MultiClamp 700B Microelectrode Amplifier

A computer-controlled amplifier for current-clamp and voltage-clamp applications

KEY FEATURES

- **Computer-controlled amplifier capable of single-channel and whole-cell voltage patch-clamp, high-speed current clamp (sharp electrode or field potential), and more**

- **Support up to two primary headstages and two optional auxiliary headstages**

The MultiClamp™ 700B Microelectrode Amplifier from Molecular Devices is a computer-controlled microelectrode current- and voltage-clamp amplifier for electrophysiology and electrochemistry. This versatile amplifier is capable of single-channel and whole-cell voltage patch-clamp, high-speed current-clamp (sharp electrode or field potentials), ion-selective electrode recording, amperometry/voltammetry and bilayer recordings. The MultiClamp 700B amplifier is designed to support up to two primary CV-7B headstages and two optional auxiliary (HS-2 or VG-2 type) headstages. Each CV-7B headstage contains a current-to-voltage converter for voltage-clamp and a voltage follower for true current-clamp. This allows the user to conveniently switch between low-noise patch-clamp recording and high-speed current-clamp recording. An optional CV-7B/BL headstage is available for bilayer recording.

Powerful features

The MultiClamp 700B Amplifier uses either an external trigger command or user-programmable voltage threshold for rapid, automatic mode-switching between current and voltage-clamp. For example, by pre-setting a voltage threshold in current-clamp mode, the amplifier will automatically switch to voltage-clamp mode when the membrane potential reaches the threshold voltage. A user-specified delay can be programmed allowing further customization of recording procedures.

Sudden changes in membrane or pipette parameters may result in undesirable oscillations during whole-cell recordings. To overcome this, the MultiClamp 700B amplifier detects current or voltage oscillations and automatically disables or intelligently reduces compensation settings to protect the cell from damage.

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CV-7B Headstage. The small profile of the CV-7B headstage makes it easy to incorporate into an electrophysiology setup. The dovetail design integrates with a base plate for easy attachment to micromanipulators.

electrode voltage

current clamp command

voltage clamp current

voltage clamp command
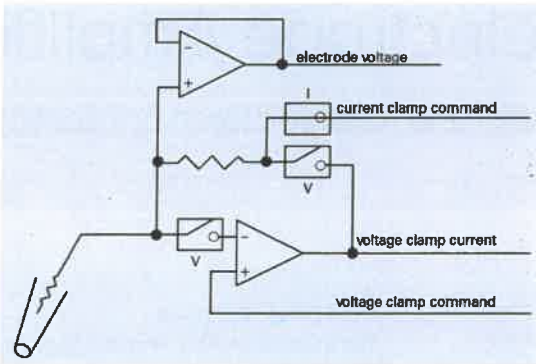
Simplified CV-7B diagram. The CV-7B headstage contains both resistor feedback voltage-following circuitry for true current-clamp operation, and voltage-to-current circuitry for voltage-clamp operation.
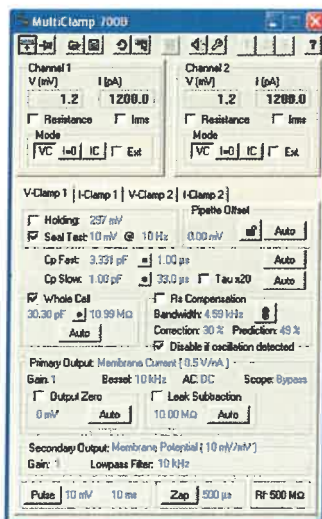
MultiClamp Commander Software Interface. The MultiClamp Commander Software uses mouse-driven "glider" fields that enable continuous parameter adjustments. Values also can be directly entered into edit boxes, or selected from tables, depending on the field. Keyboard shortcuts provide yet another method of entering values and selecting fields within the software. While the MultiClamp Commander Software can be minimized to display only the top panel meters, it can also be set to float on top of other Windows programs.

Slight voltage drift, often due to changing electrode properties, may contaminate an otherwise decent current-clamp recording. In order to maintain the membrane potential at a consistent level, the MultiClamp 700B amplifier automatically injects a compensatory current over a user-defined time course.

