Major New Features

Internal automatic mode switch

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

Oscillation suppression

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

Slow current injection

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 will automatically inject compensatory current over a user-defined time course.

Axon CNS amplifiers for the quietest recordings.

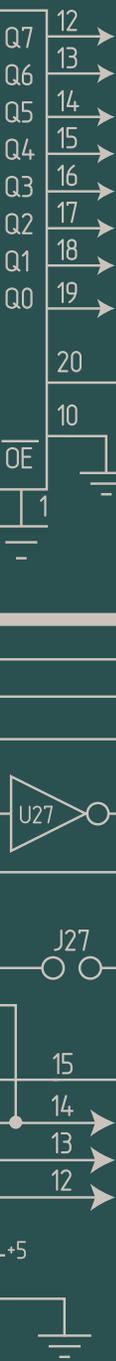
MultiClamp 700B Amplifier

Computer-Controlled Dual Channel Resistive-Feedback Patch Clamp and High-Speed Current Clamp Amplifier

The MultiClamp 700B amplifier is useful for a wide variety of intracellular or extracellular recording, including:

- High-speed Current Clamp (sharp-electrode or field potentials)
- Patch Clamp (whole-cell, macro-patch or excised patch)
- Voltammetry / Amperometry
- Ion-selective measurement
- Bilayer recording

Software Control

Instead of the usual front panel knobs and switches, the MultiClamp 700B amplifier is controlled by the MultiClamp 700B Commander, a program that runs on a host computer and communicates with the amplifier via a USB cable. This control interface provides automation of bridge balance, pipette offset, pipette and whole-cell capacitance compensation, in addition to "smart" features such as protection from oscillations and threshold-based mode change. Amplifier settings such as gain, filter frequency, whole-cell capacitance, recording mode and also input / output scale factors are automatically telegraphed to the data acquisition software via "messaging" through the computer operating system.

Optional SoftPanel Controller

Although the MultiClamp 700B amplifier is a computer-controlled amplifier, the mouse and/or keyboard is not the only means of controlling the instrument. The optional SoftPanel controller was designed for those who prefer a more conventional feel to amplifier control. By way of a USB connection, the SoftPanel controller physically replicates all essential amplifier functions by acting as a hardware extension of the MultiClamp 700B Commander software. SoftPanel knobs replicate continuous mouse controls ("gliders"), while buttons replicate single-click mouse controls.

Headstages

The MultiClamp 700B amplifier comes standard with two identical but independent CV-7B headstages, each of which contains both current-to-voltage and voltage-following circuitry. This design allows the user to rapidly switch between patch clamp recording and true high-speed current clamp recording. Thus, with two headstages, the MultiClamp 700B amplifier can perform the function of two patch clamps, two current clamps, or a combination of patch and current clamp amplifiers. Furthermore, two optional voltage-follower headstages (HS-2 type) can be connected to auxiliary inputs to allow third and fourth-point voltage recording.

The MultiClamp 700B amplifier supports up to four simultaneous headstages. Two CV-7B headstages come standard; the HS-2A headstages are optional.

The CV-7B headstage was designed for low noise and flexible recording features. However, some specialized applications require even more flexibility. For example, the rather large membrane capacitance in bilayer recording demands greater capacitance compensation. The optional CV-7B/BL headstage was developed for this purpose. Another optional headstage, the CV-7B/EC, was designed for large (± 2 V) commands required during electrochemistry recording (amperometry, voltammetry).

Requirements:

Computer Control
The MultiClamp 700B Commander program runs on the US Windows Vista/XP/2000/ME/98 32-bit operating systems, as well as Macintosh OS X, version 10.2 or higher (OS 9 is not supported) on a Power PC-based system or OS 10.4.6 on an Intel-based system.

A USB port is required to connect the MultiClamp 700B amplifier. An additional USB port is required if the optional SoftPanel controller is used to control the amplifier.

Experimental Control and Data Acquisition
Although the MultiClamp 700B amplifier is controlled by a software interface, it remains a conventional analog input/output amplifier. Thus, it requires a system for controlling your stimulus protocols and recording the output.

Our pCLAMP software and Digidata 1440A digitizer provide the most complete, integrated solution. Note: pCLAMP 9 or higher is required for automatic telegraphing.

