

Data acquisition and analysis for life science research
Software

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Software



ADINSTRUMENTS.com

What customers say about ADInstruments PowerLab Systems with LabChart (formerly Chart) software.

'The intuitive interface makes life easy. I like to change gains and display settings on the fly, something the competitor's system does not allow'. Dr. Jerrel L. Wilkens, University of Calgary, Canada

'The split screen feature [of the software], which allows data to be reviewed while it is still being collected, makes comparisons possible and rapid'. Dr Edward Zuperku, Zablocki VA Medical Center, USA

'In my opinion ADInstruments's PowerLab system has the best laboratory software. Its user friendliness and value-for-money are unbeatable. Using the software is easy, even for those who use it infrequently. This is what sets it apart from the competition. For me, PowerLab is always the first choice'. Dr. Martin van Eickels, sanofi-aventis

'We have been thrilled with the straightforward hardware set up, and the intuitive features of the software. Because the system is easy to use, I have found that we are able to focus on conducting our experiments and analyzing our data rather than spending an inordinate amount of time fussing with technical issues'. Dr. Carolynn Patten, VA Palo Alto Health Care System, USA

'The ADInstruments software is much more user friendly than other systems we have used in the past. This makes the system more versatile because you can adapt the software for multiple applications'. Mr. Terry Beltz, University of Iowa, USA

'ADInstruments PowerLab is a very safe and robust research system that is versatile and easy to use. We are now able to perform our measurements and analyses with high accuracy'. Dr. Laura Calvillo, PhD, Istituto Auxologico Italiano, Milan, Italy

'We use PowerLab primarily for pharmacology experiments such as tissue baths, whole animal hemodynamics (ECG, heart rate and blood pressure), and also isolated heart ECG measurements. It collects concurrent data and computed inputs simultaneously, and allows for easy post-run analysis. PowerLab is an easy to use and versatile solution for our data collection needs'. Dr Michael Watson, Enhance Biotech

'I am using PowerLab for recording cardiovascular parameters and for isolated tissue experiments in the organ bath assembly. I found the hardware and software versatile and easy to operate. The online and offline data computation feature is very useful in measurement and analysis. Finally, a system built from a scientist's point of view'. Professor Mohammad Fahim, University of Delhi, India

'PowerLab provides high flexibility and allows us to easily modify experimental settings according to constantly changing needs. In addition, the intuitive user interface of Chart software provides tools and options for recording, analysis, documentation and archiving of data from various experimental settings'. Dr Eckhard Weber, Novartis

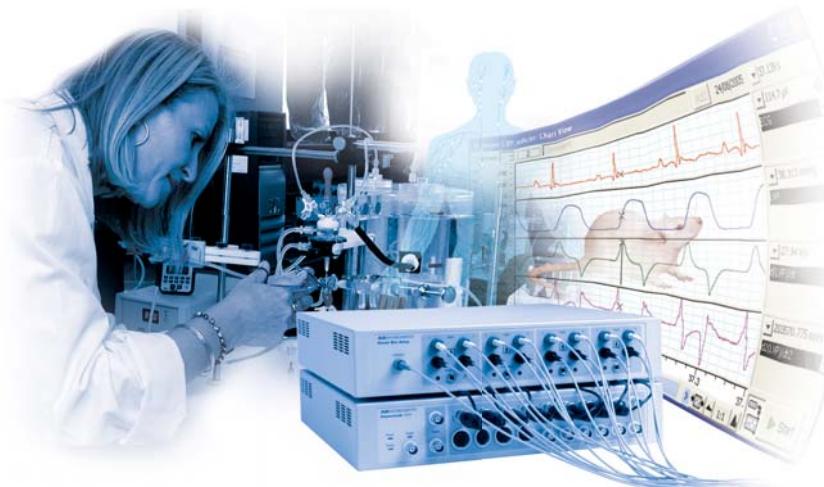
'Calibration is straightforward... I can trust the data collection process solely to the technicians... It is very important to be able to just plug something in and run it'. Dr. Michael Brands, Medical College of Georgia, USA

'I am very happy with Chart. Firstly it is easy to operate compared with other applications; secondly it has many powerful calculation and display functions. In addition ADInstruments provides excellent post-purchase support. That's why I prefer the PowerLab system with Chart'. Dr. Yasuhiro Tsukimi, Pharmaceutical Research Division, Takeda Chemical Industries, Ltd.

About ADInstruments

ADInstruments provides complete data acquisition and analysis solutions to academic institutions, government organizations and private industry. At the core of our product line is the world-renowned PowerLab® system with LabChart® and Scope™ software. Together they offer comprehensive signal processing, data recording, display and analysis features for a wide variety of research applications.

In conjunction with a computer, the systems provide the functionality of a multi-channel, real-time chart recorder, polygraph, XY plotter and digital oscilloscope. You can take advantage of variable sampling rates and remarkable resolution with the benefits of powerful, computer-based data handling and analysis.



The ADInstruments Advantage:

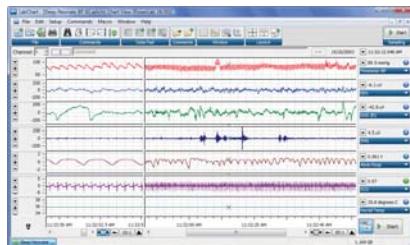
- ▷ **Experience you can trust.** ADInstruments systems have been installed in thousands of research institutes, universities, hospital and commercial laboratories worldwide. With more than 25 000 systems installed worldwide and over 7000 published scientific research papers featuring our products, you can be assured that the decision to purchase an ADInstruments data acquisition system is the right one.
- ▷ **Power and flexibility.** The flexibility of LabChart allows it to be used in a wide variety of life science applications, maximizing the returns of your investment in time and capital.
- ▷ **Intuitive and powerful software.** Our software allows researchers to concentrate on the science. Powerful data extraction and analysis features speed up the research process.
- ▷ **Data integrity.** PowerLab systems are calibrated and tested to deliver data you can trust. The software incorporates data integrity features such as multiple block recording with individual settings and calculations stored within a single file, preservation of raw data, and date stamping.
- ▷ **GLP and 21 CFR Part 11 compliance.** LabChart and our GLP software provide the required user interface, audit trail and signing components for non-repudiation of data under GLP and 21 CFR Part 11 compliance.
- ▷ **Quality and reliability.** ADInstruments products are manufactured under a quality system certified by an accredited body as complying with ISO 9001:2000
- ▷ **Excellence in customer training and support.** Our international graduate and postgraduate support staff are dedicated to making sure our customers are satisfied.

Sample applications:

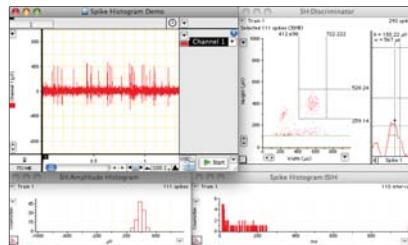
Atrial and Ventricular Pressure
Blood Pressure – Invasive
Blood Pressure – Non Invasive
Blood Flow
Cardiac Output
Cardiac Function
CO₂ and NH₃
Dissolved O₂
Dose Response
ECG, EKG
EEG and ECoG
EMG
Evoked Potentials
Extracellular Recordings
Gas Analysis
Gastrointestinal Motility
Hemodynamics
Intracellular Recordings
Ionic Concentrations
Isometric Tension
Isotonic Contraction
Langendorff Heart
Membrane Potential
Microvascular Tension
Mouse Applications
Muscle Tissue Contraction
Neurophysiology
Nitric Oxide
Oocyte Voltage Clamping
Organ Bath Experiments
Patch and Voltage Clamping
Perfused Organs
Pulse Oximetry
Respiratory Airflow
Sleep
Sympathetic Nerve Activity
Telemetry
Temperature
Ussing Chamber
Ventricular Pressure
Ventricular Pressure-Volume
Wire Myography
Working Heart

ADInstruments Research Software – An Overview

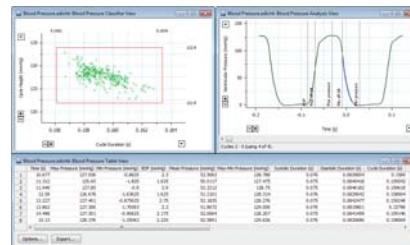
With over 20 years of development history, ADInstruments software continually sets innovation and usability standards for data acquisition and analysis in life science applications.



LabChart



Spike Histogram

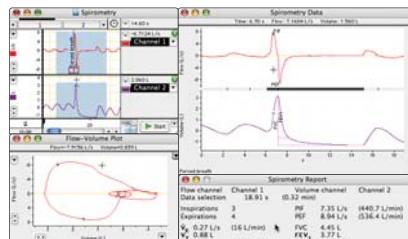


Blood Pressure

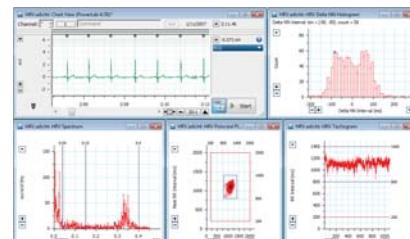
Software	Purpose	More Details
LabChart	LabChart software offers the functionality of a multi-channel chart recorder, virtual oscilloscope, XY plotter, polygraph and digital voltmeter. It allows the recording, display and analysis of up to 32 channels of data in real time, including real-time averaging on multiple channels.	Page 6
LabChart Extensions	LabChart Extensions are available free of charge to all LabChart users. They provide additional data formatting, filtering, visualization, measurement calculations and other utility features.	Page 18
LabChart Reader	LabChart Reader allows scientists that do not own a PowerLab to view and analyze (to a limited extent) LabChart data files. Scientists using PowerLab are able to share data files with their colleagues.	Page 20
LabChart Modules	LabChart Modules are application-specific acquisition and analysis add-on programs for LabChart Software. Available separately or as a collection in LabChart Pro.	Page 22
LabChart Pro	Software package that includes LabChart, all LabChart Modules and Scope. See list below for individual LabChart Module descriptions.	Page 22
■ Blood Pressure Module	The Blood Pressure Module detects, analyzes, displays and reports a set of cardiovascular parameters from arterial or ventricular pressure signals. It can be used online or offline.	Page 22
■ ECG Analysis Module	The ECG Analysis Module detects and examines ECG components online or offline providing statistical and graphical analysis. It features ECG averaging and is suitable for human and animal recordings.	Page 24
■ HRV Module	The HRV Module analyzes variability in ECG or arterial pulse recordings. A number of heart rate variability parameters, graphs and a report can be generated online or offline.	Page 26
■ Cardiac Output Module	The Cardiac Output Module allows for cardiac output calculations to be derived from a LabChart recording of a thermodilution curve.	Page 27



Scope View



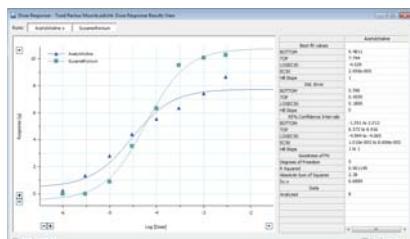
Spirometry



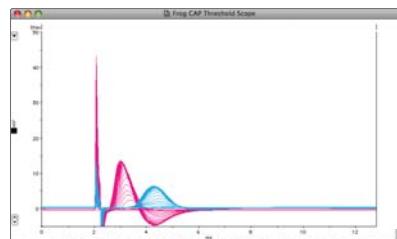
HRV

PowerLab data acquisition systems are supplied with both the Windows and Macintosh versions of LabChart software.

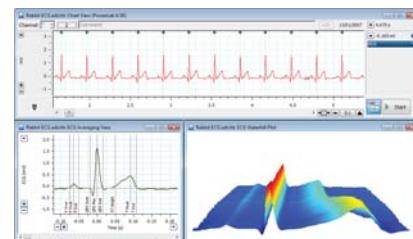
LabChart works with Windows Vista and XP and Mac OS X (Universal Binary).



Dose Response

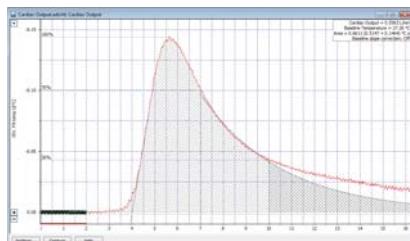


Scope

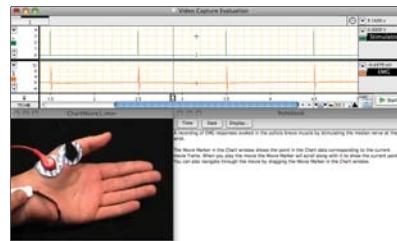


ECG Analysis

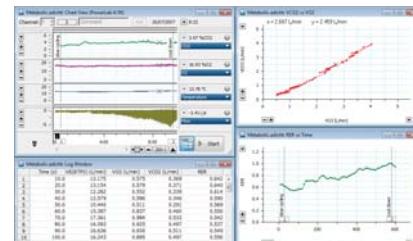
Software	Purpose	More Details
■ Metabolic Module	The Metabolic Module enables real-time acquisition and online or offline analysis of human metabolic parameters such as RER, V_{CO_2} , $\dot{V}O_2$ and $\dot{V}E$	Page 28
■ Dose Response Module	The Dose Response Module generates dose response curves and calculated values such as EC ₅₀ and Hill slopes within LabChart. It can be used in online or offline modes.	Page 29
■ Peak Analysis Module	The Peak Analysis Module provides automatic detection and analysis of multiple signal peaks in acquired waveforms. The module can be used in online or offline modes.	Page 30
■ Spike Histogram Module	The Spike Histogram Module allows the detection, discrimination and analysis of extracellular neural spike activity online or offline.	Page 31
■ Video Capture Module	The Video Capture Module is used to record and synchronize a video movie with a LabChart data file. This allows simultaneous playback and correlation between data and video recorded events.	Page 32
■ DMT Normalization Module	The DMT Normalization Module calculates the optimal pretension conditions for microvessels prior to commencing experiments using DMT wire myographs.	Page 33
■ Circadian Analysis Module	The Circadian Analysis Module analyzes data with a daily pattern. It generates graphical and tabular views of the daily and averaged circadian data.	Page 34
Scope	Scope software provides the functionality of a virtual oscilloscope or XY plotter (one or two channels displayed versus time or as XY plot). It is ideal for fast transient signals that are time-locked to a stimulus.	Page 36
GLP Client and GLP Server	In conjunction with LabChart software, GLP Client and GLP Server provide PowerLab users with an easy and reliable data acquisition solution for a GLP and 21 CFR Part 11 compliant environment.	Page 38
Education Software	Software ideal for a wide range of disciplines in both the community college and higher education institutions.	Page 40



Cardiac Output



Video Capture



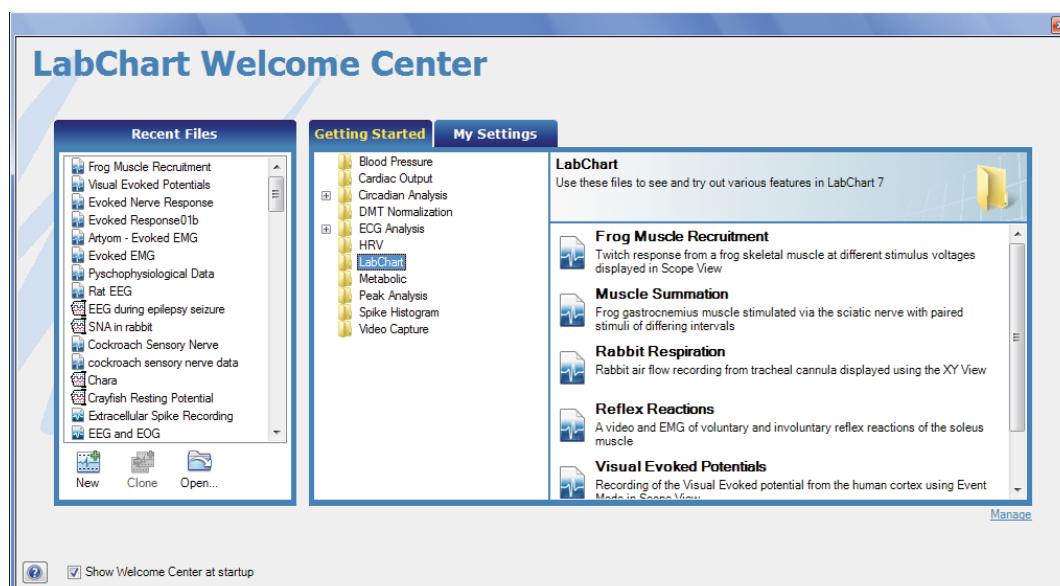
Metabolic



ADInstruments Welcome Center

LabChart 7 now features the Welcome Center, providing quick and easy access to all LabChart resources and materials. The easy-to-navigate interface opens when Labchart is launched. It features two menu panels: Recent Files and Gallery

- **Recent Files** — list the most recent documents opened, and allows opening of new and existing files, as well as cloning of file settings.
- **Gallery Panel** — includes tabs for getting started tutorials, experiments settings.



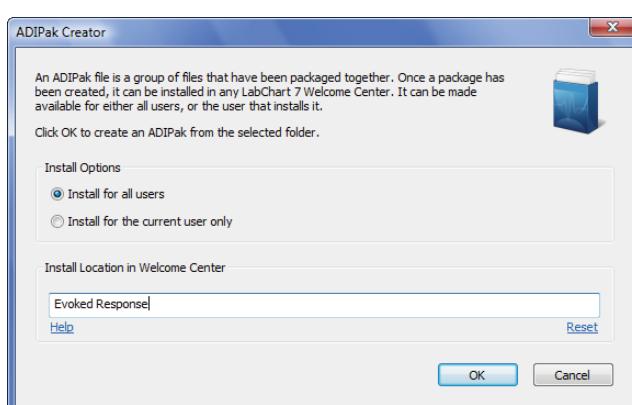
Features and benefits:

- LabChart data files, demo files, settings files, text files, documentation and multimedia files accessible through one interface
- Recent Files panel saves time and allows data files settings to be cloned
- Customize the Gallery panel to contain your desired tabs for easier access to related files
- Promotes good saving techniques when there are multiple users on the computer, for example students in a classroom laboratory.

LabChart Packages



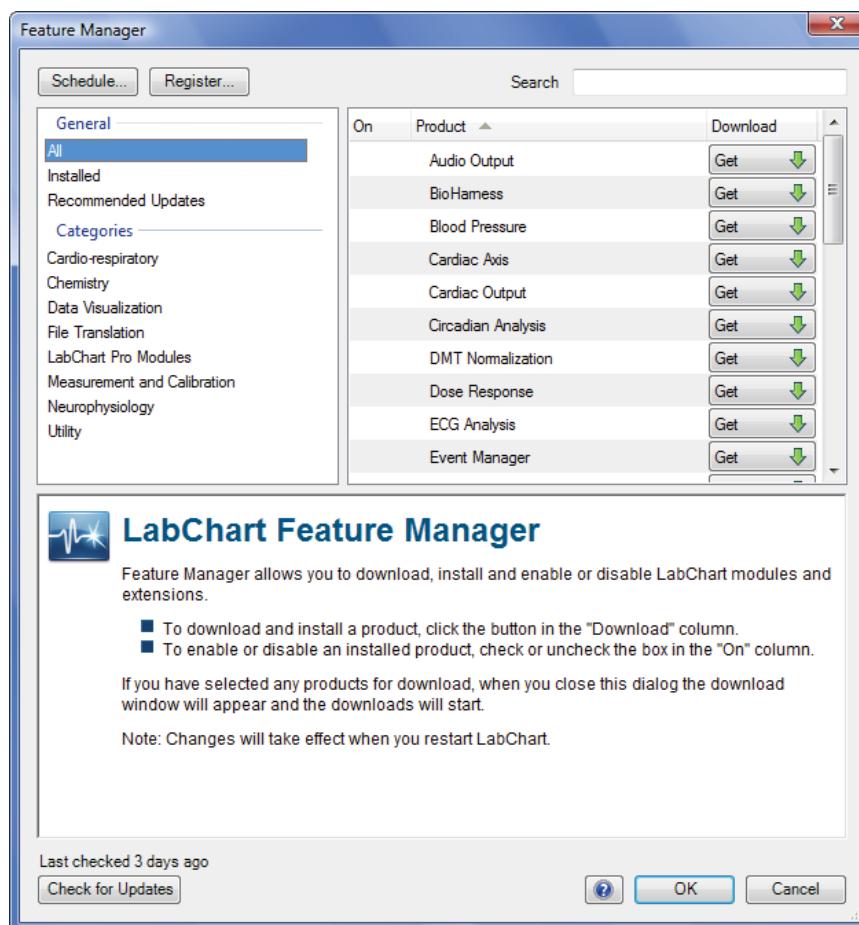
LabChart 7 for Windows users are now able to create ADIPak files for sharing content with other LabChart 7 users. Creation of user defined ADIPak is simple and content within an ADIPak is automatically installed into the welcome centre.



ADInstruments Feature Manager

Feature Manager allows you to browse and obtain any ADInstruments software using one interface. The entire list of available ADInstruments software including Modules and Extensions are now categorized in groups making it easier to find a product that suits your application. You can also look for relevant software using key terms in the search facility.

Feature Manager allows users to quickly turn LabChart extensions and modules on or off. This makes the program only load those features that are required. Manual or automatic software update checks can be performed to ensure you have the most up-to-date version of LabChart software and products.