The MultiClamp 700B amplifier enables researchers to perform experiments that were previously not possible using a single amplifier.

True current-clamp and voltage-clamp headstage

Traditionally, amplifiers are designed for optimal performance in voltage-clamp or current-clamp mode, but cannot perform both during the same experiment. The CV-7B headstages supplied with the MultiClamp 700B amplifier overcome this limitation by integrating both current-to-voltage and voltage-following circuitry. This design allows users to rapidly switch between patch-clamp recording and high-speed current-clamp recording. The CV-7B headstage has four different feedback resistors in voltage-clamp mode, allowing for a wide range of cellular recording. In current-clamp mode, the CV-7B headstage provides three different current setting resistors to clamp current from a few pA up to 200 nA.

With two headstages, the MultiClamp 700B amplifier can perform the function of two patch-clamp, two current-clamp, or a combination of patch- and current-clamp amplifiers. In addition, two optional voltage-follower headstages (HS-2 type) can be connected to auxiliary inputs to allow third- and fourth-point voltage recording. Dual headstages allow more complex synaptic experiments to be performed, as well as increasing throughput for drug discovery experiments, all at a significantly lower cost per channel.

Specialized headstages are available for bilayer and electrochemistry recordings. The optional CV-7B/BL headstage was designed to handle the large membrane capacitances found in bilayer recording. The CV-7B/EC headstage was designed to handle the large (±2V) command voltages required during electrochemistry recording.

Computer control

MultiClamp 700B Commander Software

The MultiClamp 700B amplifier is fully controlled by the MultiClamp Commander software. Computer control allows for tremendous flexibility, including broad ranges of current passing and recording levels, extensive filtering options and multiple signal outputs. Computer control simplifies the patching process by providing automation of pipette offset, fast/slow electrode capacitance compensation, whole-cell capacitance compensation, series resistance correction, pipette capacitance neutralization and bridge balance—all without moving parts.

Third-party programming

A Software Development Kit (SDK) is included to allow full integration of the MultiClamp Commander Software into third-party applications.
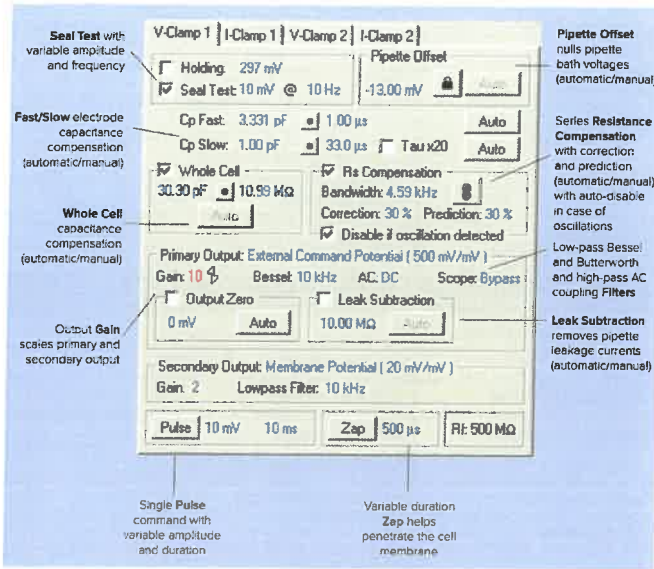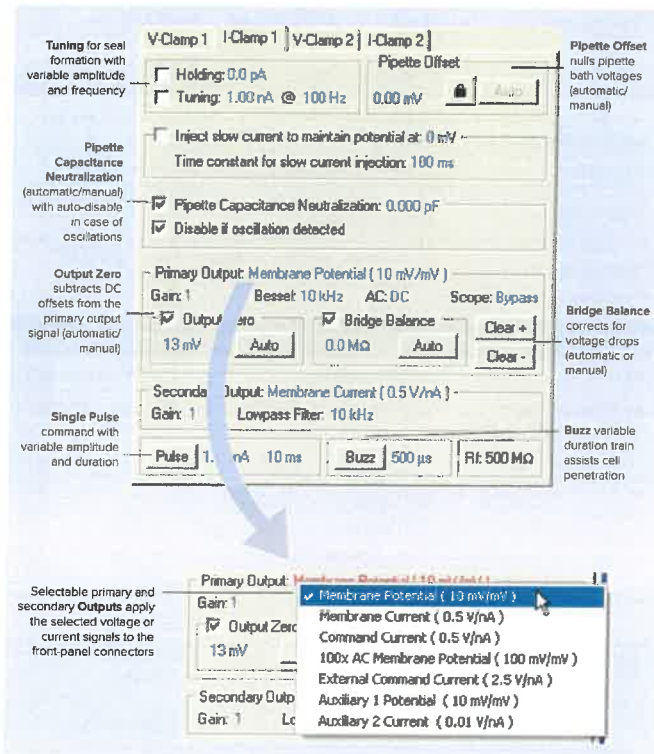
Voltage- and Current-Clamp Functions

