The pCLAMP® Software suite from Molecular Devices is the most widely used electrophysiology data acquisition and analysis program for control and recording of voltage-clamp, current-clamp, and patch-clamp experiments. The pCLAMP 10 Software suite consists of Clampex™ 10 Software for data acquisition, Clampfit™ 10 Software for data analysis, and AxoScope™ 10 Software for secondary background recording.

**ClAMPEx 10 Software: powerful electrophysiology data acquisition**

The focus of the pCLAMP 10 Software suite, is to provide users with greater flexibility to control the acquisition of electrophysiology data. In addition to the already powerful set of Clampex™ Software protocol controls, new features include:

- Support for four analog output waveforms with the Digidata® 1440A digitizer, control of eight digital outputs per epoch during a sweep, and control of split-clock sampling per epoch during a sweep. The updated protocol editor in Clampex 10 Software displays sweep parameters in time and sampling intervals in frequency for easier protocol creation. The Membrane Test now calculates $R_m$ and $C_m$ per sweep during recordings and displays the results in a new resizable window incorporating the Seal Test. P/N Leak Subtraction now automatically saves both raw data and subtracted data. The new features in Clampex 10 Software provide greater ease-of-use, which makes it the software-of-choice for controlling experiments.

**Episodic and continuous recording modes**

Clampex 10 Software is a superior program for stimulating cellular preparations in a sweep oriented “episodic” mode. Waveforms can be created from a variety of sources, such as the protocol editor in Clampex 10 Software, pCLAMP Software ABF data files, and ASCII text files. Standard protocol patterns include steps, ramps, cosines, trains of pulses (biphasic), and sinusoidal or triangular patterns. Waveform stimulation utilizes a variety of timing and triggering aids, including software protocol controls and sequencing, hardware, software, and manual triggering options. The Clampex 10 Software now supports eight digital output bits during sweeps and four simultaneous waveforms when used with the Digidata 1440A digitizer. Advanced “split-clock” capability has been added allowing users to shift the sampling rate on a per-epoch basis during sweeps, for example, for slowly changing conditioning or recovery phases of cell stimulation. For ease-of-use, all protocol durations are defined in terms of time and sampling rates in terms of frequencies.
For continuous recording, four different modes are available. Gap-free recording is a simple continuous “chart-recorder” recording mode useful for monitoring single-channels, minis, and other spontaneous activity. Fixed- and Variable-Length Event Detection modes are suitable for recording spontaneous events of regular length or varying length that are separated by long periods of inactivity. The high-speed oscilloscope mode works like a storage oscilloscope to capture triggered fixed-length sweeps of data. By providing all of these recording modes, Clampex 10 Software provides the functionality necessary for a variety of simple and complex experimental protocols.

FILTERING AND CORRECTIONS TO THE DATA
Clampex 10 Software can be used to offset voltage level differences between connected instruments, correct liquid junction potential errors arising from ionic solutions, compensate passive leak currents with P/N leak subtraction, or reduce high-frequency noise spikes and slow baseline drift with highpass and lowpass filtering. Clampex 10 Software works to compensate for a wide variety of introduced noise sources. Amplifier gain and filter settings for the Axoclamp™ 900A and MultiClamp™ 700B microelectrode amplifiers are software telegraphed so microelectrode amplifier settings are stored with the data. With Clampex 10 Software, support for BNC-telegraphed amplifiers has been expanded to the latest amplifier models.

CELL MONITORING
The Membrane Test window in Clampex 10 Software has been redesigned to allow monitoring of the pipette resistance in the bath, formation of high-resistance seals between a cell and pipette, and to measure cell membrane capacitance ($C_m$), membrane resistance ($R_m$), and access resistance ($R_a$). During acquisition, the software optionally runs the membrane test in the background, monitoring $C_m$ and $R_a$ during recording. This allows an entire experiment to be recorded into a single file, while simultaneously monitoring crucial cell parameters in real time.
Clampex 10 Software Analysis and Tools

**Cell Monitoring**

The Membrane Test feature in Clampex 10 Software handles all phases of patching a cell.

**Liquid Junction Potentials**

The embedded liquid junction potential calculator has an editable ion library for pipette/bath offsets.

**The MiniDigi Digitizer**

This unique 2-channel USB digitizer is run by the AxoScope™ 10 data acquisition software.

