EPC 10 USB

Patch Clamp Amplifier family

EPC 10 USB Single

EPC 10 USB Double

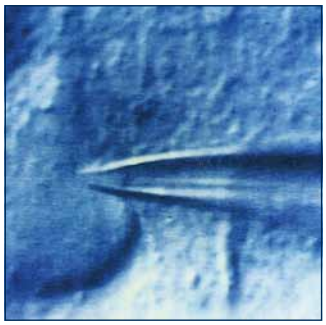
EPC 10 USB Triple

EPC 10 USB Quadro

EPC 10 USB Double

HEKA provides the finest instruments today
to achieve the needed progress of tomorrow…

Introduction



HEKA is very proud to release the EPC 10 USB - the newest member of the EPC 10 family of fully computer-controlled patch clamp amplifiers. The EPC 10 USB continues the HEKA commitment to provide the most up-to-date and technologically advanced products for scientific research. The EPC 10 USB is the successor to the revolutionary EPC 9 patch clamp amplifier, which was introduced in 1990[1)2)3)], as well as the renowned EPC 10.
The EPC 10 USB patch clamp amplifier is available with either one (EPC 10 USB), two (EPC 10 USB Double), three (EPC 10 USB Triple) or four (EPC 10 USB Quadro) integrated amplifier modules.
The EPC 10 USB is fully integrated with HEKA´s new LIH 8+8 data acquisition interface. The LIH 8+8 is a high resolution, low noise scientific data acquisition interface that utilizes the latest Analog to Digital, Digital to Analog, USB 2.0 and high-speed processor technologies. This powerful hardware combination in conjunction with either the PATCHMASTER or PATCHMASTER PRO software provides a highly-integrated system that will minimize total recording noise, eliminate compatibility problems, reduce additional equipment expense, and most importantly, set-up time.

There are many advantages to a fully digitally-controlled patch clamp amplifier. Three major advantages employed in the design of the EPC 10 USB are:

- First, since all of the functions of the amplifier are controlled by a data acquisition program all of the amplifiers hardware settings can be stored along with the data. Not only is this capability important when reviewing and analyzing the data but also for complete and thorough experimental book-keeping.
- Second, computer control allows a number of operations to be fully automated. These can include automatic mode switching (e.g. switching between the settings for establishing a seal or those for single-channel recording), automatic capacitance neutralization of C-Fast and C-Slow, and series resistance compensation. In fact, digital control of every adjustable parameter in the amplifier circuitry is implemented including full functionality test and calibration.
- Finally, the integration of the amplifier, data acquisition interface and software allows experiments to be easily replicated to exact details.

Applications

The EPC 10 USB family of amplifiers can be used, for example, for any of the following applications:

- Low noise single-channel recordings.
- Low noise whole-cell patch clamp recordings: voltage clamp and current clamp/ Low Frequency Voltage Clamp (LFVC).
- Measurements of fast action potentials (AP), fast switching between voltage and current clamp and vice versa.
- Loose-patch recordings[4)].
- Intracellular voltage recordings with high resistance electrodes.
- Field potential recordings.
- Recordings from artificial membranes (Bilayer Recordings) and nanopores.
- Study Synaptic Transmission by simultaneous stimulation/recording from multiple cells (e.g. pre- and post-synaptic cells).
- Study of Long Term Potentiation (LTP) and Long Term Depression (LTD).
- Study of Exocytosis/Endocytosis or Synaptic Transmission by
  - Measurement of whole-cell membrane capacitance
  - Measurement of on-cell membrane capacitance
  - Detection of released substances (amperometry with e.g. carbon fiber electrodes)
  - Detection of released substances under a patch (patch amperometry)
  - Combined membrane capacitance measurements with amperometry (using EPC 10 USB Double)
  - Combined patch amperometry and on-cell capacitance measurements (using EPC 10 USB Double)
- All above mentioned methods can be combined with photometric determination of e.g. the internal calcium ion concentration.