Software user interface features

Two meters display output voltage (or resistance) and current (or I_{rms}) for each channel. An Options menu allows easy set up of filters, headstage feedback resistors, audio signals, mode switching and advanced capacitance compensation parameters. Computer control allow the amplifier configuration to be saved and easily re-opened. The last state of the amplifier is independently maintained during a power-off condition. The MultiClamp Commander Software interface is not dependent upon any particular data acquisition software, and therefore can be used with most data acquisition systems in stand-alone mode.

Smart telegraphs

As the amplifier interface, the MultiClamp Commander Software provides vital information to the data acquisition program about the state of the amplifier. In addition to the values that are typically telegraphed by hardware connections on conventional amplifiers (cell capacitance, filter cutoff frequency, and output gain), the MultiClamp Commander Software provides five additional signal settings: command sensitivity, operating mode (voltage/current-clamp), scaled output signal, scale factors and scaling units of the output signal. These additional settings allow the data acquisition software, such as pCLAMP® 11 Software, to automatically configure stimulus and recording signals based on the commander software settings.

Comprehensive microelectrode amplifier solution

The MultiClamp 700B Microelectrode Amplifier offers high-quality voltage- and current-clamp capability with fast mode switching and oscillation suppression, all under convenient computer control. Together with its extensive set of signal conditioning features, the MultiClamp 700B amplifier is the choice for a large variety of experimental needs. Whether you perform whole-cell, excised or cell-attached patch-clamp recordings, sharp-electrode, field potential or ion-selective measurements, bilayer recordings with voltammetry or amperomety, the MultiClamp 700B Amplifier is a comprehensive solution for your microelectrode amplifier applications.

General specifications	
Dimensions (in.)	3.5 (H) x 19 (W) x 12 (D)
Dimensions (cm)	8.9 H) x 48.3 (W) x 30.5 (D)
Weight (lbs.)	10 (4.54 kg)
Headstage (in.)	0.875 (H) x 1.625(W) x 2.3125 (D)
Headstage (cm)	2.0 (H) x 4.0 (W) x 8.4 (D)
Channels	2 (sharing a common ground)
Communications	USB 1 Type B female ports
Rack use	Standard 19" rack-mount (2U) with handles
Benchtop use	Bayonet feet
Power	85–260 Vac 50–60 Hz, 30 watts (max.)
Safety	CE marking (Conformité Européan)
Computer	1 GHz or better processor, Windows XP Pro / 2000 / 98 SE or Mac OS X 10.4.6 (Tiger), CD-ROM drive 512 MB RAM, 500 MB HD space, 2 USB 1 ports
Software	MultiClamp™ Commander Software (included)

CV-7B technical specifications

Voltage-clamp

Gain	Feedback resistor (R_f) = 50 GΩ, 5 GΩ, 500 MΩ, 50 MΩ	

Noise (for given load, in pA$_{rms}$)		10 kHz (8-pole Bessel filter)
	50 GΩ	0.28
	5 GΩ	0.9
	500 MΩ	1.4
	50 MΩ	4.0