AutoMate Scientific®
READY FOR RESEARCH.™

Requirements:

Computer Control

The Axoclamp 900A Commander program runs on US Windows Vista/XP/2000 32-bit operating systems.

Two USB 2.0 ports are required to connect the computer to the Axoclamp 900A amplifier: one for amplifier control and one for Monitor signal display on the computer screen for discontinuous modes. An additional USB port is required if the optional SoftPanel controller is used to control the amplifier.

Experimental Control and Data Acquisition**

Although the Axoclamp 900A amplifier is controlled by a software interface, it remains a conventional analog input/output amplifier. Thus, it requires a separate system for controlling stimulus protocols and recording the output, such as a digitizer and data acquisition software. The Digidata 1440A digitizer and pCLAMP 10 data acquisition and analysis software from MDS Analytical Technologies, work together to provide the most complete, integrated solution.

** Automatic telegraphing of the Axoclamp 900A amplifier requires pCLAMP 10 software and a Digidata 1440A or Digidata 1320 series digitizer.

A complete microelectrode current-clamp and voltage-clamp amplifier.

Axoclamp 900A Amplifier

The Axoclamp 900A amplifier is a complete microelectrode current-clamp and voltage-clamp amplifier, useful for a wide range of intracellular microelectrode recording techniques. Like it's predecessor, the Axoclamp-2B amplifier, the Axoclamp 900A amplifier has a wide range of functionality and has many enhancements that improve amplifier recording capability, make the amplifier easier to use, and help your experiments last longer.

The Axoclamp 900A amplifier has several modes of operation:

- I-Clamp: two independent bridge amplifiers for voltage measurements
- DCC: discontinuous current clamp for accurate voltage measurements, even when electrode resistance changes
- TEVC: high-compliance two-electrode voltage clamp for oocytes and mammalian cells
- dSEVC: discontinuous single-electrode voltage clamp for small cells with large currents
- HVIC: high-voltage current clamp for extracellular applications such as iontophoresis
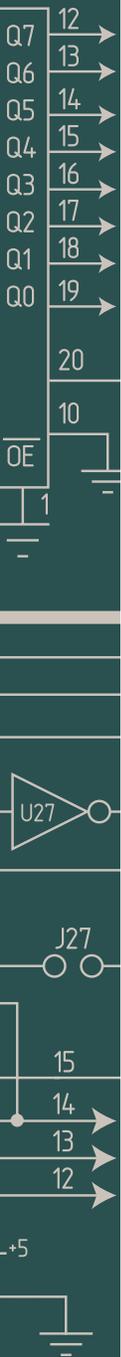
Software Control

Instead of the usual front panel knobs and switches, the Axoclamp 900A amplifier is controlled by the Axoclamp 900A Commander, a program that runs on a Windows PC computer and communicates with the amplifier via a USB interface. This control interface reports resistance, voltage, and current measurements and provides automation of Bridge Balance, Pipette Offset, and Pipette Capacitance Neutralization. In addition it has "smart" features that protect cells from potentially damaging signal oscillations and automate mode changes based on internal signal thresholds or externally-applied signals. Amplifier settings such as gain, filter frequency, recording mode and input/output scale factors are automatically telegraphed to the pCLAMP 10 data acquisition software via the USB connection.

Optional SoftPanel

Although the 900A amplifier is a computer-controlled amplifier, the mouse and/or keyboard is not the only means of controlling the instrument. The optional SoftPanel was designed for those who prefer the more conventional feel to amplifier control of knobs and buttons. By way of a USB connection, the SoftPanel controller physically replicates all essential amplifier functions by acting as a hardware extension of the Axoclamp 900A Commander software. SoftPanel knobs replicate continuous mouse controls ("gliders"), while buttons replicate single-click mouse controls.

Comprehensive Manual

We also provide a detailed User Guide that serves as a handbook of procedures for microelectrode users. Tutorials written by MDS Analytical Technologies staff and scientific consultants provide a useful guide to the operation of the instrument and are informative references for several electrophysiological techniques.

More Information

The Axoclamp 900A* main unit comes standard with:

- One Remote BUZZ Box: works for both channels
- One Clamp-1U model cell
- Two HL-U electrode holders
- One Axoclamp 900A Commander software CD
- Two USB 2.0 cables
- Two headstage baseplates
- Theory and Operation User Guide (printed)

* Two HS-9A headstages (e.g., HS-9A x0.1, HS-9A x1 or HS-9A x10) must be ordered with the Axoclamp 900A.

