

 **BIOPAC Systems, Inc.**

AcqKnowledge Tutorial & Demonstration

For Windows/PC or Mac OS X

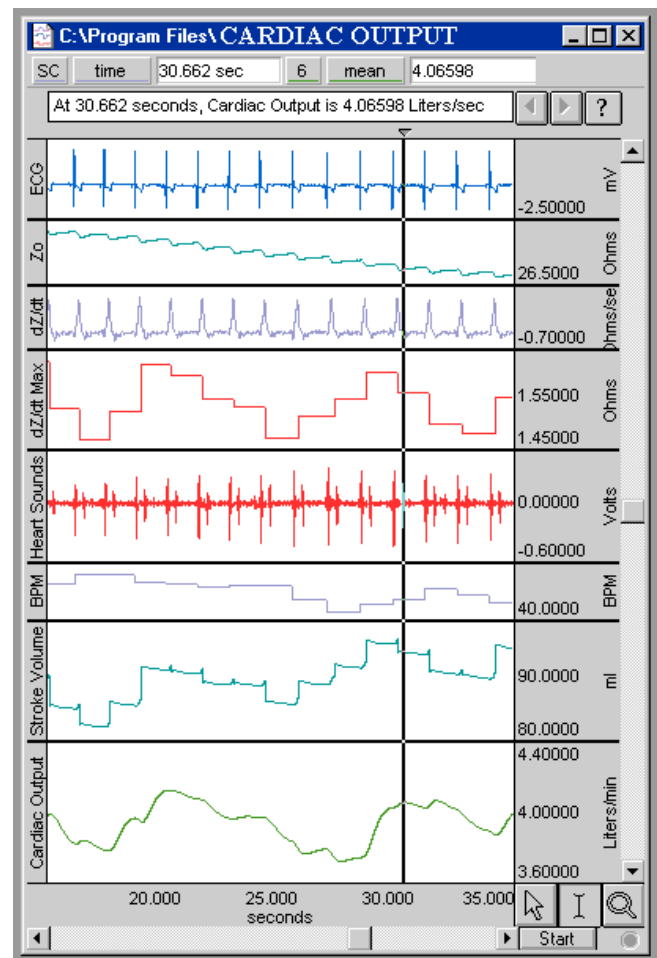
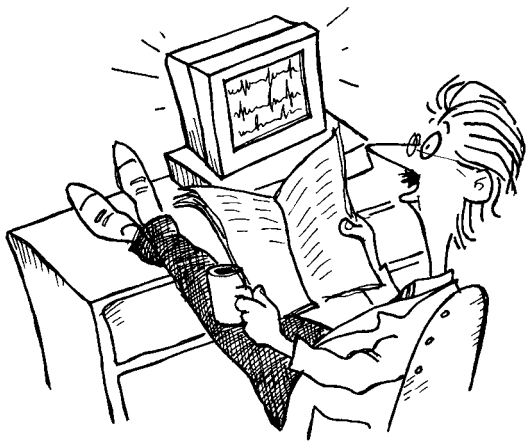


The next generation is here!

AcqKnowledge and an **MP System** turn your personal computer into a complete physiological workstation...

Do twice the work in half the time!

Complete this demo to see how **AcqKnowledge** works for you!



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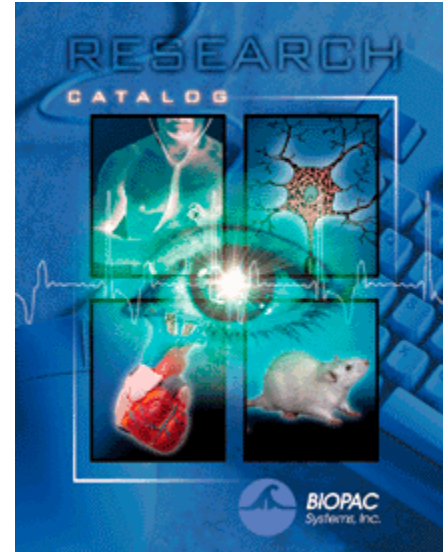
Introduction

The *AcqKnowledge* tutorial/demo comes with a variety of prerecorded data files and simulates a live recording. While it is impossible to cover every feature of the software, many of your questions will be addressed if you use this demo with our latest research catalog and the “*AcqKnowledge Software Guide*” and other online support documents (PDF format) provided in the User Support System folder.

In addition to sample data files, we have included a **Quick Start** graph template (.gtl file). **Quick Start** files provide all the settings necessary to perform a wide variety of experiments. Available **Quick Starts** are listed in the “Applications” section of our **RESEARCH CATALOG** and our website (www.biopac.com).