References

1) Electronic Design of the Patch Clamp. F.J.Sigworth. Single-Channel Recording, Second Edition, edited by Bert Sackmann and Erwin Neher. Plenum Press, New York, (1995) 95-127.
2) Design of the EPC-9, a computer–controlled patch-clamp amplifier. 1. Hardware, F.J.Sigworth, Journal of Neuroscience Methods 56 (1995) 195-202.
3) Design of the EPC-9, a computer–controlled patch-clamp amplifier. 2. Hardware, F.J.Sigworth, H.Affolter, E.Neher, Journal of Neuroscience Methods 56 (1995) 203-215.
4) Loose Patch Recording. W. Stühmer. Practical Electrophysiologica Methods, edited by H. Kettenmann and R. Grantyn. Wiley-Liss, New York, (1992) 271-273.

Models and Features

EPC 10 USB Single Patch Clamp Amplifier – *The EPC 10 USB is a complete data acquisition system, which can be used with HEKA's PATCHMASTER software. A DLL (dynamic link library) is available for software developers who are interested in writing their own Windows data acquisition software.*

The EPC 10 USB patch clamp amplifier, combined with a computer and PATCHMASTER software is equivalent to a fully-equipped recording setup, 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.

Common Features

- The only fully computerized patch clamp amplifier in the industry that has a built-in data acquisition interface.
- The integration of the built-in low noise LIH 8+8 data acquisition interface and the amplifier provides optimal grounding, removes external connections and only requires a single USB 2.0 (Hi-speed) port connection.
- Compatible with either Windows or Mac OS systems, fully controlled via the PATCHMASTER or PATCHMASTER PRO software.
- Software testing and calibration routines allows the user to verify the working condition of the instrument within minutes. Calibration, which typically required that the amplifier be taken out of service can be performed in-house, within a few minutes, with no additional expense, and more importantly no downtime to the recording setup. In addition, if needed, the headstage can be easily replaced and calibrated by the user.
- The EPC 10 USB features C-Slow compensation in the high gain range (50 GΩ feedback resistor) for low noise whole-cell measurements.
- Ultra slim low noise headstage design is optimized for single-channel, whole-cell and loose-patch current recordings.
- Resistor switching headstage with three gain ranges can be switched during an experiment.
- True Current Clamp capabilities.
- A "Low Frequency Voltage Clamp"(LFVC) mode is provided to automatically inject an appropriate amount of current to preserve the membrane potential, at a desired level during current clamp measurements.
- Gentle Switch option from voltage clamp to current clamp (injection current is equal to the current monitor in voltage clamp mode).
- Automatic or manual C-Fast and C-Slow capacitance neutralization.
- Capacitance tracking.
- Hardware leak compensation for non-voltage gated channels.
- True noise measurements from 100 Hz to 15 kHz.
- Built-in tone generator fully controlled by software.
- 16 Digital-In and 16 Digital-Out connections at the rear panel. Three of the Digital-Out connectors are also provided via BNC on the front panel.
- All amplifier settings and parameters are stored with the data.
- EPC DLL (dynamic link library) for controlling the EPC 10 USB is available for writing custom Windows applications.

EPC 10 Revision Improvements

Revision "T" Improvements

With the latest EPC 10 USB Revision "T" amplifiers we added new hardware features:

Extended Stimulus Range

The extended stimulus range:

- increases the voltage stimulus range from ± 1 V to ± 2 V in voltage clamp mode.
- increases the voltage measuring range from ± 1 V to ± 5 V in current clamp mode.
- increases the current injection capability in current clamp mode by factor of 5.

Filter 2 Bypass

An option for using the "Filter" on the current or the voltage signal. This new feature e.g. allows filtering of the voltage signal in a current clamp measurement using the Filter 2. If Filter 2 is set to "V_Bessel" or "V_Butterworth", then the current signal is filtered by Filter 1 only.

EPC 10 USB Double, Triple, Quadro Patch Clamp Amplifier

The EPC 10 USB Double, Triple and Quadro amplifiers are the optimal instruments for performing multiple patch/cell experiments. Although two, three or four amplifiers are combined in a single housing, along with the built-in LIH 8+8 interface, each amplifier is completely independent. The amplifiers and headstages are clearly identified, so the user can immediately assign the amplifiers to particular patched cells.
The PATCHMASTER software can simultaneously stimulate and acquire the response from each amplifier. Current and/or voltage signals from all of the amplifiers can be recorded, displayed and analyzed online.

The EPC 10 USB Double, Triple and Quadro amplifiers also provide an economical solutions in comparison to a combination of several individual instruments. They also have advantages of optimized noise performance, grounding, data acquisition and data storage, convenience and ease of integration over multiple external amplifiers.