Fast capacitance compensation magnitude	• Up to 12 pF for 50 GΩ range • Up to 36 pF on all other ranges
Fast capacitance compensation tau	0.5 μs to 1.8 μs
Slow capacitance compensation magnitude	• 0–1 pF for 50 GΩ range • 0–3 pF on all other ranges
Slow capacitance compensation, tau ranges	10–200 μs and 200–4000 μs
Whole cell capacitance compensation	• 500 MΩ range: C_m from 1–278.4 pF; R_s from 0.4–744.7 MΩ • 50 MΩ range: C_m from 11.06–3080 pF; R_s from 0.036–67.31 MΩ
Series Resistance compensation	Bandwidth is adjustable from 0.32 to 16 kHz
Series resistances correction (0–100%)	• 0.4 to 744.7 MΩ on 500 MΩ range • 0.036 to 67.31 MΩ on 50 MΩ range

Current-clamp

Gain	R_f = 5 GΩ, 500 MΩ, 50 MΩ
Compliance	±3 V
Rise time	• < 10 μs for load of 10 MΩ on 50 MΩ range (filter bypassed) • < 30 μs for load of 100 MΩ on 500 MΩ range • < 150 μs for load of 1 GΩ on 5 GΩ range)
Pipette capacitance neutralization	-8–16 pF

Test signals

Voltage-clamp.

Seal test amplitudes	0 to ±1 V at electrode
Pulse amplitudes	0 to ±1 V at electrode
Seal test frequency	Selectable from 2–1000 Hz
Pulse duration	Selectable from 0.1–500 ms
Zap	Fixed at +1 V with selectable 0.025–50 ms duration

Current-clamp

Tuning amplitude	0 to ±10 V/R_f A at electrode (see DC range)
Tuning frequency	Selectable from 2–1000 Hz
Pulse amplitude	0 to ±10 V/R_f A at electrode (see DC range)
Pulse duration	Selectable from 0.1–500 ms
Buzz amplitude	Fixed at 15 V$_{p-p}$ signal to the headstage capacitor, with selectable 0.05–500 ms duration
Clear (±) amplitude	Fixed at ±15 V signal to the headstage capacitor

Contact Us

Phone: +1-800-635-5577
Web: www.moleculardevices.com
Email: info@moldev.com
Check our website for a current listing of worldwide distributors.

DC holding commands

Voltage-clamp

Holding	±1000 mV
Pipette offset	±100 mV

Current-clamp

Range	• ±200 nA (50 MΩ R_f) • ±20 nA (500 MΩ R_f) • ±2 nA (5 GΩ R_f)
Pipette offset	± 200 pA

Output gain and filters

Scaled output filters

Lowpass	Four-pole Bessel or Butterworth
Bessel cutoff (-3 dB)	2–30 kHz, Bypass
Butterworth cutoff	3–45 kHz, Bypass
Highpass	Single-pole Bessel
Highpass cutoff	0.1–300 Hz, DC (-3 dB)

Scope filter

Lowpass	Two-pole Bessel
Lowpass cutoff	1 kHz, 3 kHz, 10 kHz, Bypass (-3 dB)

Output gain

Post-filter gain	1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000

Audio monitor

Current or voltage (x 1 or x 100) from either Channel 1 or Channel 2 is available for direct monitoring or via a voltage-to-frequency converter (VCO)

VCO range	4 kHz at +100 mV to 0.3 kHz at -100 mV
Audio output	Jacks drive a 50 Ω headphone directly, or a powered external speaker
Audio input	Jacks allow mixing of amplifier output with other signals, such as a PC sound card output

Ordering information

Item	Description	Part number
MultiClamp 700B Microelectrode Amplifier	• MultiClamp 700B Amplifier with power cord • (2) CV-7B headstages (with mounting plates) • (2) Patch-1U model cells • (1) MultiClamp commander software CD • (1) USB cable • Theory and operation user guide (printed)	MULTICLAMP 700B

Optional accessories

SoftPanel™ Controller		1-SOFTPANEL
Headstages	For bilayers	1-CV-7B/BL
	For electrochemistry	1-CV-7B/EC
Auxiliary headstages	For voltage recording	HS-2 series
	For virtual ground or bath clamp	VG-2 series
Bilayer model cell		1-MCB-1U

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