

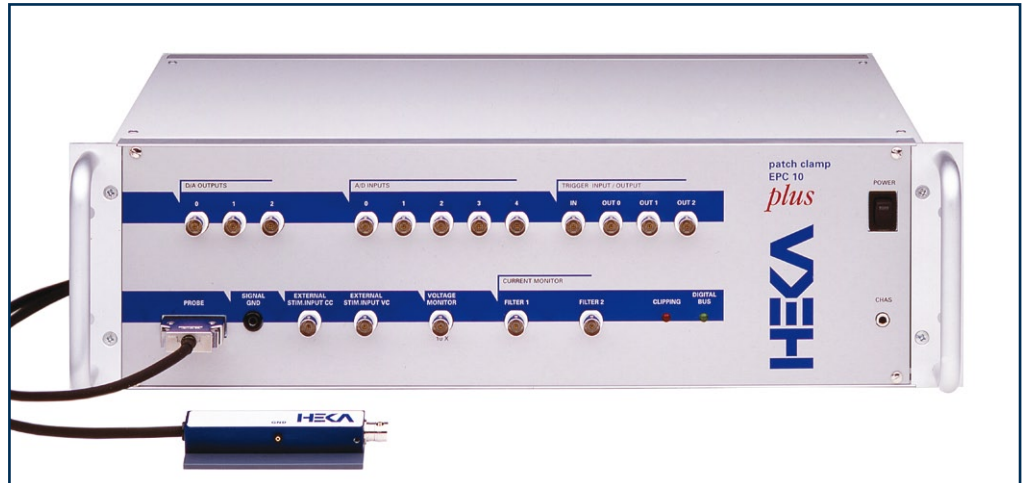


EPC 10 PLUS

Patch Clamp Amplifier

EPC 10 PLUS

EPC 10 PLUS Double

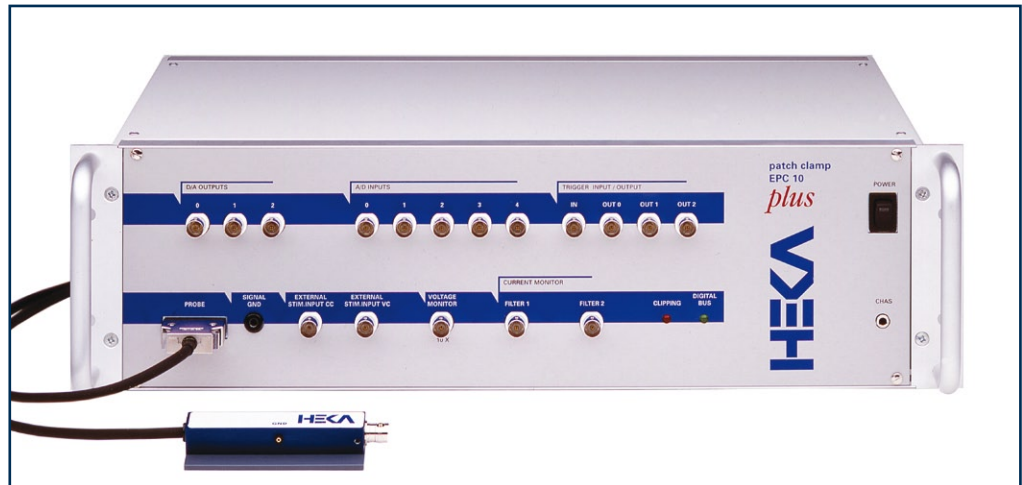


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to achieve the needed progress of tomorrow...



EPC 10 PLUS Patch Clamp Amplifier

Available as PCI or USB version



Introduction

The **EPC 10 PLUS** is a fully computer controlled patch clamp amplifier with a built-in high-end interface board. Continuing the tradition of providing the world's best electrophysiology amplifier, the EPC 10 PLUS has all the features of the EPC 10; but it goes much further in offering many improvements with respect to data acquisition capabilities. The EPC 10 PLUS features an interface with eight 18-bit AD converters that are sampled in phase. The premium acquisition parameters make the EPC 10 PLUS best suitable for multi-channel and high-resolution recordings.

Applications and Main Features

For applications and main features of the EPC 10 PLUS please refer to the sections EPC 10 USB patch clamp amplifier and InstruTECH ITC-18 interface.

Enhanced Features

EPC 10 PLUS with ITC-18 built-in

The fully computer controlled EPC 10 PLUS has an ITC-18 AD/DA converter interface built-in and is connected to the host computer via the PCI-18, PCI-18v3 or USB-18 host interface board.

True 16-bit data resolution

The ITC-18 uses separate 18-bit AD converters for each channel to provide true 16-bit data resolution.

Current, Voltage and 5 additional AD channels

The EPC 10 PLUS can simultaneously record the current and voltage monitor channels of the patch clamp amplifier and five additional AD channels from other devices. The five channels can be used e.g. to record fluorescence signals, amperometric signals, or signals from other amplifiers in parallel to the signals from the clamped cell. The maximum acquisition rate is given by 200 kHz divided by the number of sampled AD-channels.