By using the available material, you will be able to simulate the use of the software for your particular application.

AcqKnowledge is incredibly flexible and there are usually many ways to perform different analysis functions. If you are unclear about how *AcqKnowledge* can address your specific requirements, please consult with our Application Specialists for the most expedient solution.



Basic Questions

What is the MP System?

Each MP System (MP100 or MP150) is a complete and expandable data acquisition system that functions like an on-screen chart recorder, oscilloscope and X/Y plotter, allowing you to record, view, save and print data. It includes all the necessary hardware and software required to turn any computer into a powerful data acquisition workstation specifically designed for life science applications.

Since the MP System takes advantage of the capabilities of your computer, it's as powerful as larger and more expensive data acquisition systems, but has a familiar, easy to use graphical interface. The MP System will reduce your equipment setup time and increase the quality of your results. By harnessing the power of your computer, the MP System gives you publication quality results with a minimum of effort.

This guide and the accompanying demonstration highlight some of the features of *AcqKnowledge* by working through some common applications and showing you some sample data files.

What do I need to run the demo?

Minimum requirement: Windows 2000 or XP

Mac OS X 10.3.x

Macintosh users: If installation fails, disable extensions (hold the shift key down while you restart the computer) and then repeat installation. Restart again to enable extensions.

What will the demo disk show me?

The demo pretends the MP100 data acquisition unit is connected to your computer and the software effectively simulates the recording of a variety of signals. When you press the button, data will be plotted on screen exactly as if data were actually being recorded from a subject. You can stop the recording at any time. You can then scroll through the data, examine specific sections, take readings, and perform analysis. Sample data files are also included: ECG data, EEG data, EMG data, respiration data, and—for use with the *Specialized Analysis Package* for the Mac—Cardiac Output 1 and Cardiac Output 2. A graph template file is also included: QuickStartEMG.gtl.

What can't I do in the demo?

Almost all demo software features are exactly the same as in the actual *AcqKnowledge* program. You cannot save, print, use the on-line averaging function, copy measurements or data to the journal, or use the sound option—these are the only limitations.

The **MP150** is not demonstrated but software functionality is similar to the MP100, with a few additions to allow for the MP150's increased speed, expanded stimulator features, and Ethernet interface options.

Hardware configurations



MP150 System



MP100 System

The basic components of the MP System are shown above. All workstations include:

- MP acquisition unit
- *AcqKnowledge* software
- Universal (non-amplified) module that allows you to connect existing equipment such as pre-amplified electrodes, transducers, blood flow meters, force plates, and chart recorders.

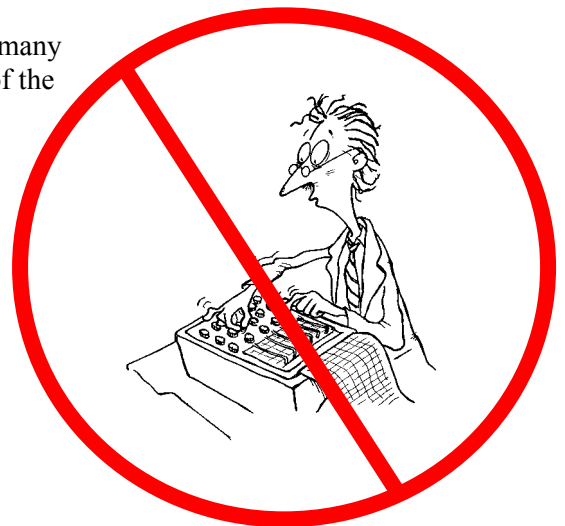
BIOPAC Systems, Inc. manufactures amplifiers and signal conditioning modules designed to measure an array of life science data including EMG, respiration, pulse, EEG, temperature, eye movement, skin conductance, evoked potentials, microelectrode recordings, electrical bioimpedance, laser Doppler flow, CO₂ and O₂ gas analysis, and electrogastrogram. We also offer a general-purpose amplifier that allows you to connect other devices, including bridge transducers like pressure, force, and strain gauges. In addition, you can mix and match amplifiers designed to collect specific kinds of physiological signals (such as ECG, respiration, and EMG). These modules snap together, allowing you to create a customized data acquisition workstation.

For MP150 System configurations, *AcqKnowledge* can be used with multiple MP150 data acquisition units to

- control multiple, independent experiments on one computer
- increase the total number of channels used for a single experiment (e.g., 32-channel EEG)

To synchronize the Start of multiple units, use the External Trigger function. To combine up to 60 channels of data into one file, use the Merge Graphs feature.

Since the data is stored on your computer and can easily be transformed, many of the time-consuming setup tasks that other systems require are a thing of the past.



