PC-505B

Patch Clamp

The lowest noise, switchable, resistive-feedback patch clamp amplifier currently available

- Lowest noise — approaching theoretical limit
- Calibrated Cap Comp and Series R circuitry
- % Compensation circuitry
- Independent V hold and I hold controls
- Zap safety switch
- LED meter
- 3 year warranty

The PC-505B is the lowest noise, switchable, resistive-feedback patch clamp amplifier available. This model also has features of particular interest to those doing whole cell studies. The slow capacitance compensation circuitry has been combined into a single control and allows direct measurement of membrane capacitance. The companion Series R control displays the access resistance and the new % correction circuit compensates up to 90% of the access resistance. These and other features make the PC-505B an extremely capable amplifier.

Switching Headstages

Two selectable feedback resistors in the headstages permit single channel and whole cell recording on the same cell. A 50 GΩ resistor is used in both switching models for low noise single channel recording with currents to 200 pA.

LC-201B Headstage (50 GΩ/500 MΩ)
This headstage with 500 MΩ feedback resistor will handle whole cell currents up to 20 nA.

HC-202B Headstage (50 GΩ/50 MΩ)
For larger whole cell currents, the 50 MΩ resistor in this headstage permits currents up to 200 nA.

Bilayer Headstage

W4-205B Bilayer Headstage (50 GΩ/500 MΩ modified)
The 50 GΩ resistor headstage is modified for artificial bilayer capacitances up to 250 pF.

Headstage Resistor Selection

Headstage feedback resistance is dynamically switched at the amplifier front panel. LED's indicate resistor selection and the corresponding multiplying factor applied to the current gain [Im] switch setting.

Operating Modes

The PC-505B has three modes of operation: voltage clamp, zero current clamp, and current clamp.

V Clamp

In voltage clamp mode, the input range is ±1 V. Active commands (V hold, junction and auto zero, test pulse, zap) and external inputs are scaled and summed at the headstage input. Capacity compensation and speed test are also active.

Io

Zero current is essentially a standby mode used to preset voltage hold or current hold levels before switching to voltage or current clamp. All commands are inactive with the exception of junction zero which, in this case, functions as an offset control for the electrode and tip potentials associated with the pipette.

I Clamp

Current clamp mode clamps the cell to a current level determined by the current hold setting and any external commands. Capacitance compensation is inactive in this mode.

Commands

Voltage and current commands applied to the cell include: voltage and current hold, junction and auto zero, test pulse, speed test, and zap.

V & I Hold

Holding potentials and currents are set with separate controls eliminating the need to reset levels when switching between voltage and current clamp modes.

Junction & Auto Zero

Adjusting for offset potentials is performed with either the manual junction zero control or with auto zero. The offset potential is read on the meter or at the Vc x10 output.

Test Pulse & Speed Test

Test Pulse and Speed Test are internally generated 50/60 Hz signals. Test pulse is attenuated by the command sensitivity and is useful for monitoring the formation of a gigaseal. The speed test signal is applied to the headstage input to allow for tuning the headstage response. A rear panel speed test switch allows for an external signal to be used.

PC-505B

Patch Clamp (continued)

Zap

Variable duration pulse used to rupture the cell membrane for whole cell recording.

Signals applied to the command input are attenuated at one of three levels with the command sensitivity selector.

Capacitance & Resistance Compensation: Fast Compensation

Stray capacitance between the input and electrode resistance is compensated with two pair of controls, C-Fast 1 and C-Fast 2. Amplitude and time constant of each pair is independently adjustable. Whole cell capacitance compensation is adjusted with the single control, C-Slow. Membrane capacitance is read from the C-Slow calibrated dial. The companion Series R control is used in conjunction with the C-Slow and its calibrated dial provides a reading of the access resistance. C-Slow may be disabled to view the uncompensated signal. The % Correction control is used to increase the command signal to compensate for the voltage drop across the access (Series R) resistance. Correction is adjustable up to 90%.

Outputs

Signals at the Im output are filtered at the selected cutoff frequency set with the 4-pole Bessel filter. Selecting Bypass presents the full bandwidth signal to the Im output. Filtered and unfiltered Im output is also available at the instrument rear panel. Additional outputs are the membrane voltage Vm x10 and the sum of the voltage commands Vc x10, both at x10 gain.

Voltammetry with PC-505B

PC-505B functions as an excellent low-noise potentiostat for voltammetric and other electrochemical measurements. In this mode, the V hold (electrode potential) is increased to a maximum of ±1 volt and the maximum external command signal to ±2 volts at electrode or sensor.

