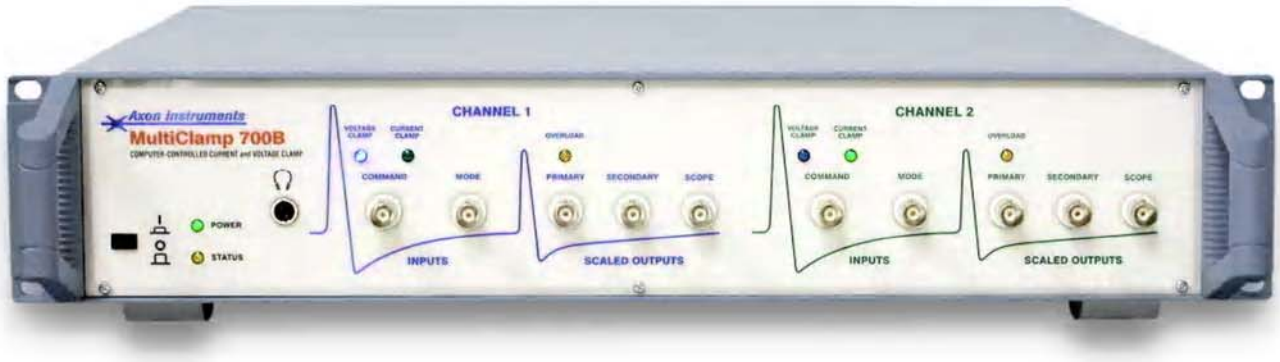
MultiClamp 700B

700B双探头自动膜片钳放大器

This successor to the popular MultiClamp 700A amplifier offers powerful and convenient enhancements that will allow you to perform experiments not previously possible with a single instrument.



Three major new features allow you to…

Switch Modes Conditionally

Instantly switch recording modes by using the membrane potential as the trigger. Pre-set a voltage threshold in current-clamp mode, and MultiClamp 700B will automatically switch to voltage-clamp when the membrane potential reaches that voltage level. User-specified delay will allow you to perform creative new experiments.

Suppress Oscillations

Sudden changes in membrane or pipette parameters may result in undesirable oscillations during whole-cell recording. MultiClamp 700B will detect current or voltage oscillations and automatically disable or intelligently reduce compensation settings to protect your cell from damage.

Preserve Membrane Potential

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, MultiClamp 700B will automatically inject compensatory current over a user-defined time course.

Other quality improvements…

- Second scaled output with signal conditioning
- Improved current clamp holding and offset resolution
- USB communication replaces the previous RS-232 communication
- Support for two (optional) voltage-following headstages
- Support for (optional) bilayer headstage
- Adjustable MultiClamp Commander window size with scrollbars
- User-defined control sensitivity (Fine, Medium, Course)

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Chapter 7

Specifications

Unless otherwise specified, $T_A = 20^oC$, 1 hr warm-up time.

Main Unit

Line Voltage 85 - 260V
Line frequency 50 - 60 Hz

Fuse 5 mm x 20 mm 2A slow
Case 8.89 cm high x 48.26 cm x 30.48 cm deep (3.5″ x 19″ x 12″ deep) rack mountable

CV-7 Headstage

Dimensions 4.06 x 8.38 x 2.03 cm (1.6″ x 3.3″ x 0.8″)

Voltage Clamp

Gain: $R_f = 50\ G\Omega, 5\ G\Omega, 500\ M\Omega, 50\ M\Omega$

10 kHz Noise (8-pole Bessel filter):	50 G	0.28 pArms
	5 G	0.9 pArms
	500 M	1.4 pArms
	50 M	3.0 pArms

5 kHz Noise (4-pole Butterworth filter):	50 G	0.15 pArms
	5 G	0.5 pArms
	500 M	0.8 pArms
	50 M	2.0 pArms

Fast capacitance compensation magnitude:

0 - 12 pF for 50 G range.

0 - 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 G range.

0 - 3 pF on all other ranges.

Slow capacitance compensation tau:

10 µs to 10 ms in two ranges (10 – 200 µs and 200 – 4000 µs).

Whole cell capacitance compensation:

C_m from 1 pF to 100 pF and R_s from 400 k to 1000 M on 500 M range.

C_m from 2.5 pF to 1000 pF and R_s from 100 k to 100 M on 50 M range.

Series Resistance compensation:

Bandwidth is adjustable from 0.32 to 16 kHz.

Series resistances corrected varies from 0.4 to 1000 M on 500 M range and 0.1 to 100 M on 50 M range.

