

PC-501A

Patch Clamp

patch clamp

A workhorse patch clamp amplifier equally at home in research and teaching labs



- Independent V Hold and I Hold
- Stability in Current Clamp with selection of three I Clamp response speeds
- 4-Pole low-pass Bessel filter
- Internally generated test signals
- Zap circuit with variable duration

The PC-501A Patch Clamp is a “workhorse” equally at home in research and teaching labs. Most single channel and whole cell studies are easily handled with this modestly priced instrument.

With a choice of four headstages, a wide range of patch, whole cell and bilayer applications are covered.

Headstage Choices

Four resistive-feedback headstages are available for the PC-501A:

- 5101-10G (10 G Ω) headstage for recording single channel currents up to ± 1 nA. Noise level measured at 1 kHz is 60 fA.
- 5101-01G (1 G Ω) headstage for whole cell studies with currents to ± 10 nA.
- 5101-100M (100 M Ω) headstage for whole cell studies with currents to ± 100 nA.
- 5101-10GB (10 G Ω) headstage modified for bilayer capacitances up to 250 pF. Maximum current is ± 1 nA.

Operating Modes

- V Clamp Mode: Input is clamped to a maximum of ± 1 V. Commands are the sum of the holding voltage and any external input signals.
- Zero Current Mode: Bridges the voltage and current clamp modes. All commands are inactive except the junction zero, which functions in this case as an offset control for the electrode and tip potentials associated with the pipette.

- I Clamp Mode: In current clamp mode, active commands are the current hold and any external command input signals, summed. Clamp stability is enhanced with the selection of three clamp speeds.

Compensation Controls

- Voltage Offsets (including junction potentials): are automatically compensated with the auto zero or manually with the junction zero.
- Capacity Compensation: Paired controls; fast (0-5 μ sec), medium (0-2 msec) and slow (0-20 msec) compensate the current transient caused by a step command signal. Each pair has a separate control for amplitude and time constant.
- Series Resistance: Signal errors contributed by the electrode (access) resistance in whole cell recording are subtracted from the output with the series R comp control. The compensated resistance (0-100 M Ω) is read from a 10-turn dial.
- Leak Subtraction: Used to compensate leakage current due to the voltage drop across the seal (shunt) resistance.

Outputs/Signal Conditioning

The I_m signal is bandwidth limited by a 4-pole Bessel filter with six frequency cut-offs and can be bypassed to obtain the full 10 kHz bandwidth. Gain is selected with a 7 position switch and scaled to the headstage resistor.

Additional outputs are $V_m \times 10$ (membrane voltage at $\times 10$ gain) active in current clamp mode and $\sum V_c \times 10$ (the sum of all commands at $\times 10$ gain). Rear panel outputs include; gain telegraph and sync output.

Voltammetry with PC-501A/V

A simple modification to the PC-501A makes it suitable for voltammetric measurements. This includes increasing the holding voltage potential to ± 1 V and the external voltage signal level to ± 2 V maximum. Internal switches can be installed to allow switching between normal [patch] and voltammetry operation. Contact our technical support department for details.

PC-501A

Patch Clamp (continued)