EPC 10 USB Double

EPC 10 USB Quadro

Product Content

The **EPC 10 USB** Patch Clamp Amplifier includes:	The **EPC 10 USB Double** Patch Clamp Amplifier includes:	The **EPC 10 USB Triple** Patch Clamp Amplifier includes:	The **EPC 10 USB Quadro** Patch Clamp Amplifier includes:
• One amplifier	• Two amplifiers	• Three amplifiers	• Four amplifiers
• One headstage	• Two headstages	• Three headstages	• Four headstages
• One interface board	• One interface board	• One interface board	• One interface board
• One pipette holder	• Two pipette holders	• Three pipette holders	• Four pipette holders
• One model circuit	• One model circuit	• One model circuit	• One model circuit
• One printed manual	• One printed manual	• One printed manual	• One printed manual
• Cables to connect to the computer and power line	• Cables to connect to the computer and power line	• Cables to connect to the computer and power line	• Cables to connect to the computer and power line
Item No.: EPC 10 USB	*Item No.: EPC 10 USB Double*	*Item No.: EPC 10 USB Triple*	*Item No.: EPC 10 USB Quadro*

EPC 10 USB Patch Clamp Amplifier family

Extending an EPC 10 USB

Example 1 - *EPC 10 Double + EPC Single Amplifier*

3 Probes

Example 2 - *EPC 10 Triple + LIH 8+8 Interface*

3 Probes +
9 A/D In +
5 D/A Out

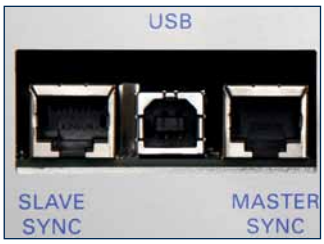
Example 3 - *2 x EPC 10 Quadro Amplifier*

8 Probes

with an LIH 8+8

The number of input and output channels available on the front panel of the EPC 10 USB family of amplifiers can be extended by combining an EPC 10 USB amplifier with an additional LIH 8+8 interface. This may be especially useful when using an EPC 10/n USB amplifier in which the number of available outputs is decreased because of internal usage to stimulate the additional amplifiers.

with a second EPC 10 USB



The number of recording channels and the number of amplifiers can be increased by connecting two EPC 10 USB amplifiers. On the rear panel of the EPC 10 USB there are "Slave Sync" and "Master Sync" CAT5 connectors. EPC 10 USB amplifiers can be connected in such a way to create 8 or 16-channel parallel patch clamp amplifiers. This type of connection can be applied to either the single, double, triple and quadro versions of the amplifier.

For example, a 8-channel parallel patch clamp amplifier can be configured by connecting two EPC 10 USB Quadro. These 8 independent patch clamp amplifiers can be controlled by one copy of PATCHMASTER. Expandability to a 16-channel parallel patch clamp amplifier can be done by connecting four EPC 10 USB Quadro. In this case the amplifiers are controlled by two copies of PATCHMASTER that are synchronized and data can be automatically transferred to a single data file.

with an EPS Probe Selector

A headstage multiplexing device called the Probe Selector can also be used with the EPC 10 USB family of amplifiers. The Probe Selector is available with up to 16 headstages. The headstage mulitplexing device can turn a single EPC 10 USB patch clamp amplifier, e.g. into a sixteen channel serial patch clamp device. Almost each amplifier of an EPC 10/n USB can be extended by a single Probe Selector, resulting in systems with 32 or 64 channels.

Alternatively, a single EPS Probe Selector can be connected to an EPC 10 USB Double or EPC 10 USB Quadro patch clamp amplifier. In this configuration, the EPC 10 USB Double is converted into a 2 by 8 - channel amplifier, meaning that two channels (parallel) are mulitplexed 8 times. The EPC 10 USB Quadro would be turned into a 4 by 4 – channel amplifier, meaning that four channels (parallel) are mulitplexed 4 times. The active probe(s) of the Probe Selector behaves like a headstage connected directly to the EPC 10 USB amplifier. "Non-active" probes are held at their individual holding potentials in medium gain range.

with a TIB 14S Trigger Interface

In order to output 14 digital channels via BNC connectors, a TIB 14S trigger interface can be connected to the EPC 10 USB via the Digital I/O connector. The TIB 14S allows either manual or software controlled switching of the digital lines. The TIB 14S can also drive magnetic valves directly.