No calibration required!

Efficient Collection

The MP System has several advantages over other recording systems. *AcqKnowledge* is extremely flexible, giving you full control over how data is collected. You can analyze your data either while it is being acquired or after the fact. The *AcqKnowledge* software allows you to perform a range of measurements, calculations, and transformations after the data has been collected—most can be performed with a click or two of the mouse button. *AcqKnowledge* comes with over 40 **Quick Starts**, which include all the settings for a variety of experimental protocols (which are explained further in our **RESEARCH CATALOG**):

APPLICATIONS

12-lead ECG Recordings	Jewett Sequence
Animal Studies	Langendorff & Working Heart Preparations
Auditory Evoked Response	Lung Volume Measurement
Autonomic Nervous System Studies	LVP
Biomechanics Measurements	Multiple-channel Sleep Recording
Blood Flow	Nerve Conduction Studies
Blood Pressure	Nystagmus Investigation
Cardiac Output Measurement (Noninvasive)	On-line Analysis
ECG Analysis	Pulsatile Tissue Studies
Einthoven's Triangle & 6-lead ECG	Psychophysiology
EMG and Force	Range of Motion
Event-related Potentials	Real-time EEG Filtering
Evoked Responses	Respiratory Exchange Ratio
Extra-cellular Spike Recording	Saccadic Eye Movements
Gait Analysis	Sexual Arousal Studies
Heart Sounds	Somatosensory Evoked Response
Indirect Blood Pressure Recordings	SpO ₂ Analysis
Integrated (RMS) EMG	Tissue Bath Monitoring
Isolated Lung Studies	Visual Evoked Response

Since the MP System is a computer-based system, data files can be copied, saved and backed-up like other computer files. You can also export data to other programs, either in numerical format for use with programs like Excel or SAS, or save data in graphical format and place the images into programs like Word, WordPerfect, or PageMaker.

While data is being collected, *AcqKnowledge* also allows you to....

- Easily change the number of channels used for collection (up to 16 analog, 16 calculation and 16 digital).
- Plot the waveforms to make full use of available screen space.
- Scroll back through the old data while new data is being collected.
- View recorded values graphically and numerically.
- Perform, display and store on-line calculations during the recording.
- Have complete control over acquisition parameters such as variable sample rates, length of recording, and when to begin a recording.
- Use the on-screen annotation and journal while recording data.
- Store the data directly to any disk or device. The amount of data you collect is limited only by the available disk space.

Let's begin...

This demonstration illustrates some of the basic features of the BIOPAC hardware and software, and assumes you have already installed the *AcqKnowledge* demo to your hard drive (if not, insert the CD and follow the Install Wizard).

To begin, open the *AcqKnowledge* program:

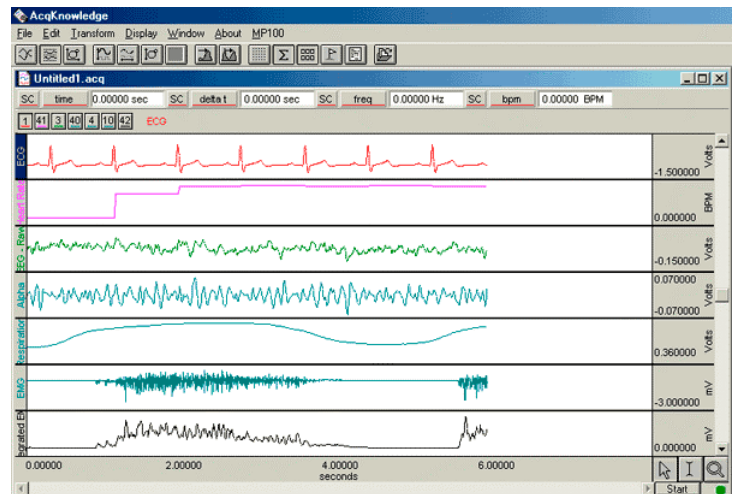
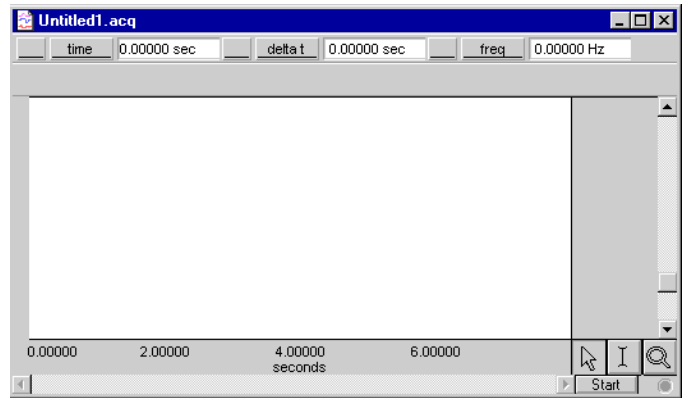
PC: use the **Windows Start** menu

Mac: double-click on the *AcqKnowledge* Demo icon (and if necessary, select File menu > New > Graph)

An “Untitled” graph window should be generated.