**ONLINE ANALYSIS**

To analyze data in real-time, the Clampex 10 Software features online analysis. With online analysis, multiple regions can be simultaneously analyzed by an extensive set of peak-oriented measurements, such as peak amplitude, area, mean, and standard deviation. Measurement regions can be adjusted in real time for LTP experiments. Several measurements, such as half-width, rise and decay times, and rise and decay slopes are useful for cardiac analyses. Measurements are displayed in their own window and different trace colors identify each search region to simplify interpretation.

**SEQUENCING KEYS**

Sequencing keys control the setup and timing of operations, including loading protocols, recording data, setting analog and/or digital holding levels, running the Membrane Test, inserting comments into the Lab Book and data file, and linking to the next operation. By using Sequencing Keys, complex experiments can easily be automated and provide a powerful way to link the actions of an entire experiment.

**MINIDIGI DIGITAL CHART RECORDER**

The MiniDigi™ digitizer provides two 1 kHz 16-bit analog inputs which run independently of Clampex™ 10 Software acquisition. As a secondary background digitizer, the MiniDigi digitizer can act as a chart recorder to concurrently record between sweeps or record an entire experiment.
Clampfit 10 Software Data Preparation and Analysis

**COMPREHENSIVE ELECTROPHYSIOLOGY DATA ANALYSIS PROGRAM**

Clampfit 10 Software offers dedicated functions to quickly prepare data for analysis. In this new software version, noise can be removed from signals using highpass, lowpass, and bandpass filters with Bessel, Butterworth, Chebyshev, Gaussian, or RC responses. Specialized notch and electrical interference filters can be used to remove specific noise frequencies and harmonics from recorded signals. Several different methods are available to adjust the baselines of recordings: constant values or averages can be subtracted from all points of the recording, linear drifting baselines can be adjusted by applying a slope correction, or, for unstable baselines, a manual correction using a poly-line can be applied. Additional data analysis functions are averaging, normalization, control subtraction, and peak alignment.

**DATA ANALYSIS**

Included with Clampfit 10 Software is a comprehensive palette of tools for analyzing and graphing electrophysiological data. For curve fitting, users can select from 37 pre-defined functions or define their own. Fits can be customized by selecting fitting methods and applying fitting seeds, models can be compared with different terms, and fits can be extrapolated to view curves, components, residuals, tauls, etc. Specialized analysis tools include Fast Fourier Transform, Variance-Mean analysis, Perievent analysis, Burst analysis, and other statistical analyses. To display results and data, a range of graph types are available in the Graph windows. Graphs are dynamically linked to their Results window data so any manipulations made in the Results window updates the corresponding data in the Graph window.

Numerous peak statistics can be directly measured. Up to eight separate regions of interest, as well as a baseline region, enable the analysis of complex data. Online statistics can be recreated during offline review, eliminating the need to save separate statistics files during acquisition. A power spectrum (FFT) for noise analysis can be applied to individual, averaged, or segmented spectra, and produces a log-scaled graph of the results. Standard auto and cross-correlation analyses provide the means to compare data for patterns within or across populations. For synaptic modulation studies, the V-M analysis in Clampfit 10 Software provides a robust method for pre-/post-synaptic site identification.
Clampfit 10 Software Analysis

**Event Detection Analysis**
Clampfit 10 Software has extremely flexible Event Detection that analyzes spontaneous and evoked action potentials and post-synaptic data. Events are detected by either crossing a threshold or through a pattern-matching Template Search. Template Searches are designed for analyzing spontaneous events, such as miniature synaptic EPSPs and IPSPs. These events vary in amplitude but not shape, and thus are ideal for detection by the Clampfit 10 Software scalable shape-based algorithm. For added flexibility, multiple categories of events can be simultaneously detected and sorted for secondary analysis. The integrated environment of Clampfit 10 Software links the detected events in the data to the spreadsheet and graph windows to enable quick evaluation of the information within the context of the entire dataset.

**Single-Channel Analysis**
The Clampfit 10 Software single-channel analysis contains updated analyses and full processing of up to 1 million events on continuous and episodic data. Naturally expressed channels or artificial bilayers can be studied and open, closed, and sub-conductance levels can be detected up to eight levels in the data. An adjustment for baseline drift can be automatically applied, and an idealized record of the channel activity created. Amplitude and dwell-time histogram plots, including log and cumulative plots, can be created. Clampfit 10 Software also has specialized analyses, such as P(open), Burst Analysis, Latency Analysis, for evoked responses, and Nonstationary Fluctuation Analysis to estimate channel conductance.

