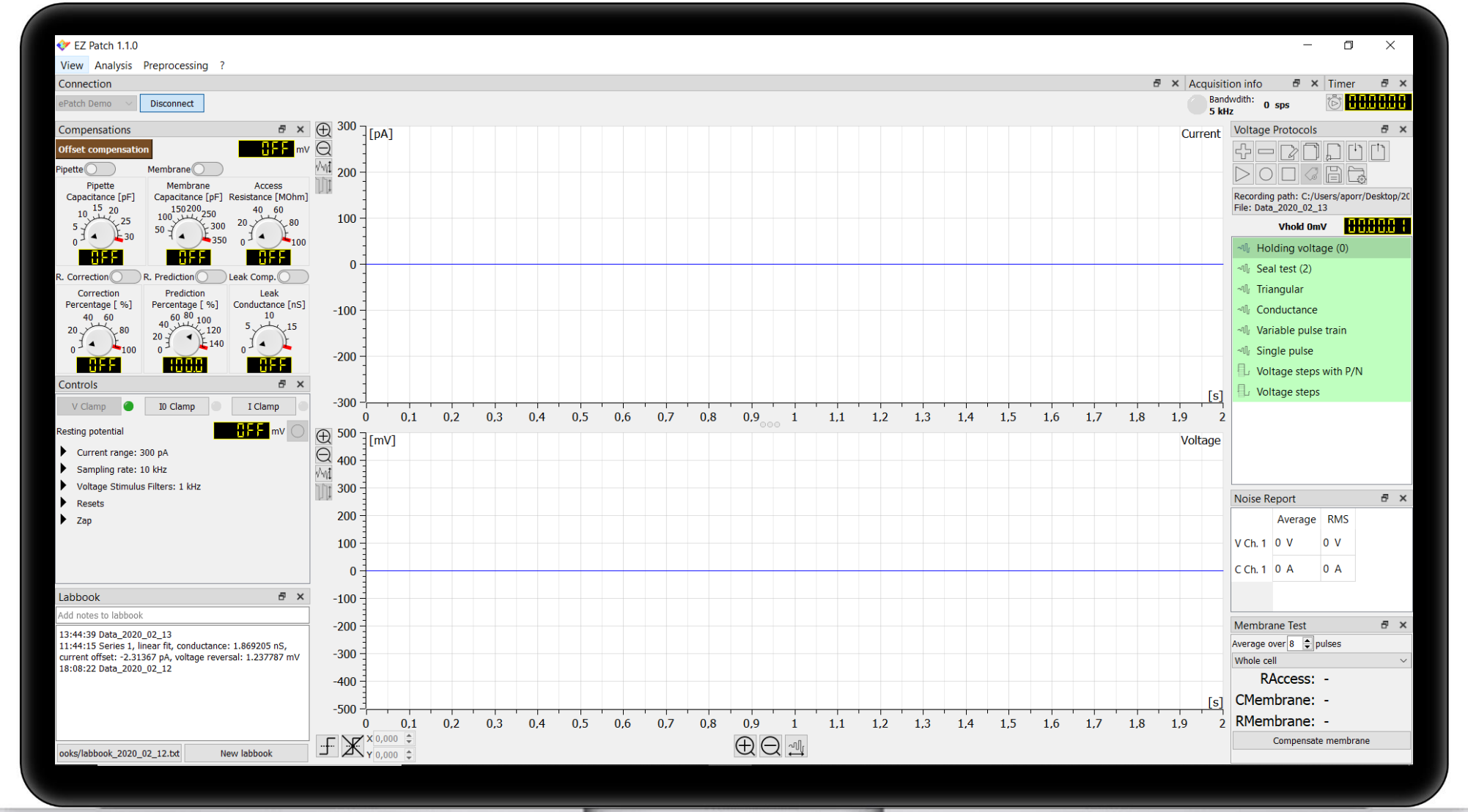
- Customizable user-friendly Windows-format interface
- Real-time display of voltage and current digitized data
- V-clamp, I_0-clamp and I-clamp modes
- Parametric voltage and current protocols editor
- Automatic or manual control of compensation settings
- Membrane parameters estimation to keep track of cell health
- Resting potential recording in true-zero current mode
- Real-time data analysis in voltage-clamp mode (I/V graph, event detection, dwell time, FFT, etc.)
- Real-time action potential waveform analysis (AP treshold detection, AP frequency, AP slope, etc.)
- “Store sweep” tool to easily compare data during the recording
- Digital LabBook
- Two data output saving formats: .dat and .abf
- Programmable Digital-Output to external devices
- Available for Windows and Mac OS

EZ-Patch software

The new interface designed and developed for the ePatch devices

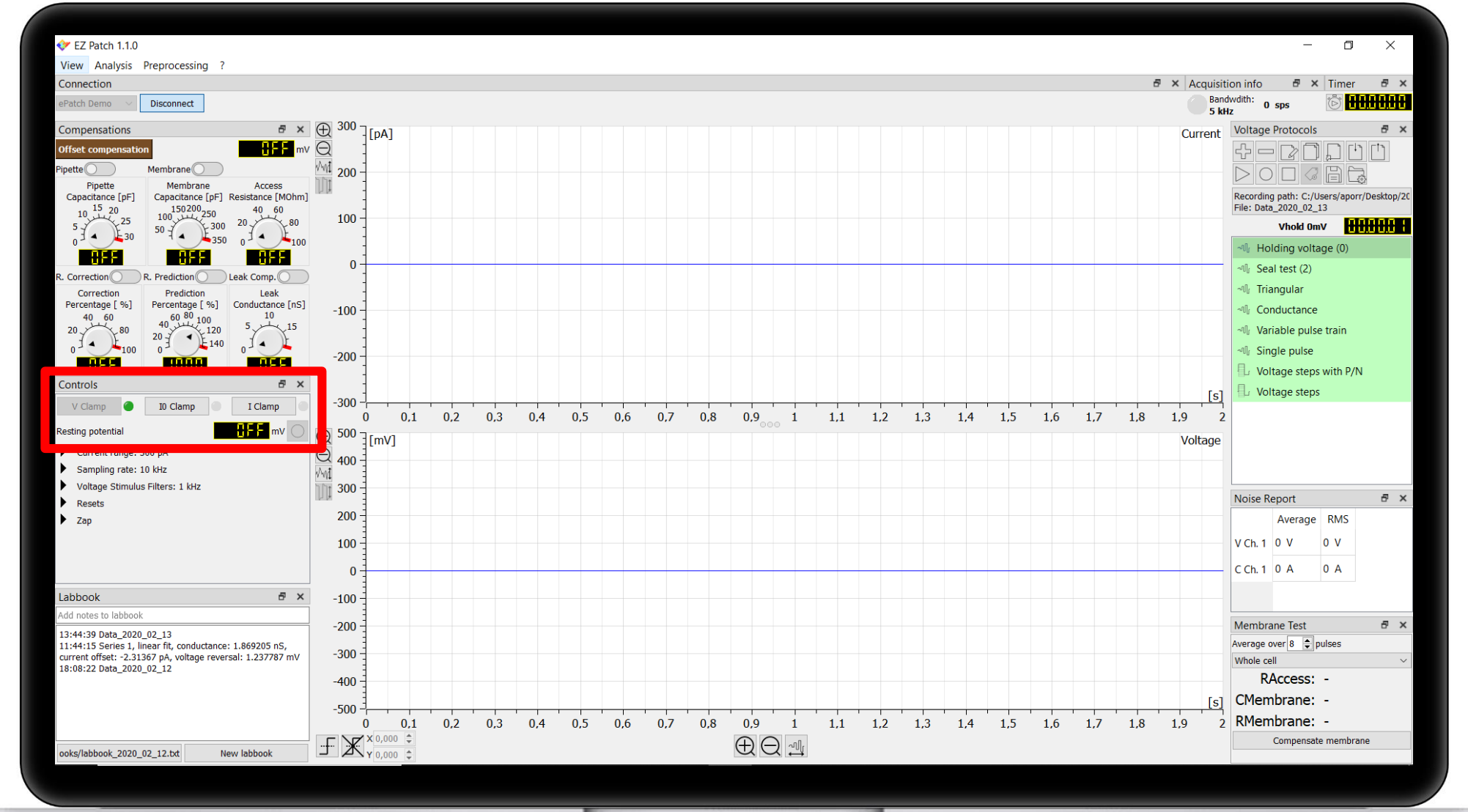
EZ-Patch software

New layout with clearer and more accessible commands



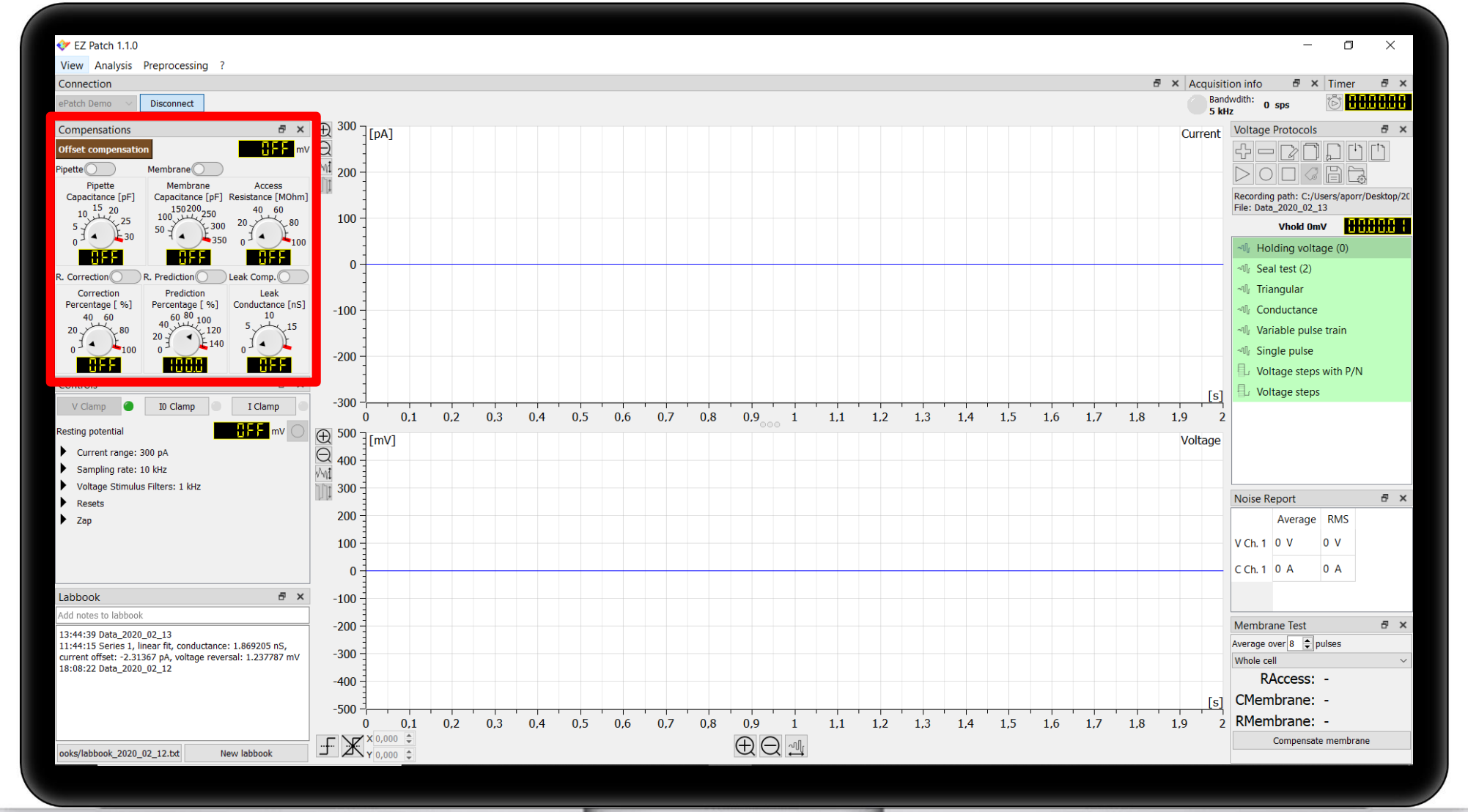
EZ-Patch software

V-clamp, I0-clamp and I-clamp modes



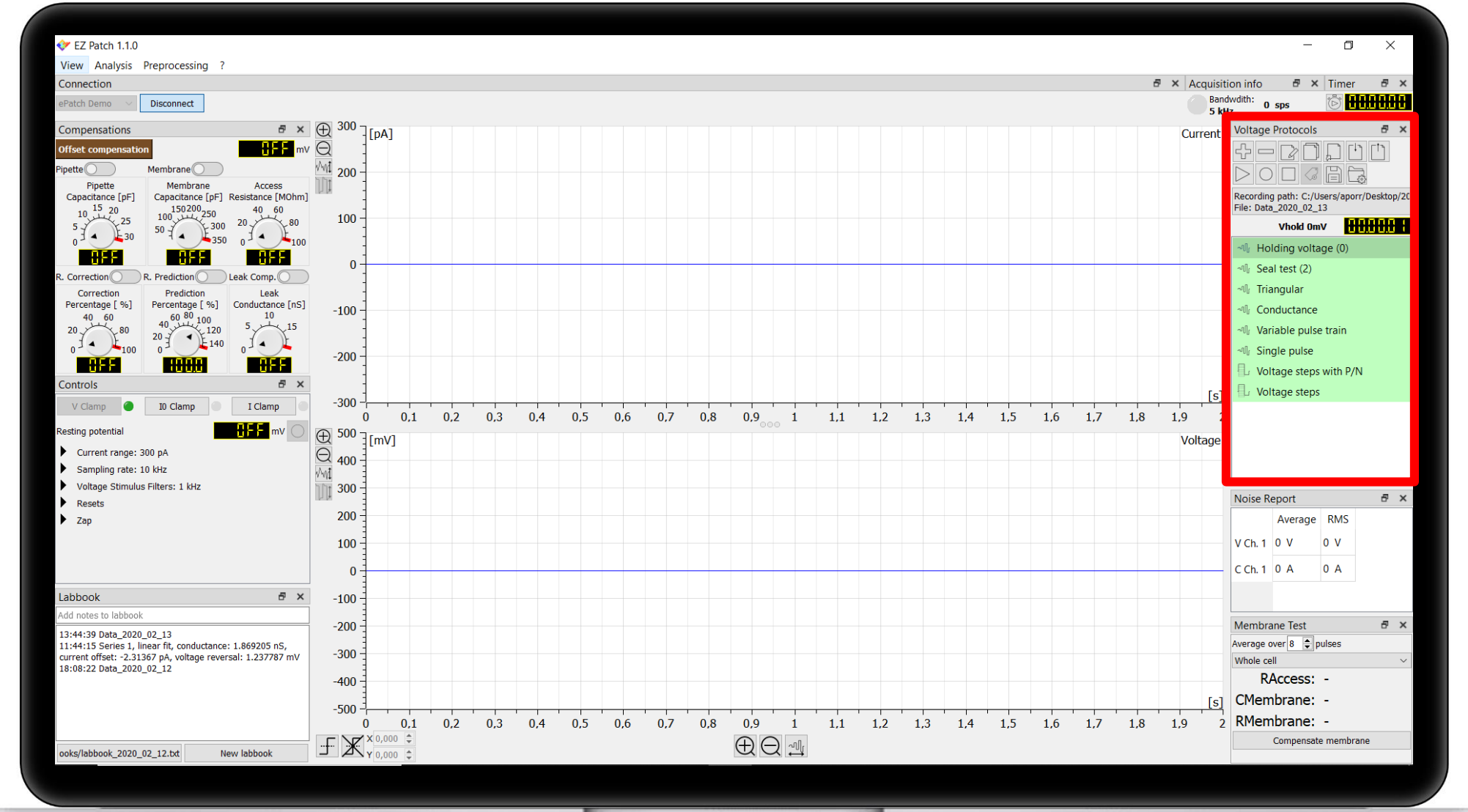
EZ-Patch software

Easy control of compensation settings



EZ-Patch software

Acquisition manager

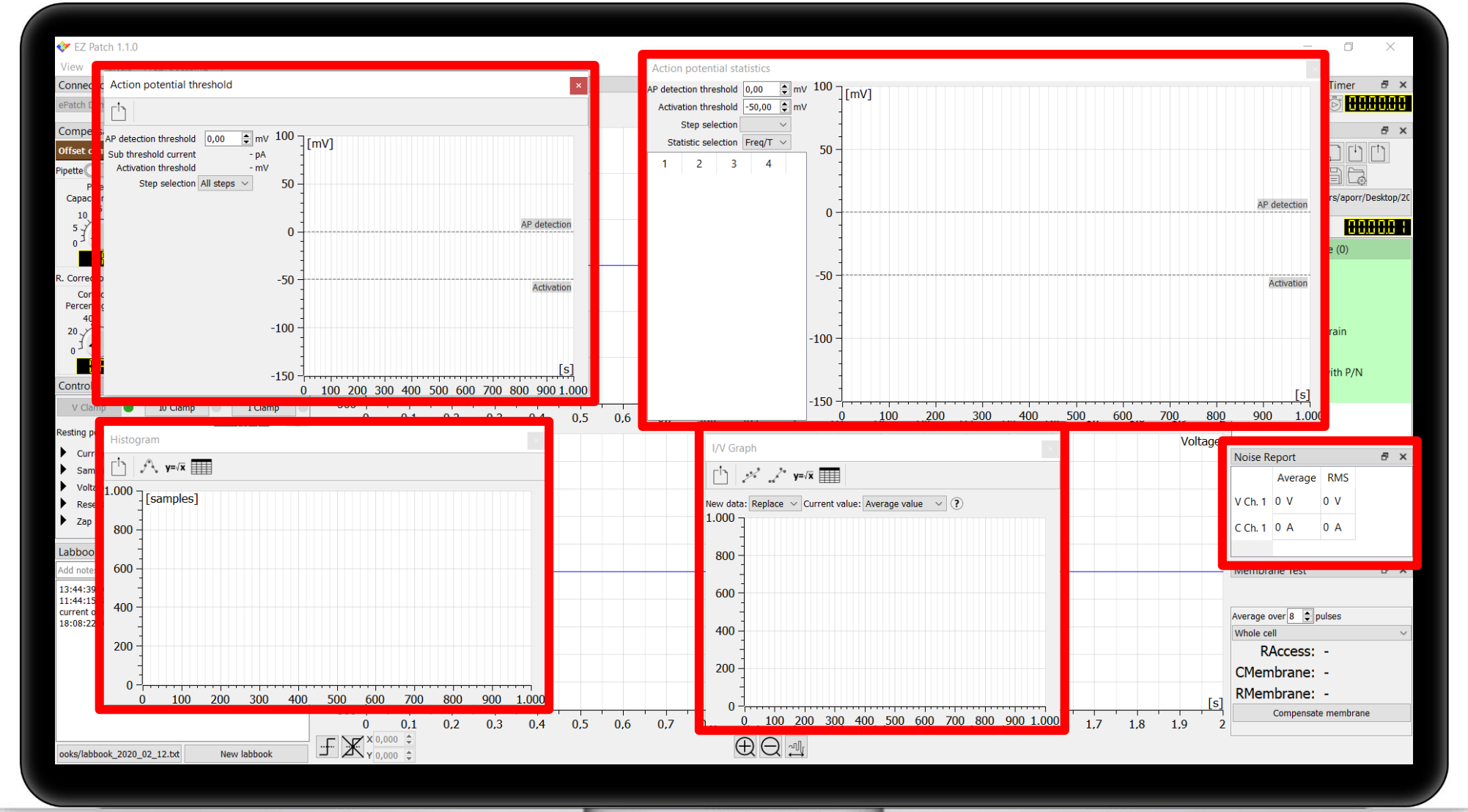


EZ-Patch software

Real time whole-cell parameters estimation

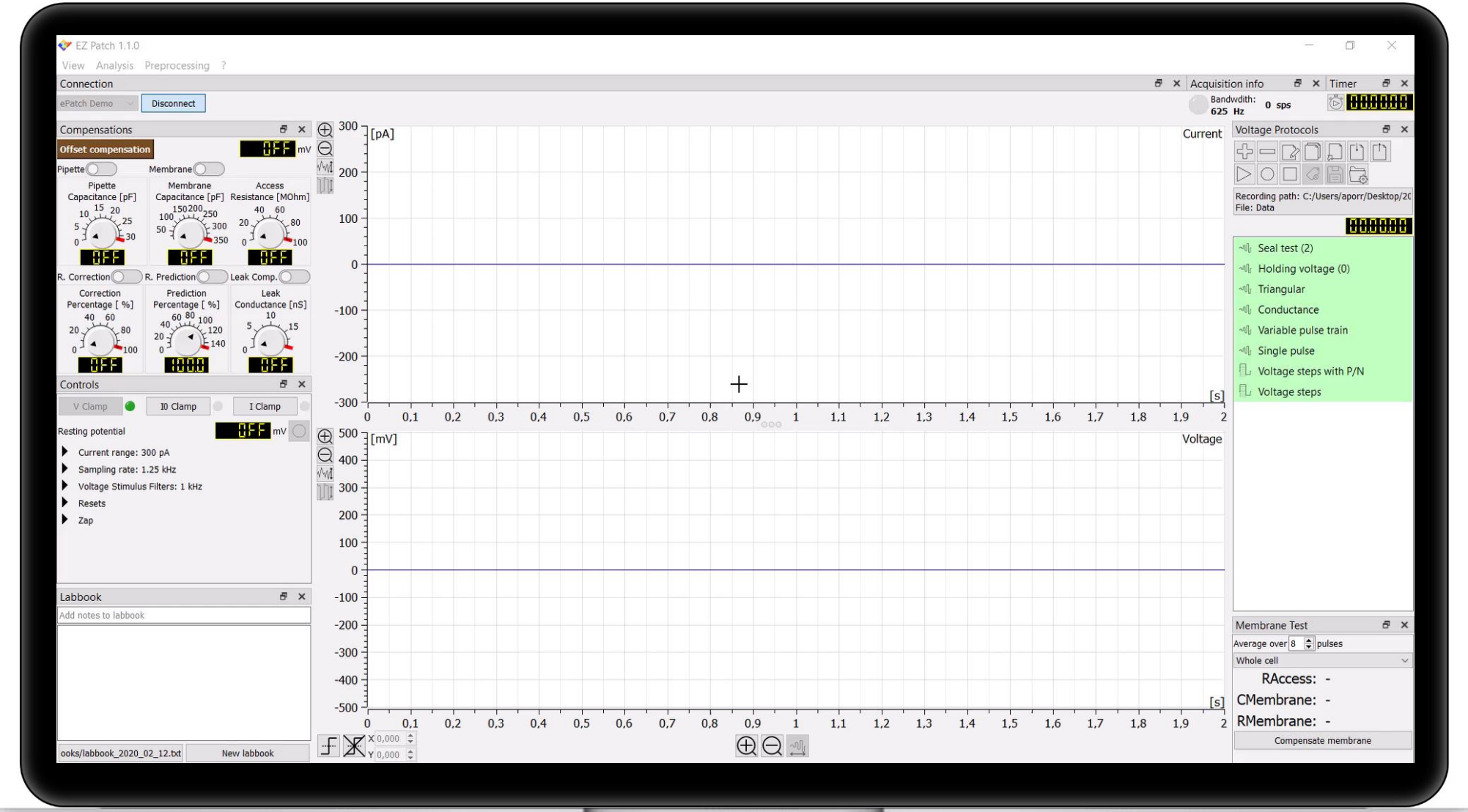
EZ-Patch software

Real time analyses both in V-clamp and C-clamp mode



EZ-Patch software

Customizable graphical interface

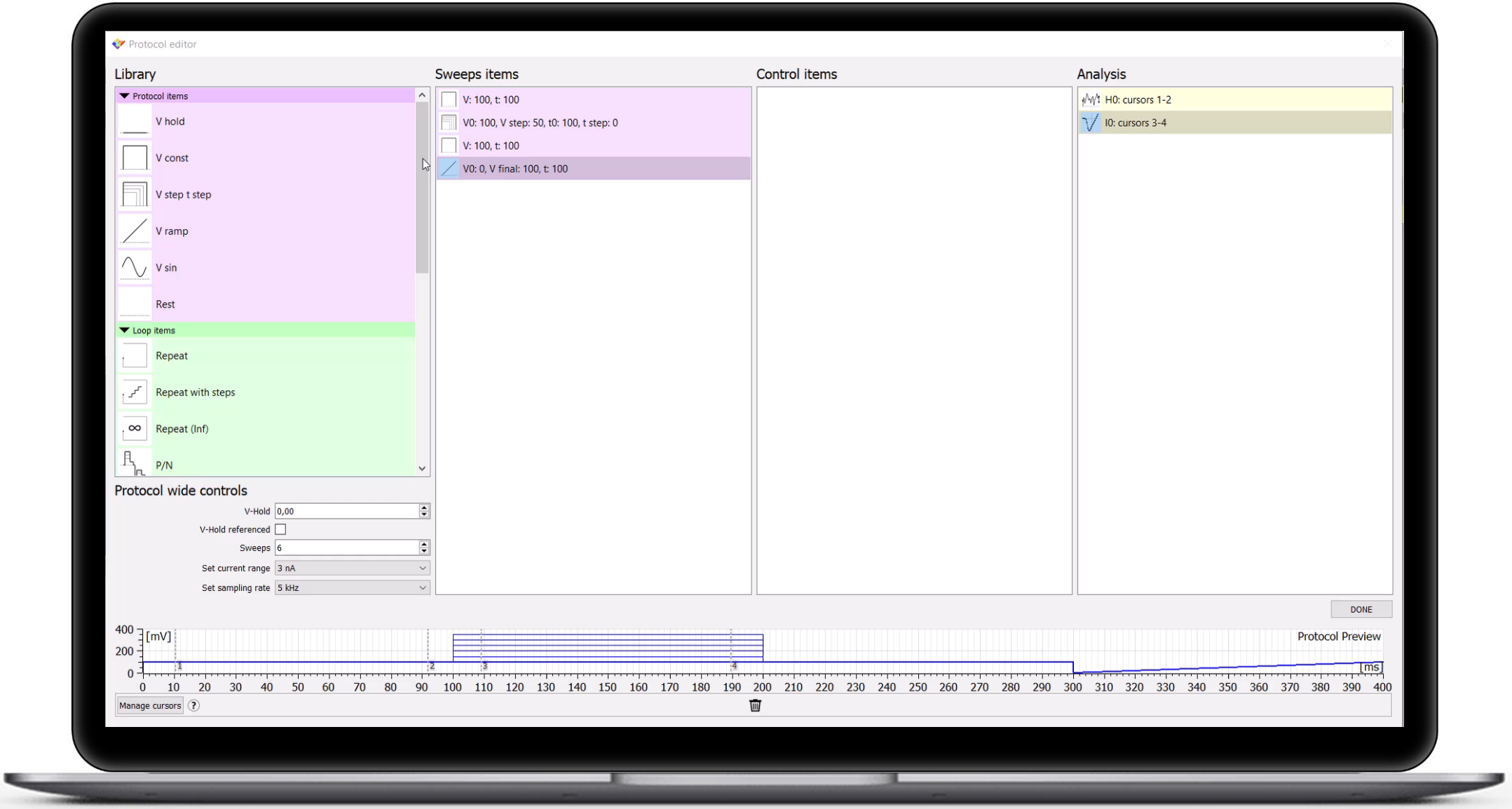


EZ-Patch software

From the pipette dipped in the bath to the file saved within the hard drive

EZ-Patch software

The protocol editor



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VC - ePatch
Case studies

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VC - ePatch: Publications

eLIFE
elifesciences.org

RESEARCH ARTICLE

The HCN domain couples voltage gating and cAMP response in hyperpolarization-activated cyclic nucleotide-gated channels

Alessandro Porro[1], Andrea Saponaro[1], Federica Gasparri[1], Daniel Bauer[2], Christine Gross[2], Matteo Pisoni[1], Gerardo Abbandonato[1], Kay Hamacher[2], Bina Santoro[3], Gerhard Thiel[2], Anna Moroni[1]*

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RESEARCH ARTICLE

WILEY

Actin filaments modulate electrical activity of brain microtubule protein two-dimensional sheets

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Abstract
The cytoskeleton of eukaryotic cells contains networks of actin filaments and microtubules (MTs) that are jointly implicated in various cell functions, including cell division, morphogenesis, and migration. In neurons, this synergistic activity drives both the formation of axons during development and synaptic activity in mature neurons. Both actin filaments and MTs also are highly charged polyelectrolytes that generate and conduct electrical signals. However, no information is presently available on a potential electrical crosstalk between these two cytoskeletal networks. Herein we tested the effect of actin polymerization on the electrical oscillations generated by two-dimensional sheets of bovine brain microtubule protein (2D-MT). The voltage-

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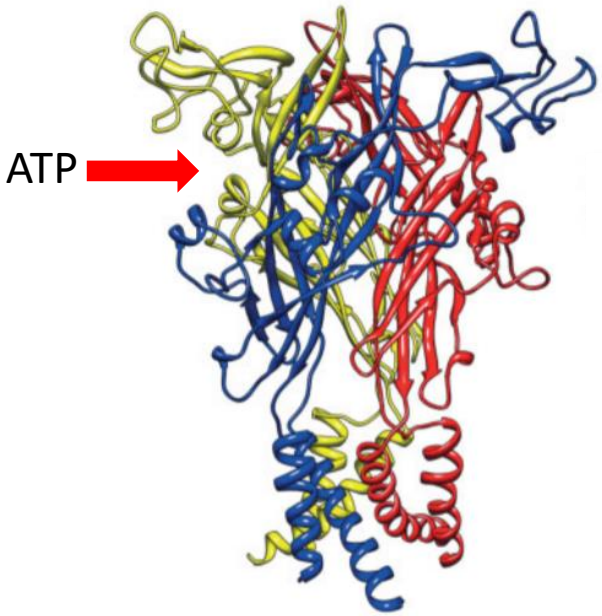
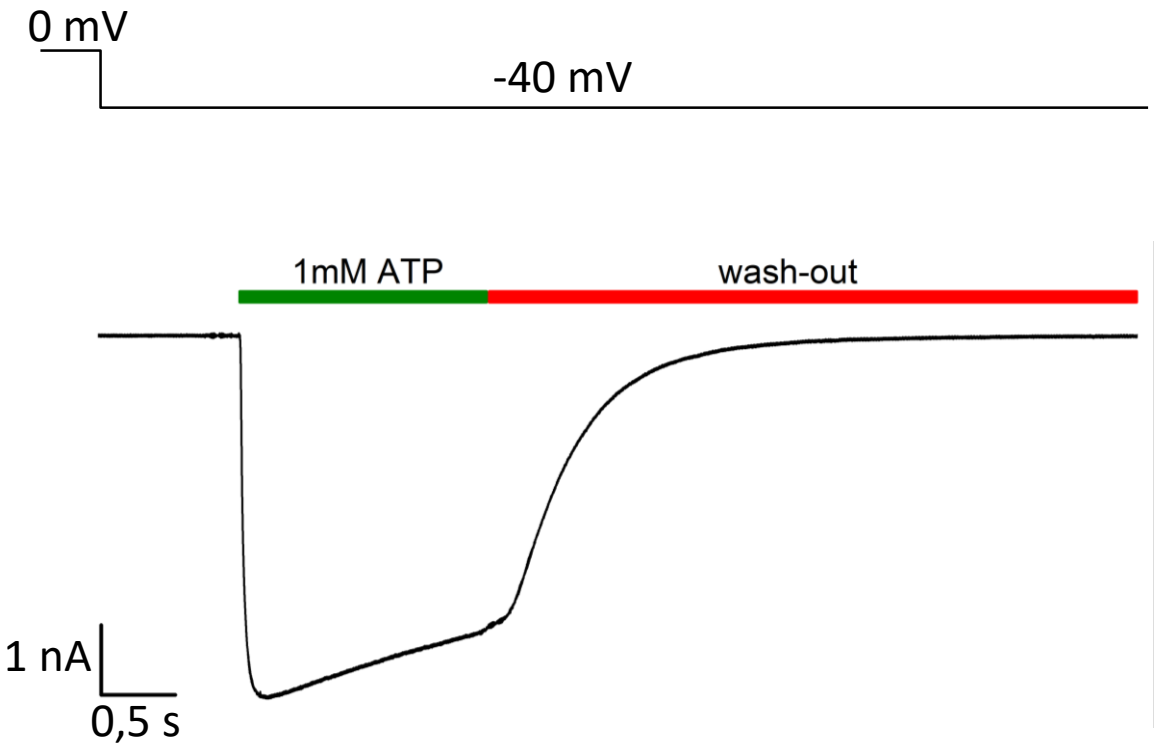
VC - ePatch: Case study

The ePatch was used to record currents of P2X2 receptor transiently expressed in mammalian HEK cells



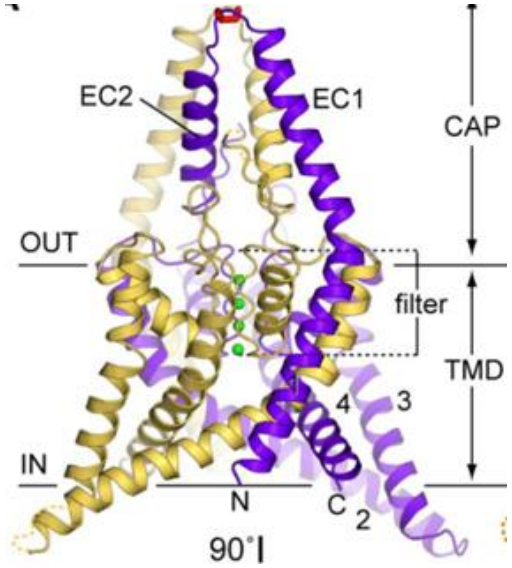


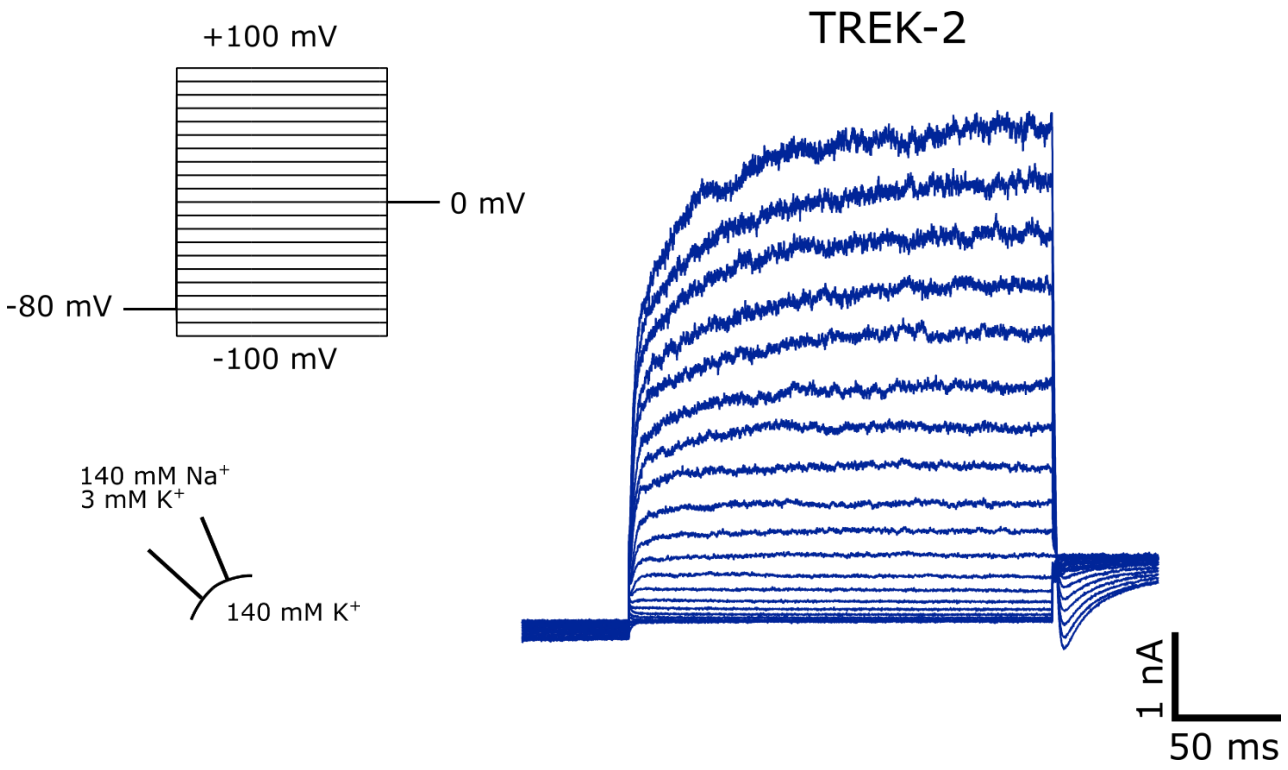
Whole-cell inward current of P2X2 receptor obtained in gap-free mode perfusing ATP for ~ 1,5 s.

F. Gasparri (Department of Biosciences – University of Milan)

VC - ePatch: Case study

The ePatch was used to record currents in excised patches of human TREK-2 channels expressed in HEK 293 cells.





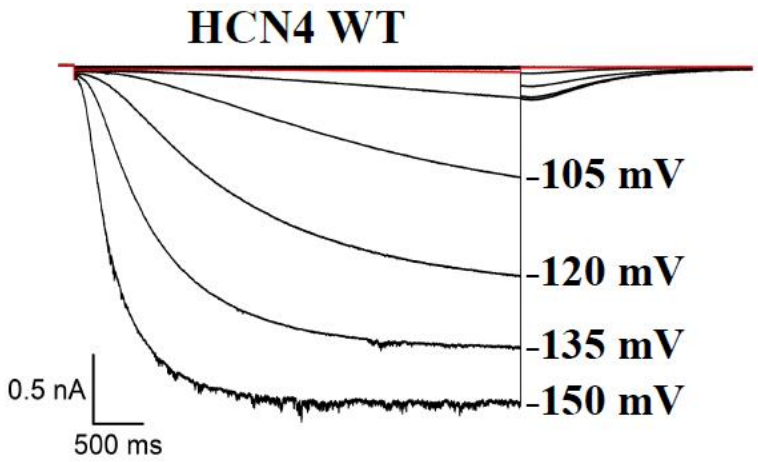
Macroscopic current recording of TREK-2 channel obtained in voltage clamp mode from an inside-out patch.

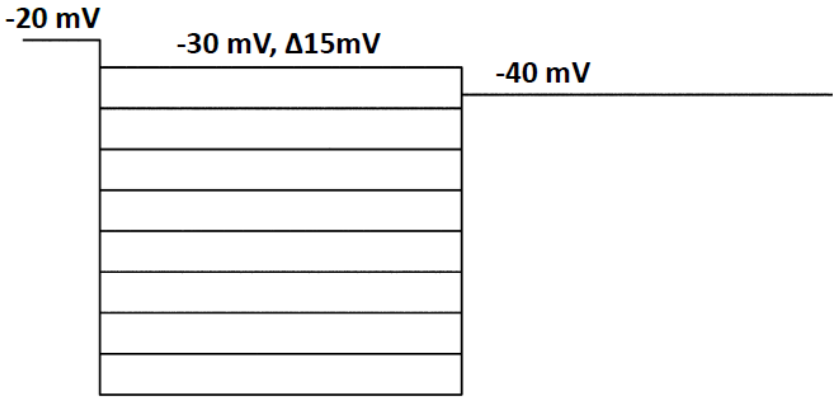
UNIVERSITY OF OXFORD

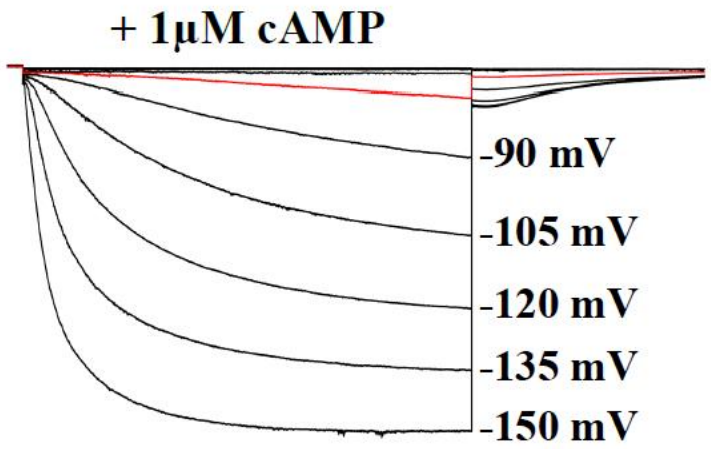
M. Arcangeletti (S. Tucker lab, Department of Physics, University of Oxford UK)

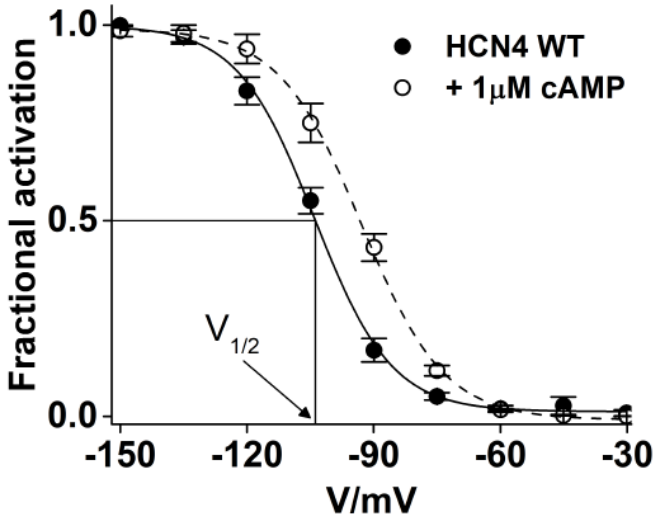
VC - ePatch: Case study

Study of the cAMP response of HCN4 channel overexpressed in HEK293T cells









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Questions?