Click on the **Start** button in the lower right hand corner of the screen and you will immediately see data scrolling across the main window (the data was taken from an adult male subject). This is a simulated real-time recording, and is what you would see during actual use of the MP System. Data will be collected for 30 seconds—you may stop the demo earlier by clicking on the “Stop” button. (To increase the recording period, adjust the “Total Length” in the Set up Acquisition dialog box from the MP100/MP150 menu).

- Click “Yes” if you are prompted to overwrite existing data when you click Start.



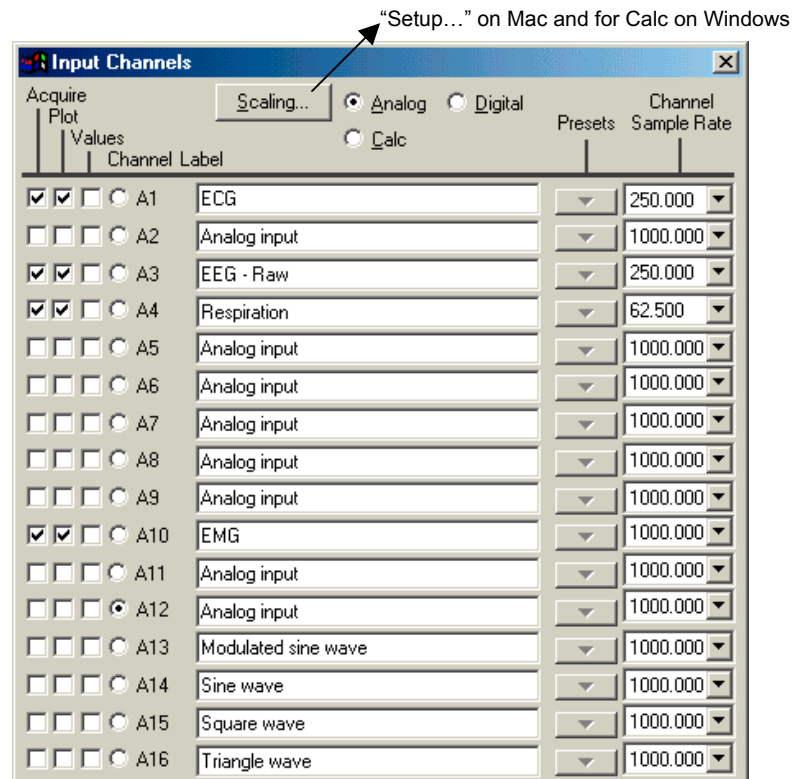
Recording Data

One advantage of the MP System is its flexibility. Since the MP System *AcqKnowledge* software uses the familiar point-and-click interface, many of the operations that used to require mechanical adjustments are now just a mouse click away. Now you can change the amount and type of data you collect just by clicking the mouse in a dialog box.

To see how easy this is, choose the “**Set up Channels**” item from the MP100/150 menu. You will see three columns of boxes next to rows of text boxes that describe different types of sample data. If you would like to collect and plot sample data for a given channel, check the boxes that correspond to the **Acquire** and **Plot** columns for that channel.

For instance, in the real program (not the demo), you could deselect the Plot boxes for one or all of the Analog channels, which are normally checked for plotting at startup in the sample file.

When you press the **Start** button to begin acquisition, data will be collected on these channels, but that data will not be plotted on the screen as it is being acquired.

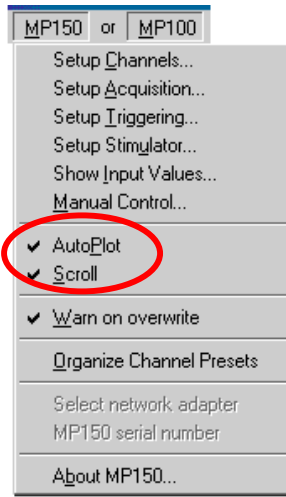


During a recording, when the data plot reaches the right edge of the window, the waveforms continuously scroll from right to left. For long recordings, it may be desirable to view the data collected earlier in the acquisition while new data is coming in.