Feature Manager allows you to:

- Browse the entire catalogue of LabChart software including modules and extensions according to scientific application categories and functions
- Search for suitable LabChart software using keywords
- Download and install any LabChart software
- Schedule or check for updates to get the latest software
- Register to gain free access ADInstruments software updates, teaching experiments, application notes and other resources



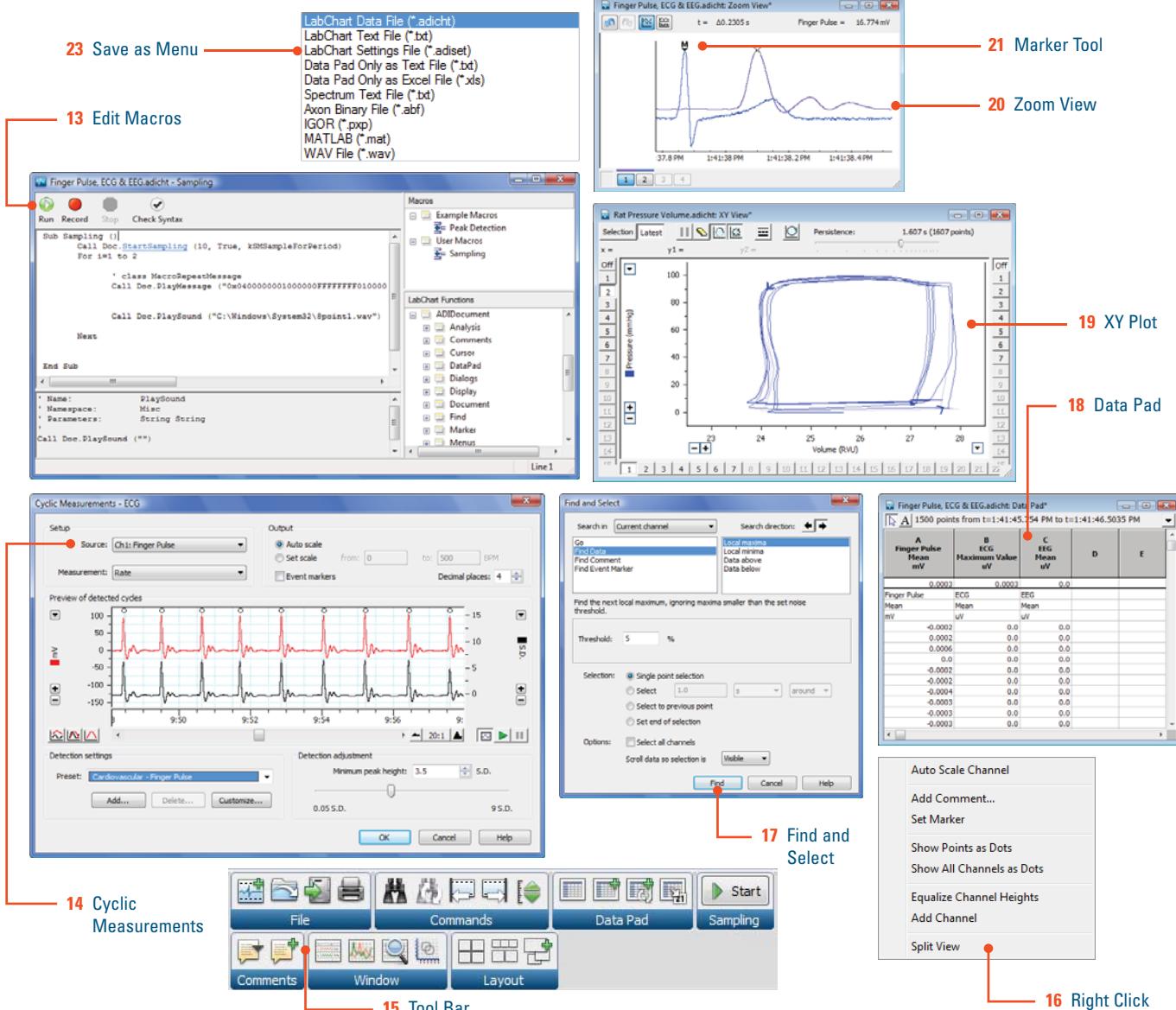
Key LabChart Features

The screenshot displays several windows from the LabChart software:

- 2 Multiple Block Sampling:** A callout points to a window titled "Data Buffering" showing recorded data and settings for "Calculated Data Smoothing of ECG".
- 3 Disk Buffering:** A callout points to the "Data Buffering" window.
- 4 Software-Controlled Settings:** A callout points to the "Input Amplifier" window, which shows real-time signal monitoring and settings like "Range: 500 mV" and "Low pass: Off".
- 5 Input Amplifier:** A callout points to the "Input Amplifier" window.
- 6 32 Channels with Variable Sampling Rates:** A callout points to the "Channel Settings" window, which lists 32 channels with various acquisition parameters.
- 7 Scope View:** A callout points to a separate "Scope View" window showing a digital oscilloscope interface.
- 8 Split Bar:** A callout points to a horizontal bar in the main chart area that separates two different data streams.
- 9 Customizable Comments:** A callout points to a comment box labeled "Finger Pulse" with the value "21.3 mV" displayed.
- 10 Channel Calculations:** A callout points to a context menu for the "Finger Pulse" comment, showing options like "Digital Filter...", "Integral...", "Shift...", "Smoothing...", and "Legacy".
- 11 DVM:** A callout points to the numerical value "21.3 mV" displayed in the comment box.
- 12 LabChart Modules & Extensions:** A callout points to a separate window titled "Dose Response - Toad Reticular Muscle.adcht: Dose Response Results View", showing a scatter plot of response vs log dose.

- Welcome Center:** Access LabChart files and resources quickly and easily within the one interface. (pg 4)
- Multiple Block Sampling:** Record multiple blocks of data with different sampling rates, filter settings and amplification, all within a single file.
- Disk Buffering:** Automatically store data in a buffer, protecting it even in the event of a power failure.
- Software-Controlled Settings:** Set all acquisition and analysis settings quickly and precisely using the software.
- Input Amplifier:** Select amplification, filtering, units conversion options and preview the signal in real time. (pg 8)
- 32 Channels with Variable Sampling Rates:** Record and analyze data on a maximum of 32 channels with independent sampling rates.

- Scope View:** Use the functions of a digital oscilloscope. Average and display up to 16 inputs, use channel calculations and extract parameters. (Windows only) (pg 12)
- Split Bar:** Split the Chart View to compare data recorded earlier with data being recorded in real time. (pg 13)
- Customizable Comments:** Add comments during or after recording. Following a recording you can easily find, edit, move and delete comments in the data file.
- Channel Calculations:** Perform calculations on any signal, online or offline, without losing raw data.
- DVM:** View a numerical display of the amplitude, sampling rate or calculated value of any signal in a stand alone, resizable mini-window. (pg 12)



- 12 LabChart Modules & Extensions:** Use a wide range of specialized software add-ons for fast and easy analysis.
- 13 Editable Macros:** Automate your recording and analysis with editable macros.
- 14 Cyclic Measurements:** Use a wide range of statistics and functions online and offline to analyze periodic or cyclic signals. (pg 17)
- 15 Toolbar:** Use the new toolbar to access your favorite features and customize the layout for optimum recording and analysis views.
- 16 Right Clicking:** Quickly access features in a LabChart channel with a click of a mouse button.
- 17 Find and Select:** Use the Find and Select function to locate data of interest quickly and accurately. (pg 15)
- 18 Data Pad:** Extract and log data and statistics to a spreadsheet manually or automatically. Data Pad supports OLE linking. (pg 16)
- 19 XY Plot:** Plot variables against each other to observe their relationship as XY or XYY displays.
- 20 Zoom View:** Magnify data view to obtain more detail. Features multiple zoom and history. (pg 13)
- 21 Marker Tool:** Mark a reference point on the recorded data and measure differences to that point. (pg 14)
- 22 Feature Manager:** Search and download ADInstruments software including Modules and Extensions. Schedule automatic or perform manual software updates. (pg 5)
- 23 Save As:** Save and export LabChart files as setting files, text files, Excel files or other proprietary data formats.



LabChart

LabChart software provides a range of powerful features that transcend the limitations of pen-and-ink recorders and 'do-it-yourself' data acquisition systems. It transforms your computer into a digital chart recorder with analysis features such as data extractions, arithmetic calculations, statistical analyses, data display and graphing options.

LabChart is supplied with all PowerLab systems for the latest Windows (Vista and XP) and Mac OS X computer operating systems.

LabChart can:

- continuously record and display up to 32 channels of data (up to 16 raw and up to 32 calculated signals)
- perform online or offline analysis
- display a range of specialized View windows including Scope View, Zoom View and XY View
- automatically recognize PowerLab models, amplifiers and smart transducers
- automatically export recorded values to other graphical or statistical packages
- ensure compliance with Good Laboratory Practice guidelines and FDA 21 CFR Part 11 regulations when used with GLP Client and GLP Server software (see page 34 for more details)

LabChart is continuously being developed and kept up to date with the latest operating systems and hardware technology, all catering to our customers' research needs.

Fast and Easy Set-up

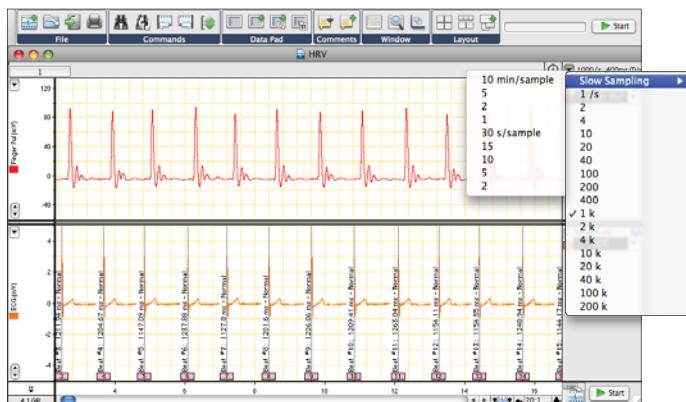
Input Amplifier

Easy set up using the Input Amplifier allows you to:

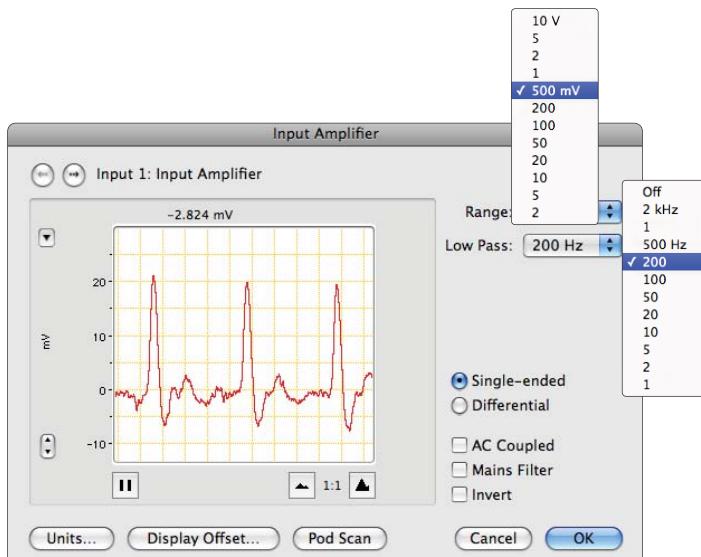
- preview the incoming signal and optimize the data recording
- select an appropriate recording range
- shift and stretch the vertical axis to optimize the display area
- remove unwanted drift and noise with high-pass and low-pass filters
- invert the signal and view any signal offset

Easy Units Conversion

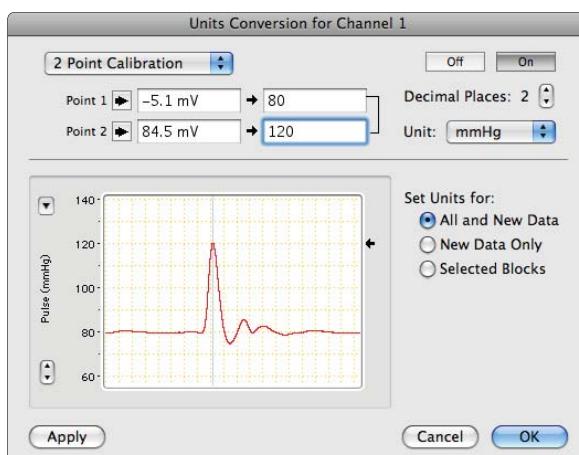
You can convert the input voltage signal to useful units such as mA, mmHg, pH, g, or any custom defined unit by performing a linear calibration using the Units Conversion dialog. The raw data is always kept and available for recall at anytime. For non-linear sensors, multipoint calibration of up to twelve points can be performed using the Multipoint Calibration Extension.



LabChart data file and Sampling Rate pop-up menu.



Input Amplifier dialog is used to optimize the data being recorded.



Units Conversion dialog.

Change Channel Settings in Seconds

You can quickly set up recording and display parameters for every channel from a single convenient location, using the Channel Settings dialog. The Channel Settings dialog can be used to:

- label channels with titles
- turn channels on or off
- adjust the signal input range
- select filters
- perform units conversion
- change the color or style of the data trace
- turn channel separators on or off
- select and set up channel calculations
- select independent sampling rate for each channel

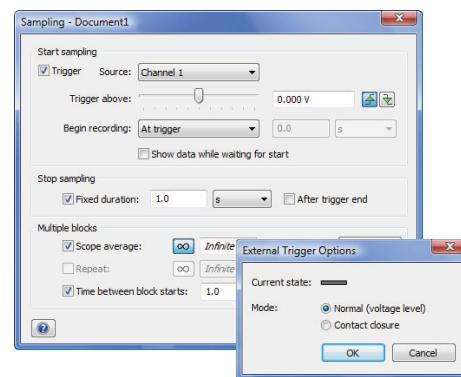


The Channel Settings dialog allows access to a range of dialogs for quick set up of channel parameters.

Triggering and Scope View Sampling

You can control how and when LabChart starts and stops recording. You can use the controls to set up the type of trigger event, any delay before recording, how many times to repeat triggering and how multiple blocks in Scope View are handled.

Starting and stopping a recording can be done using an external trigger signal, stimulator or by setting a threshold voltage to trigger from one of the recording channels. Pre-triggering and post-triggering options are also available.



Trigger dialog with pop-up menus.

Quick Stimulation Set-up

The Stimulator feature in LabChart provides software-controlled generation of a stimulus or series of stimuli (pulsed or stepped waveforms) through the PowerLab analog outputs or an isolated stimulator.

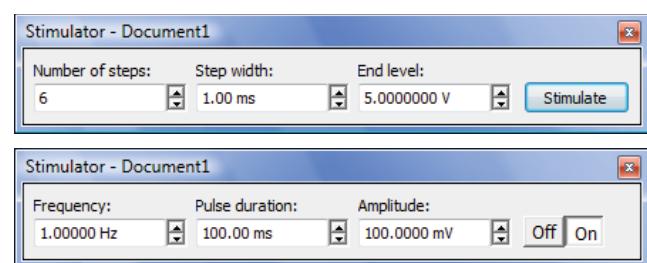
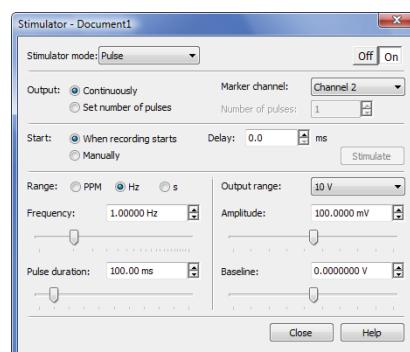
Stimulation Modes

The type of stimulus waveform generated is selected in the Stimulator dialog. The types of output waveforms can be selected in continuous or discrete waveform mode. Available waveform types may differ according to the hardware and software you are using.

Stimulator Panel

After setting stimulation parameters in the Stimulator dialog, you can easily start or stop the stimulation and change the settings while sampling, by using the Stimulator Panel mini-window.

The Stimulator Panel mini-window floats in front of the active Chart View window and can be moved around the screen, providing quick and easy control of stimulation parameters such as frequency, duration and amplitude.



Stimulator dialog (top) with Stimulator Panels for discrete (middle) and continuous (bottom) stimulation.

Recording Features

Data File Structure

The LabChart data file structure makes it easy to work with the file during and after recording. It also includes a number of data integrity features, providing you with a recording that you and your peers can trust. Benefits include:

- experimental settings automatically stored within the one data file
- a single file can contain multiple recordings of experimental data (Data Blocks) with different settings
- analysis settings, computations and comments are also stored within the file
- raw data is retained at all times
- data files can be appended
- disk buffering to protect your data even if power fails during recording

Adding Comments While Recording

Simply type in a comment and press 'Enter/Return' to add a quick note during or after the recording. You can also assign relevant phrases to particular Function keys to note when certain conditions are introduced to an experiment during recording.

Customizing Comments

You can Edit, Delete or Move comments in the Chart View. In addition, the Comment & Exclusions feature provides the list of all the comments made during the recording. It allows you to:

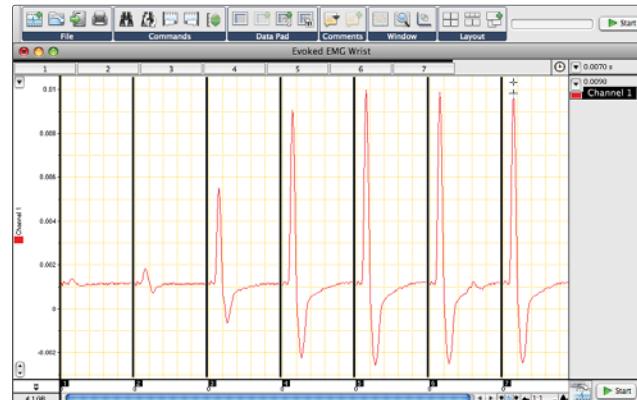
- search for comments using a word filter
- display the date and time of the comment
- modify or delete comments
- go to the location of a particular comment in the recording

Using Timed Events

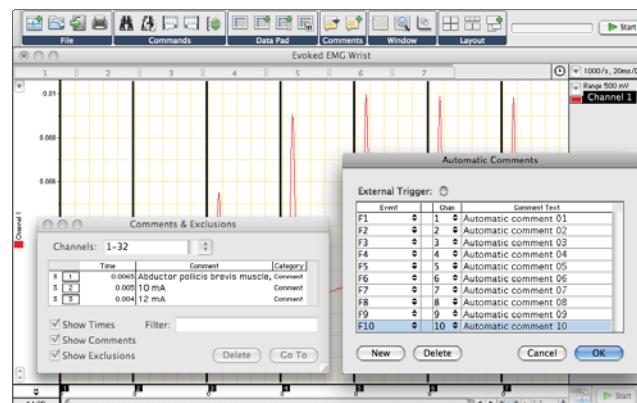
The Timed Events (Mac only) feature allows you to create a list of actions to be performed at stages during a recording. LabChart will perform the actions at the times you have specified. This is useful in long recordings with repetitive events. There are three types of events that can be chosen:

- setting a PowerLab output voltage
- adding a comment
- applying a digital output configuration which can turn switches (e.g. auto-injectors) on or off

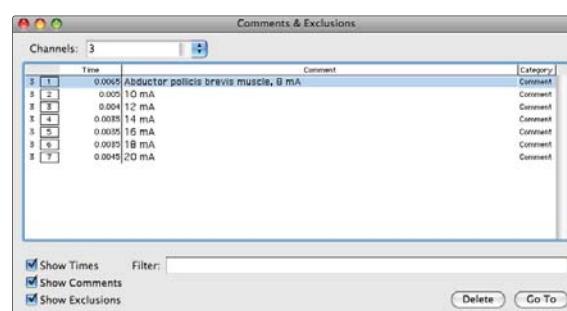
This feature can be replicated in LabChart for Windows using the Event Manager Extension.



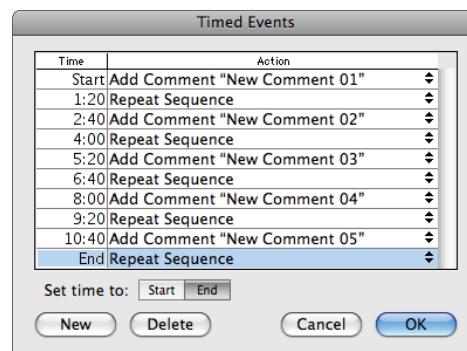
Single data file with several data blocks.



The Automatic Comments dialog (right inset) allows pre-setting of comments with function keys. The Comments & Exclusions dialog (left inset and below) lists and finds comments in the data file.



Comments & Exclusions.

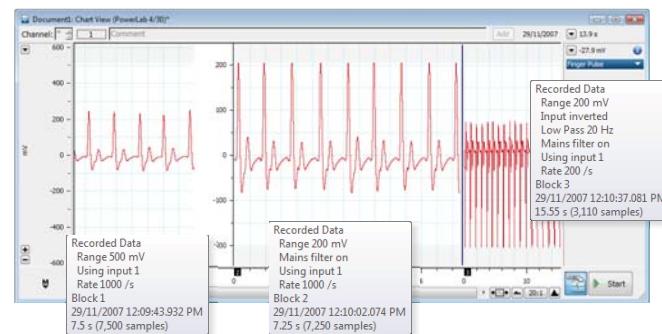


Timed Events dialog showing a list of selected actions.

Storing Recording Information

Recorded continuous data is saved within LabChart as a Data Block. Any number of experimental recordings can be performed and saved in a single data file. A Data Block indicates breaks in the recording as well as changes to experimental parameters. It contains recording information such as:

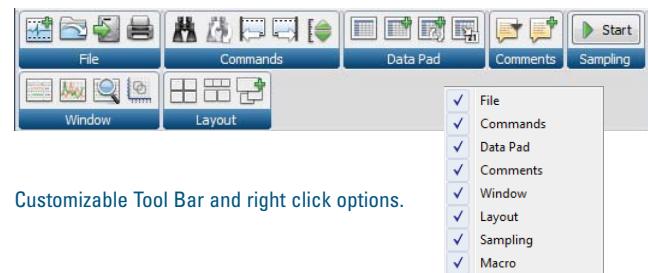
- recording range
- sampling rate
- channel number and Data Block number
- filters used
- date and time when the block was recorded
- number of samples



Multiple recordings and corresponding Data Block information.

Customizable Tool Bar

The customizable Tool Bar provides you with fast and easy access to the key LabChart features. Features displayed on the tool bar can be turned on or off by right-clicking over the tool bar and checking/unchecking the desired features.



Customizable Tool Bar and right click options.

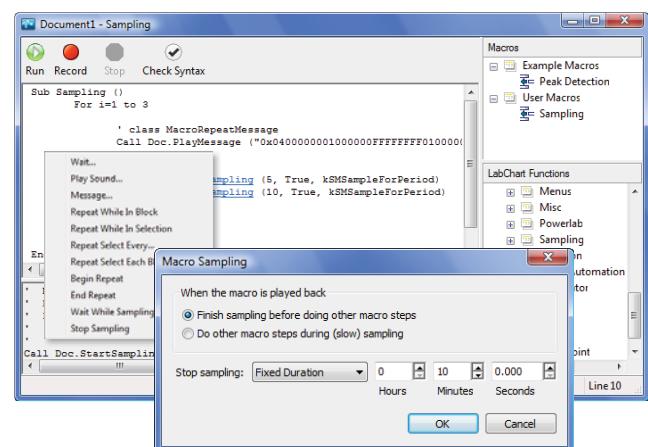
Right-Clicking Mouse Options

Channel functions can be accessed quickly by right-clicking the mouse over relevant panes of the channel in the Chart View. A function menu is brought up for the feature of interest.