Current Clamp

Rise time < 10 µs for load of 10 M on 50 M range (Output Filter bypassed).
Rise time < 30 µs for load of 100 M on 500 M range.
Rise time < 150 µs for load of 1 G on 5 G range.

Test Signals

Voltage Clamp

The available test signals are Seal Test, Pulse and Zap.
Seal Test and Pulse amplitudes are selectable from 0 to ±1 V at the electrode.
Seal Test frequency is selectable from 2 to 1000 Hz.
Pulse duration is selectable from 0.1 to 500 ms.
Zap is fixed at +1V at the electrode but with selectable 0.1 to 50 ms duration.

Current Clamp

The available test signals are Tune, Pulse, Buzz and Clear (+/-).
Tune and Pulse amplitudes are selectable from 0 to ±10 V/R_f amps at the electrode.
Tune frequency is selectable from 2 to 1000 Hz.
Pulse duration is selectable from 0.1 to 500 ms.
Buzz amplitude is fixed at ±15 V signal to the headstage capacitor but with selectable 0.05 to 500 ms duration.
Clear (+/-) amplitude is fixed at ±15 V signal to the headstage capacitor.

DC Holding Commands

Voltage Clamp

±1000 mV range in 30 µV steps
Auto Pipette Offset adjusts DC holding potential to zero Membrane Current.

Current Clamp

±20 nA range in 0.7 pA steps (50 MΩ range)
±2 nA range in 0.07 pA steps (500 MΩ range)
±0.2 nA range in 0.007 pA steps (5 GΩ range)

Note: External command can provide up to 10 times the above holding currents.

Auto Pipette Offset adjusts DC holding current to zero Membrane Potential.

Output Gain and Filters

Output Gain

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

Secondary: Post-filter gain of 1, 2, 5, 10, 20, 50, 100.

Primary Output Filters

Lowpass four-pole Bessel frequencies (Hz): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300, 400, 600, 800, 1k, 1k2, 1k4, 1k6, 1k8, 2k, 2k2, 2k4, 2k6, 2k8, 3k, 4k, 6k, 8k, 10k, 12k, 14k, 16k, 18k, 20k, 22k, 24k, 26k, 28k, 30k, Bypass.

Lowpass four-pole Butterworth frequencies (Hz): 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330, 360, 390, 420, 450, 600, 900, 1k2, 1k5, 1k8, 2k1, 2k4, 2k7, 3k, 3k3, 3k6, 3k9, 4k2, 4k5, 6k, 9k, 12k, 15k, 18k, 21k, 24k, 27k, 30k, 33k, 36k, 39k, 42k, 45k, Bypass.

Highpass single-pole Bessel frequencies (Hz): DC, 0.1, 1, 3, 10, 30, 100, 300.

Secondary Output Filters

Lowpass single-pole Bessel filter fixed at 10 kHz frequency, or Bypass.

Scope Filter

Lowpass two-pole Bessel filter with four –3 dB cutoff frequencies (Hz): 1k, 3k, 10k, Bypass.

Command Inputs

20 mV/V or 100 mV/V sensitivity for V-Clamp;

400 pA/V or 2 nA/V sensitivity for I-Clamp.
Input impedance is 10 kΩ.

Mode Switching

External

When enabled in MultiClamp 700B Commander software, 0 V input to MODE BNC selects I-Clamp mode and 5 V input selects V-Clamp mode. This mode can be used in conjunction with Internal Auto Mode switching to return mode to I-Clamp (see Internal Mode Switching).

Internal

When enabled in MultiClamp 700B Commander Options / Auto menu, switch from I-Clamp to V-Clamp is automated when Vm threshold crossing is detected.

- Positive to Negative or Negative to Positive crossing
- Vm threshold: ±1000 mV
- Delay to switch: 0-500 ms, in 2 ms steps
- Delay to return from V-Clamp: 20ms – 500 seconds, in 10 ms steps (this can also be done manually or with External Mode BNC)

Switching Speeds

Auto, from I-Clamp to V-Clamp: < 0.5 ms
Auto, from V-Clamp to I-Clamp: ≈ 22 ms

Mode switching performed manually with the mouse, keyboard or SoftPanel interface will always be slower than automatic switching, due to delays in computer operating system communication. Add approximately 30 msec to the above speeds to estimate typical manual switching speeds.

Audio Monitor

The Audio Monitor output can select Current, Voltage or Voltage x 100 for either Channel 1 or Channel 2. The selected signal is available for direct monitoring or via a voltage-to-frequency converter (VCO). The VCO ranges from ~4000 Hz @ +100 mV to ~300 Hz at –100 mV.