**Spreadsheet Analysis**
Primary analysis results populate a spreadsheet where secondary analyses can be performed. These results can be analyzed within Clampfit 10 Software or exported to Microsoft Excel software for further analysis. The secondary analyses available within Clampfit 10 Software are analysis of variance, F-test, Chi-squared, Komolgov-Smirnov, rank correlations, and Student’s t-Test. Graphing secondary data can be as easy as selecting a data column and clicking on the Create Graph Button. Available graphing options include line, scatter and various histogram plots (e.g., normalized, frequency, log [square root] and cumulative).
SYSTEM REQUIREMENTS

Operating system: US Windows XP Pro SP2 or 2000 SP4

CPU: 1.2 GHz Pentium (2.4 GHz recommended)

Drives: 500 MB HD space DVD/CD-ROM

Display: 1024 x 768 resolution

Ports: USB 1 (for Security Key)
      USB 1.1 (for MiniDigi 1 Digitizer)
      USB 2.0 (for Digidata 1440A Digitizer)

Slots: PCI (for Digidata 1322A Digitizer)

SUPPORTED HARDWARE**

- Digidata 1440A 16-Channel Digitizer
- Digidata 1322A 16-Channel Digitizer
- MiniDigi 1 Two-Channel Digitizer
- CyberAmp® 380 Signal-Conditioning Amplifier
- Axoclamp 900A Sharp Electrode Amplifier
- Axopatch 200B Microelectrode Amplifier
- MultiClamp 700B Microelectrode Amplifier
- Most BNC-telegraphed amplifiers also supported.

** Supports all previous versions in a model line.

BUNDLED HARDWARE*

- Digitizer type: MiniDigi 1 Digitizer
- Channels: 2
- Channel type: Analog input
- Input range: ±10 V
- Resolution: 16 bits
- Sampling rates: 1 Hz–1 kHz
- Filter types: Analog, min./max.
- Control software: AxoScope 10 Software
- Communication: USB 1.1

* Not supplied with upgrades from pCLAMP Software version 9.

ORDERING INFORMATION

pCLAMP 10 Data Acquisition and Analysis Software
Part Number: pCLAMP 10 Standard
- pCLAMP 10 Software CD
- MiniDigi™ 1 digitizer*
- USB 1.1 cable*
- USB 1.0 security key
- User guide (printed)

* Not supplied with upgrades from pCLAMP Software version 9.

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DataXpress 2 Software

ELECTROPHYSIOLOGY DATA MANAGEMENT AND ANALYSIS SYSTEM

DataXpress® 2 Software from Molecular Devices is a data management and analysis system for electrophysiology data. By incorporating an SQL database with over 100 attributes, users can quickly query and sort information about their assays. The software's trial editing, analysis and graphing capabilities provide users with a comprehensive set of tools to analyze and interpret their data. DataXpress 2 Software seamlessly integrates with the PatchXpress® 7000A Automated Parallel Patch Clamp System from Molecular Devices and incorporates a powerful graphical macro editor for automated data analysis that reduces the time required to analyze electrophysiology data.

The power of the DataXpress 2 Software lies in its ability to manage not only raw data, but also meta-data, such as information about compound addition, cells and solutions, operator, cell health parameters and many more categorizing properties. The graphical macro editor allows users to create standardized analysis procedures that automatically calculate, for example, compound response, IC_{50} or EC_{50} values, current-voltage relations or voltage-dependent channel gating.

POWERSFUL DATABASE TO MANAGE ELECTROPHYSIOLOGY DATA
DataXpress 2 Software stores information using a variant of the MDCStore™ Database, a database structure used in several Molecular Devices applications. This structure uses an ODBC-compliant database and the MDC File Server software to efficiently manage information. (See Figure 1.) Data files are parsed for their attributes, which are stored in the database. Raw data files are stored elsewhere on the network via the MDC File Server. The SQL database serves as a hub from which data from multiple acquisition systems can flow while multiple users are analyzing data. With over 100 attributes that can be queried, users can rapidly search and sort the database for information about their assays. User permission levels and data sharing capability ensure that users see only raw data and analysis results that they have permission to view and analyze. The use of an ODBC interface for the connection between the DataXpress Software clients and server provides improved database connection reliability.
Effective concentration percentage. Information is conveniently displayed in a spreadsheet format for easy management and can be exported in Microsoft Excel format or as comma separated value (CSV) files for further analysis. To facilitate interpretation, data can be visualized and graphically presented automatically as multiple plots, histogram plots, scatter plots or line graphs. Both graphs and numerical results can be copied to the clipboard to include them in a presentation, in a lab notebook or in other documentation.