Automating LabChart with Macros

Macros group a set of commands to speed up repetitive tasks and to automate recording and analysis. Simply record a Macro, save it, and use it at anytime. Commands available for selection during the recording of a Macro include:

- Wait...
- Play Sound...
- Message...
- Speak Message...
- Repeat Select Every...
- Begin Repeat
- End Repeat
- Set Units Conversion..., and many others.

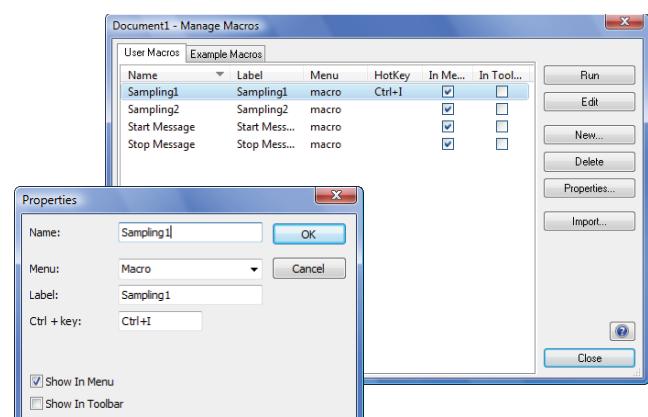


Macro script (top), Macro Commands (middle) and Macro Sampling dialog (bottom).

Easy Management of Macros

During the recording of a macro your actions in LabChart are captured. The recorded macro can be replayed at any time. You can easily manage your library of macros using the Manage Macros and Macro Properties dialogs. They allow you to:

- create, run and delete macros
- edit macros using Macro Scripting (Win)
- view macro properties
- import macros (Win)
- place a recorded macro in the menu or toolbar



Manage Macros dialog (top) and Macro Properties dialog (bottom).

Data Display Options

Scope View for Signal Averaging

Scope View allows your computer to function as a digital oscilloscope. Scope View provides multichannel averaging of signals in real time. You can perform simultaneous recording on Chart View and Scope View.

Features and benefits of Scope View include:

- Multi-channel signal averaging
- Unlimited sample and page numbers
- Recording of each sweep to a different page that can be averaged and overlaid for analysis
- Data extraction from Scope View using Data Pad
- Advanced, editable scripting to automate repetitive tasks
- Channel calculations support
- Configuration of sampling settings and data recording start/stop

Record data using either data blocks or events

- **Block Mode:** Pages are generated according to blocks created for each signals. A new block is created each time recording is started. The timing and triggering of blocks is controlled using the Sampling dialog
- **Event Mode:** Pages are generated based on the location of the event marker to generate a virtual sweep. Useful for analyzing and comparing elements of a periodic waveform

Channel Height Customization

The height of the channel (display area) can be quickly and easily reduced or enlarged by clicking and dragging the horizontal channel separators.

Amplitude Axis Adjustment

You can also use the Set Scale option to select the bottom and top range values of the scale, then fine tune the appearance of the signal by dragging or stretching the scale to make the most of the available display space. Axis options include:

- Auto scale
- Auto scale all channels
- Unipolar
- Bipolar
- Invert scale and data (Windows)

Display Signal Values in Real Time

The DVM window displays signal values in units calibrated for that channel. Values appear in a resizable window which can be placed anywhere on the screen.

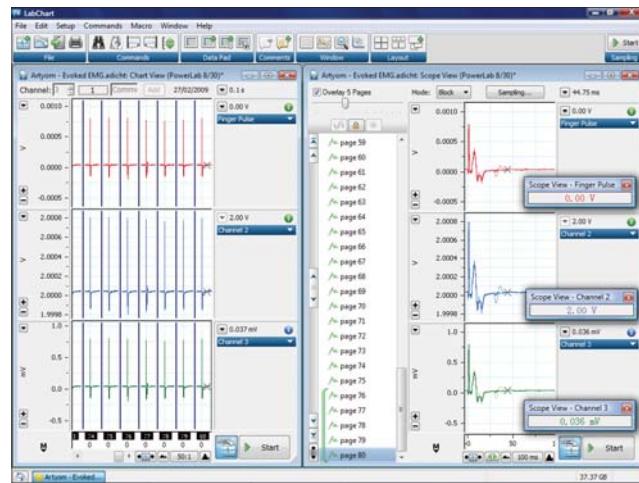
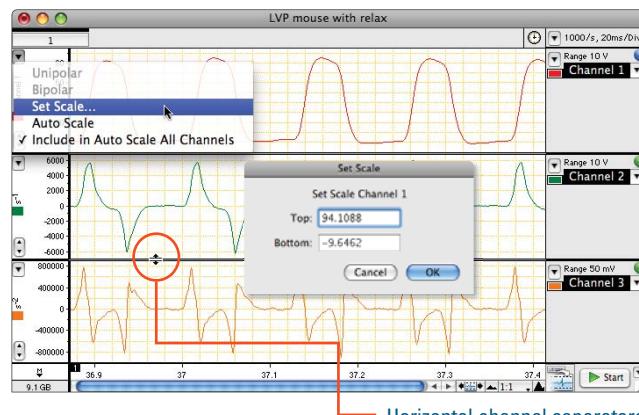
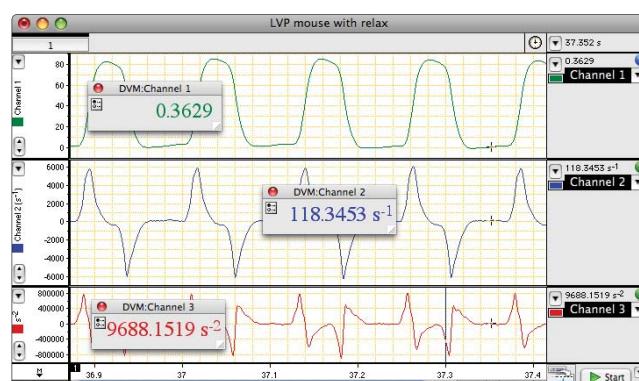


Chart View (left) and Scope View (right).



Horizontal channel separators and scaling options.



LabChart with DVM windows for easy viewing of numerical data.

Compare Data

Using the Split Bar you can divide the data display area vertically and compare sections of previously recorded data with data being currently acquired. You can use the Scroll buttons, in both panes of the Chart view, to review already recorded or live data.

Customizing LabChart

The following display options and recording controls can be customized:

- **Tool Bar** — customize the tool bar content
- **PowerLab Startup** — choose the mode PowerLab and LabChart start in
- **External Trigger** — select from voltage or contact closure modes
- **Waveform Cursor** — select one of four cursor shapes
- **Menus** — modify the menus and their commands
- **Keyboard Shortcuts** — add or change shortcuts
- **Controls** — activate or deactivate Start
- **License Manager** — manage your software licenses
- **Memory Cache** — set the amount of RAM that acts as a memory cache
- **Data Buffering** — choose where to store the data
- **Default Settings** — choose to save your experimental settings as start up settings
- **Feature Manager** — download, install and enable or disable LabChart modules and extensions

Zoom In on Recorded Data

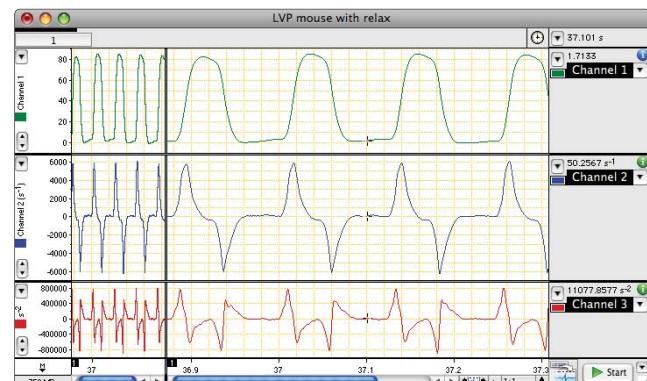
The Zoom View enlarges and displays sections of data for closer examination. Data from any number of channels can be overlaid or stacked. You can repeatedly zoom in further on the data by making repeated selections in the Zoom View and navigate back and forth between the multiple zooms using the History button.

The XY View

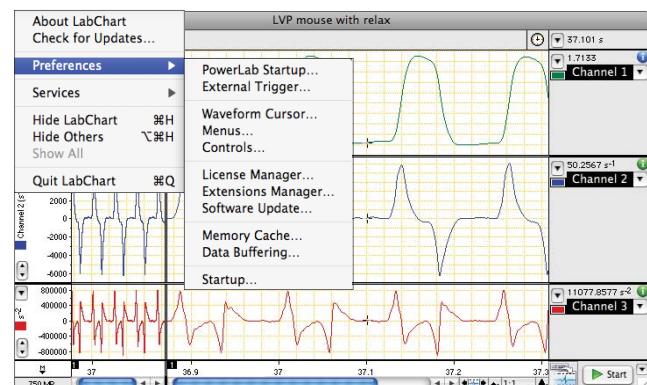
The XY View plots data in one channel against data from one or two other channels, online or offline. You can use this feature to establish the relationship between two parameters recorded at the same time.

Plotting periodical signals against one another may result in loops. The XY View incorporates loop features such as:

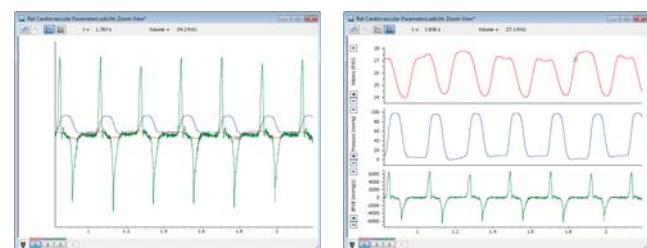
- direction arrows — to show the direction of the loops
- fade mode — to fade older loops
- loop analysis — to calculate the area of the loop (Win)



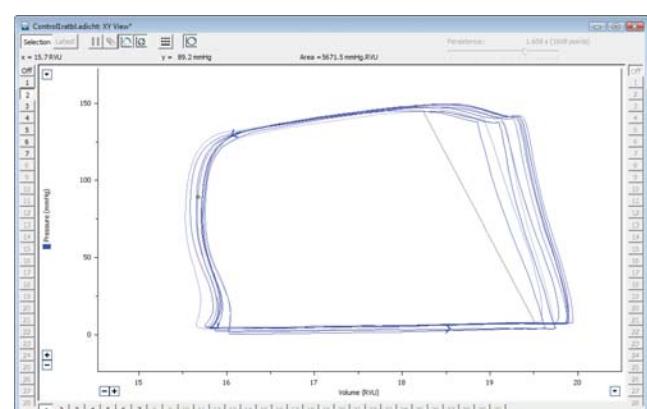
Dividing the display area by dragging the split bar.



Preferences menu listing several customizable features.



Selection from multiple channels enlarged in the Zoom View. Zoom displayed as an overlay (left) and stack (right).



XY View with ventricular volume versus pressure.

software

Spectrum

Spectrum uses discrete Fast Fourier Transform to convert data from the time domain to the frequency domain. You can use it to:

- observe and differentiate the frequency components of the signal
- estimate the main frequency component of your signal
- help set up filtering to remove any unwanted signal frequencies

Notebook

The Notebook feature allows you to type in notes before, during or after your experimental recording. The Notebook:

- keeps all your notes in the one data file
- can be recalled at any time
- unlike pieces of paper, is impossible to misplace

Movie View

The Movie View allows you to view video associated with LabChart data file captured using the Video Capture Module. You can control video play/pause option, watch synchronized view of movie with data file and use the Movie Marker to center the Chart View corresponding to the movie.

Organizing Layouts

The Layout feature allows you to customize and save your display in preferred layout option. These include:

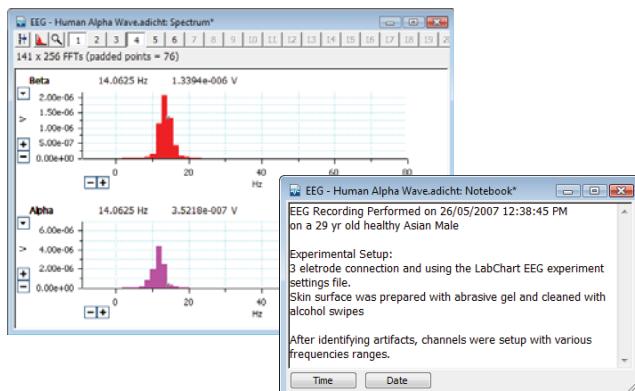
- Cascade
- Smart Tile
- Tile
- Arrange Icons
- Tile Mini Windows
- Close All Data Analysis Features

Waveform Cursor

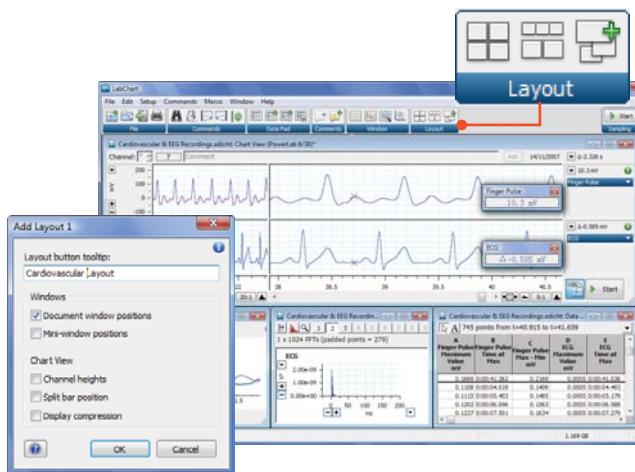
You can make instant discrete measurements by placing the Waveform Cursor over the data display area. The Rate/Time display shows the time at the cursor location, and the Range/Amplitude display for each channel shows the amplitude of the waveform.

Using the Marker Tool

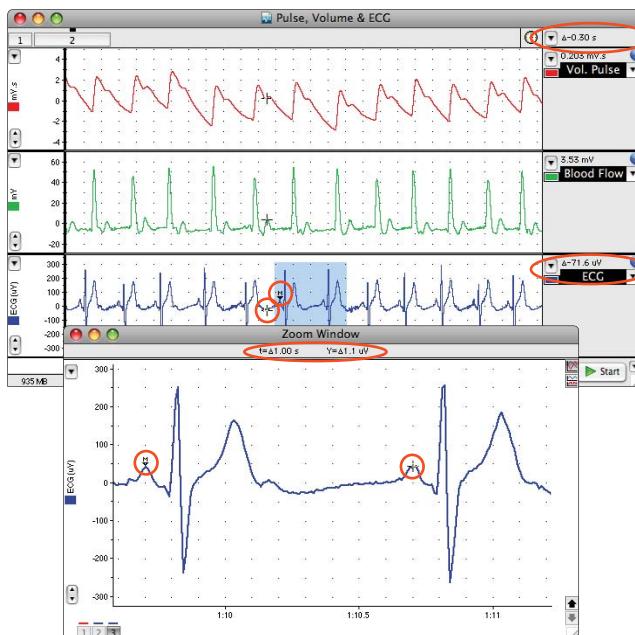
The Marker can be dragged and locked onto a waveform at a point of interest to make relative measurements with respect to its position. By moving the cursor along the waveform, on either side of the Marker, you can measure and display the relative time and amplitude difference to the cursor position.



Spectrum (left) and Notebook (right) features.



Customizable layouts to suit your needs.



The Marker can be used for making relative measurements in Chart (top) as well as Zoom Views (bottom).

This feature is also available when you enlarge the data using the Zoom feature. The Zoom Window is ideal for measuring the time or voltage difference between two points in one or two different waveforms.

Finding Data

You can quickly find specific points of interest within a data file using the Find and Select feature. Search and make selections on any number of channels based on your desired criteria. Available commands are:

- **Go** — go to a specific location on the data such as data block boundaries
- **Find Data** — find the peaks or troughs in the waveform
- **Find Comment** — search for specified comments
- **Find Event Marker** — search for markers (Win)

Repeatedly Finding Data

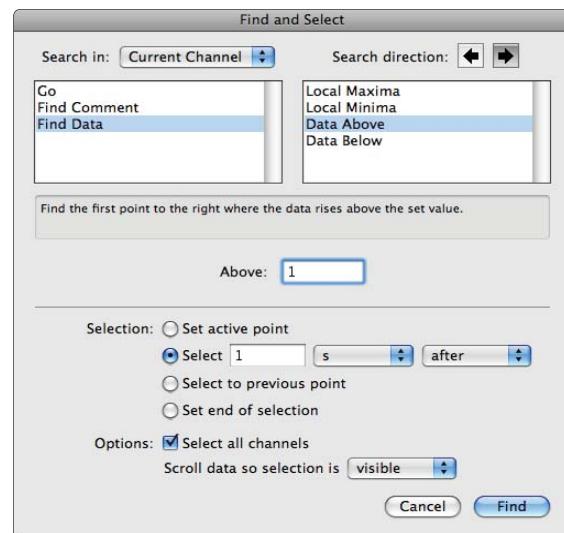
Once the find and select criteria have been set up, you can choose Find Next from the Commands menu, or use the Ctrl-F3 shortcut, to find and select the next such feature. You can repeat this command as required.

Data Transfer via Copying and Pasting

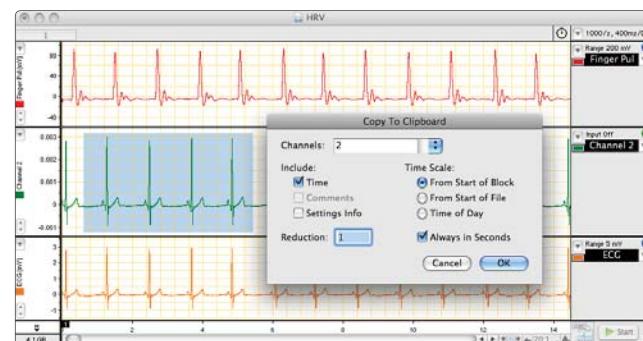
Instead of saving a selection, contents of the Data Pad, or an entire LabChart file as a standard .txt file, you can copy selected data to the Clipboard as data points or an image. Data points can then be pasted directly into the same or another LabChart file, or into a different application. Image files can be pasted into any suitable word processing, presentation, image processing or graphic design application.

OLE with LabChart for Windows

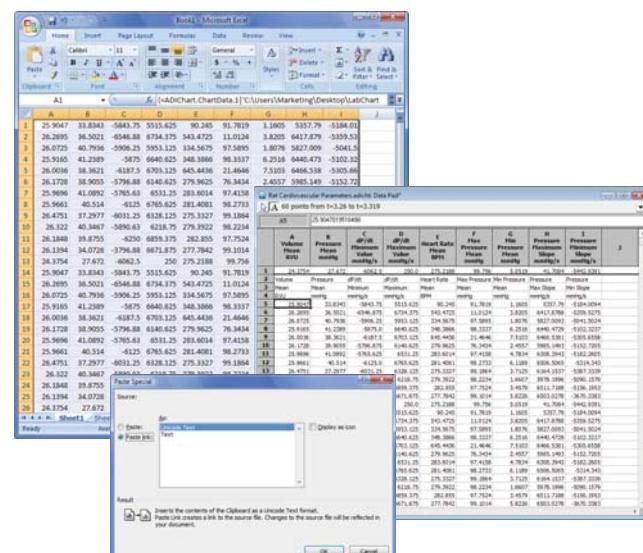
Incoming or already recorded values can be exported using other OLE client programs such as Excel. The link from LabChart to Excel is dependent so that any change to the data selection in LabChart will automatically update the values in Excel. OLE is available from the Chart View mode as well as from the Data Pad.



Find and Select Data dialog.



Copying and pasting data.



OLE linking allows data to be acquired and updated online or offline into other software programs such as Excel.

Analyzing Data with Data Pad

The Data Pad allows you to log raw signal points or calculated values from any channel into a table. You can automate the addition of values prior to recording using the ‘Timed Add to Data Pad’ feature which periodically logs data to the Data Pad as it is recorded. ‘Timed Add to Data Pad’ in conjunction with LabChart OLE linking allows real time plotting of X-Y curves in Excel to allow qualitative linear regression analysis. Alternatively you can select the data of interest after it has been recorded and simply choose the ‘Add to Data Pad’ command. The ‘Multiple Add to Data Pad’ command is another feature that can repeatedly extract values from recorded data.

Data Pad contents can be saved as a text file or be copied to other programs. Using OLE you can also export incoming values to Excel in real time.