Software Control Options

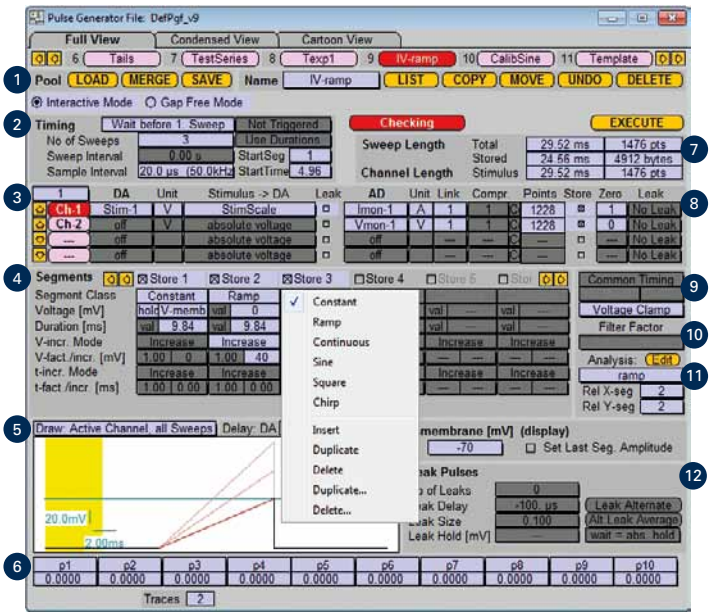
PATCHMASTER

The EPC 10 USB family of amplifiers can be controlled with PATCHMASTER software on either Windows (XP, Win7, Win8) or Mac (OS X 10.4+) platform. PATCHMASTER is a multi-channel stimulation/acquisition and control software. For more details please refer to the PATCHMASTER brochure.

Complete amplifier control. Each amplifier control can be accessed through the software and many tasks such as compensation of capacitance values can be automated and executed on a single mouse click or button press.
Amplifier parameters can be read and set from the software allowing sophisticated control loops.

Sophisticated design of your stimulation protocols. The Pulse Generator window within PATCHMASTER defines all of the parameters for data acquisition, waveform generation and external device control. A Pulse Generator File (PGF) is comprised of any number of predefined sequences

1. **Sequence Pool:** A paging bar that loads, saves, copies etc. the pool of available stimulation sequences.
2. **Timing:** Specification of the number of sweeps, sweep interval and sampling rate.
3. **DA-channels:** Multiple DA-channels and digital trigger lines can be selected for output.
4. **Segments:** The stimulation pattern consists of an arbitrary number of segments with each segment having a defined type, duration, amplitude and increment/decrement factors.
5. **Template Preview:** Graphical display of the stimulation template.
6. **PGF-Parameters:** Global variables can be used for sequence editing.



7. **Sweep Length:** Display of the stimulus length and amount of acquired data.
8. **AD-channels:** Up to 16 channels can be acquired simultaneously. Data compression and store/non-store flags on individual traces can reduce the required data storage capacity.
9. **Break Condition:** User control of AD-channel acquisition. Stops data acquisition if one condition becomes true.
10. **Filter Factor:** Input filter is set automatically with respect to the sampling rate.
11. **Analysis:** Direct link of the PGF to the corresponding analysis method.
12. **Leak:** Determines various parameters of the leak pulses for p/n subtraction.

Entire experimental procedures at the touch of a button. Simple or complex experimental procedures can be designed and stored within the Protocol Editor and executed from the Control Window of PATCHMASTER.
The idea is to generate a list of events or tasks, which comprise your complete experiment, and can be executed automatically. Within a procedure, feedback from external inputs, amplifier controls, online analysis results or user inputs and experimental parameters can be adjusted. A protocol can be started/called from another protocol. Various tasks such as repeat loops, input queries or conditional statements allow for the generation of complex interactive processes.
Scientists asking for complex, precisely timed experimental protocols will appreciate the vast array of features within the Protocol Editor. The high degree of automation options will increase efficiency and minimize experimental errors.

