dPatch® Ultra-fast Low-noise Digital Patch Clamp Amplifier System vs. Brand aX Low-noise Amplifier

Major Features

Specification	dPatch	Brand aX	Sutter Advantage
Computer Control	YES, fully digital design, controlled by SutterPatch® software	NO, analog knobs and buttons	State-of-the-art design
Data Acquisition	YES, high-speed computer interface integration, SutterPatch software included	NO, requires separate interface and software	12 analog I/O, 16 digital outs
Field Upgradable Software And Firmware	YES	NO	Easy upgrades to keep performance optimized
Built-in Software Lock-in Amplifier	YES	NO	High-resolution membrane capacitance measurements
Integrated Dynamic Clamp Capability	YES	NO	The fastest dynamic clamp for ion channel research
Support For Two Headstages	YES	NO	Headstages with full Plug-and-Play capability
Installation	Simple	Complicated	System is ready to run "out of the box" with a USB 3 computer connection. Grounding problems are minimized.

Whole Cell Voltage Clamp

Specification	dPatch	Brand aX	Sutter Advantage
Feedback Elements	500 MΩ, 50 MΩ	Same	
Noise, 500 MΩ	0.7 pA$_{RMS}$ Range (10 kHz)	1.1 pA$_{RMS}$	36% lower noise
Noise, 50 MΩ Range (10 kHz)	2.3 pA$_{RMS}$	3.0 pA$_{RMS}$	23% lower noise
Bandwidth, Both FB Ranges	250 kHz	50 kHz	5X higher bandwidth
Output Filter Ranges	13 settings from 100 Hz to 1 MHz	5 settings from 1 kHz to 100 kHz	More settings, 10X higher bandwidth
Output Filter Type	8-pole Bessel	4-pole Bessel	8-Pole provides a lower-noise signal
Pipette Cap Compensation Range	20 pF	10 pF	2X compensation range

Single Channel Voltage Clamp

Specification	dPatch	Brand aX	Sutter Advantage
Feedback Element	1 pF / integrator	1 pF / integrator	
Bandwidth	1 MHz	100 kHz	10X higher bandwidth
Noise, 10 kHz	0.22 pA$_{RMS}$	0.13 pA$_{RMS}$	No active cooling*
Pipette Cap Compensation Range	20 pF	10 pF	2X compensation range

Current Clamp

Specification	dPatch	Brand aX	Sutter Advantage
Circuit Architecture	FastFollower™ true current clamp	Modified voltage clamp	Produces very accurate membrane voltage waveforms
10 to 90% Rise Time			
Rp = 1 MΩ	2 µs	15 µs	7.5X faster rise time
Rp = 10 MΩ	3 µs	20 µs	6.7X faster rise time
Mode Switching Voltage Clamp to Current Clamp	Special circuitry minimizes glitches	No glitch compensation	Near-zero glitch

* Active cooling causes numerous problems that actually create more "noise" in the long run. The heat generated by Peltier cells cause thermal drift in manipulators, making it almost impossible to stay patched while doing single-channel work. As a company that makes micromanipulators, we are highly sensitive to the performance of the system within a complete electrophysiology rig. Active cooling can help get a slightly better noise specification on paper, but in the real world the disadvantages far outweigh the slight gain in specsmanship. In addition, the limited life expectancy of Peltier elements causes reliability concerns that we found unacceptable.