AutoMate Scientific®
READY FOR RESEARCH.™
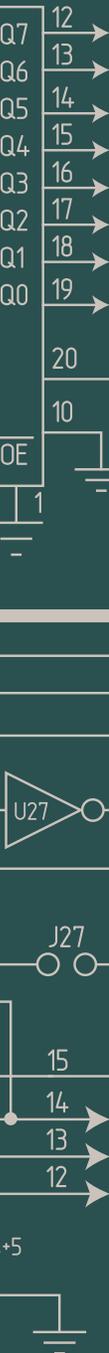
Advantages

Pipette Offset

The Axopatch 200B amplifier provides ±250 mV of offset potential.

Seal Test

The convenient seal test may be used in voltage clamp mode (5 mV pulse) or in current clamp mode (50 pA (ß=1) or 500 pA (ß=0.1).

Dual Command Potentials

Two separate command potential inputs allow you to sum command input signals from two different sources. The back panel command is scaled to afford greater range (up to ±1V), and so is quite useful for electrochemical measurements.

Holding Command

The Holding Command of the Axopatch 200B has been enhanced over that of its predecessors with the addition of a X1 and X5 switch that allows you to choose either 0 - 200 mV or 0 -1 V ranges. An ON/OFF switch can disable this control when an external command from a computer is used to establish the holding potential.

Pipette Capacitance Compensation

In operation in both voltage- or current-clamp modes, controls the magnitude and tau of two time constants, Fast and Slow.

Cell Capacitance Compensation

Compensate up to 100 pF (ß=1) or 1000 pF (ß=0.1) to allow recording from a large range of cell sizes.

Output Gain

Ten gain settings spanning a 1000-fold range may be selected to scale the output to the most desirable level, a range double that previously available.

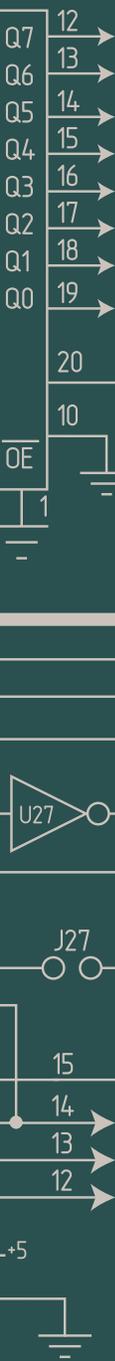# Bringing patch-clamp noise down to unprecedented levels.

Axopatch 200B Amplifier

The Axopatch 200B patch clamp offers the lowest-noise patch-clamp amplifier technology. The open circuit (amplifier) noise in patch-mode has been reduced to unprecedentedly low levels: < 15 femtoAmps (rms) below 1 kHz bandwidth, < 60 femtoAmps (rms) below 5 kHz bandwidth, and < 130 femtoAmps (rms) below 10 kHz bandwidth, all measured with an 8-pole Bessel filter. Noise is still low (145 femtoAmps rms below 10 kHz bandwidth) with a pipette holder attached. This translates into lower noise during actual recordings; this noise performance is achieved in part by cooling the input field-effect transistors inside the headstage to well below 0° C.

Better noise performance is only part of the story. The redesigned, slim headstage improves electrode access to the preparation by making it easier to fit under your microscope. We now include BOTH whole-cell ranges (previously available only in two separate headstages) in one headstage.

The 200B amplifier includes all of the features of the 200A amplifier, and a few more. Enhancements include three recording configurations in a single headstage (one patch and two whole cell ranges, with capacitance compensation ranges of 100 pF and 1000 pF), increased voltage and current command ranges (to ±1V) for electrochemical measurements, built-in capacitance dithering capability for capacitance measurements, and addition of series resistance compensation to the current clamp circuitry to improve performance. Seal Test now provides current steps in current clamp mode as well as voltage steps in voltage clamp mode. Leak Subtraction is now more

sensitive in the most important resistance range. The recording bandwidth has been doubled to up to 100 kHz. Command and bandwidth ranges are larger. Series Resistance compensation is now active in current clamp as well as in voltage clamp mode to enable bridge balance to be used.