Analysis options include:

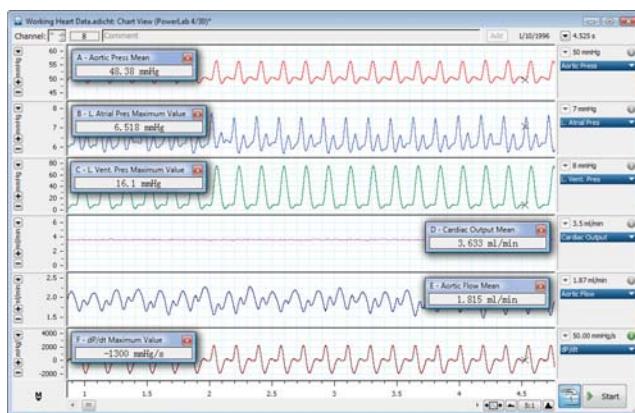
- **Statistics** — calculate the mean, SD, RMS, max and min value, time at max and min values and number of points
- **Selection & Active Point** — obtain the start time, end time, duration and number of points
- **Comments** — list time or value of active points, comments and comment numbers or times
- **Slope** — get the average slope value, max and min slope or time at max and min slopes
- **Integral** — calculate time integrals online or offline
- **Block Information** — obtain the range, sample interval, block number, block duration, samples in block, start time, start date and sampling rate
- **Cyclic Measurements** — extract periodic parameters from waveforms including frequency, rate, mean, min and max, 1/3 max + 2/3 min, height, integral, variance, min and max derivatives
- **XY Loop Calculations** — calculate the area inside the XY loop, x or y value and slope at the reference point in XY loop, minimum and maximum x or y value, time at minimum and maximum x or y value, and mean of x or y value in XY loop in the XY View
- **Scope** — obtain page number, page duration and page start time containing the active point or selection from Scope View

Quick Help Features

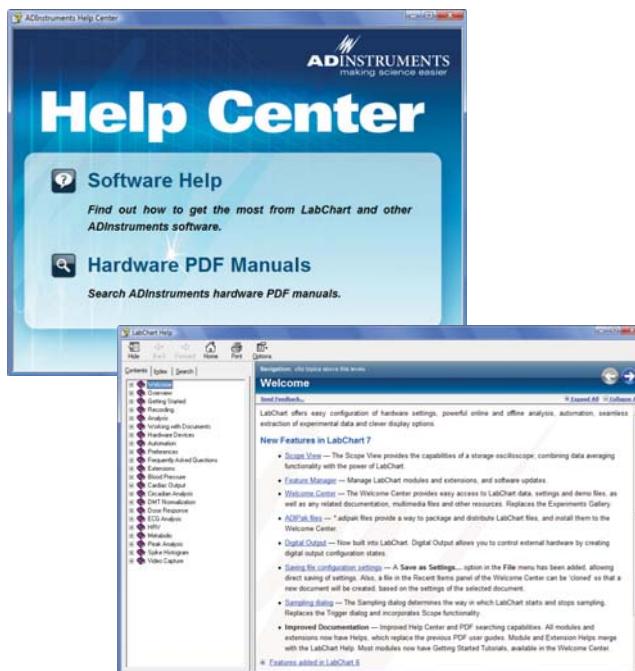
LabChart's Help Center, accessed through the main Menu, provides you with Online Help (Windows only) topics cover LabChart as well as all Extensions and Modules. LabChart Modules feature step-by-step tutorials. There are also links to our website and contacts for our worldwide distribution and support network.

A	B	C	D	E	F	G	H	I	J
Aortic Press Mean	Aortic Press Maximum Value	Aortic Press Minimum Value	L_Atrial_Press Mean	dP/dt Maximum Value	dP/dt Minimum Value	L_Vent_Pres Mean	L_Vent_Pres Maximum Value	Cardiac Output Mean	Aortic Flow Maximum Value
49.687	47.4024	47.4024	47.4024	4.0174	2450.0008	2450.0012	70.4	4.6	3.9824
Aortic Press Mean	Aortic Press Maximum Value	Aortic Press Minimum Value	L_Atrial_Press Mean	dP/dt Maximum Value	dP/dt Minimum Value	L_Vent_Pres Mean	L_Vent_Pres Maximum Value	Cardiac Output Mean	Aortic Flow Maximum Value
Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Maximum	Maximum
mmHg	mmHg	mmHg	mmHg	mmHg	mmHg	mmHg	mmHg	ml/min	ml/min
mmHg	mmHg	mmHg	mmHg	mmHg	mmHg	mmHg	mmHg	ml/min	ml/min
49.5119	48.3778	48.3778	48.3778	4.3217	2250.0	1899.9997	74.9	2.7	3.8135
51.0771	48.3778	48.3778	48.3778	4.3117	2250.0	1899.9997	74.8	2.7	3.8075
51.1449	48.3295	48.3295	48.3295	4.4417	2250.0	1899.9997	74.8	2.7	3.8193
51.1574	48.3779	48.3779	48.3779	6.3052	2300.0012	1890.0004	75.0	2.8	3.8165
51.1607	48.4206	48.4206	48.4206	6.3232	2300.0012	1899.9997	75.0	2.8	3.8189
51.1881	48.4206	48.4206	48.4206	6.3777	2300.0012	1899.9997	75.2	2.9	3.8059
50.3036	48.4206	48.4206	48.4206	6.3781	2250.0	1899.9997	74.8	2.8	3.8136
51.0529	48.4206	48.4206	48.4206	6.3962	2300.0012	1899.9997	75.2	2.8	3.8124
51.0599	48.4206	48.4206	48.4206	6.3996	2300.0012	1899.9997	75.2	2.8	3.8126
51.0940	48.4206	48.4206	48.3019	2299.9993	-2900.0015	74.9	2.8	3.8128	2.3854
51.0963	48.4206	48.4206	48.3977	2299.9993	-2900.0015	75.7	2.7	3.8051	2.3559
51.2467	48.4206	48.4206	48.3977	2299.9993	-2900.0015	75.1	2.8	3.8024	2.3524
51.4793	48.3779	48.3779	48.3779	6.3294	2250.0	1899.9997	75.3	2.7	3.8094
51.7973	48.3779	48.3779	48.3779	6.3128	2300.0012	1890.0015	75.2	2.8	3.8049
50.3018	48.3779	48.3779	48.3779	6.3804	2250.0	1899.9997	75.1	2.8	3.8167
50.3069	48.4206	48.4206	48.4206	6.3959	2300.0012	1899.9997	75.1	2.8	3.8129
51.1114	48.4206	48.4206	6.2721	2300.0012	1899.9997	75.4	2.8	3.8085	2.1463
51.1151	48.4743	48.4743	48.4743	6.2971	2299.9993	1899.9997	75.2	2.8	3.8093
51.1292	48.4743	48.4743	48.4743	6.3414	2299.9993	1899.9997	75.3	2.8	3.8094
51.1949	48.4743	48.4743	48.4743	6.4848	2300.0012	1899.9997	75.1	2.8	3.8042
51.1949	48.4743	48.4743	6.4286	2300.0012	1899.9997	75.5	2.8	3.8081	2.3879
51.7009	48.4743	48.4743	6.3744	2299.9993	-2900.0015	75.6	2.9	3.8995	2.1268
51.7009	48.4206	48.4206	6.3744	2299.9993	-2900.0015	75.7	2.8	3.8059	2.3509
50.3089	48.4206	48.4206	6.4268	2299.9993	-2900.0015	75.2	2.9	3.8059	2.3539
51.0218	48.4743	48.4743	6.4455	2299.9993	1899.9997	75.6	2.8	3.8073	2.3897
51.1293	48.5226	48.5226	6.3125	2298.0002	1899.9997	75.2	2.8	3.8088	2.3879
51.1722	48.4743	48.4743	6.3712	2299.9993	-2900.0015	75.4	2.8	3.8127	2.3826

Data Pad with extracted and calculated blood pressure parameters.



LabChart Window with floating Data Pad mini-windows.



LabChart Help dialogs.

Channel Calculations

This feature allows you to apply calculations to data channels online or offline. The following channel calculations are built into LabChart:

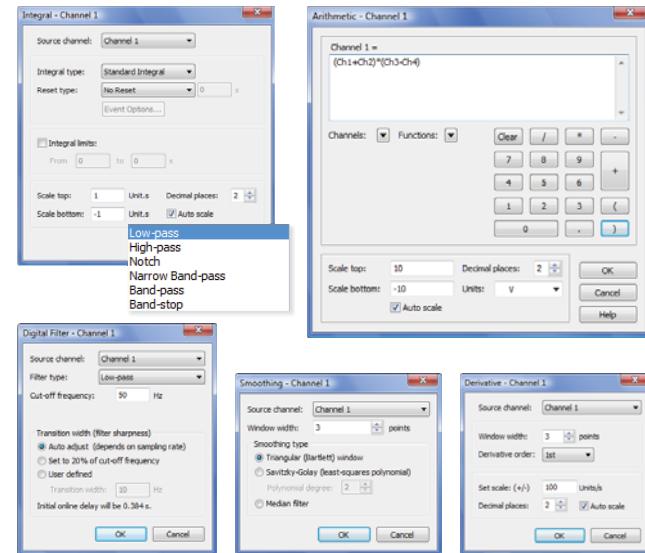
- **Arithmetic** — mathematically manipulate data in channels using algebraic, trigonometric, logarithmic, noise and filtering functions.
- **Cyclic Measurements** — analyze periodic waveforms to derive functions such as rate, period and frequency as well as cyclic mean, maximum, minimum and height
- **Derivative** — display the first and second derivative
- **Digital Filter** — select from six online or offline filter types: low-pass, high-pass, notch, narrow band-pass, band-pass and band-stop
- **Integral** — measure areas under waveforms
- **Smoothing** — remove unwanted high frequencies and noise from a waveform
- **Shift** — shift data in a channel backwards or forwards in time

Cyclic Measurements

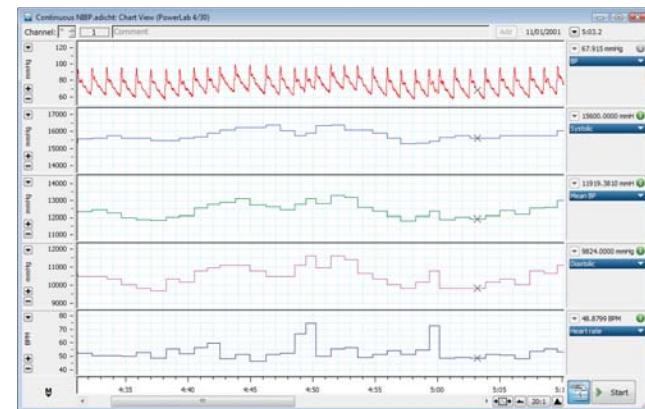
Cyclic Measurements provide powerful processing of periodic waveform signals as they are being recorded, converting raw data from one channel to computed data displayed in another.

Following measurements are available:

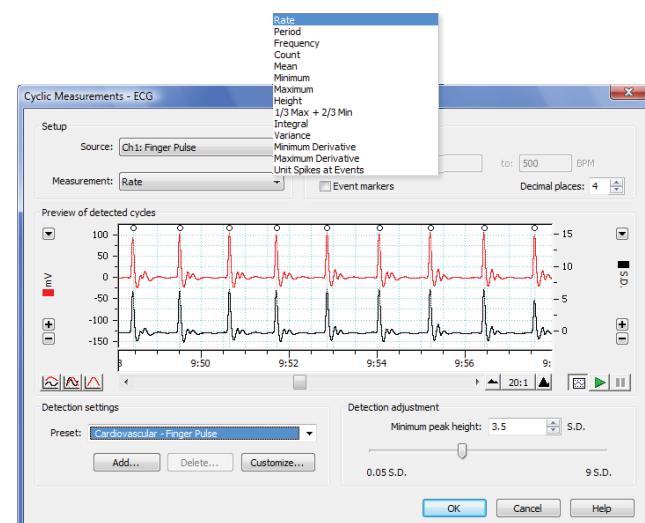
- **Rate** — calculate rates e.g. heart rate from ECG or pulse
- **Period** — measure time taken to complete a cycle
- **Frequency** — calculate event frequencies
- **Count** — counts number of events or cycles
- **Mean** — derive the mean of a cyclic waveform
- **Min, Max, 1/3 Max + 2/3 Min** — use these, for example, to calculate the diastolic, systolic and mean BP from an arterial blood pressure trace
- **Height** — calculate maximum minus minimum height
- **Integral** — measure areas under waveforms
- **Variance** — detect variance of values within a given cycle of a waveform
- **Min and Max Derivative** — calculate minimum and maximum derivatives in a given cycle of a waveform
- **Unit Spikes at Events** — place markers on a second channel where a peak occurs on the input channel



Dialogs of some of the calculation functions available in every channel.



Channel Calculations using the raw data from channel 1 to calculate heart rate, systolic, diastolic and mean pressure on other channels.



Cyclic Measurements enable online or offline analysis of waveforms.



LabChart Extensions

LabChart Extensions add specific features and functionality to LabChart software and are available free of charge to all LabChart users. LabChart Extensions are available to download from the Software Updates section of our website.

LabChart Extensions

File Translation:

- Export MATLAB
- Export Axon
- Export QuickTime
- Export Igor
- Export WAV
- PVAN
- Read Acqknowledge
- Translate Binary
- Translate EDF

Neurophysiology:

- RMS & Noise
- Evoked Response
- Fast Response Output
- Template
- Telegraph

Filtering:

- RMS & Noise
- Savitzky-Golay
- Signal Averaged ECG (SAECG)

Cardio-respiratory:

- Spirometry
- Signal Averaged ECG (SAECG)
- Cardiac Axis
- Ventricular Pressure
- XY Plot

- **Absorbance** — convert spectrophotometer outputs from Transmittance to Absorbance
- **Amplitude Histogram** — display and analyze the amplitude distribution of a signal (allows for definition of bin width and additional analysis such as mean, standard deviation and standard error)
- **BioHarness** — allows the recording of comprehensive physiological data using ADInstruments Zephyr Technology Ltd BioHarness hardware in real time and data logging mode
- **Cardiac Axis** — automate the calculation of frontal plane ECGs and vector cardiograms and display of the instantaneous cardiac vector
- **Curve Fit** — perform non-linear, least squares fitting of built-in and user-defined equations to data that has been recorded as a function of time
- **Digital Output** — allows the simple management of the digital output bits for PowerLab models that provide a digital output (26T, /30 series, 4/SP, 8/SP, 16/SP and 4/ST)
- **Evoked Response** — analyze physiological responses to a stimulus; parameters include value, latency, peak height, half-width, latency to peak
- **Event Manager** — monitor user defined events online using numerous criteria and perform a variety of user defined actions
- **Export Axon** — save LabChart files in the ABF (Axon binary format) which can be read by pClamp
- **Export IGOR** — export LabChart data files in a form that can be directly read by the graphing analysis package IGOR Pro
- **Export MATLAB** — save LabChart data files in a format that can be opened and read by the MATLAB® analysis package
- **Export QuickTime** — save LabChart data files as QuickTime® movies for viewing using any QuickTime supported platform. Or for use in multimedia presentations
- **Export WAV** — export LabChart for Windows files as uncompressed audio WAV files (Audio WAV files can be played by a number of industry-standard applications)
- **Fast Response Output** — control the digital outputs on 30 series PowerLab units and analog outputs on 20, 25 and 30 series PowerLab units for generation of rapid responses from within the PowerLab
- **Function Generator** — create data by using mathematical functions
- **Multipoint Calibration** — perform linear and non-linear multipoint calibration of transducers, sensors, and other devices
- **Peak Parameters** — determines a number of parameters including peak height, width and slope for an individual peak. Useful for determining parameters of action potentials such as cardiac potentials, EPSP and IPSP

Please note that not all extensions are available for both Windows and Mac operating systems and that some extension features may differ between computer platforms. See our website for a current list and any new extensions.

- **pH Measurement** — allows calibration of pH and ion selective electrodes using single or double point methods
- **Play Sound** — allows selected LabChart data to be played as sound
- **PVAN** — export LabChart Pressure and Volume data directly into the Millar® Instruments PVAN application
- **Audio Output** — play back recorded LabChart data as sound
- **RMS & Noise** — determine the power content of a signal (the RMS gives total power content, including the DC component; Noise gives the AC component only)
- **Read AcqKnowledge** — provides easy means to import BIOPAC® AcqKnowledge® (.acq) files into LabChart
- **Savitzky-Golay** — perform offline least-squares smoothing especially suited to removing noise from data such as ECG and differential calculations
- **Scheduler** — allows the scheduling of recordings across one or more LabChart data files. Can also be used with external scheduling devices such as the TR Scheduler Pod
- **Signal Averaged ECG** — use SAEKG to analyze ECG signals and display an averaged cycle, hence removing noise and unwanted signal components
- **Shift** — shift data backwards or forwards in time
- **Spirometry** — process signals from pneumotachometers and display respiratory parameters such as \dot{V}_E , V_T , Frequency, PIF, PEF, FVC and FEV₁, as well as generating flow volume plots and spirometry reports
- **STM** — display the amplitude of the frequency components of a signal as a function of time (a spectral-temporal map), allowing you to determine regions where a particular frequency is dominant and to correlate this with other signals, (applications include heart or lung sounds, sleep apnea, voice studies, EEG and electric motor resonance frequencies)
- **Telegraph** — use of the gain-telegraph output from an electrophysiological amplifier to display data at the correct scale after a gain change
- **Template** — match a data template with similar occurrences in a larger data set, (Template provides a choice of three different algorithms – RMS Error, Correlation or Convolution)
- **Translate Binary** — save and export LabChart for Windows data files in a simple binary format or import binary documents that have either been exported from LabChart or generated by another application
- **Translate EDF** — save LabChart data as an EDF (European Data Format) file and read EDF files
- **Ventricular Pressure** — analyze recordings of cardiac ventricular pressure
- **XY Plot** — display a real-time XY window that plots one channel of data against another while sampling

LabChart Extensions

Utility:

Audio Output
Digital Output
Event Manager
Export QuickTime
Fast Response Output
Play Sound
Scheduler
Shift
Telegraph
Template

Data Visualization:

Amplitude Histogram
Spectral Temporal Mapping (STM)
Telegraph
Peak Parameters

Measurements & Calibrations:

Multipoint Calibration
Absorbance
Evoked Response
Spirometry
Ventricular Pressure
Template

Chemistry:

Absorbance
Multipoint Calibration
Curve Fit
pH Measurement

Analysis Windows:

Amplitude Histogram
Curve Fit
Spectral Temporal Mapping (STM)
XY Plot



LabChart Reader

LabChart Reader is a free application program that allows individuals that do not own a PowerLab data acquisition system and/or LabChart to view LabChart as well as Chart 5 data files. The program includes all standard LabChart analysis and display features. However, advanced analysis with LabChart Modules and Extensions, as well as file saving are only available with the full version of LabChart software.

LabChart Reader Benefits

LabChart Reader allows you to:

- collaborate with other scientists easily
- used by students to view and analyze real experimental/research data
- provide data files to publishers/reviewers
- make data files available through file downloads from your website

LabChart® Reader

is available for:

Windows Vista & XP

Mac OS X

Save as LabChart File



LabChart data file

Distribute File

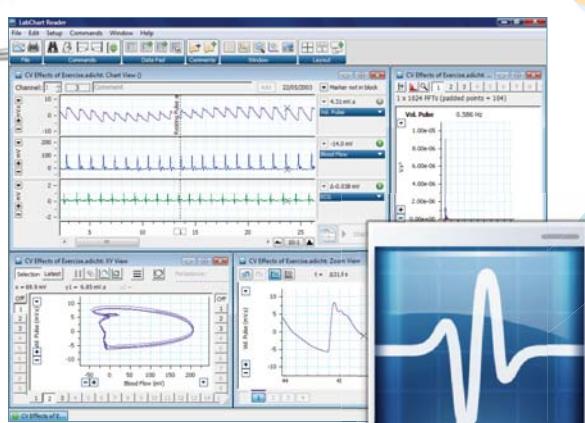
- ✓ Email
- ✓ CD/USB
- ✓ Website
- ✓ Presentations
- ✓ Education

Open File

Examples of distribution and use

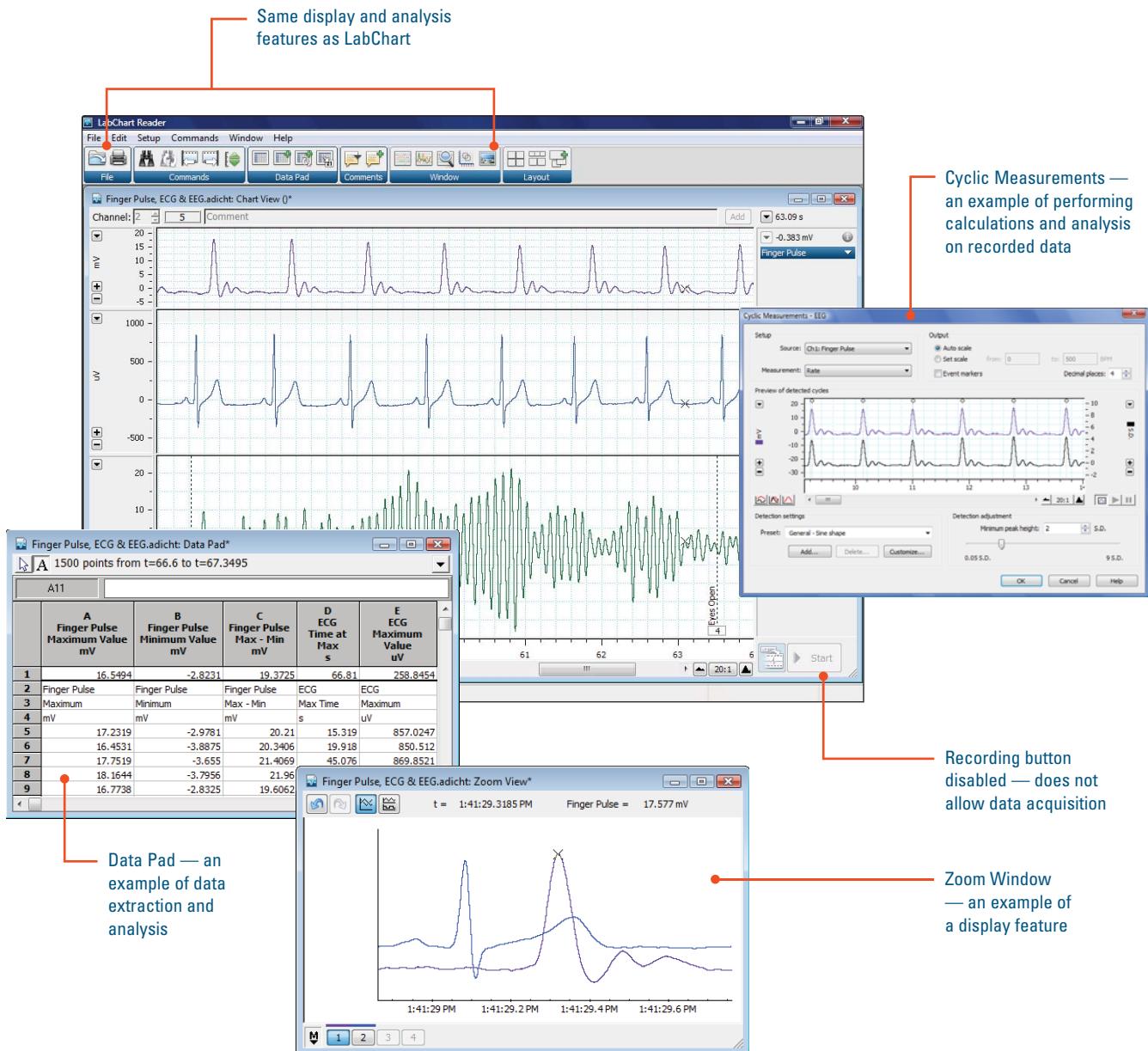


PowerLab data acquisition system with LabChart



View and analyze data in LabChart Reader

LabChart Reader Features



With LabChart Reader you can:

- Open LabChart data files and view recorded data
- Perform calculations and analyses
- Analyze data
- Print data

A full version of LabChart is required to:

- Record new data
- Open other file formats
- Save data
- Use our advanced analysis extensions and modules

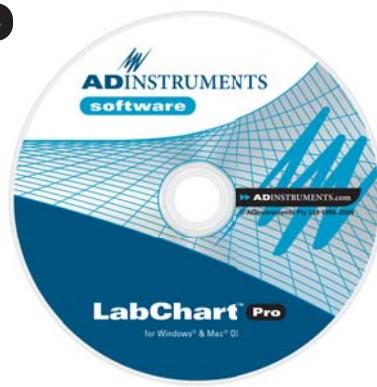
LabChart Pro and LabChart Modules

LabChart modules provide highly specialized data acquisition and analysis features for specific applications. Examples include Blood Pressure, ECG Analysis, Dose Response and Video Capture. The modules are available for purchase as a complete set in LabChart Pro or individually. LabChart Pro users are entitled to free software updates for five (5) years.