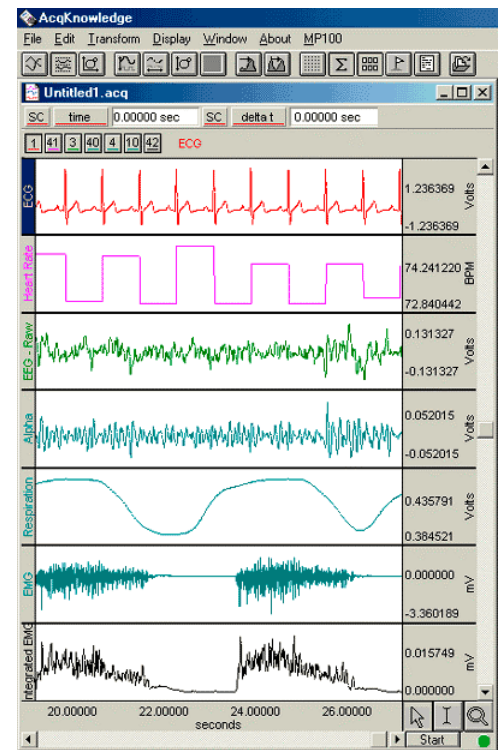
To demonstrate this, go up to the MP menu and uncheck **Scroll** and **AutoPlot** (the checkmarks will disappear).

Start the acquisition again.

- Now, when the data plot reaches the right limit, the screen will not be re-written.

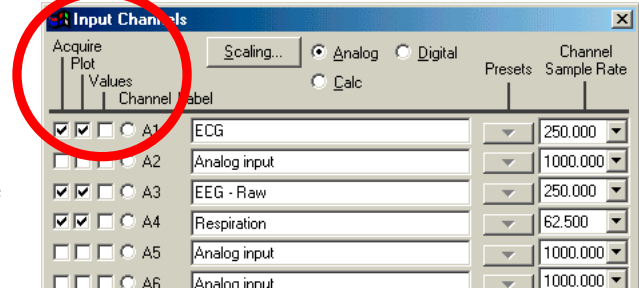


At this point, you can use the horizontal scroll bar to look back through the data. Note that the scroll bar position indicator is changing while the data collection is taking place. This indicates that the record is getting longer as new data is being acquired. You can re-select “AutoPlot” to again view the new data as it is acquired, and “Scroll” as desired.



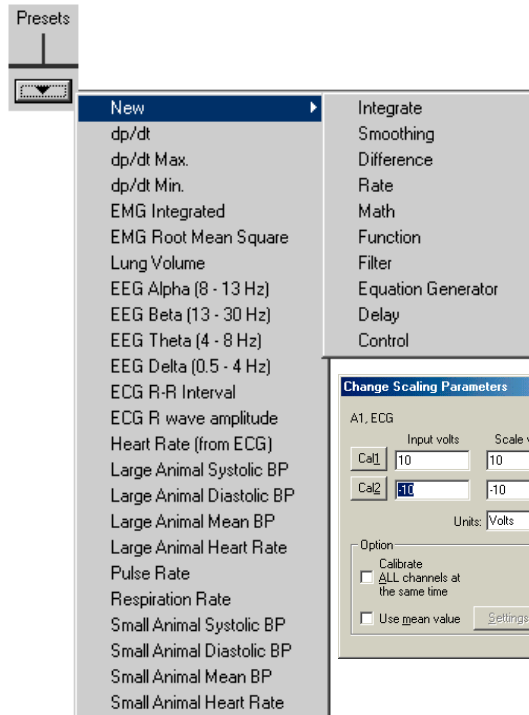
During long recordings, you may wish to do other things with your computer, such as word processing. By minimizing or resizing the window, the MP System can be busily collecting data in the background while you're using another program. The MP System software will never miss any data. You can even reposition the windows to watch the data coming in while you are typing away in your word processing program.

In addition to the ability to collect data in the background, AcqKnowledge also gives you total control over the channel acquisition parameters. To illustrate this, choose “**Set up Channels**” from the MP menu. To the left of each channel, the “**Acquire**” checkbox enables acquisition and the “**Plot**” checkbox enables plotting. If Acquire is on but Plot is off, data from that channel will be recorded, but not plotted on the screen. After the data is recorded, you can turn the channel plotting on by pressing the **Option** (Mac) or **Ctrl** (PC) key and clicking in the channel boxes at the upper left of the graph window ECG.