Software Control Options

EPCMASTER

In situations where the EPC 10 USB amplifier is used in conjunction with a custom data acquisition system, HEKA provides the software EPCMASTER for control of the amplifier functions. Amplifier functions can be set from another application by use of the Batch Control interface of the EPCMASTER software. EPCMASTER is free of charge.

EPC.DLL

To integrate the EPC 10 USB amplifier and data acquisition system in customized software on Windows, HEKA provides an EPC.DLL (dynamic link library).

Headstages

Red Star Headstage

All EPC 10 USB patch clamp amplifiers are now shipped standard with the Red Star Headstage with improved noise performance. Especially the most relevant bandwidth between 1 and 10 kHz is now significantly improved.

RMS noise values, Red Star Headstage EPC 10 vs. EPC 9 Headstage:

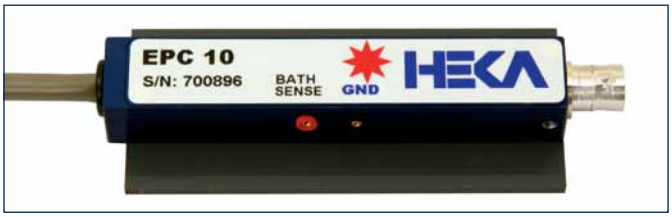
- 1 kHz 31 fA vs 35 fA
- 3 kHz 72 fA vs 90 fA
- 5 kHz 120 fA vs 150 fA

Features:

- Improved noise performance in the important 1 – 10 kHz band
- Three feedback resistors for three gain ranges, switchable during the experiment
- Optimized for single-channel and whole-cell recordings
- Retrofittable on older EPC 10 amplifiers

3-Electrode Mode Headstage (Optional)

With the 3-Electrode Headstage the EPC 10 USB can measure the potential difference between a third electrode (reference) and the ground (counter) electrode without having current flowing through the reference electrode. The reference electrode stays in equilibrium! The potential difference is added to the command potential for the working electrode. With the 3-Electrode Mode Headstage the EPC 10 USB patch clamp amplifier has the performance of a high-end potentiostat/galvanostat with a scan range of ± 2 V.

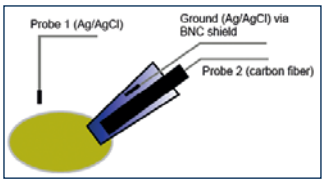


Patch Amperometry Headstage (Optional)

The detection of released substances from cells as oxidation current at carbon fiber electrodes is often directly combined with electrical measurements from cells.

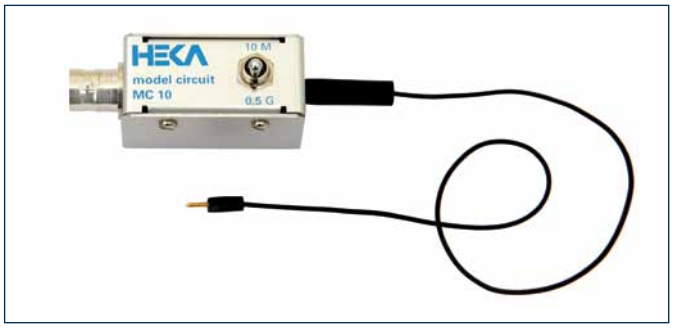
A typical measuring configurations is:

- Patch Amperometry combined with on-cell capacitance measurements

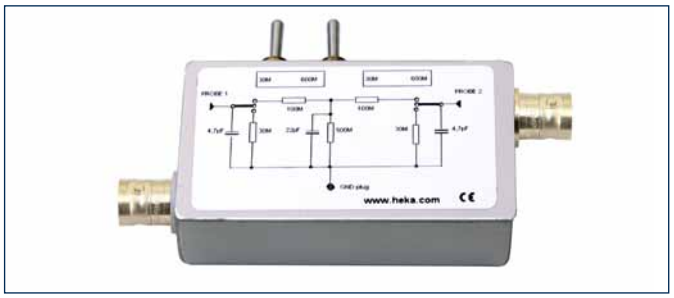


Model Circuits

MC 10 Model Circuit
Model circuit for verification of single-electrode voltage clamp amplifiers, such as the EPC 10 amplifier. The model circuit connects to the probe input and can be switched to simulate one of tree conditions, an open pipette in the bath, a cell-attached configuration and a whole-cell configuration.