LabChart™ Pro

LabChart and Scope Software
Blood Pressure
HRV
Cardiac Output
ECG Analysis
Metabolic
Dose Response
Peak Analysis
Spike Histogram
Video Capture
DMT Normalization
Circadian Analysis



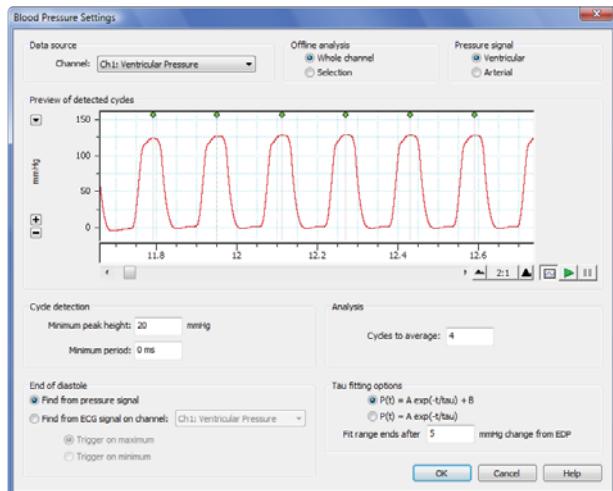
Blood Pressure

Windows

The Blood Pressure Module allows you to identify and analyze various parameters of arterial and ventricular pressure online or offline.

Analysis settings can be set prior to (for online analysis) or after recording (for offline analysis). The Blood Pressure Settings dialog allows the selection of:

- the pressure signal to be analyzed (arterial or ventricular)
- cycle detection parameters
- cycle averaging options
- end of diastole and tau fitting options (ventricular pressure only)



Blood Pressure Settings dialog.

For ventricular pressure signals, the end of diastole can be identified using either the pressure signal, or an ECG signal that is synchronized with the pressure signal. The time constant (Tau) provides a measure of the of isovolumic relaxation of the heart.

Once the detection and analysis settings are selected:

- pressure cycles are automatically identified and marked in the pressure trace
- marked cycles contain information such as cycle time, number, duration and height

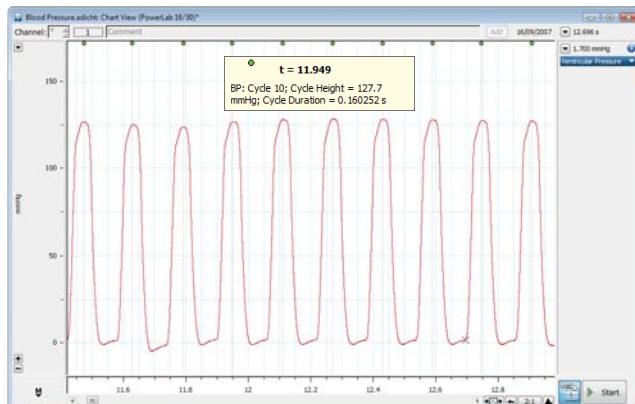
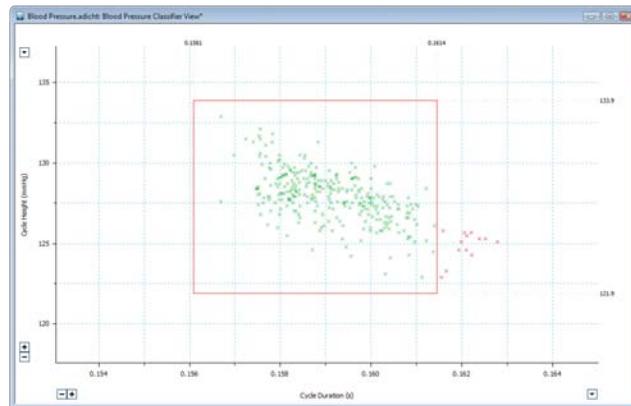


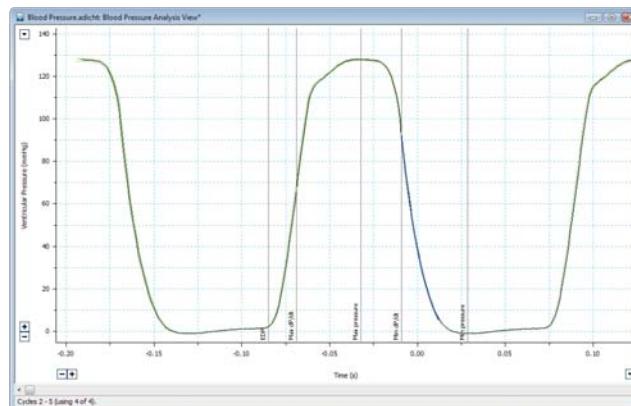
Chart View of a ventricular pressure recording. Note Cycle Markers above the trace and cycle information pop-up.

You can use the Classifier View to identify cycles that differ in duration or height, and to include or exclude any cycle groups from the analysis.



Blood Pressure Classifier View. Points outside the cycle height and duration limits (red crosses) are not included in the analysis.

The Analysis View displays groups of averaged cycles and highlights key parameters calculated by the module. Averaging takes the number of cycles specified in the Blood Pressure Settings dialog and calculates an average cycle. Cycle averaging creates a more accurate representation of the blood pressure waveform in the presence of noise or interference.



Blood Pressure Analysis View displaying a ventricular pressure cycle.

The parameters marked on a ventricular cycle are:

- end diastolic pressure
- maximum dP/dt
- maximum pressure
- minimum dP/dt
- minimum pressure
- Tau

The parameters marked on an arterial cycle are:

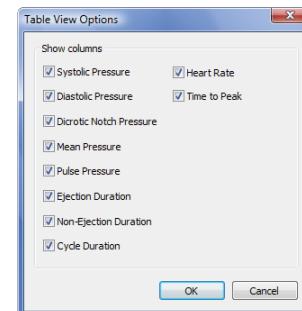
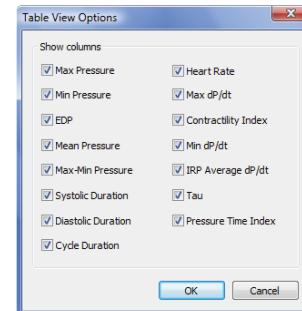
- diastolic pressure
- systolic pressure
- dicrotic notch

The Table View displays a wide range of calculated parameters for each averaged cycle. The contents of the Table View can be exported for further analysis.

	Time (s)	End Pressure (mmHg)	EDP (mmHg)	Max-Min Pressure (mmHg)	Cycle Duration (s)	Heart Rate (BPM)	Max dP/dt (mmHg/s)	Contractility Index (UI)
1	10.0000	127.700	1.30000	128.700	0.159000	377.391	6475.00	93.4417
2	11.1120	125.450	1.42500	127.475	0.159542	376.077	6317.50	96.0566
3	11.9460	127.850	2.90000	128.790	0.159618	375.897	6525.00	89.8141
4	12.9900	126.470	1.62500	128.714	0.159804	377.388	6405.00	89.9824
5	13.7070	127.451	2.90000	128.772	0.159349	376.772	6405.00	82.8849
6	13.8620	127.306	2.20000	128.596	0.157980	376.793	5375.00	81.6000
7	14.4980	127.301	2.17500	128.207	0.159146	377.013	6450.00	91.7497
8	15.1300	128.376	2.22500	128.626	0.158069	376.562	61.3048	91.3048
9	15.2820	128.379	1.45000	129.311	0.158361	376.453	6475.00	96.0452
10	16.3960	130.579	2.63000	131.280	0.157942	380.482	6350.00	93.3714
11	17.0290	129.752	2.18000	131.163	0.158360	376.882	6367.50	100.842
12	17.4410	128.980	2.47500	130.785	0.157792	380.343	6623.00	80.8913
13	17.8530	128.482	1.45000	129.512	0.158352	377.472	6475.00	88.5783
14	18.9280	128.026	2.47500	128.904	0.158403	376.584	6357.50	93.9296
15	19.3630	125.324	1.27500	127.213	0.159383	376.448	6367.50	92.0721
16	20.2010	127.225	2.40000	128.154	0.158532	376.472	6500.00	79.0023
17	21.1330	127.311	1.30000	128.248	0.158269	376.257	6367.50	81.8229
18	21.4600	126.736	2.40000	127.641	0.158377	376.364	6467.50	87.2442
19	22.1010	126.825	2.30000	128.550	0.157980	380.518	6367.50	79.5950
20	22.7390	126.597	1.90000	127.938	0.158681	377.641	6500.00	93.4526
21	23.1510	127.258	2.45000	128.312	0.158553	376.523	6475.00	84.5424
22	23.9900	125.790	1.62500	127.538	0.159312	376.419	6367.50	96.4515
23	24.4260	127.876	2.17500	128.751	0.158320	376.302	6475.00	84.0909
24	25.2700	125.977	1.67500	127.927	0.158812	377.399	6400.00	80.1853
25	25.8980	126.453	2.30000	128.454	0.158394	376.521	6475.00	89.1444
26	26.5300	126.423	1.72500	128.503	0.158440	376.196	6425.51	87.0771
27	27.1720	128.651	2.25000	128.504	0.158396	376.797	6500.00	89.0988
28	27.7040	126.720	1.30000	128.279	0.159118	376.279	6367.50	82.2995
29	28.4460	127.286	1.30000	128.287	0.159114	376.813	6475.00	88.2973
30	29.0800	125.731	1.30000	127.457	0.158809	377.812	6360.00	81.8563
31	29.7140	126.776	2.70000	127.701	0.159004	377.350	6425.00	90.7166
32	30.3530	126.002	2.25000	127.777	0.158293	376.284	6425.00	86.3482
33	30.9850	126.398	1.85000	127.811	0.158323	376.557	6475.00	94.2943
34	31.6210	126.950	2.52500	128.131	0.158368	376.865	6425.50	92.3638

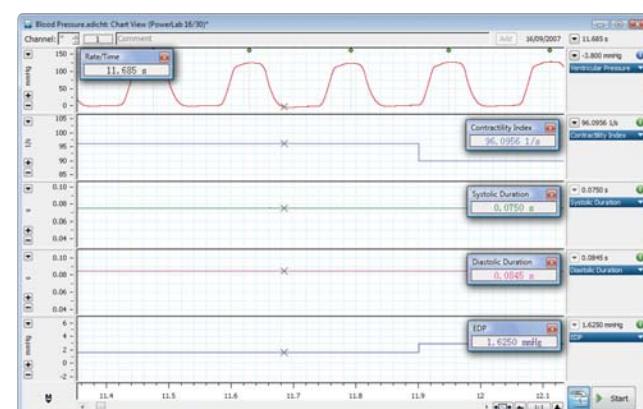
Blood Pressure Table View.

The available selection of individual parameters in the Table View Options dialog depends on whether an arterial or ventricular signal is being analyzed.



Blood Pressure Table View Options Dialog showing parameters for Ventricular pressure (left) and Arterial pressure (right).

Parameters calculated by the Blood Pressure module can be displayed in LabChart as continuous data on separate channels. This provides online analysis of pressure parameters to monitor experimental protocols.



Selected ventricular pressure parameters displayed on separate channels in real time.

ECG Analysis

Windows

The ECG Analysis Module for Windows provides automatic detection and analysis of recorded ECG signals in LabChart. As the raw data is unaltered by calculations, the ECG can be re-analyzed at any time. The module is suited for ECG analysis from any species and features preset detection parameters for humans, pigs, dogs, rabbits, guinea pigs, rats and mice.

The ECG Analysis Module advantages include:

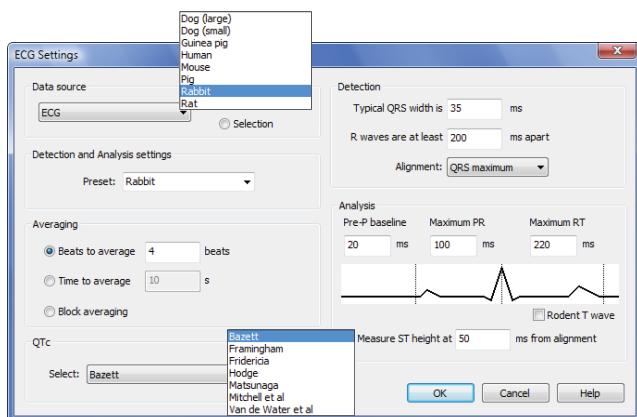
- online/offline ECG analysis and extraction of parameters
- automated detection and averaging of ECG cycles
- automated tabulation of ECG parameters
- automated online or offline ECG Analysis Plots
- linking between the LabChart, ECG Analysis and Table Views for quick navigation to points of interest



Chart View with Beat Markers showing included beats (green) and excluded beats (red) from analysis.

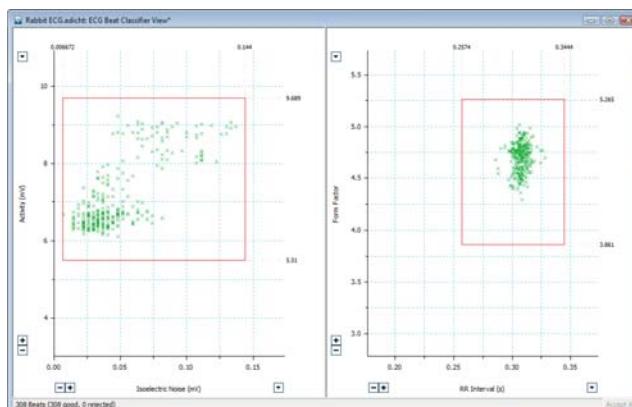
The Settings dialog allows the user to select settings for a particular species, or manually configure detection settings for optimal identification of waveforms in the recorded ECG. These settings include:

- presets
- detection settings
- calculation formula of QTc
- averaging options of ECG beats
- analysis interval



ECG Settings dialog showing Presets (top) and QTc formulas (bottom).

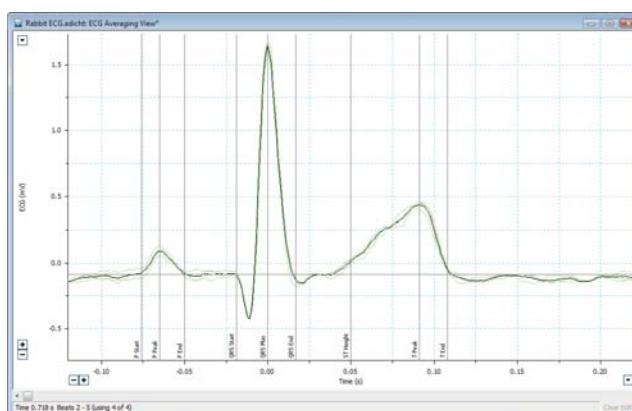
Beat markers appear above the data trace in the Chart View when beats within the recorded ECG are identified. Left-clicking on these markers provides the beat number and the RR interval from the previous beat.



ECG Beat Classifier View.

The Classifier View feature enables the detection and removal of unwanted individual or groups of beats from the analysis. The left panel allows exclusion of beats with excessive 'noise' such as muscle activity, while the right panel identifies beats with different RR intervals or altered QRS shape.

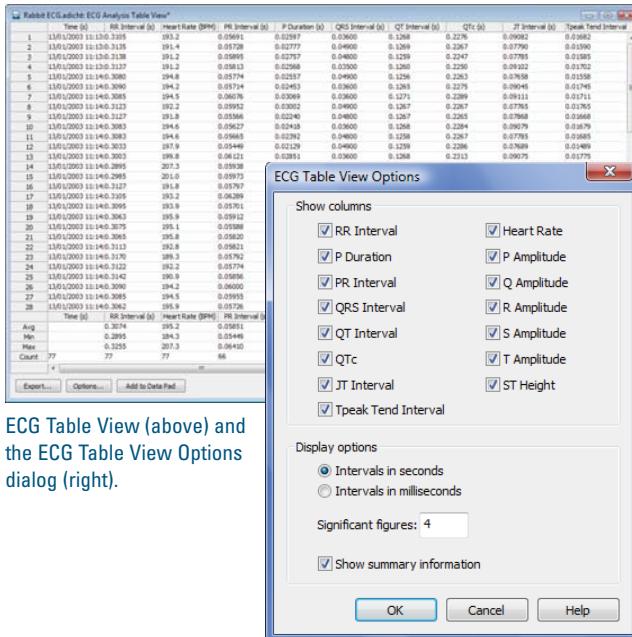
The Averaging View displays each beat along with the average as set in the ECG Settings dialog. The module automatically identifies and labels the ECG parameters. These can be manually adjusted or deactivated by right-clicking in the ECG Averaging View.



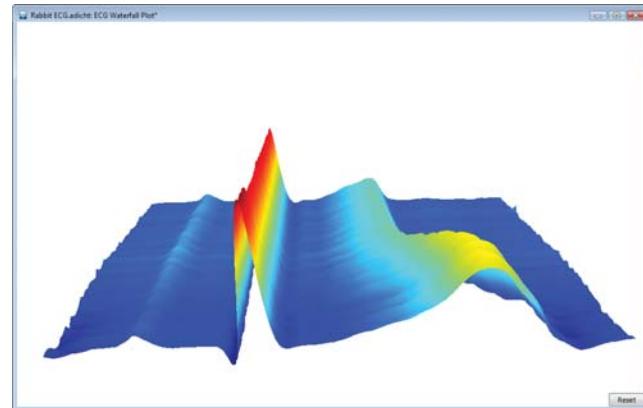
ECG Averaging View. The average waveform is shown in black, with identified parameters labeled.

The ECG parameters for each average are automatically logged in the Table View and include values of:

- P, Q, R, S, T amplitudes
- time intervals such as RR, PR, JT, QT and QTc



ECG Table View (above) and the ECG Table View Options dialog (right).



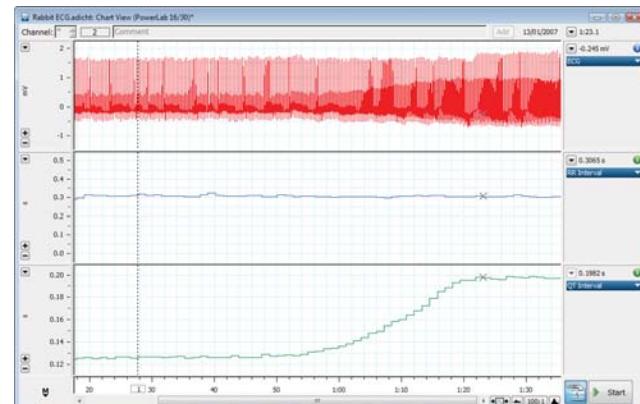
The ECG Waterfall Plot displays a 3D plot of averaged beats.

In addition, each ECG parameter calculated by the ECG Analysis Module can be displayed in a separate channel in Chart View by selecting ECG Analysis... in the Channel Calculation pop-up menu.

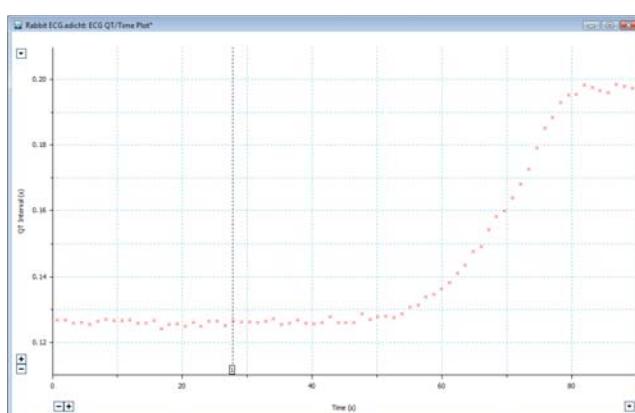
This table is divided into two sections. In the upper section, each data row corresponds to the averaged values calculated from multiple cycles, while the lower section provides a statistical summary of all the rows. ECG parameters and summary information can be selected individually for display using the Table View options dialog. ECG parameters from the Table View may be exported to other applications for further analysis, or added directly to the LabChart Data Pad.

The ECG Module provides several Analysis Plots to allow quick qualitative analysis of the ECG recording. These Analysis Plots are automatically generated either online or offline and include:

- QT/RR Plot (QT Interval versus RR Interval)
- QT/Time Plot
- RR/Time Plot
- Waterfall Plot



RR Interval and QT Interval calculated using the ECG Analysis Module and displayed in two separate channels in Chart View.



Analysis Plots such as QT interval versus Time are ideal to illustrate effect of dofetilide on the QT prolongation of the ECG signal.

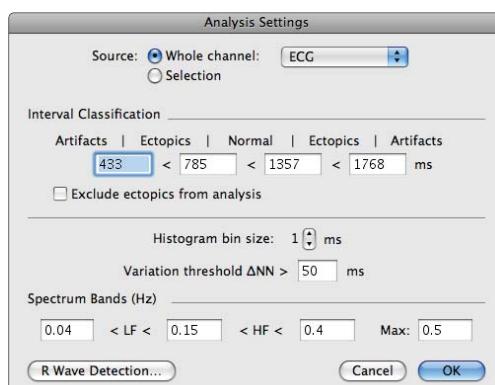
HRV

The HRV (Heart Rate Variability) Module is an analysis tool for use in animal and human cardiovascular studies. It allows the user to analyze ECG or pulse signals for variations in the interval between heart beats.