8-Channel Cophasic Acquisition

The EPC10 PLUS makes use of the separate AD converters for each channel to achieve cophasic acquisition on all input and output channels. With cophasic acquisition, the acquisition board samples all AD-channels at once, and all DA-channels are simultaneously updated to their new output values. Thus, there is no time delay between the different ADC-samples and no delay between setting a DA-channel and acquiring its corresponding AD-channels. For this reason, cophasic acquisition is the most desirable behavior of an acquisition board.

Software Control Options

The EPC 10 PLUS amplifiers can be controlled with PATCHMASTER software on either a Windows (2000/XP and VISTA) or Mac platform. PATCHMASTER is a multi-channel stimulation/acquisition software supporting up to 16 input and 16 output channels.

In situations where the EPC 10 PLUS amplifier is being used in conjunction with a custom data acquisition system, HEKA provides the software EPCMASTER for control of the amplifier functions. This software is provided free of charge. To integrate the EPC 10 PLUS amplifier and data acquisition systems in customized software on Windows, HEKA provides an EPC DLL (dynamic link library).

EPC 10 PLUS available as Single and Double Patch Clamp Amplifier



Product Content

The **EPC 10 Plus** Patch Clamp Amplifier includes:

- One amplifier
- One headstage
- One interface board with choice of PCI-18, PCI-18v3, or USB-18 host interface
- One pipette holder
- One model circuit
- One printed manual
- Cables to connect the EPC 10 Plus to the computer and power line

Item No.:

- EPC 10 Plus / PCI-18
- EPC 10 Plus / PCI-18v3
- EPC 10 Plus / USB-18

The **EPC 10 Plus Double** Patch Clamp Amplifier includes:

- Two amplifiers
- Two headstages
- One interface board with choice of PCI-18, PCI-18v3, or USB-18 host interface
- Two pipette holders
- One model circuit
- One printed manual
- Cables to connect the EPC 10 Plus to the computer and power line

Item No.:

- EPC 10 Plus Double / PCI-18
- EPC 10 Plus Double / PCI-18v3
- EPC 10 Plus Double / USB-18



Technical Specifications

General

Number of Amplifiers/Headstages

EPC 10 PLUS Single:	1
EPC 10 PLUS Double:	2

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

Choice of PCI-18, PCI-18v3, and USB-18

Dimensions Main Unit

	Single	Double
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
	mounts in a 19" rack	

Weight Main Unit

	Single	Double
	11.4 kg 24.8 lbs	12.2 kg 16.5 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 100V to 120V and 200V to 240V 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 PLUS Double, 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 MOhm 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:	50 GOhm,	± 200 pA current range
medium gain range:	500 MOhm,	± 20 nA current range
high gain range:	5 MOhm,	± 2 µA 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:	appr. 180 fA rms (theoretical limit)
up to 3 kHz:	appr. 320 fA rms (theoretical limit)
up to 10 kHz:	appr. 580 fA rms

High gain range:

up to 1 kHz:	< 30 fA rms
up to 3 kHz:	< 85 fA rms
up to 10 kHz:	< 350 fA rms

Bandwidth

100 kHz (low and medium 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 PLUS Single and Double allow to directly sample the current signal of Filter 1 via the MUX channel.

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 ± 1000 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)

C-Slow Compensation

Automatic or manual compensation in all gain ranges. 0.2 to 1000 pF in low and medium range, 0.2 to 100 pF in high range. Rs range 1 MOhm to 1 GOhm.

Synchronous C-Slow Compensation

The EPC 10 PLUS Double provides 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 cell.

Series Resistance Compensation

Maximal compensation is 95% with the optimal setting being dependent on the cell capacitance.

Equivalent time constants: 2 μ s, 10 μ s, 100 μ s

Ranges: 1 to 1000 MOhm (medium range), 0.1 to 10 MOhm (low range)

Hardware Leak Subtraction

Linear leak can be either subtracted automatically or manually.

Injection time constant: 100 μ s

Ranges: 0 to 2 nS (high range), 0 to 200 nS (medium range), 0 to 20 μ s (low range)

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

Provided by the PSA 12 tone generator.

Volume and Resistance/Frequency ratio can be adjusted by the PATCHMASTER software. Frequency range: 200 Hz to 4 kHz.

Current Clamp Mode**Current Injection**

Three current injection gains are selectable:

1 pA/mV; range ± 1 nA

10 pA/mV, range ± 10 nA

100 pA/mV; range ± 100 nA

Voltage Gain

Two gain ranges are selectable:

V-mon x 10, range ± 1000 mV

V-mon x 100, range ± 100 mV

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 μ s
	DA output voltage range:	± 10 V
	Number of AD converters:	8
	DA/AD resolution:	18 bit
	Data resolution	16 bit
	Fastest Sampling Rate:	
	1 channel	200 kHz
	8 channels	25 kHz
Free DA channels:	EPC 10 PLUS Single:	3
	EPC 10 PLUS Double:	2
Free AD channels:	EPC 10 PLUS Single:	5
	EPC 10 PLUS Double:	3

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.



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