TESC Model Circuit (Optional)
Model circuit for verification of double patch configurations. The model circuit connects to two probe inputs, simulating two electrodes measuring from the same cell. Two switches toggle between various conditions typically observed during an electrophysiological experiment.



Technical Specifications

General

Number of Amplifiers/Headstages

EPC 10 USB Single:	1
EPC 10 USB Double:	2
EPC 10 USB Triple:	3
EPC 10 USB Quadro:	4

Amplifier Control
Fully software controlled patch clamp amplifier featuring e.g. direct access to all amplifier settings, automatic calibration and self testing/diagnosis procedures.

Host Interface USB 2.0

Dimensions Main Unit

	Single	Double	Triple	Quadro
Depth x Width	31.1 x 48.3 cm 12.3 x 19.0 inch			
Height	14.5 cm 5.7 inch	18.0 cm 7.1 inch	26.9 cm 10.6 inch	
	mounts in a 19" rack			

Weight Main Unit

	Single	Double	Triple	Quadro
	11.4 kg 24.8 lbs	12.2 kg 16.5 lbs	15.3 kg 33.3 lbs	16.5 kg 38.9 lbs

Dimensions Headstage
D x W x H: (90 x 17 x 14.5) mm / (3.54 x 0.67 x 0.57) inch

Power Supply
Power requirements are 125 Watt. The logic controlled power supply automatically switches the voltage range. It operates in the ranges 90 V to 120 V and 210 V to 250 V at line frequencies of 50 or 60 Hz. A shielded transformer minimizes noise pickup from power line frequencies.

Ground Lines
A Signal ground is accessible via a Banana plug on the front panel of the main unit and via a connector pin on the headstage. In case of EPC 10 Double, Triple and Quadro, all amplifiers share the same ground.
A Chassis ground is accessible via a Banana plug on the front panel of the main unit. Chassis and Signal ground are connected via a 10 MΩ resistor.

Voltage Clamp Mode

Current Measuring Resistors
The headstage provides three feedback resistors. The gain ranges can be switched during the experiment.

Low gain range (5 MΩ):	± 2 µA current range
Medium gain range (500 MΩ):	± 20 nA current range
High gain range (50 GΩ):	± 200 pA current range

Current Gain Settings

Low gain range:	0.005, 0.01, 0.02, 0.05, 0.1, 0.2 mV/pA
Medium gain range:	0.5, 1, 2, 5, 10, 20 mV/pA
High gain range:	50, 100, 200, 500, 1000, 2000 mV/pA

Input Capacitance < 1 pF

Noise Performance
Measured with open input via external 8-pole Bessel filter.
Medium gain range:

up to 1 kHz:	~ 180 fA rms (theoretical limit)
up to 3 kHz:	~ 320 fA rms (theoretical limit)
up to 10 kHz:	~ 580 fA rms

High gain range:

up to 1 kHz:	~ 31 fA rms
up to 3 kHz:	~ 72 fA rms
up to 10 kHz:	~ 350 fA rms

Bandwidth
100 kHz (low and medium gain range), > 60 kHz (high gain range)

Current Filter
Filter 1 is a 6-pole Bessel pre-filter with 10 kHz, 30 kHz, 100 kHz, and HQ 30 kHz. The EPC 10 USB Single, Double, and Triple allow to directly sample the current signal of Filter 1.
Filter 2 is a 4-pole filter with 100 Hz to 15 kHz bandwidth with selectable Bessel or Butterworth characteristics. Filter 2 is usable in series with Filter 1 or as separate filter for external signals.

Holding Potential
Software controlled holding within a ± 2000 mV range.

External Stimulus Input (VC)
Via a BNC connector at the front panel an external stimulus input can be added to the internal set holding potential. An external stim scaling circuit allows scaling of the external stimulus with a factor in the range of – 1.0 to + 1.0.

Compensations in Voltage Clamp Mode

Pipette Offset Potential Compensation
Automatic or manual adjustment of the offset potential in the range ± 200 mV.

Injection Capacitors
The C-Fast compensation signal is injected via a 1 pF capacitor. The C-Slow compensation signals are injected via a 10 pF capacitor in medium and low gain and via a 1 pF capacitor in high gain range.