ECG signal recorded in LabChart and HRV Report providing subject details and heart rate variability statistics.

The HRV Module uses a threshold detector to detect the R component from each raw ECG waveform and generate RR Interval data. Beats are automatically distinguished by the software and classified into three groups; normal, ectopic or artifact.

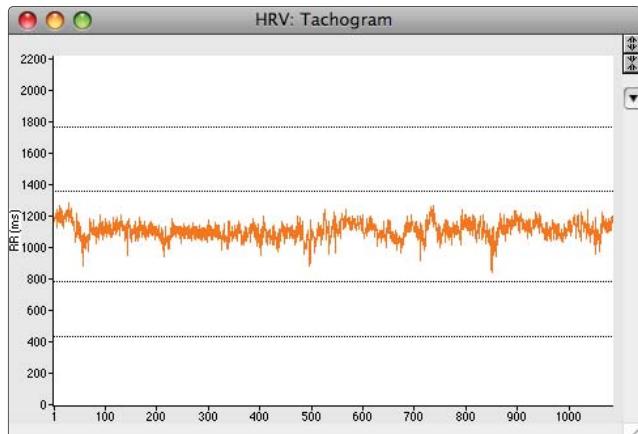


The Analysis Settings dialog.

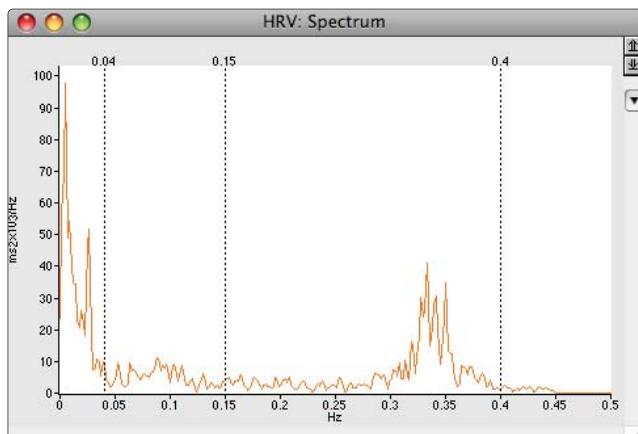
HRV Module features allow you to:

- adjust artifact/ectopic interval classification limits
- exclude artifacts or include beats in the analysis on an individual basis
- delete or add RR intervals
- adjust the histogram bin size

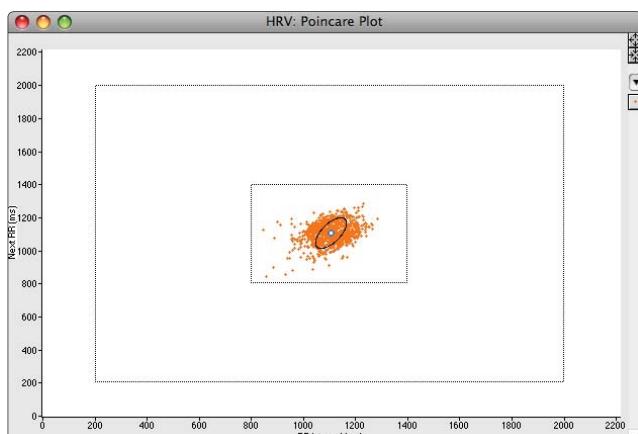
The HRV Module uses the RR interval data to generate a number of plots and statistics including: Poincaré Plot, Period Histogram, Delta RR Histogram, Tachogram, Spectrum and generate a Report featuring subject data and a range of statistical measures.



The Tachogram window plots the RR duration against the corresponding beat number.



Spectrum window with a power spectrum of the RR intervals.



In the Poincare Plot each RR interval is plotted against the preceding RR interval. The interval classification limits are easily adjusted to change the classification boundaries.

Cardiac Output

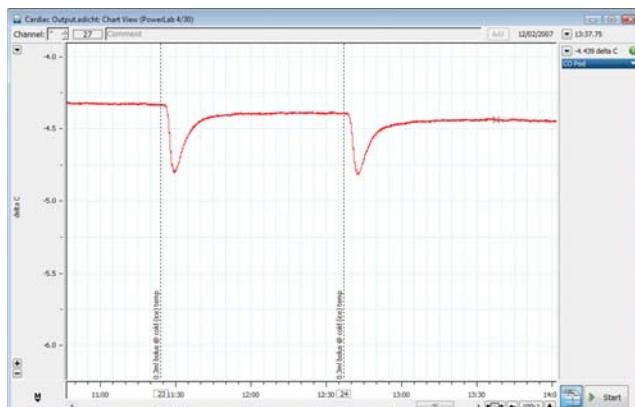
Windows

The Cardiac Output Module for Windows provides an analysis tool to easily determine the cardiac output from a recorded thermodilution curve measured in small animals.

The module features allow the user to:

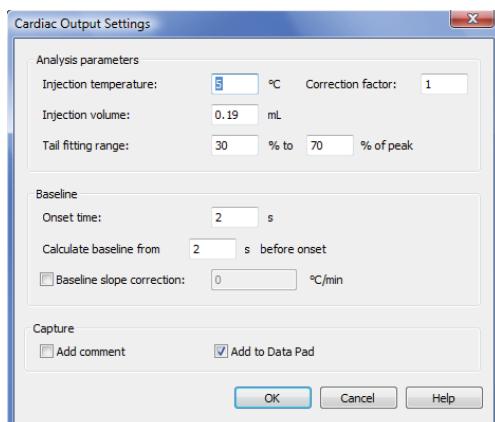
- set up experiment and calculation parameters
- automatically calculate and display cardiac output from recorded thermodilution curves
- extract and export cardiac output values to other programs for further statistical analysis

The cardiac output calculation is based on the area under the thermodilution curve and takes account of baseline drift and prolongation of the decay curve, due to recirculation of the injectate.



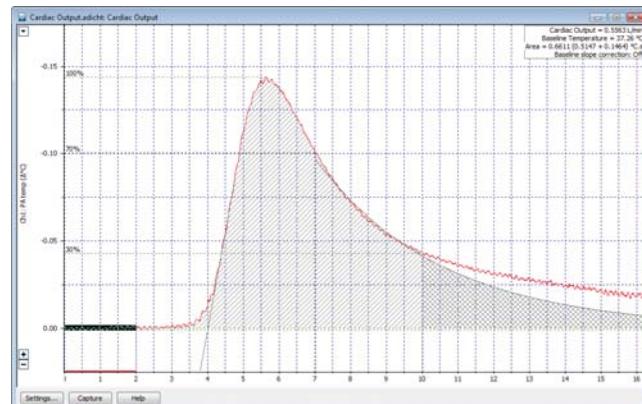
LabChart recording of a thermodilution curve from a small animal after an injection of cold saline. The recording was made using the ADInstruments Cardiac Output Pod and an Ultra-Fast Thermocouple.

The module calculates cardiac output in mL/min and generates a graphical display featuring the area under the curve. Analysis parameters are quickly selected in the Cardiac Output settings dialog.



Cardiac Output Settings dialog allows the user to define the parameters used in the calculation of cardiac output.

A correction factor option has been included in the settings to account for warming of the injectate as it is injected through the catheter, or any other correction factor related to the experimental conditions.



A thermodilution curve showing baseline determination (red line), area under the curve (shaded region) and cardiac output values (top right-hand corner) calculated using the Cardiac Output Module.

Each cardiac output determination uses a baseline temperature calculated for each thermodilution curve. Any baseline drift can also be corrected by selecting baseline data and choosing Set Baseline Correction from the Cardiac Output Settings dialog.

Depending on the injectate temperature, there may be some permanent cooling of the blood. As the cooled fluid is recirculated the thermodilution curve does not return to its baseline value. The Tail Fitting range allows the user to define a portion of the downslope of the recorded thermodilution curve from which an exponential curve is calculated and extrapolated to a baseline. The portion of the downslope used in this calculation is specified as a percentage of the curve full height.

The Capture option in the settings dialog allows the addition of a comment and the resulting cardiac output values on the selected thermodilution curve. Selecting Add to Data Pad automatically transfers calculated values to the Data Pad spreadsheet.

Metabolic

Windows
Mac OS

The Metabolic Module provides a comprehensive set of features for metabolic data acquisition and analysis from human subjects. The software is ideal for use with the ML870B80 Exercise Physiology System.

The Exercise Physiology System records inspired or expired airflow from a pneumotach and CO₂ and O₂ concentrations from expired air in a gas mixing chamber. The simultaneous measurement of respiratory gas concentrations and airflow allows for the following metabolic variables to be calculated and displayed online using the Metabolic Module:

- \dot{V}_E expired minute volume [L/min]
- \dot{V}_{O_2} oxygen consumption [L/min]
- \dot{V}_{CO_2} carbon dioxide production [L/min]
- RER respiratory exchange ratio

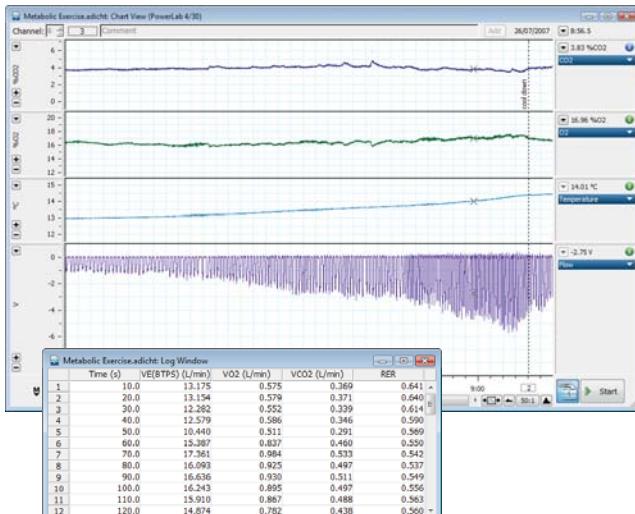
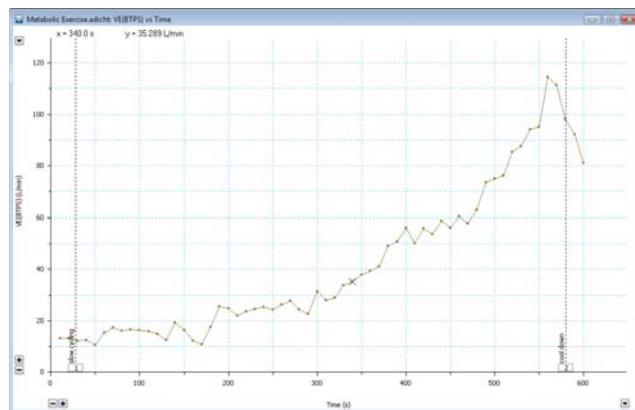


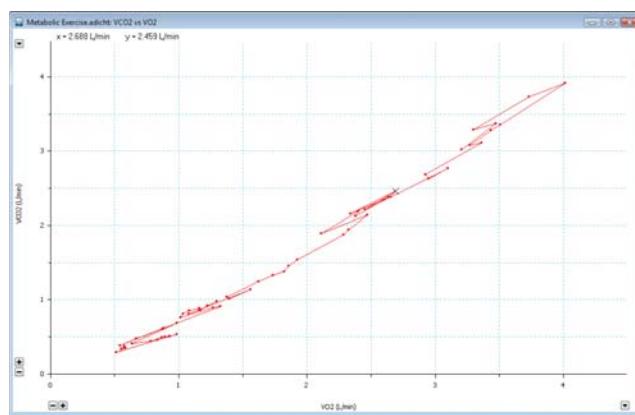
Chart View (top) showing measurements of %CO₂, %O₂ and airflow. The Log Window (above) extracts real-time averaged ventilation and gas calculations.

The module allows the user to set environmental and subject details as well as gas calibration. Experimental settings can be saved as a Settings file, removing the need to reconfigure LabChart before each experiment. Settings are also saved along with the recorded data in a standard LabChart data file. They are restored automatically when a file of either type is opened.

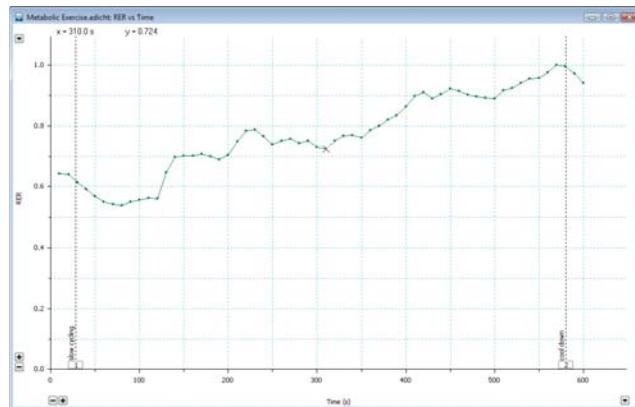
The Metabolic Module generates a number of graphs, plotting metabolic variables against time or each other (online or offline). The plots are constructed from time-averaged data points (tabulated in the Log Window). The plots and the Log Window are updated in real time and can be printed or exported.



Metabolic Window showing a plot of \dot{V}_E versus Time.



Metabolic Window showing a plot of \dot{V}_{CO_2} versus \dot{V}_{O_2} .



Metabolic Window showing a plot of RER versus Time.

The Metabolic Module and the Exercise Physiology System are typically used in the following applications:

- continuous measurements of metabolic parameters
- respiratory gas analysis
- pulmonary function analysis
- indirect calorimetry
- anaerobic threshold
- spirometry
- biopotential measurements

Dose Response

Windows

The Dose Response Module provides online or offline data extraction and analysis of *in vivo* and *in vitro* dose response experiments using LabChart.

The Dose Response Module is ideal in the analysis of responses to chemical, electrical or physical agonists/antagonists. Applications include:

- isolated preparations – smooth
 - skeletal
 - cardiac
- cardiovascular studies – blood pressure
 - heart rate
- neurophysiology – membrane potentials
 - nerve activity

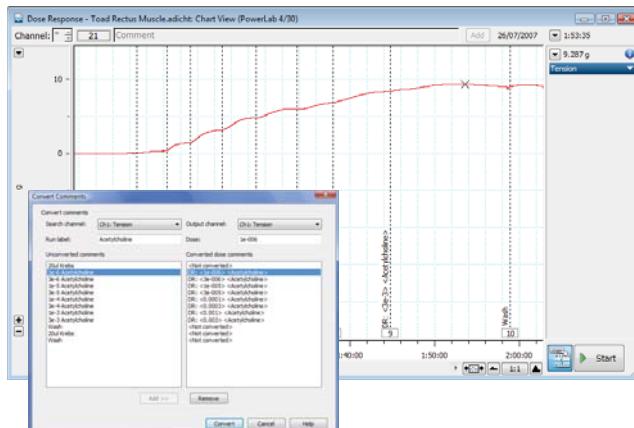
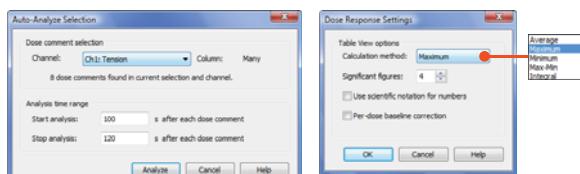


Chart View (top) with Dose Response Comments. The Convert Comments dialog (bottom) identifies comments corresponding to changes in doses and converts these comments to Dose Response Comments.

These Dose Response Comments, with the associated dose and response levels, are used by the software module to calculate a number of parameters including:

- Average
- Maximum
- Maximum – Minimum (Response Height)
- Integral (Area)
- Minimum

The detection and calculation of parameters can be automated in the Auto-Analyze Selection dialog.



Auto-Analyze Selection (left) and Dose Response Settings (right) dialogs.

In addition, the Dose Response Module:

- tabulates the results automatically or manually
- generates instantaneous Hill curves
- displays single or multiple response curves
- calculates EC₅₀ and Hill slopes
- exports the results in XML and tab-delimited text format for use in other applications
- links displays in the Table View, Analysis View and Chart View

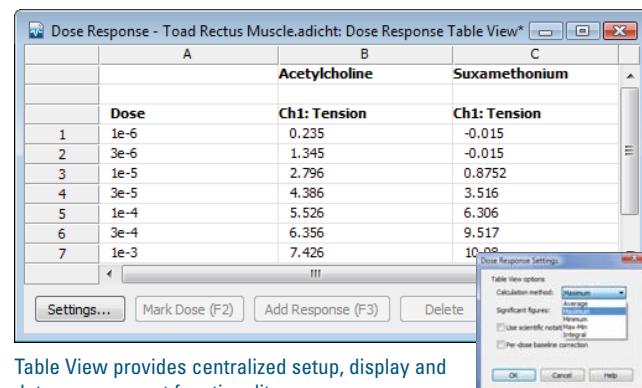
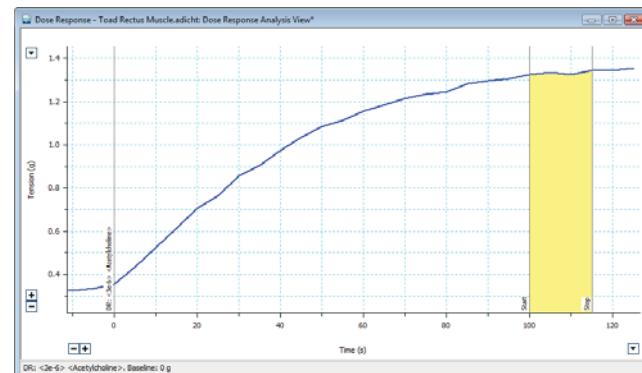
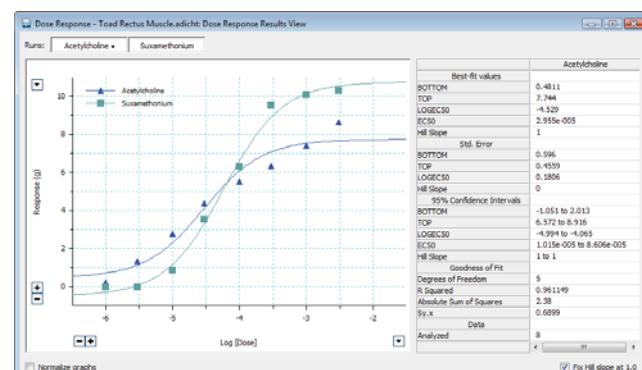


Table View provides centralized setup, display and data management functionality.



Analysis View allows the inspection and manual adjustment of the calculation region and the optional baseline adjustment for each response.



Result View, with parameters of fitted sigmoid curves, allows simultaneous display of multiple curves with optionally fixed top, bottom and Hill slopes.

Peak Analysis

Windows

The Peak Analysis Module for Windows provides automatic detection and analysis of single or multiple peaks in periodical signals recorded in LabChart.

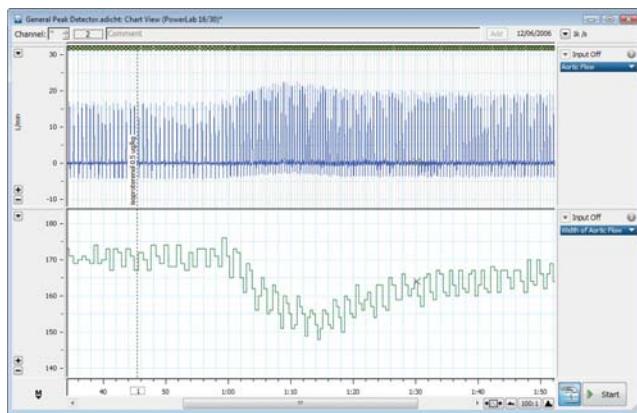
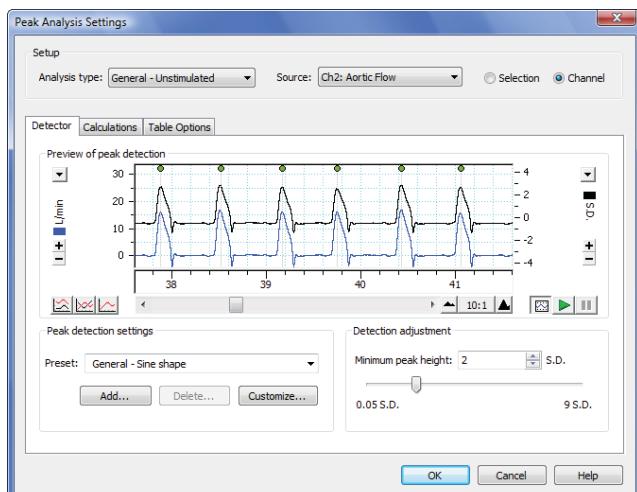


Chart View with detected peaks in the top channel and calculated peak width displayed as a continuous signal in the bottom channel

You can use the Peak Analysis Module either online or offline for a wide range of applications including:

- isolated tissue studies
- hemodynamic measurements
- amperometry
- cardiac physiology
- neurophysiology
- cell current measurements

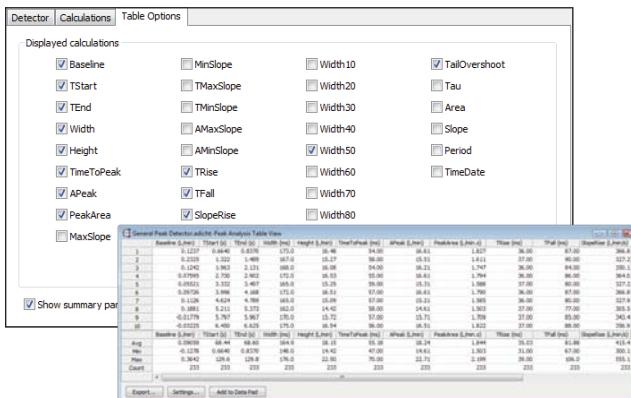


Settings dialog allows the selection of analysis type and customization of Detector, Calculations and Table Options.