**Comprehensive Electrophysiology Analysis Tools**

To analyze electrophysiology data, DataXpress 2 Software features a comprehensive set of analysis tools. (See Figure 2.) Using the now-integrated trial editing functions, users can adjust the baseline, perform arithmetic operations on trials, average, filter, time shift and apply other signal conditioning functions to their datasets. Up to 18 different measurement types (e.g., peak amplitude, time of peak, mean current, and 15 other types; see Figure 3) from up to eight different time regions within trials can be applied to recordings. DataXpress 2 Software provides an extensive selection of 16 different types of analyses, such as current/voltage, curve fitting, tools for IC_{50} and EC_{50} analysis and effective concentration percentage. Information is conveniently displayed in a spreadsheet format for easy management and can be exported in Microsoft Excel format or as comma separated value (CSV) files for further analysis. To facilitate interpretation, data can be visualized and graphically presented automatically as multiple plots, histogram plots, scatter plots or line graphs. Both graphs and numerical results can be copied to the clipboard to include them in a presentation, in a lab notebook or in other documentation.
Automated Data Analysis Using Graphical Macro Editor

Trial Editing and Analysis commands are recordable using the graphical macro editor of DataXpress 2 Software. Macros are created as a sequence of dialog-configured commands, making them straightforward to create and edit. A window displays the macro steps in a tree format so it is always easy to see the details of your analysis. (See Figure 4.) Multi-step Undo and Redo functionality allows a user to experiment with analysis steps and see the results before saving the macros. The ability to run a macro while recording another allows the creation of complex macros from a library of commonly used sub-macros. Once saved, macros can be replayed and applied to new datasets to efficiently automate data analysis. Macros can be stored and managed on a user basis and shared with other DataXpress software users. A comprehensive set of sample macros, together with step-by-step tutorials on their use, is provided to help users get started with setting up customized analysis procedures.

Summary

DataXpress 2 Software is a data management and analysis system for highly flexible and efficient handling of electrophysiology data. Assay attributes are stored in a SQL server database, allowing users to quickly browse, query and sort their experiments. The software has powerful trial editing, analysis and graphing features that facilitate the interpretation of raw data and the compilation of results. Using a graphical macro editor, users can create standardized analysis procedures for automated analysis of
DataXpress 2 Software

DataXpress 2 Software significantly reduces both the time and the effort required to analyze electrophysiology data.

SYSTEM REQUIREMENTS

**DataXpress 2 Software (Server)**

PatchXpress 7000A Systems ship with a database server computer pre-configured with DataXpress 2 Software. Users who are planning to install the DataXpress 2 Software on a different computer should contact Molecular Devices Tech Support. The requirements listed below may differ, depending on user-specific implementations.

- **Processor:** 1 GHz
- **Memory:** 512 MB
- **Hard Disk size:** > 150 GB; a mirrored RAID array (RAID 1) or data file storage on a file server network share is recommended
- **Network:** Fast Ethernet (100 Mbps)
- **USB port:** 1 available
- **Operating system:** Microsoft Windows 2000 or XP Professional. Microsoft SQL Server 2000 Personal Edition or higher (MSDE/SQL Server 2005 Express Edition is not recommended.)

DataXpress 2 Software does not support operating system emulators (e.g., VMWare, etc.).

**ORDERING INFORMATION**

DataXpress 2 Software upgrade (from DataXpress software version 1.0)

- **Part Number:** DataXpress 2 Upgrade
- **DataXpress 2 Software (Client)**
  - **Processor:** 1 GHz
  - **Memory:** 512 MB
  - **Hard Disk size:** 5 GB free
  - **Network:** Fast Ethernet (100 Mbps)
  - **Operating system:** Microsoft Windows 2000 or XP Professional

DataXpress 2 Software does not support operating system emulators (e.g., VMWare, etc.).

- **License for 2 concurrent seats**
- **USB software protection key**

Additional DataXpress 2 Software seat

- **Part Number:** 1-6195-0001
- **License for an additional concurrent seat**
- **USB software protection key programming or exchange**