A Superb Instrument

The Axopatch 200B amplifier is the latest version of the premier Axon Instruments patch-clamp amplifier incorporating the innovative Capacitor-Feedback technology for single-channel recording, and resistive-feedback for whole-cell recording, providing the best possible performance for single-channel and whole-cell patch clamping. Convenient features include ZAP (to rupture patches when going whole cell), dual-speed current clamp (to allow faster current clamping in small cells), Holding Command to set voltage commands in voltage clamp and current commands in current clamp, and a choice of three gain settings on the dedicated current output (for patch, whole-cell and loose-patch modes). The Axopatch 200B amplifier provides the lowest-noise single-channel recording available. The amazingly low open-circuit noise of 0.13 pA rms (10 kHz) increases to only 0.145 pA rms when a patch-pipette holder is attached to the headstage input and the pipette capacitance is fully compensated (to eliminate capacitance charging transients). The power of capacitor-feedback technology is capacitor feedback at room-temperature is clearly superior to resistive feedback technology; cooled capacitor-feedback is even better! An unprecedented achievement in the field of ultra-low noise recordings!

Unparalleled Performance, Utility and Ease of Use

Efficient controls for whole-cell capacitance compensation, a unique "super-charging" form of series-resistance compensation that complements the conventional "correction" form, and a variable LAG control; output gain with 1000-fold dynamic range; 4-pole Bessel filter; onboard leak subtraction; dual external-command inputs; versatile panel meter displaying Holding Command, rms current noise, membrane potential, tracking potential and current at the headstage input; telegraph output of values for output gain, filter frequency, headstage mode (gain) and measured cell capacitance; ZAP; and dual-speed current clamp. Also, with the Axopatch 200B amplifier the bath is grounded for convenience of use and straightforward addition of command and compensation potentials.

Quiet Single-Channel Recording

Integrating Headstage Mode

With unprecedented low noise and superb linearity, the Axopatch 200B capacitor-feedback integrating headstage is ideal for measuring sub-picoamp current signals.

Bilayers

Headstages useful in artificial bilayer experiments must be stable with large input-capacitance loads. The Axopatch 200B amplifier is rock solid with an input capacitance of 1000 pF.

Superb Whole-Cell Performance

Resistive Headstage Mode

In whole-cell recording more current noise is produced by the cell and the environment than by the patch clamp amplifier. Hence, the benefits of a low-noise capacitor-feedback headstage cannot be effectively utilized in whole-cell mode. For this reason, the Axopatch 200B amplifier uses traditional resistor feedback headstage electronics for the whole-cell mode of patch clamp recording. The CV 203BU headstage includes two feedback resistors to provide a wide range of current-passing capacity in the whole-cell mode. The 500 megaohm feedback resistor (ß=1) provides both low noise and a large current passing ability (20 nA). For larger currents, one can switch to the 50 megaohm feedback-resistor (ß=0.1) to pass up to 200 nA.

800.998.MATE | www.autom8.com | 812 Page Street, Berkeley, CA 94710 USA
tel 510.845.6283 | fax 510.280.3795 | e-mail info@autom8.com

AutoMate Scientific®
READY FOR RESEARCH.™

Genuine Axon CNS components for every experiment.

Optional CV-5 Series Headstages for the GeneClamp 500B amplifier

- CV-5-100GU patch-clamp headstage (100 mV/pA)
- CV-5B-100GU bilayer patch-clamp headstage (100 mV/pA)
- CV-5-1GU macro-patch headstage (1 mV/pA)
- CV-5-100MU voltammetry headstage (100 mV/nA)

CV-5 headstages operate with the GeneClamp 500 amplifier. Each headstage has one feedback resistor for current-to-voltage conversion. The transfer resistance of the 100G, 1G and 100M versions are 100 GΩ, 1 GΩ and 100 MΩ, respectively. The "B" version has an extended capacitance compensation range suitable for bilayers. The 100G version is ideal for single-channel recording and vesicular-release amperometry. The 1G version is suitable for macropatch applications. The 100M version is used for fast cyclic voltammetry using carbon-fiber microelectrodes.