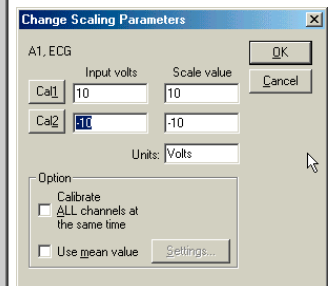


The “**Values**” checkbox will cause the channel’s current value to be numerically displayed in the “Input Values” window. Select a “**Channel**” to setup by clicking in the circle next to the channel numbers, and edit the “**Label**” as desired.

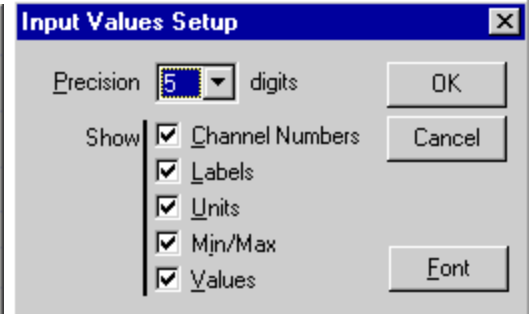
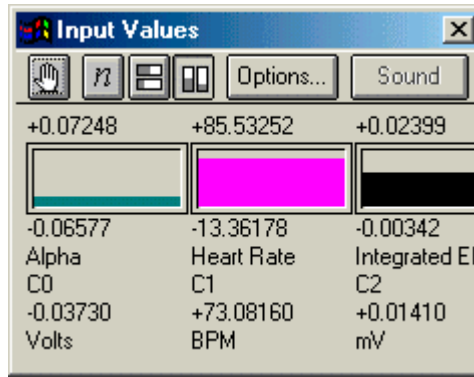
Calculation Channel “**Presets**” offer an easy way to get started. When you choose “**Calc**” in the Set up Channels dialog, the Presets menu is activated. Click on the (arrow icon) to generate a list of preset options. Use an existing preset, or modify it to create a new one, and then organize the channel presets (via the MP menu) to suit your needs. Calculation Presets can only work in conjunction with Analog input presets, or with other calculation channels that are ultimately pointing to an Analog source channel. Use MP menu > Set up Channels > “**Setup...**” to set the Source for a Calculation channel.



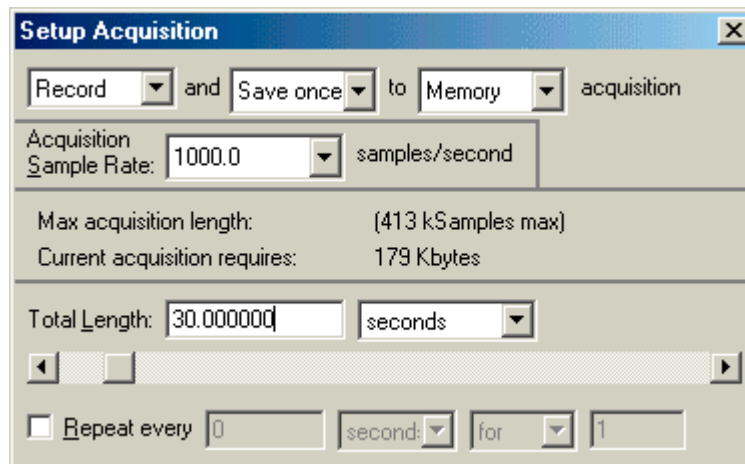
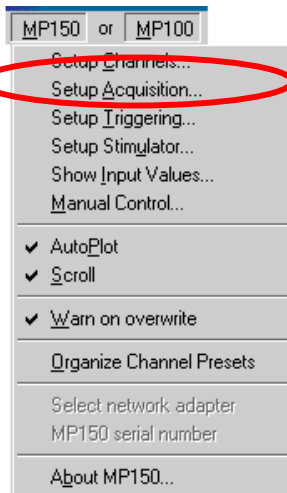
You can easily translate the voltage read by the MP100/150 data acquisition unit into the units of the device being measured. Click the “**Scaling...**” (PC) or “**Setup...**” (Mac) button to generate the Change Scaling Parameters dialog and then enter values and a units label to convert incoming signals into other units (such as ft/lbs, millimeters, liters, etc.).



To instantaneously view the input channel values in numerical and/or bar chart format, choose “**Show Input Values...**” from the MP menu. This is useful for displaying data as it is being acquired, and can be especially useful for biofeedback procedures. Click on the “Options” button to generate controls for the size, precision, and format of the values in the “Input values” window.