Advantages of this module include:

- automatic peak detection within an entire channel or data selection
- calculation of a wide range of peak parameters

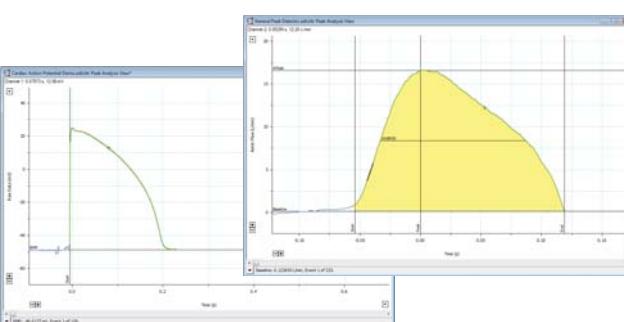
- automatic tabulation of extracted peak parameters that can be exported to other applications
- detection of positive or negative peaks
- graphical display of calculated parameters as continuous signals in LabChart channels
- data linking between LabChart, Peak Analysis and Table Views for easy navigation to data of interest



The Table View (bottom) displays calculated parameters chosen in Table Options (top) for all detected peaks. These values can be exported as a text file, or they can be added to the LabChart Data Pad feature OLE with other applications such as Microsoft Excel.

In addition, Peak Analysis has several default settings suitable for analyzing general and specific types of waveforms. These include

- **Action Potentials** — ideal for intracellular neuronal action potentials
- **Cardiac Action Potentials** — ideal for monophasic intracellular and extracellular cardiac action potentials
- **Evoked Responses** — ideal for monophasic peaks that follow a stimulus
- **General Unstimulated** — ideal for peaks in waveforms without stimuli
- **Population Spikes** — ideal for extracellular evoked responses
- **Synaptic** — ideal for synaptic measurements



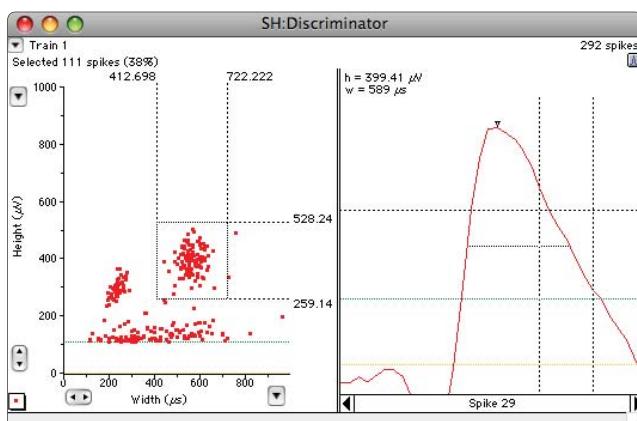
Analysis View provides the visual analysis of each peak and its parameters. Examples here show Peak of an aortic flow signal (top right) and a cardiac action potential (bottom left).

Spike Histogram

Windows
Mac OS

The Spike Histogram Module is used for specialized analysis of extracellular recordings sampled at high rates. The software provides a variety of statistical analyses and discriminates online or offline between different units.

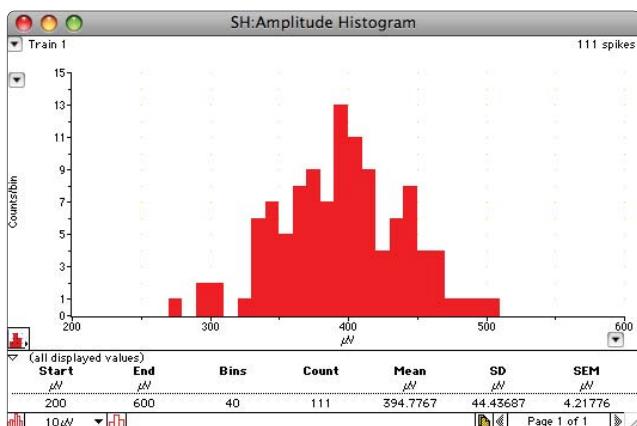
To provide reliable discrimination against unwanted units in multi-unit recordings, the Spike Histogram Module incorporates a dual height and width window discriminator. This method is faster than template matching and provides better performance than simple amplitude window discrimination.



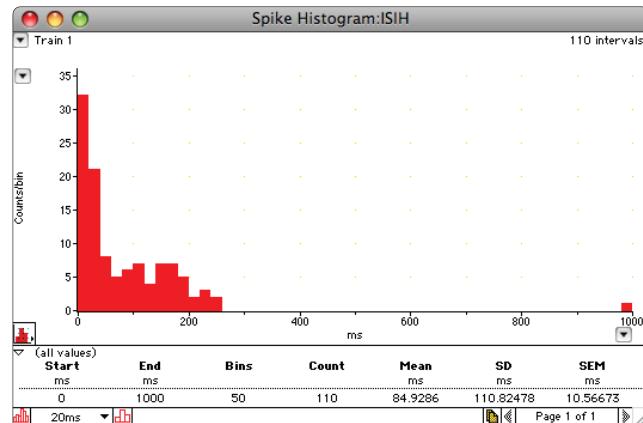
Spike Discriminator View showing some of its many interactive controls. The dragable limit lines have been set to select a cluster of spikes.

The Spike Histogram Module allows you to generate a number of analysis graphs from the analyzed selection of spikes. These include:

- amplitude histogram
- interspike interval histogram
- peristimulus time histogram
- ratemeter



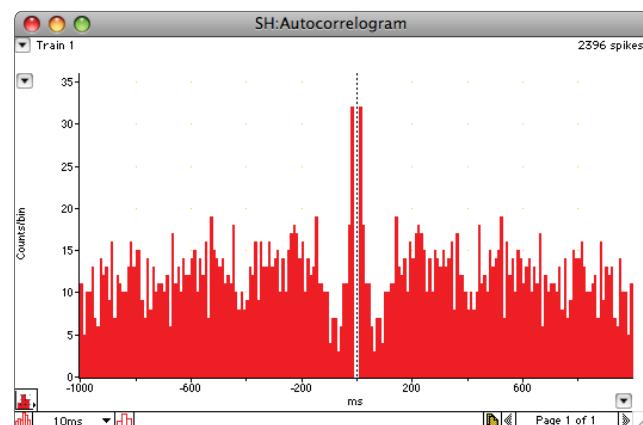
Amplitude Histogram View showing the number of spike amplitudes that fall within voltage categories of a certain size specified by the user.



The Interspike Interval Histogram View provides a summary of interspike intervals within user set time lines.

The Ratemeter Window displays a frequency time plot that indicates the firing rate of spikes selected by the discriminator. The graph/graticule type pop-up menu provides control over the appearance of the plot.

The autocorrelation operation (Mac only) on all spikes in a selection will highlight any inherent periodicity in the signal, with peaks indicating a signal at that frequency. The Crosscorrelation operation (Mac only) allows the detection of periodicity or temporal dependence of the firing of one neuron with another. Thus, if the firing of one neuron causes another to fire, this effect should be detected by crosscorrelation analysis.



Autocorrelation allows the detection of periodicity in spike frequency.

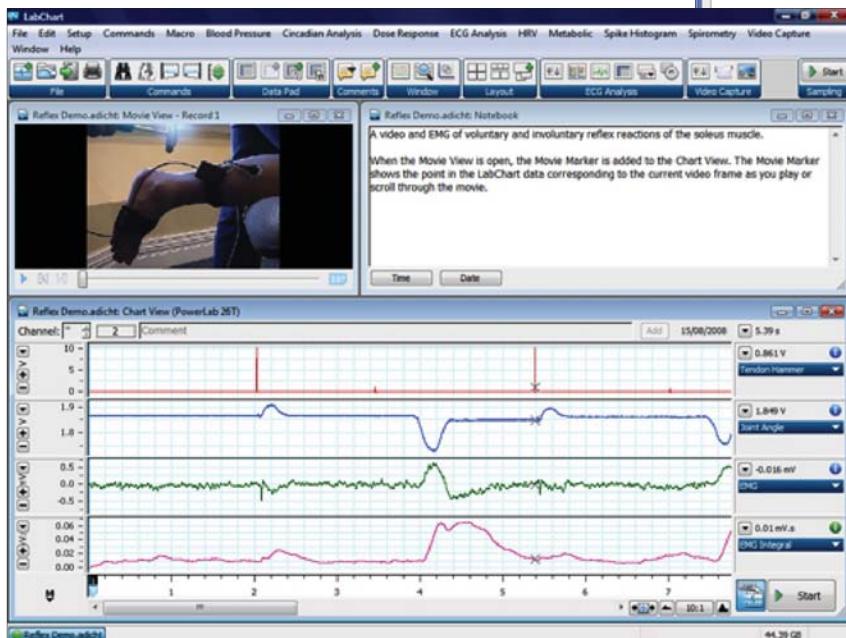
The Spike Histogram Module for Windows allows data to be saved as a .nex file and opened in NeuroExplorer for further analysis.

Video Capture

Windows
Mac OS

The Video Capture Module adds video and audio capability to LabChart providing simultaneous recording and synchronization of a Windows Media Video or Mac QuickTime movie and a LabChart data file. The Video Capture Module supports most video cameras with USB connections or input from any frame capture cards supported by Windows Media Player.

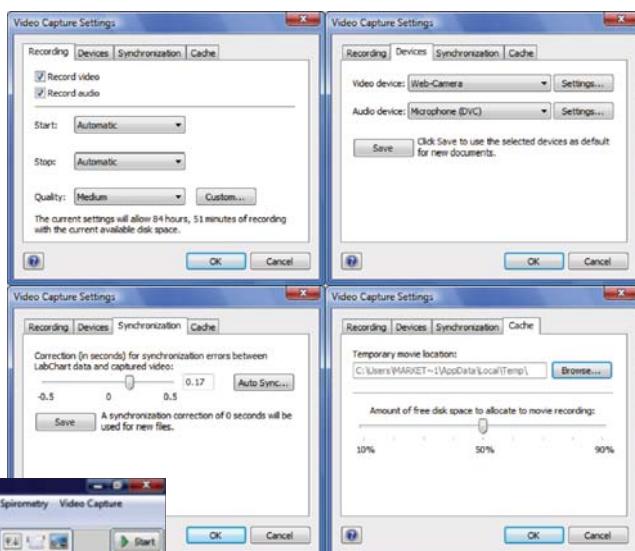
The data and the movie can be played back together, allowing you to observe what is happening in the movie simultaneously with any point in the recorded data, or vice versa.



A synchronized recording of LabChart data (EMG, Joint Angle and Tendon Hammer Strikes) with a .wmv movie of the experiment. Note: The Movie Market in Chart View and the Progress Marker in QuickTime correspond to the same time in the synchronized recordings.

Once recorded, the movie can be played back in tandem with the LabChart data file. After recording is finished, the recorded movie can be viewed by clicking on the Movie View dialog box. When the Movie View is open, the Movie Marker can be used to show the point in the LabChart data file corresponding to the current movie frame. This is useful when trying to find the exact data point corresponding to a particular event, or vice versa.

Users can navigate through the data or movie frames by dragging the Movie Marker in LabChart. Alternatively, users can scroll within the movie and correlate each point in the movie with the corresponding point in the data file. LabChart data files and associated movies will be automatically saved in the same file location.



Recording, Devices and Synchronization tabs in the Video Capture Settings dialog.

The Settings dialog allows the selection of:

- video and/or audio recordings
- control of start/stop recording
- quality of recording
- video/audio instrument settings
- synchronization settings of recording devices with LabChart to allow frame-accurate video/data recordings
- hard disk space allocation

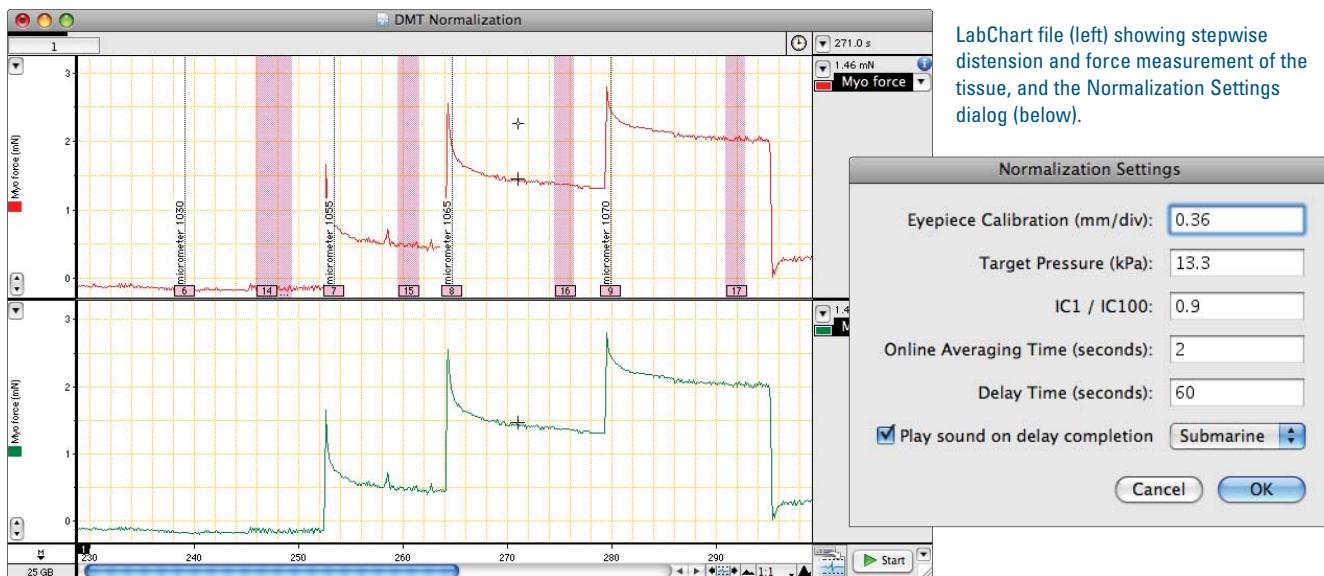
The Video Capture Module for Windows includes a tutorial available as part of the module to guide users through initial video recording set up in LabChart, including hardware connection, settings, synchronization, recording and analyzing.

DMT Normalization

Windows
Mac OS

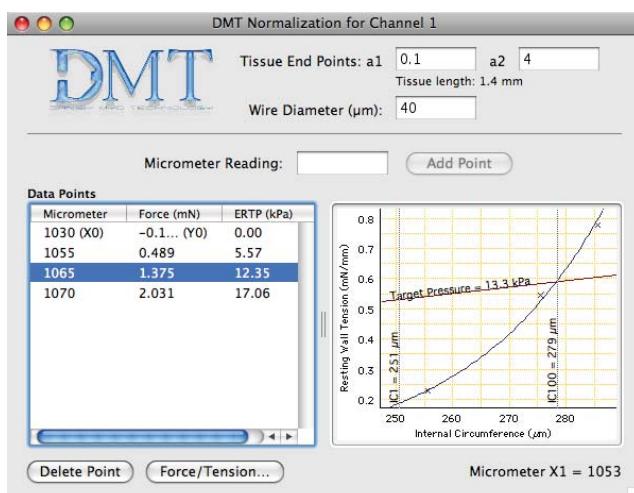
The DMT Normalization Module provides a fast, easy, standardized and validated method for the calculation of optimal pre-tension conditions for microvascular or other small tubular tissue experiments. The module is configured for use with PowerLab, LabChart and DMT Wire Myographs.

As pre-tension can affect the function of smooth muscle, it is important to standardize the tension placed on individual tissues. The normalization procedure determines the optimal internal circumference at which each tissue would be relaxed under a transmural pressure of 100 mmHg. This index is denoted as IC100 and is calculated for each tissue mounted on the wire myograph, taking into account the size and amount of contractile components of the tissue.



The DMT Normalization Module:

- automatically calculates tissue length
- provides online and offline determination of tissue effective pressure
- calculates the optimal pre-tension (micrometer setting) for each piece of tissue prior to experimentation



DMT Normalization window with stepwise distension of the tissue using the micrometer and the developed force measured. The graph on the right is automatically generated from the calculated internal circumference and resting wall tension.

The Normalization Settings dialog allows the selection of:

- microscope calibration
- target pressure
- IC1/IC100 ratio
- online averaging time
- force reading delay when using the automated feature

Each LabChart channel has a separate Normalization window in which the tissue end points (for determination of tissue length) and wire diameter can be entered.

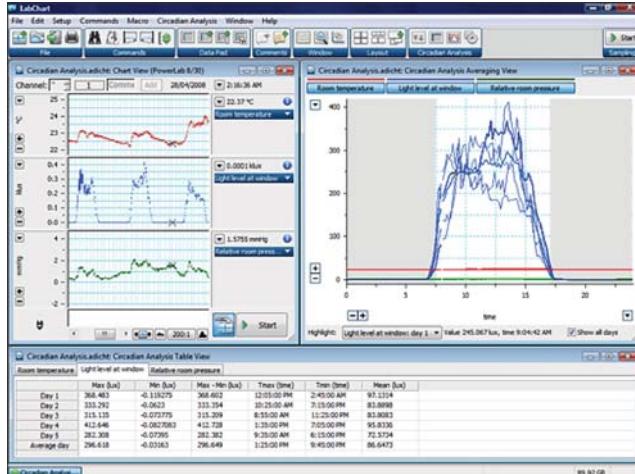
Micrometer values and force measurements are entered in this window either online (while recording) or offline. A graph of the measured internal circumference versus resting wall tension of the vessel is created from which the IC100 and IC1 are calculated.

From these values the module easily calculates the final micrometer setting for achieving uniform and accurate pre-tension conditions for each tissue being studied. This means their normalizing data is collected at the time of experimentation.

Circadian Analysis

Windows

The Circadian Analysis Module for Windows analyzes data with a daily pattern and generates graphical and tabular views of the daily and averaged circadian data. Each day's recording is split into a user-determined number of intervals. Interval data are averaged, plotted, displayed numerically and analyzed to reveal parameters including the minimum, maximum and mean value for each day, as well as the average day.



LabChart Window displaying Chart View (top left), Circadian Analysis Averaging View (top right) and Circadian Analysis Table View (bottom).

Circadian Analysis can be used for a wide range of applications including:

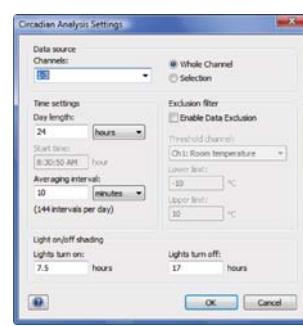
- hormonal studies
- sleep studies
- telemetry studies
- long-term studies of physiological variables.

Feature and benefits include:

- day-by-day analysis of data over multiple channels
- analysis of continuous, intermittent or calculated data
- customizable circadian period start time and length
- optional data exclusion filter
- ability to export derived numerical parameters as a tab-delimited file

The Circadian Analysis Settings dialog allows you to:

- select the number of channels to be included in the analysis
- choose to analyze the whole channel or a selection
- adjust time settings including the circadian period (day length), day start time and averaging interval



Circadian Analysis Settings Dialog

- enable and configure data exclusion filter to ignore data outside preset limits for calculating averages
- adjust the light on/off shading feature to represent day and night in the Averaging View

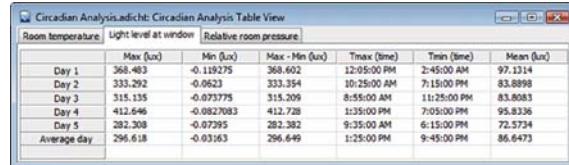
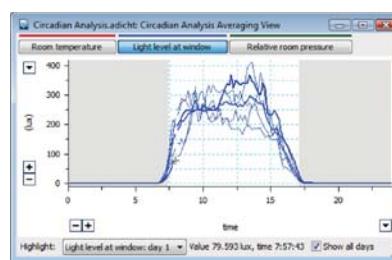


Table View

The Circadian Analysis Table View automatically calculates and displays the following parameters for each day, as well as determining an average day:

- maximum
- minimum
- maximum – minimum
- time at maximum
- time at minimum
- mean



Averaging View

The Circadian Analysis Averaging View displays and plots the averaged interval data for single or multiple channels. Users can select to either:

- view the automatically calculated average day
- show all days as an overlay on top of the average day
- select a specific day from the highlight drop-down list or by clicking on its trace
- view the values for any specific point in time obtained by hovering over the trace
- view each channel's data separately, or show multiple channels in the same view using the buttons along the top of the view

Table View data is exportable as a tab delimited file into other programs (such as Microsoft Excel). The Averaging View can be copied into LabChart's Data Pad or other applications with plot image and text showing the values of all copied data points.

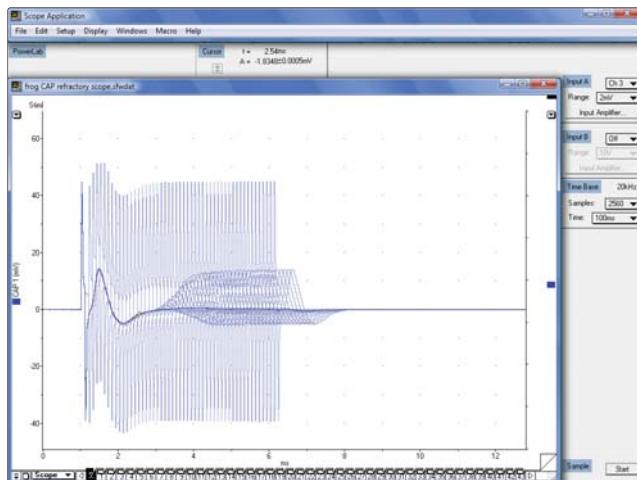
The Circadian Analysis Module for Windows has a tutorial available as part of the module to guide users through each feature using either their own data file or supplied sample data file.