Headstages, holders, model cells, cables, odd bits

Headstages

HS-2 and HS-2A unity-gain headstages

The HS-2 and HS-2A headstages are used with Axoclamp 2 and GeneClamp amplifiers. They are all unity-gain voltage recording headstages but they come in a variety of different current-passing gains for applications as diverse as extracellular recording, bath-potential recording, ion-sensitive recording, ionophoresis and intracellular recording from small or large cells. For ultra-high impedance electrodes, special circuitry inside the headstage prevents any DC current from leaking into the input through the capacitance neutralization circuit.

HS-4-x1MGU relay-switched unity-gain headstage

HS-4 headstages may be used with Axoclamp 2 amplifiers to maximize the voltage across the electrode during two-electrode voltage clamp. In all other modes the HS-4 acts like an HS-2 headstage. Available only with current-passing gain x1MG. The VG-2 headstage must be used for current measurement.
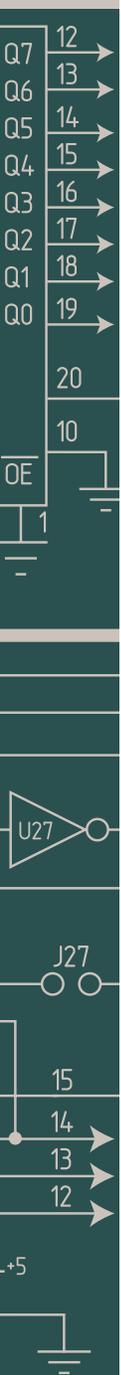
VG-2 virtual-ground headstage

The VG-2 virtual ground headstage may be optionally used with Axoclamp 2 amplifiers to measure whole-bath current. Standard current-measurement gains are x0.1, x1 and x10. x100 is also available. Current recording ranges for these virtual ground headstages are: ±0.1 µA (x0.1), ±1 µA (x1), ±10 µA (x10), ±100 µA (x100).

VG-2A-x100 bath clamp headstage

The VG-2A-x100 bath-clamp headstage may optionally be used with Axoclamp 2 or GeneClamp amplifiers to clamp the bath potential at zero volts. This eliminates the effect of series resistance in the bath grounding electrode and the bath solution. It can also minimize the extent of DC voltage shifts resulting from changes in the bath solution or temperature.

Mechanical Mounting Options

A 4" (102 mm) long removable insulated mounting rod is provided at no charge with most headstages. Diameter is 5/16" (7.9 mm) unless 1/4" or 3/8" (6.3 or 9.5 mm) is specified by purchaser. Additionally, all headstages include an insulated mounting plate. Many manufacturers of micromanipulators provide custom mounting brackets for Axon CNS headstages.

Holders

Headstage pipette holders and replacement parts available for all Axon CNS Instruments headstages. Please see our web page: http://www.autom8.com/amp_headstages.html for complete parts list.
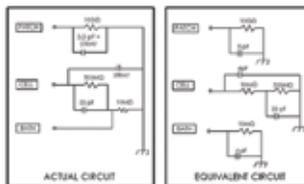
Model Cells

Model Cells	Headstages		
	HS non-U type 2 mm socket	CV non-U type 1 mm socket	HS & CV U type 1 mm socket
Non-U type 2 mm pins Clamp-1, MCB-1, MCO-1 E1, E2*, MCW-1	No adapter needed	2 mm socket to 1 mm pin APN 1-2200-063	2 mm socket to 1 mm pin APN 1-2200-063
Non-U type, recessed 1 mm pins MCO-1 E3*, Patch-1	1 mm socket to 2 mm pin APN 1-2200-083	1 mm socket to 1 mm pin APN 1-2200-062	1 mm socket to 1 mm pin APN 1-2200-062
U type 1 mm pins Clamp-1U, MCB-1U, MCO-1U E1, E2, E3*, MCW-1U, Patch-1U	1 mm socket to 2 mm pin APN 1-2200-083	1 mm socket to 1 mm pin APN 1-2200-062	No adapter needed

*E - electrode input # All ground connections on model cells and headstages have 2 mm sockets, except the CV203BU headstage, which has a 1 mm ground socket.
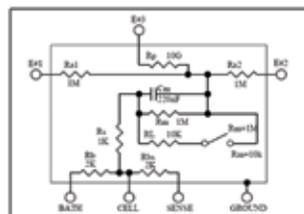
Clamp 1U-model cell
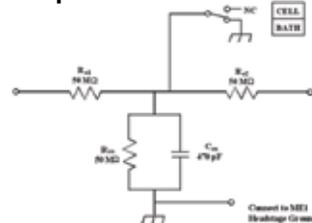
Patch 1U-model cell

MCO 2U-oocyte model cell

Q7 12
Q6 13
Q5 14
Q4 15
Q3 16
Q2 17
Q1 18
Q0 19

20

10

OE

1

U27

J27

15

14

13

12

+5

New Features

- Membrane Test calculates Ra and Cm per sweep during a recording
- Membrane and Seal Tests combined into a single resizable window
- Support for four stimulus waveforms (with the Digidata 1440A digitizer)
- Control of eight digital outputs per epoch during a sweep
- Control of split-clock sampling per epoch during a sweep
- Leak subtraction automatically saves both raw and corrected traces
- All protocol durations are entered in time units
- Support of the new Digidata 1440A digitizer
- Support of the new Axoclamp 900A amplifier
- New ABF 2.0 file format

Applications

pCLAMP 10 is suitable for a wide variety of applications.

Uses:

- Action Potentials (APs)
- Current-clamp
- Electromyography (EMG)
- Electrooculography (EOG)
- Excitatory Post-Synaptic Currents (EPSCs)
- Excitatory Post-Synaptic Potentials (EPSPs)
- Inhibitory Post-Synaptic Currents (IPSCs)
- Inhibitory Post-Synaptic Potentials (IPSPs)
- Long-Term Depression (LTD)
- Long-Term Potentiation (LTP)
- Miniature excitatory potentials (Minis)
- Ratio dyes (with PMTs)
- Single-channels
- Slices
- Spike trains
- Synaptic networks
- Voltage-clamp
- Whole-cell

The most widely-used patch clamp data acquisition and analysis program.
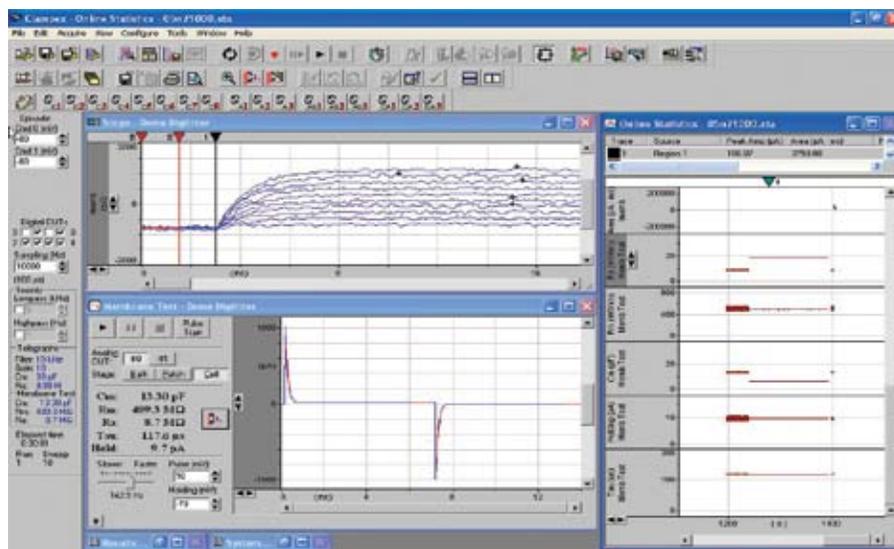
pCLAMP 10 Software

The pCLAMP 10 software suite fulfills many different experimental needs, such as synchronized stimulation, event detection, and online analysis. It is the most widely-used data acquisition and analysis program for the control and recording of voltage-clamp, current-clamp, and patch-clamp experiments. Three separate programs are included: Clampex 10, AxoScope 10, Clampfit 10.

Clampex 10 expands the range and quality of your data acquisition experiments. These improvements should prove useful for a wide variety of applications, allowing more flexibility in your experimental protocols.
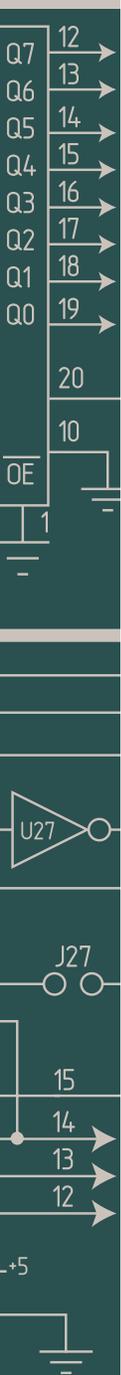
Requirements
Minimum:
- Windows 2000, 1.2 GHz CPU, 512 MB RAM, 500 MB hard disk, 1024 x 768 display, CD-ROM drive, 1 USB 1.1 port, Digidata 1320 series digitizer, 1 PCI slot (full height)

Recommended:
- Windows 7 (32- or 64-bit), 2 GHz CPU, 2 GB RAM, 32 GB hard disk, 1024 x 768 display, CD-ROM drive, 3 USB 2.0 ports, Digidata 1550A digitizer, Network connection

USB 2.0 interface means extremely easy installation and setup.

Easy to Use

Designed to support continuous data acquisition within a multitasking operating system, the Digidata 1550A digitizer is fully supported by our AxoScope 10 for Windows and pCLAMP 10 for Windows electrophysiology software.

With its USB 2.0 interface, you can easily connect the Digidata 1550A to a laptop computer without the need for a peripheral PC card.

Digidata 1550A Data Acquisition

Presenting the latest Digidata 1550A digitizer for low-noise experiments. This high-resolution 16-bit data acquisition system is self-contained and communicates with the host computer via a USB 2.0 interface, which means extremely easy installation and setup. Designed for ease-of-use and fast results, the Digidata 1550A comes with versatile AxoScope for Windows software and is ready to take data immediately after installation. Absolutely no programming is necessary.

The Digidata 1550A has a maximum sampling rate of 500 kHz per channel, with an outstanding total data throughput rate of 4 megasamples per second. Both the inherent digitizer noise and channel crosstalk noise are rated at less than ±1 mV average p-p at 10 kHz, within a ±10 V input range. The front panel is well laid out with eight analog input channels and eight analog output channels, eight general digital outputs, one dedicated digital output to trigger devices such as oscilloscopes, trigger inputs to start acquisition and to tag data. The back panel has four additional analog instrument telegraph inputs, as well as a DB-25 connector for the digital outputs.

Specifications

Analog Inputs

- Input channels: 8 single-ended
- ADCs: 8
- Sampling rates**: 1 Hz - 500 kHz
- Resolution: 16-bit
- Input range: -10 to +10 V
- Input resistance: >1 MΩ
- Gain value: 1

**Maximum aggregate throughput rate is 500 kHz x 8 input channels = 4 Megasamples/sec

Analog Outputs

- Channels: 8
- DACs: 8
- Sampling rates: 1 Hz - 500 kHz
- Resolution: 16-bit
- Output range: -10 to +10 V
- Output impedance: < 0.5 Ω
- Output short circuit to signal ground: ±25 mA

Digital Inputs

- Input type: TTL compatible
- Trigger Inputs
- Input type: TTL compatible
- TAG: rising-edge sensitive
- START: rising-edge sensitive

Digital Outputs

- Number of bits: 8 (of 16) supported in software
- SCOPE: dedicated trigger output
- Output driver: advanced CMOS (AC) compatible
- Output current: ±4 mA source, ±32 mA sink

Cable

Type: USB 2.0 braided
Length: 3 meters

AxoScope

AxoScope software is turn-key data acquisition and analysis software for Windows, designed to replace oscilloscopes, chart recorders, and FM tape recorders. AxoScope software provides up to sixteen channels of analog acquisition and four different acquisition modes. Acquire data continuously in Gap-Free mode with simultaneous display, at up to the speed of the digitizer. Set a trigger threshold for the Fixed-Length Events, Variable-Length Events or High-Speed Oscilloscope modes. Tag and add comments to the data in real time. Set analog output holding values. Open Axon-format ABF data files and quickly analyze sections of interest with an array of browsing and basic analysis tools. Preview data and page layout before printing. Additional features include voice tags, which allow tagging of data with spoken comments (requires a microphone and sound card), low-pass and high-pass digital filtering of incoming data, and Store Trace, which freezes a snapshot of a waveform on the screen for comparison with subsequent input.

The Digidata 1550A rack mountable main unit comes standard with:

- USB 2.0 cable
- External auto-switching power supply
- Power cable
- AxoScope 10 software CD
- Printed manual

MDS Analytical Technologies/Axon CNS Ordering Information