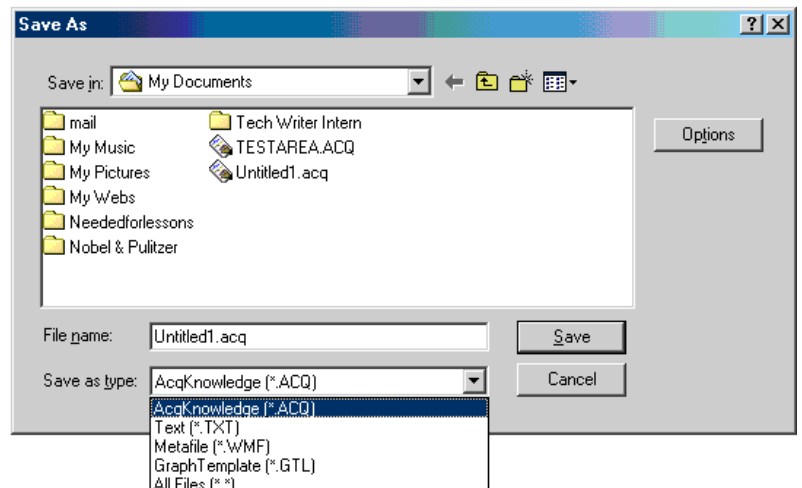


To further control the acquisition, select “**Set up Acquisition**” from the MP menu to generate the “Acquisition Setup” window. This is where you will set up parameters controlling data collection. The basic options are “Sample rate” and “Total Acquisition Length.” Sample rate is analogous to the mm/sec setting on a chart recorder. To change it, simply type the desired value in the “Sample rate” box or make a selection from the pop-up menu. To set the amount of data to record, either adjust the “Total Acquisition Length” scroll box or enter the length value directly. The units for the length can be set to samples, msec, seconds, minutes, or hours by clicking on the pop-up menu to the right of the “Total Acquisition Length” value. Beginning the acquisition again (clicking on the “Start” button) will cause these new settings to go into effect (the demo is locked to an acquisition sample rate of 1000 samples/second).



The storage device can be set to store data to **memory, disk, or MP100/150**, or, for more sophisticated acquisitions using signal averaging, **Averaging** (the demo is locked to Memory). Any storage medium that you can copy a file to can be used (including removable hard disks and optical disks). For most applications, the MP System is limited only by the computing environment (system speed, available memory and the like). *AcqKnowledge* will only let you enter valid parameters.

All acquisition parameters and window positions are saved along with the data when the “**Save**” command is chosen. This way you can open a data file and collect new data without having to reset any parameters. The “Save” dialog box is not available in the demo but is shown here for reference. Saving the data as an “**ACQ**” file saves data in a binary file format that uses minimal disk space. “Text” is a standard ASCII format that can easily be read by other programs. PICT (Mac) and WMF (PC) files can be read by most drawing and word processing programs. The powerful **Graph Template** feature lets you save predefined experiment parameters—then you just open a Graph Template and click “Start” to recreate the protocol and acquire data under the same settings. *AcqKnowledge* “**Quick Start**” Graph Template files are available for dozens of applications and can be used as a starting point for customized applications. A sample **Quick Start** file is installed with the Samples folder (open as Type: Graph Template).



Easy Viewing

The AcqKnowledge software makes it easy to display and view your data. We have designed the software to provide an easy to use interface for working with data and displaying information. AcqKnowledge includes...

- On-screen measurement tools that can be used to instantly find a host of measurements, including minima, maxima, intervals, BPM, and more.
- Functions that allow you to superimpose, tile, compress, expand, duplicate, or remove waveforms.
- Standard computer editing features that allow you to cut, copy and paste data using familiar commands.
- Built-in ability to view several files on the screen at the same time.
- Printing utilities that allow you to produce high-resolution plots.



No more manual data extraction!