Specifications

Headstages:	
LC-201B Headstage (50 GΩ/500 MΩ) Single channel currents to 200 pA, whole cell currents to 20 nA.	
HC-202B Headstage (50 GΩ/50 MΩ) Single channel currents to 200 pA, whole cell currents to 200 nA.	
W6-205B Bilayer Headstage (50 GΩ/500 MΩ modified) For artificial bilayer capacitances up to 250 pF, currents to 20 nA.	
Noise (referred to input) Measured with an 8-pole Bessel filter, input open, 50 GΩ resistor:	DC to 1 kHz 0.035 pA RMS DC to 5 kHz 0.150 pA RMS
Bandwidth	25 kHz
Voltage Clamp Commands:	
Command In BNC	±10 V Max, AC or DC, applied to input
Voltage Hold	±200 mV Max with 10-turn control
Junction Zero	±100 mV Max with 10-turn control
Internal Test Pulse	1 V 50/60 Hz (line freq.) square wave attenuated by Command Sensitivity
Command Sensitivity	x0.1, x0.01, and x0.001
Zap	1.0 V Pulse, adjustable duration from 0.1 to 10 msec
Current Clamp Commands:	
Command In	±1000 pA max with Command Sensitivity @ x0.1 ±100 pA max with Command Sensitivity @ x0.01 ±10 pA max with Command Sensitivity @ x0.001
Current Hold	±1 nA with 10-turn control
Internal Test Pulse	1 nA 100 Hz square wave through Command Sensitivity
Command Sensitivity	x 0.1, x 0.01, and x 0.001

Specifications (continued)

Fast Capacitance Compensation (Voltage Mode):	
C Fast 1 C Fast 2	0.1 to 1.75 µsec, 0 to 5 pF 0.33 to 8.5 µsec, 0 to 15 pF
Whole Cell Compensation:	
C Slow	0-100 pF with 10 turn control
Series R	0-10 MΩ with 10 turn control
% Correction	0-90% of Series R
Leak Subtraction	50 GΩ Headstage Resistor ∞ to 50 GΩ 500 MΩ Headstage Resistor ∞ to 500 MΩ 50 MΩ Headstage Resistor ∞ to 50 MΩ
Front Panel Outputs: Im (membrane current), selected in the range of: Gains of 0.05 to 10 mV/pA with 50 MΩ headstage resistor Gains of 0.5 to 100 mV/pA with 500 MΩ headstage resistor Gains of 5 to 1000 mV/pA with 50 GΩ headstage resistor	
Vc x10	Summation of all commands amplified by 10
Vm x10	Membrane voltage amplified by 10
Im Low-Pass Filter	0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20 kHz and Bypass (4-Pole Bessel)
Panel Meter:	3½ Digit LED reads (full scale):
Junction Zero	±199.9 mV
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
RMS Noise	1.999 pA
Rear Panel Outputs:	
Gain Telegraph	From 0.5 to 7.0 V in 0.5 V steps.*
Filter Telegraphs	From 0.2 to 2.0 V in 0.2 V steps.*
Im/Vm Telegraph	Logic levels, V-Clamp=1, I-Clamp=0
Sync Out	Signal for synchronizing an oscilloscope to internal test
Power Requirements	110 to 130 or 220 to 250 VAC, 50/60 Hz , 15 VA
Physical Dimensions:	
Main Unit	8.9 x 43.2 x 30.5 cm, H x W x D
Headstage	1.9 x 3.5 x 5.7 cm, H x W x L, with 1.8 m cable
Mounting Rod	6.3 mm D x 6.3 cm cm L
Shipping Weight	11.4 kg
Warranty	Three years, parts and labor

** Compatible with Axon pClamp and Heka PatchMaster.*

Order #	Model	Product
Line operating voltage if other than 100-130 VAC.		
W4 64-0000	PC-505BLC	Patch Clamp PC-505B with LC-201B Headstage*
W4 64-0001	PC-505BHC	Patch Clamp PC-505B with HC-202B Headstage*
W4 64-0002	PC-505BHB	Patch Clamp PC-505B with HB-205B Bilayer Headstage*
** Supplied with model cell and rack mount hardware.*		
Additional/Replacement Headstages		
W4 64-0004	LC-201B	50 GΩ/500 MΩ Headstage
W4 64-0005	HC-202B	50 GΩ/50 MΩ Headstage
W4 64-0006	HB-205B	50 GΩ Headstage for Bilayer
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