C-Fast Compensation
Automatic or manual compensation in all gain ranges:
0 to 15 pF, 0 to 8 µs tau (calibrated)
0 to ~ 80 pF (Extended C-Fast)

C-Slow Compensation
Automatic or manual compensation in all gain ranges:
0.2 to 1000 pF (low and medium range), 0.2 to 100 pF (high range).
Rs range 1 MΩ to 1 GΩ.

Synchronous C-Slow Compensation
The EPC 10 USB Double, Triple and Quadro provide the option for synchronous C-Slow compensation pulses on multiple cells. This is essential for using the C-Slow compensation when measuring on multiple electrically connected cells.

Series Resistance Compensation
Maximal compensation is 95% with the optimal setting being dependent on the cell capacitance.
Equivalent time constants: 2 µs, 5 µs, 10 µs, 100 µs

Hardware Leak Subtraction
Automatic or manual linear leak subtraction in all gain ranges: 0 to 2 nS (high range), 0 to 200 nS (medium range), 0 to 20 µS (low range).
Injection time constant: 100 µs

Software Leak Subtraction
A versatile p/n leak subtraction is provided in combination with the PATCHMASTER software.

Other VC Features

Zap Pulse
Provided by the PATCHMASTER software. The amplitude (up to ± 1 V) and duration is programmable.

Audio Resistance Monitor
A 3.5 mm jack is provided at the rear panel for connecting phones or speakers.
Volume and Resistance/Frequency ratio can be adjusted by the PATCHMASTER software. Frequency range: 1 Hz to 10 kHz.

Current Clamp Mode

Current Injection
Four current injection gains are selectable:

0,1 pA/mV range:	± 1 nA
1 pA/mV range:	± 10 nA
10 pA/mV range:	± 100 nA
100 pA/mV range:	± 1 µA

In the "Extended Stimulus Range" the current injection capability in current clamp mode is increased by factor of "5".

Voltage Gain

Two gains are selectable:		Bit resolution:
V-mon x 10:	± 1000 mV	30 µV
V-mon x 100:	± 100 mV	3 µV

Voltage Filter
Filter 2 setting do also allow the filtering of the voltage signal in a current clamp measurement.

Voltage Measuring Range
The voltage measuring range is ± 1 V (± 5 V when using the "Extended Stimulus Range") in current clamp mode.

External Stim Input (CC)
Via a BNC connector at the front panel an external stimulus input can be added to the internally set holding current. The scaling factor is determined by the selected current injection gain.

C-Fast in CC Mode
C-Fast is active in current clamp mode to allow voltage recordings at high bandwidth.

Bridge Mode
The voltage drop across the pipette resistance can be compensated.

Low Frequency Voltage Clamp (LFVC)
Automatic current tracking readjusts the holding current to fix any slow voltage drift while in current clamp mode.

Gentle Switch
When switching from voltage to current clamp, the holding current is automatically set to the "I-mon" in voltage clamp mode.

Fast Mode Switching
The PATCHMASTER software allows to rapidly switch between current and voltage clamp mode and vice versa during data acquisition.

DA/AD Converter

Stimulation	Number of DA-converters:	4
	Settling Time:	1 µs
	DA output voltage range:	± 10 V
	Number of AD-converters:	2
	DA/AD resolution:	16 bit
	Fastest Sampling Rate:	
	2 channels	200 kHz
	8 channels	50 kHz
Free DA channels:	EPC 10 USB Single:	3
	EPC 10 USB Double:	2
	EPC 10 USB Triple:	1
	EPC 10 USB Quadro:	0
Free AD channels:	EPC 10 USB Single:	5
	EPC 10 USB Double:	3
	EPC 10 USB Triple:	1
	EPC 10 USB Quadro:	0

Digital Input/Output

Digital I/O:	16 digital in and 16 digital out channels are provided on a 40 pin male connector on the rear panel.
Digital In:	16 channels provided at the Digital In connector on the rear panel.
Digital Out:	16 channels provided at the Digital Out connector on the rear panel, three of them are also provided via BNC on the front panel.
Trigger In:	Via 1 BNC connector on the front panel data acquisition can be triggered externally.

Master/Slave Sync
2 CAT5 connectors for synchronization of a second amplifier/interface system are provided at the rear panel.

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