LabChart Specifications

	Windows	Mac
Minimum system requirements	<ul style="list-style-type: none"> ■ Windows XP or Windows Vista ■ 100 MB free hard disk space ■ Display with 1024 x 768 resolution ■ USB interface for operation with PowerLab ■ CD-ROM drive for software installation 	<ul style="list-style-type: none"> ■ Mac OS X 10.4 or later ■ 100 MB free hard disk space ■ Display with 1024 x 768 resolution ■ USB interface for operation with PowerLab ■ CD-ROM drive for software installation
Installation requirements	100 MB free hard disk space	100 MB free hard disk space
Printers	Windows compatible	Mac compatible
Export formats	Binary, Axon, IGOR, MATLAB, QuickTime, Wav, Text, PVAN, EDF	IGOR, MATLAB, QuickTime, Text
Display mode	Chart, Zoom, XY View, Scope, Movie	Chart, Zoom, XY Plot, Overview, Movie
Maximum storage limits	Unlimited	2 GB file size after compression
Channels supported	32 channels	32 channels
Maximum throughput	400 kHz (with PowerLab 30 Series hardware)	400 kHz (with PowerLab 30 Series hardware)
Maximum sampling speed	Up to 200 kHz per channel (PowerLab 30 Series hardware)	Up to 200 kHz per channel (PowerLab 30 Series hardware)
Recording modes	Continuous to memory (RAM) or disk	Continuous to memory (RAM) or disk
Trigger sources	User, external trigger input, internal timer or channel voltage level	User, external trigger input, internal timer or channel voltage level
Trigger modes	Post-trigger, pre-trigger and event trigger	Post-trigger, pre-trigger and event trigger
Stimulator mode	Pulse: 0.1Hz–2 kHz (up to 2000 pulses) Step: 2000 steps (width 0.05 ms to 1 s)	Pulse: 0.1–200 Hz (up to 2000 pulses) Step: 200 steps (width 0.15 ms to 20 s). triangle, ramp, sine
Statistics	Statistics — mean, standard deviation, standard error, maximum value, time at maximum, minimum value, time at minimum, maximum – minimum, number of points, RMS, 1/3 Max + 2/3 Min Selection — time, date, value, start, end, duration, number of points Comments — comment time, comment number, full comment, comment numbers only Slope — average, maximum, time at maximum slope, minimum, time at minimum slope Integral — integral, integral from minimum, integral from start, integral from baseline Block Information — range, sample interval, sampling rate, block number, block duration, samples, start time, start date Cyclic Measurements — event count, cycle count, average cyclic frequency, rate, period, minimum/maximum cyclic period, average cyclic minimum, average cyclic maximum, average cyclic height, average 1/3 Max + 2/3 Min Scope — Page number, page duration and page start time containing the active point or selection from Scope View XY Loop Calculations — calculates the area inside the XY loop, x or y value and slope at the reference point in XY loop, minimum and maximum x or y value, time at minimum and maximum x or y value, and mean of x or y value in XY loop in the XY View	Statistics — mean, standard deviation, standard error, maximum value, time at maximum, minimum value, time at minimum, max – min, number of points, integral, integral from minimum, integral from start, integral from baseline, RMS, 1/3 Max + 2/3 Min Selection Information — start, end, duration, number of points Cursor and comments — time, value, comment full, comment numbers only, comment number, comment time, comment duration Slope — average, maximum, time at maximum slope, minimum, time at minimum slope Block Information — range, sample Interval, block number, block duration, samples, start time, start date, sampling rate Cyclic Measurements — event count, cycle count, frequency, rate, period, minimum period, maximum period, average minimum, average maximum, average peak-to-peak, average 1/3 Max + 2/3 Min
Online computations	Cyclic Measurements: Rate, period, frequency, count, minimum, maximum, height, integral, variance, derivative, 1/3 Max + 2/3 Min, Unit Spikes at Events	Integral
Calculations	Arithmetic, Cycle Variables or Cyclic Measurements, Derivative, Digital Filter, Integral, Shift, Smoothing	
Further analysis	Additional Extensions and Modules are available to increase the functionality and analysis capabilities of LabChart	

Scope

Scope software, supplied with PowerLab systems, provides powerful display, recording and analysis features to transform your computer into a two-channel storage oscilloscope, XY plotter or Power Spectrum (FFT) analyzer. Scope is used commonly to measure any high-frequency signals such as action potentials and evoked responses, that are time-locked to a stimulus.

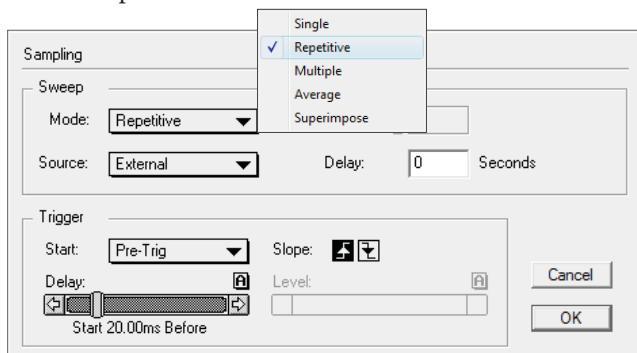


Scope's main window provides easy access to the full range of features.

Fast Set-up, Adjustable Recording

The user-friendly Scope interface allows quick selection of settings. These include:

- sampling rates up to 200 000 samples per second
- sweep modes as either a single, repetitive, multiple, average or superimposed sweep
- sweep widths from 2.5 milliseconds to 20 minutes
- time-base display as either sampling frequency, time per division or time per sweep
- multiple axis display options
- automation of experiment procedures using macros
- data display in time or frequency domains, or as an XY plot



Sampling dialog showing Sweep and Trigger Controls.

Windows
Mac OS

Triggering

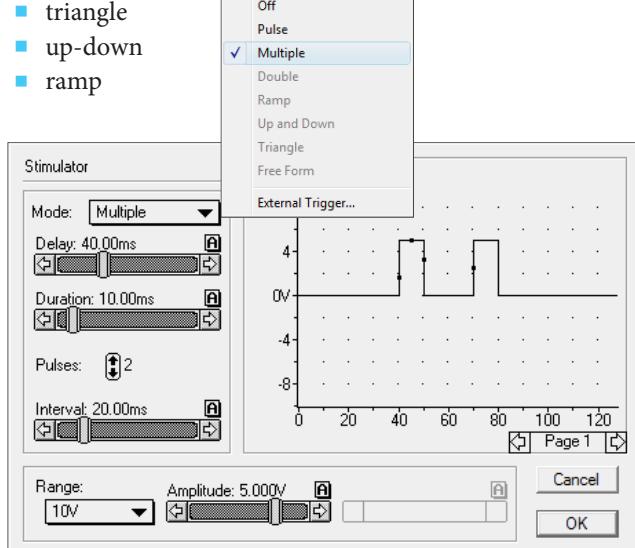
Start or stop recording at pre-specified experimental events or an input signal level

- use pre-triggering or post-triggering options with adjustable delays
- trigger from a TTL signal
- triggering sources include user, external trigger input or a voltage level on any channel

Stimulation

Scope software allows you to choose from many stimulation modes including:

- single
- double
- multiple
- pulse
- free form
- triangle
- up-down
- ramp



Stimulator dialog showing setting options and the shape of the stimulus waveform. The waveform can be adjusted manually.

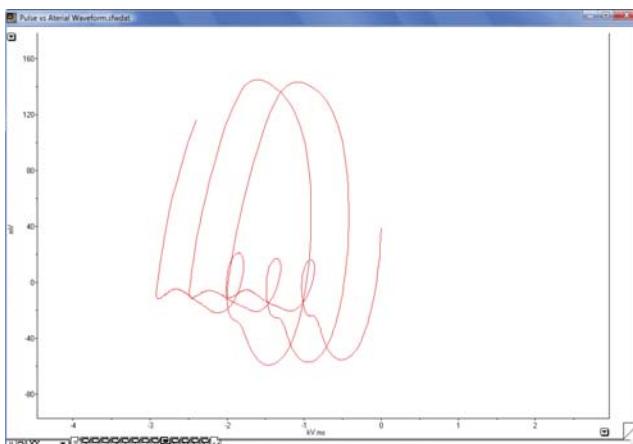
Using the stimulator you can:

- select the mode, voltage range, delay, duration, number of pulses and interval in the one location
- adjust the stimulator output from 100 µV to 10 V
- view the stimulus waveform before its application
- use the Stimulator Panel to adjust stimulation settings while recording

Comprehensive Analysis

The Analysis options allow you to:

- choose from the standard Scope mode, XY plot mode or FFT mode for data analysis, interpretation and display
- easily transfer individual data points or selections to the Data Pad to record statistical information
- build a cumulative history across multiple recordings to enable fast, easy comparisons using the Data Pad
- transfer data to other programs for further analysis
- apply smoothing, offset, addition, subtraction, multiplication, division, inversion, absolute value, squaring, integration and differentiation functions to raw data on any selected channel
- add, subtract, multiply or divide data in one or both channels
- revert to raw data if required



XY plots can be generated with a click of the mouse.

Comprehensive Display

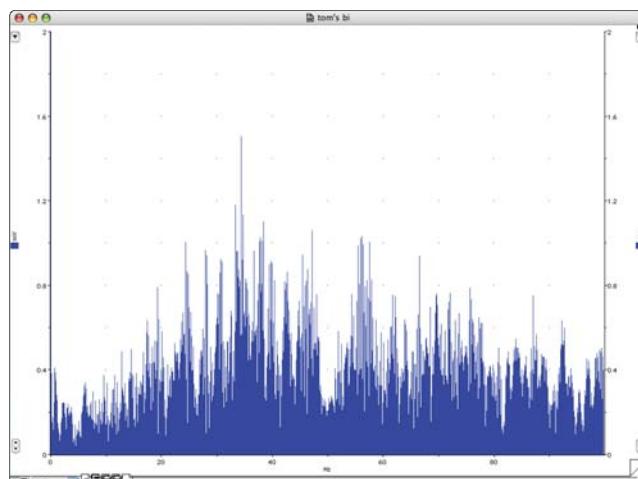
Scope's display options allow you to:

- display channels with axis titles
- use the Zoom window to highlight selections of interest
- overlay channels by simply double-clicking on the channel separator
- adjust the channel separator to display a single channel
- change the viewing mode to FFT or XY without losing the raw data
- overlay stimulator markers with recorded waveforms for easy reference
- adjust the waveform using the amplitude axis controls
- change the appearance of the display, for example color and line width of waveforms and the graticule

Printing

Printing options include:

- print entire records, a selected portion of a page, Zoom and XY windows or Data Pad
- select printing modes — normal, high resolution or color
- print large files quickly by using the Faster Printing option
- print multiple pages on one sheet



You have the option of viewing data as a power spectrum (FFT).

Scope Specification

Max sampling rate	200 000 samples/second 256 to 2560 points per sweep
Recording modes	Single, repetitive, multiple, average and superimpose sweeps (optional sweep delay)
Online computations	<ul style="list-style-type: none"> ■ Smoothing, shifting, addition, subtraction, multiplication, division, inversion, squaring, absolute value, integration, differentiation, reciprocal ■ Inter-channel operations: add, subtract and multiply
Data Pad analysis	<ul style="list-style-type: none"> ■ Statistics: mean, standard deviation, standard error, max value, time at max, min value, time at min, max - min, integral, number of points ■ Integral - absolute, positive, negative ■ Selections: start, end, duration, page number, date, time ■ Cursor: time and value ■ Slope: average, max and min
Storage limits	999 sweeps or pages

GLP Client & Server

Windows

GLP has become the recognized standard for performing non-clinical testing of pharmaceuticals. ADInstruments offers an easy and reliable data acquisition solution for a GLP and 21 CFR Part 11 compliant environment.

Features and benefits include:

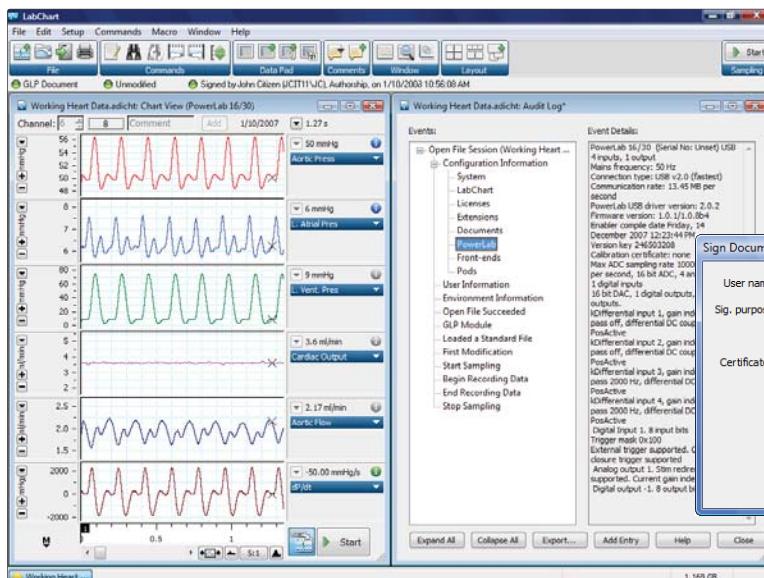
- data acquisition systems that are compliant with GLP and 21 CFR Part 11 regulations
- centralized authorization system that supports an unlimited number of users
- a system that does not allow unauthorized access or tampering of files
- public-key private-key user validation to guarantee user authentication
- easy installation, administration, maintenance and record keeping
- user-friendly system that does not hinder research

GLP Client

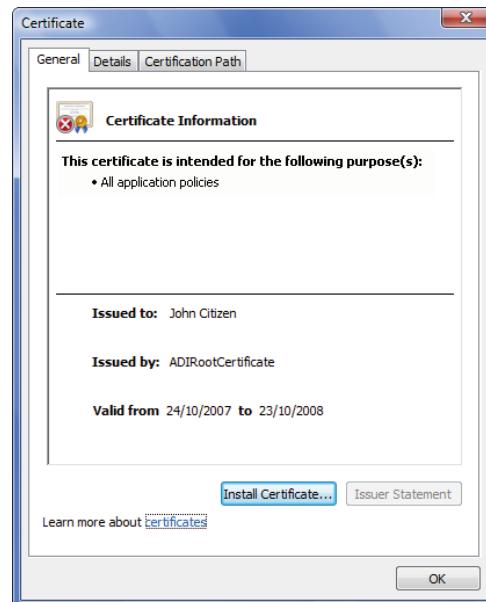
The GLP Client provides the user interface, audit trail and signing components required to meet Laboratory GLP and 21 CFR Part 11 requirements.

GLP Client features include:

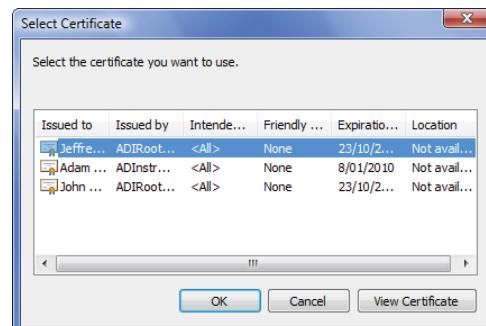
- securely signed data files to avoid tampering
- a non-editable audit trail recording file operations
- preservation of raw data
- data and audit trail in a single file
- visual indication of file validity
- date and time stamping



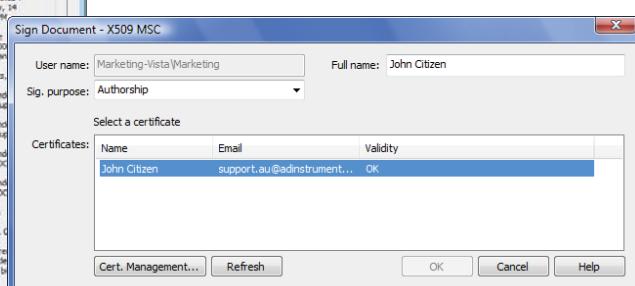
LabChart application window with GLP Status Bar. Recorded data is seen on the left screen with the GLP Audit Log on the right.



The GLP Certificate dialog containing information of ownership and validity.



The Select Certificate dialog allows selection of the appropriate certificate.



The Sign Document window is where LabChart Documents are signed and verified.

GLP Server

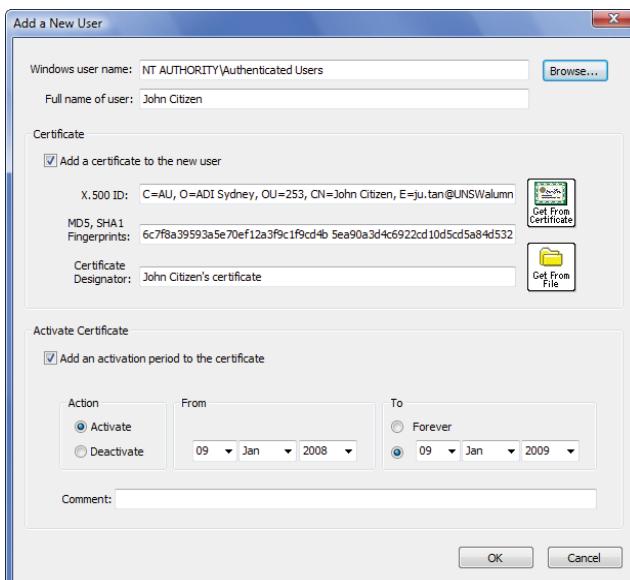
The GLP Server works together with the GLP Client. It allows centralized authorization for signing LabChart files as well as a means to check validity of signatures. At the administration level, it determines which users are permitted to create, modify or sign GLP documents.



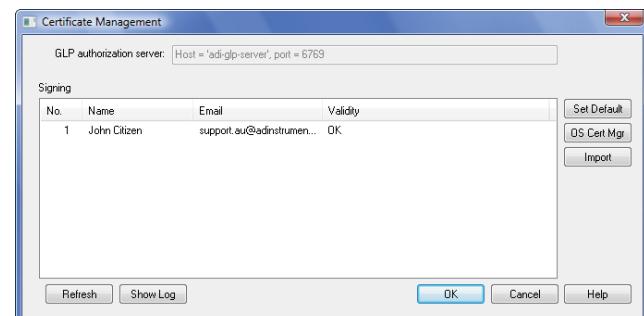
The configuration Checklist provides a quick way to check the server and user status.

GLP Server provides:

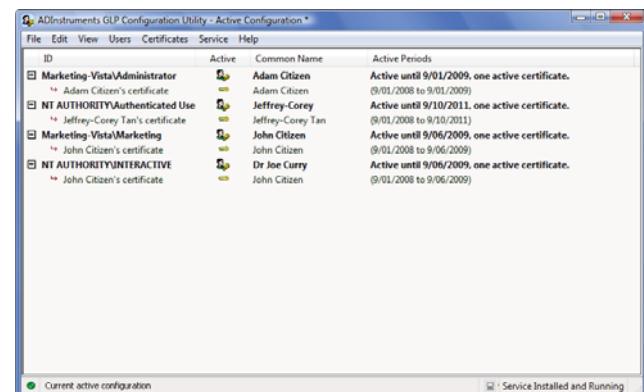
- verification of signature validity when files are opened
- users with authority to sign files upon saving
- access to remote configuration
- license for an unlimited number of users
- extensive and customizable logging



Adding a new user, the specified GLP certificate and the active period of the certificate.



The Certificate Management dialog allows you to import and manage installed certificates.



The GLP Configuration Utility allows the system administrator to add, delete or change user privileges.

Training and Certification

ADInstruments understands that introducing a GLP system can present challenges. With this in mind we provide on-site installation, training and user certification services.

Calibration Service

ADInstruments can provide periodic calibration for your PowerLab hardware to confirm the system is working within specifications. Calibration can be organized within your GLP time frame and includes a calibration certificate. Ask your ADInstruments representative for more information or see the support section of our website.

GLP Validation Unit

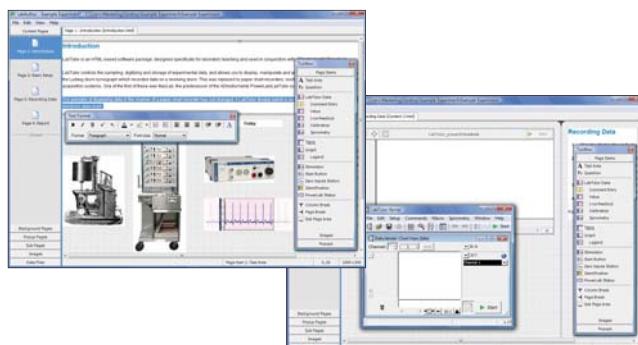
To make sure your data stands up to the scrutiny of GLP and 21CFR Part 11, the Validation Unit is available for purchase. It allows for in-house, periodic validation of ADInstruments data acquisition hardware and software.

Software in Education

ADIInstruments also manufactures data acquisition systems for life science education. Suitable for one to four year undergraduate courses as well as graduate programs, ADIInstruments Teaching Systems are ideal for a wide range of disciplines including physiology, pharmacology, general biology, nursing and allied health, medicine, biomedical engineering and more.

LabTutor®

LabTutor makes teaching easier by combining background information, protocols, real-time data acquisition, analysis and reporting into one program. No training is necessary to use LabTutor. The step-by-step experiment instructions and interactive activities ensure that the understanding of scientific principles remain the key focus. In the past, students had to refer to manuals and use several software programs to complete experiments and laboratory reports. Now all they need is LabTutor, which comes with a wide range of physiology, biochemistry, exercise and pharmacology experiments available from our website.



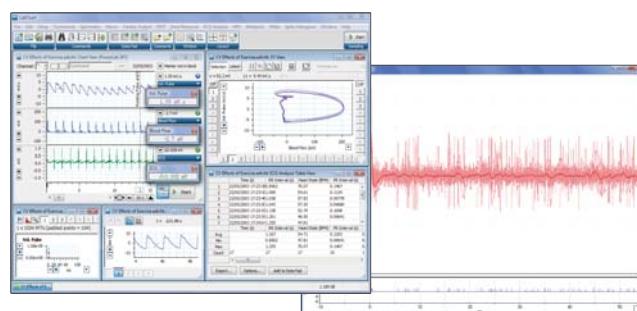
LabChart® and Scope™

LabChart and Scope software are ideal for courses that require flexibility and high-levels of experimentation. Their advanced data acquisition and analysis features are ideal for use in undergraduate and post-graduate courses as well as advanced research projects. The depth of the software allows it to grow with your students' progress and skills. A wide range of preconfigured LabChart Experiments are available from the ADIInstruments website.



LabAuthor®

LabAuthor provides educators with the ability to customize and create LabTutor experiments to suit their curriculum. Creating complete experiments for your students has never been easier. The LabAuthor interface uses simple 'drag and drop' to create all the components of an experiment page. Separate setting dialogs allow the user to easily format all components. Simply click, hold and drag new objects, text and graphics into experiment templates. The student friendly data acquisition channels with the appropriate filtering, range, sampling and display settings for the experiment is a effortless.



Wealth of Teaching Resources

Our education team (consisting of resident scientists and practising educators) is continually developing and adding to the range of ADIInstruments Resources. LabTutor, LabChart and Scope experiments are available free of charge to registered PowerLab users from our website and new experiments are added on a regular basis. In addition, technique notes, experiment notes and education application pages are also a great website resource. Find all of these resources at: www.adinstruments.com/education

ADIstruments Research Systems are used in prestigious institutes, universities, colleges and commercial laboratories around the world. Here's a selection: