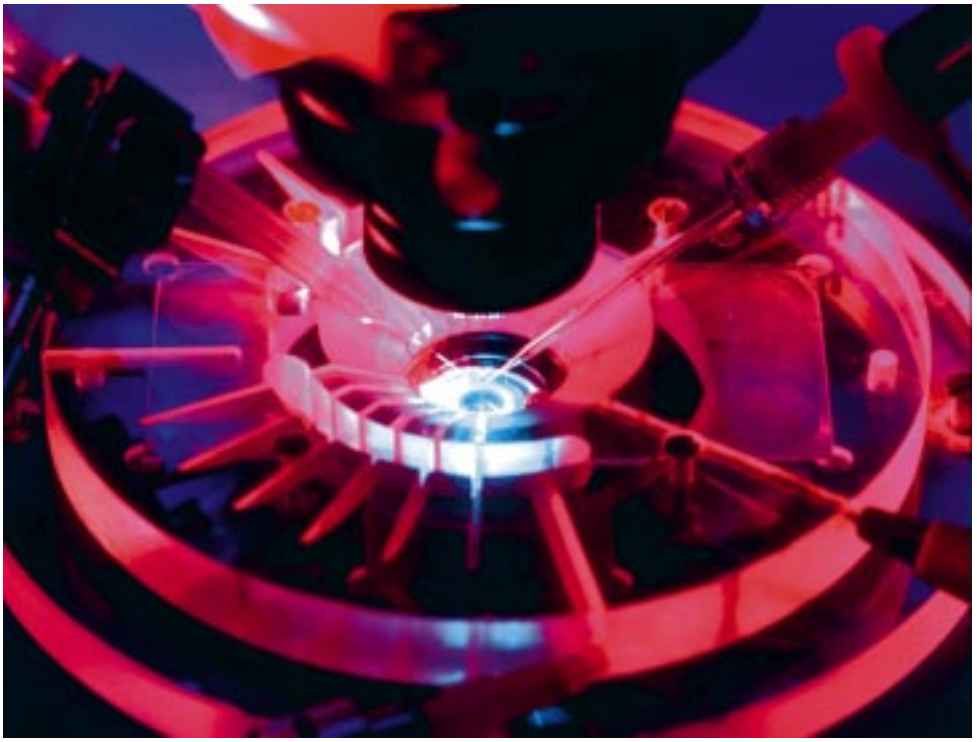
EPC 9 patch clamp amplifier



If you believe your job is to make new discoveries...

...discover EPC 9,
the highly integrated Patch Clamp Amplifier system with built-in:

- Digital Oscilloscope
- Pulse Generator
- Analog Filter
- Data Acquisition & Analysis

EPC 9 features

- Fully computer controlled (Mac and PC based)
- Automatic selftest and calibration
- Automatic Capacitance Neutralization
- Capacitance Tracking
- Variable, high-quality Filters
- Automatic leak subtraction
- Currents up to 2 µA

EPC 9 - a completely new approach to patch clamping

To keep pace with todays rapidly changing demands in electrophysiological research you need flexible, easy-to-use and powerful instruments.

The EPC 9 represents a new development in the field of Patch Clamp Amplifiers. The experience of HEKA as the first manufacturer of Patch Clamp Amplifiers in the world (EPC 5, EPC 7) combined with the practical experience obtained in the Göttingen Nobel-Prize laboratories of Prof. Neher rendered this step into the future possible. The EPC 9 unifies all of this experience and in addition offers many detailed improvements (implemented according to our customers wishes and proposals).

The EPC 9 features state-of-the-art amplifier technology. It includes an additional amplification range for large currents, new hardware filters and an improved headstage design to reduce noise levels. The most significant advance is the adjustment and control of the amplifier at the software level. This provides the tools necessary to perform virtually every patch clamp experiment. This also allows for the simplification and automation of experimental procedures and gives enormous flexibility for future extensions. The instant automatic neutralization of leakage currents, capacitance, and series resistance quickly and effortlessly yield measurements of the highest quality, all while retaining the possibility of full manual control of the amplifier. Also, the automatic adjustments are performed more accurately and faster than by the most skilled scientist. Therefore, the versatility of the amplifier and its superb technical specifications make the EPC 9 the instrument of choice for cellular and tissue experimentation.

The versatility of the EPC 9 makes it useful in many research areas besides the classical fields like single-channel and whole-cell measurements. It is also an ideal instrument for loose-patch experiments, capacitance measurements (monitoring of endo- and exocytosis), recordings from plant cells and organelles, and studying reconstituted ion channels in artificial membranes. The integration of the EPC 9 amplifier with the ITC-16* AD/DA interface and the connected computer constitutes a further step in the minimization of total recording noise. Complemented by the intrinsic low noise level of the EPC 9 itself, this integrated system effectively eliminates all interferences that in conventional systems often arise from ground loops. Furthermore, the full digital control by a computer running our dedicated software achieves a well-compensated measuring arrangement necessary for a minimum of noise by providing automatic leak and capacitance neutralization at every stage of the experiment.

*Instrutech Corporation, N.Y.

The highly advanced integration of hardware and software of the EPC 9 system eliminates compatibility problems, time-consuming set-up operations, and training time. Furthermore it saves the expenses for additional instruments. The EPC 9 Patch Clamp Amplifier combined with a computer is equivalent to a fully equipped set-up which includes a patch clamp amplifier, a digital storage oscilloscope, a variable analog filter, a sophisticated pulse generator, and a full featured data acquisition and analysis system.

Compare the EPC 9 with any other amplifier system on the market and prepare yourself for an amazing experience!

Journal of Neuroscience Methods 56 (1995) 195-202 and 203-215
F.J. Sigworth, Design of the EPC-9, a computer-controlled patch-clamp amplifier. 1. Hardware
F.J. Sigworth, H. Affolter, E. Neher, Design of the EPC-9, a computer-controlled patch-clamp amplifier. 2. Software

Test Pulse

There are two test pulse modes: built-in test pulses (double or single) and use of a stimulation template from the pulse generator as test pulse.

Controls

All values can be set automatically or manually by either the mouse or the keyboard.

Filters

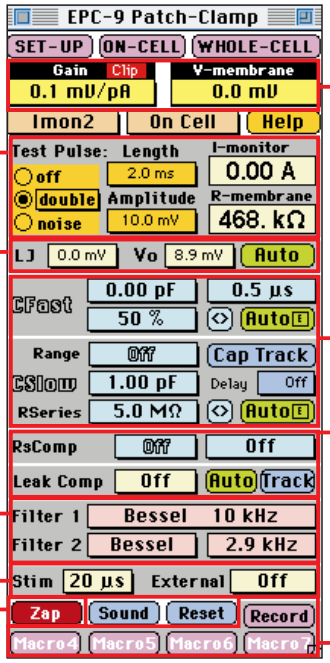
Two built-in high quality hardware filters (Butterworth/Bessel) perform excellent signal conditioning and remove the expense of purchasing additional filter instruments.

Stimulus

The stimulus can be filtered by activating the stimulus switch.

Zap Pulse

A high voltage pulse is applied to the pipette in order to rupture the patch membrane. The parameters (duration and amplitude) can be specified.



Documentation

All EPC 9 settings will be stored with the raw data for easy reconstruction, analysis, and documentation of your experimental procedures.

Automatic Compensations

Automatic routines for leak and capacitive transient compensations, performing these tasks faster and more accurate than even the most experienced experimentor. Capacitance tracking allows continuous updating of membrane capacitance and series resistance compensation during recording sessions.

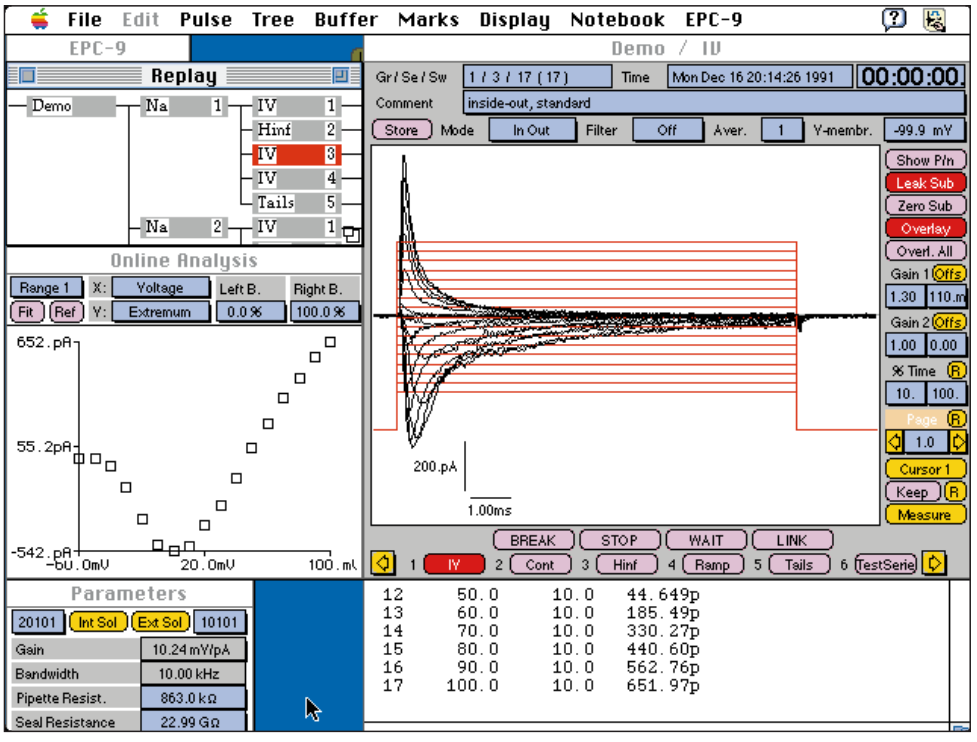
Leak and Rs Compensation

This controls a hardware leak compensation. The series resistance compensation corrects for membrane voltage errors under conditions of high access resistance between pipette and cell interior.

Macros

Macro features allow the recording of routine functions and then accessing these Macros by a simple click of a button.

For further features of **PULSE**, the program for data acquisition and analysis in electrophysiology, such as pulse generator, on-line analysis, oscilloscope window, data processing, and many others, please refer to our separate brochure.



Headstage
The input circuitry is contained in a hybrid integrated circuit.
Current measuring resistors:
50 GOhm (high range)
500 MOhm (medium range)
5 MOhm (low range)
Injection/compensation capacitors:
1 pF (all ranges)
10 pF (medium and low range)
Noise measured with open input: (8-pole Bessel filter, high range)
DC to 1 kHz: 0.03 pA RMS
DC to 3 kHz: 0.08 pA RMS
DC to 10 kHz: 0.25 pA RMS
Maximum bandwidth:
100 kHz (medium and low ranges)
60 kHz (high range)

Filters
The EPC 9 contains two built-in filters for the current-monitor signal.Filter 1 is a 3-pole prefilter with 10 to 100 kHz, Bessel responses. Filter2 is a 4-pole, 500 Hz to 15 kHz filter with selectable Bessel or Butterworth characteristic.

Capacitance Compensation
Automatic or manual adjustment of the fast and slow capacitance cancellation.
Capacitance tracking for measuring cell surface area.
C-fast:
0 to 15 pF, 0 to 8 µs time constant
C-slow:
0.2 to >1000 pF, limited only by the voltage step size
R-series:
1 MOhm to 1 GOhm

Series Resistance Compensation
Automatic trimming is also available as manual adjustment. The maximum compensation is 95 %; the optimum setting depends on the cell capacitance.
Equivalent time constant:
1 µs
10 µs
100 µs
Range:
1 to 1000 MOhm (medium range)
0.1 to 10 MOhm (low range)

Leak Subtraction
Linear leak subtraction can be performed either manually or automatically.
Range:
0 to 2 nS (high range)
0 to 200 nS (medium range)
0 to 20 µS (low range)

Pipette Offset
Automatic or manual adjustment of the pipette offset in a range of +/- 200 mV.

Holding Potential
Software controlled holding potential with a total range of +/- 1 Volt.

Current Clamp
Commanded CC:
1 pA/mV input; up to 10 nA
Mode:
Fast and slow

Stimulation
Four 16-bit Digital-to-Analog (DA) converters are provided by the built-in data acquisition interface.
DA-Resolution:
16 bits
Settling Time:
2 µs
Update rate:
200 kHz maximum
Stimulation range:
+/- 10 Volts

Data Acquisition
One 16-bit Analog-to-Digital (A/D) converter provided by the built-in data acquisition interface with eight differential inputs.
A/D-resolution:
14,5 bits, for sampling rates up to 100 kHz
12 bits, for sampling rates up to 200 kHz

ZAP
A ZAP pulse is provided by the stimulator software. Amplitude (up to 1 Volt) and duration are programmable.

Audio Monitor
Also provided by software.

Noise Measurement
True RMS measurements from 100 Hz to 15 kHz.

Related Products
PULSE / PULSEFIT
Patch clamp data acquisition and analysis software for Windows NT/95/3.1 and MacOS.
X-CHART
Software implemented chart-recorder for Windows NT/95/3.1 and MacOS.
TIDA
Electrophysiological data acquisition and analysis for personal computers under MS-Windows NT/95.
EPC 7
The classic patch-clamp amplifier for single channel and whole-cell measurements.
EPC 8
The successor of the EPC 7. Manual or digital control selectable.
PIP 5
Temperature controlled micro pipette puller.

Service & Support
As the first manufacturer of patch clamp amplifiers in the world HEKA knows the needs of scientists. We provide exceptional pre and post sales customer support from our trained international sales representatives and our own technical support advisors. With thousands of high performance hardware and software products in daily use worldwide we understand all aspects of data acquisition systems not just the software. You can get everything from signal conditioning and acquisition to analyzing and data backup systems from one supplier, to avoid compatibility headaches.

Picture front page: Patch Clamp set-up at the Max-Planck- Institute for Brain Research in Frankfurt / Main (Foto: Filser)

We reserve the right to effect technical changes as development progresses. Special versions are available on request. Further technical data are provided by a detailed description, which is available on request. A guarantee of one year applies on all instruments.

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