Specifications

Headstages:	
5101-10G Headstage	With 10 GΩ resistor for single channel recording, maximum current ±0.8 nA*
5101-01G Headstage	With 1 GΩ resistor for whole cell currents to ±8 nA*
5101-100M Headstage	With 100 MΩ resistor for whole cell currents to ±80 nA*
5101-10GB Headstage	With 10 GΩ modified for bilayer capacitances up to 250 pF Maximum current is ±1 nA
Noise:	
Measured with an 8-pole Bessel filter and 10 GΩ headstage, input open.	
DC to 1 kHz	0.06 pA RMS
DC to 5 kHz	0.20 pA RMS
DC to 10 kHz	0.40 pA RMS
High Frequency Boost	Increases bandwidth to 10 kHz. Front panel adjustable with Speed Test for 1 GΩ and 10 GΩ headstages
Voltage Clamp Commands:	
Command Input	Applied voltage attenuated by Command Sensitivity, Max input ±10 V
Command Sensitivity	Attenuates CMD IN by x0.1, x0.01 or x0.001.
V Hold	Adjustable from zero to ±200 mV with 10 turn control.
Junction Zero	Adjustable between ±100 mV with 10 turn control.
Test Pulse	100 Hz square wave, amplitude at the electrode dependent on Command Sensitivity;
	100 mV @ x0.1
	10 mV @ x0.01
	1.0 mV @ x0.001
Zap	1.5 V pulse with duration adjustable from 0.1 to 10 msec
Current Clamp Commands:	
Command Input	±1.0 nA max. with Command Sensitivity @ x0.1 ±100 pA max. with Command Sensitivity @ x0.01 ±10 pA max. with Command Sensitivity @ x0.001
Series Resistance	Zero to 100 MΩ, read from 10 turn digital dial
Compensation Capacity	Three ranges with amplitude and time constant
Compensation	Fast (0-5 μsec), Medium (0-2 msec), Slow (0-20 msec)
Leak Subtract	Adjustable from ∞ to 10 GΩ for 10 GΩ headstage, ∞ to 1 GΩ for 1 GΩ headstage, ∞ to 100 MΩ for 100 MΩ headstage
Im Output Low Pass Filter	4 pole Bessel with -3 dB frequencies at 0.1, 0.2, 0.5, 1, 2, and 5kHz. Bypass allows full 10 kHz bandwidth
Outputs:	
Im (membrane current)	Gain is adjustable, in the range of: 10 to 1000 mV/pA with 10 GΩ headstage 1 to 100 mV/pA with 1 GΩ headstage 0.1 to 10 mV/pA with 100 MΩ headstage
Vc x10	Sum of all commands (Vc +h, Junction Zero, Auto Zero and Series R) x 10
Vm x10	Membrane Voltage x 10
Gain Telegraph	DC voltage scaled to Im:
Output (rear panel)	From 3.0 to 4.2 Volts for 10 GΩ headstage, 0.2 V steps From 1.6 to 2.8 Volts for 1 GΩ headstage, 0.2 V steps From 0.2 to 1.4 Volts for 100 MΩ headstage, 0.2 V steps Compatible with acquisition software.*
Panel Meter	3½ digit LCD provides DC or average readout of:
Vc + h In	Sum of all commands and V Hold, ±199.9 mV
∑ Vc	Sum of all Commands, ±199.9 mV
Vm	Membrane voltage (current clamp mode) ±199.9 mV
Im	Membrane Current, ±1999 pA
Power Requirements	100 -130 VAC or 220-240 VAC, 50/60 Hz, 10 VA

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Specifications (continued)

Physical Dimensions:	
Control Unit	13.3 x 43.2 x 25.4 cm, H x W x D
Headstage	5.7 x 2.9 x 2.5 cm, H x W x L, with 1.8 m long cable
Detachable Mounting Rod	6.2 mm dia x 6.3 cm L
Shipping Weight	11.4 kg (25.1 lbs)
Warranty	Three years, parts & labor

* Output volt maximum 8V/Rf

** Molecular Devices pClamp and Heka PatchMaster.

Order #	Model	Product
W4 64-0007	PC-501A/10	Patch Clamp PC-501A with 5101-10G Headstage (10 GΩ)
W4 64-0008	PC-501A/9	Patch Clamp PC-501A with 5101-01G Headstage (1 GΩ)
W4 64-0009	PC-501A/8	Patch Clamp PC-501A with 5101-100M Headstage (100 MΩ)
W4 64-0010	PC-501A/10B	Patch Clamp PC-501A with 5101-10GB Bilayer Headstage
W4 64-0012	PC-501AV/9	Patch Clamp PC-501A for Voltammetry with 5101-01G Headstage (1 GΩ)
W4 64-0013	PC-501AV/8	Patch Clamp PC-501A for Voltammetry with 5101-100M Headstage (100 MΩ)

Supplied with rack mount hardware. Electrode Holder must be purchased separately based on your glass outer diameter.

Also, specify line operating voltage if other than 100-130 VAC.

Electrode Holders for PC-501A and PC-505B

W4 64-0821	QSW-A10P	Straight Holder 1.0 mm glass OD
W4 64-0822	QSW-A12P	Straight Holder 1.2 mm glass OD
W4 64-0823	QSW-A15P	Straight Holder 1.5 mm glass OD
W4 64-0978	QSW-A17P	Straight Holder 1.7 mm glass OD
W4 64-0824	QSW-A20P	Straight Holder 2.0 mm glass OD

Additional/Replacement Headstages

W4 64-0014	5101-10G	Headstage with 10 GΩ Resistor
W4 64-0015	5101-01G	Headstage with 1 GΩ Resistor
W4 64-0016	5101-100M	Headstage with 100 MΩ Resistor
W4 64-0017	5101-10GB	Headstage with 10 GΩ Resistor for Bilayer

Optional Accessories

W4 64-0018	MC-10G	Model Cell for 5101-10G (10 GΩ) Headstage
W4 64-0019	MC-01G	Model Cell for 5101-01G (1 GΩ) Headstage
W4 64-0020	MC-100M	Model Cell for 5101-100M (100 MΩ) Headstage
W4 64-0021	MC-10GB	Model Cell for 5101-10GB (10 GΩ) Bilayer Headstage