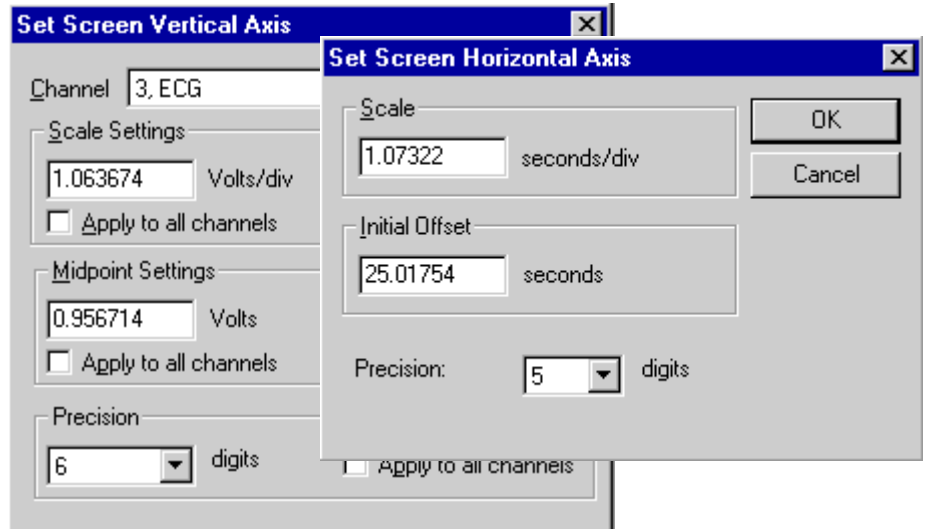
In the upper left portion of the acquisition window there is a row of small boxes that indicate the acquired channels. The box on the left corresponds to the waveform at the top of the screen. The box that appears depressed is the selected (or “active”) channel. Only one channel can be selected at a time. The color for each channel’s waveform and indicator box correspond and can be changed. Measurements can be taken from any channel, while transformations and editing operations apply to the selected channel or, in some cases, to multiple channels. To select a channel, click on the waveform using the arrow tool. On the Mac, the axis Grid Locks(s) must be locked for the Grid Tool to function on a channel. See the “Read Me” file on the Demo CD for details of Grid Functionality on the Macintosh.

The screenshot shows the AcqKnowledge software window with the following labeled components:

- Channel indicator boxes:** A row of small colored boxes at the top left of the plot area.
- Measurement Region:** A blue box highlighting a portion of the top waveform.
- Active Channel Label:** The label 'ECG' next to the selected channel's indicator box.
- Vertical scale region:** A blue box highlighting the vertical axis scale and measurement values for the ECG channel.
- Channel labels:** Labels for each channel on the left side: ECG, EEG, Alpha, Respiration, ECG, and Integrated ECG.
- Vertical scroll bar:** A vertical bar on the right side of the plot area.
- Mac only — Grid controls:** A zoomed-in view of the grid control panel, showing numerical values and control buttons.
- Horizontal Scale Region:** A blue box highlighting the horizontal axis scale and time values.
- Cursor Tools:** A set of icons at the bottom right for interacting with the data.

In the preceding screen shot, channel 1 (ECG) was selected and its indicator box depressed. The “label” of the selected channel appears to the right of the channel boxes. The vertical scroll bar adjusts the vertical offset of the selected channel. You may use it to slide the selected waveform’s scale up or down.

To adjust the vertical scale of the selected channel, click the mouse on the vertical scale region. The vertical scale dialog box will be generated. Type in a value that is about half the current value and click on the “OK” button. The selected waveform’s screen amplitude should now be twice as large as it was before. You have complete independent control over each channel.



To display the optimal vertical scale for all channels choose “**Autoscale waveforms**” from the “Display” menu. (PC users can also access the Autoscale option with a right-click on the mouse.)

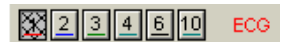
You may also compress or expand the displayed waveforms along the horizontal (time) axis. Simply click anywhere in the horizontal scale region. The horizontal scale box is generated, allowing any entry. After the “OK” button is pressed, the screen will be redrawn with the new time scale setting.

When grids are locked, the horizontal and vertical scale dialogs will include lock settings and link to grid controls.

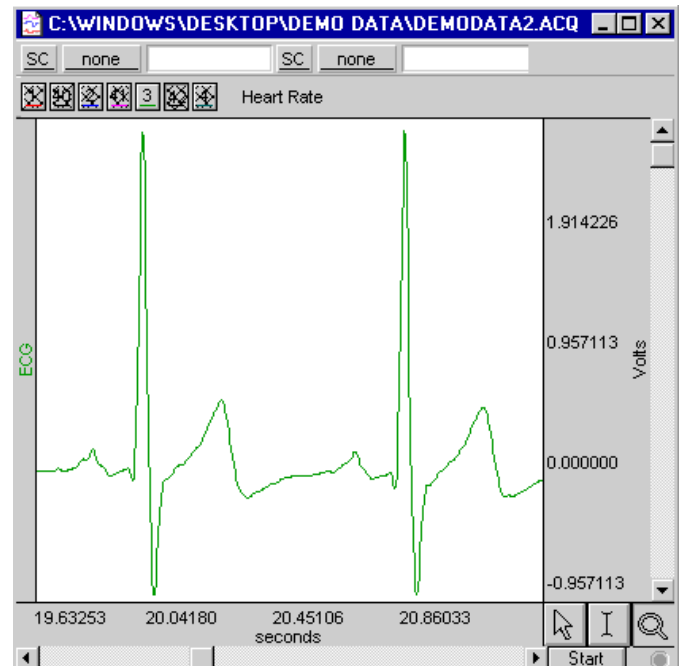
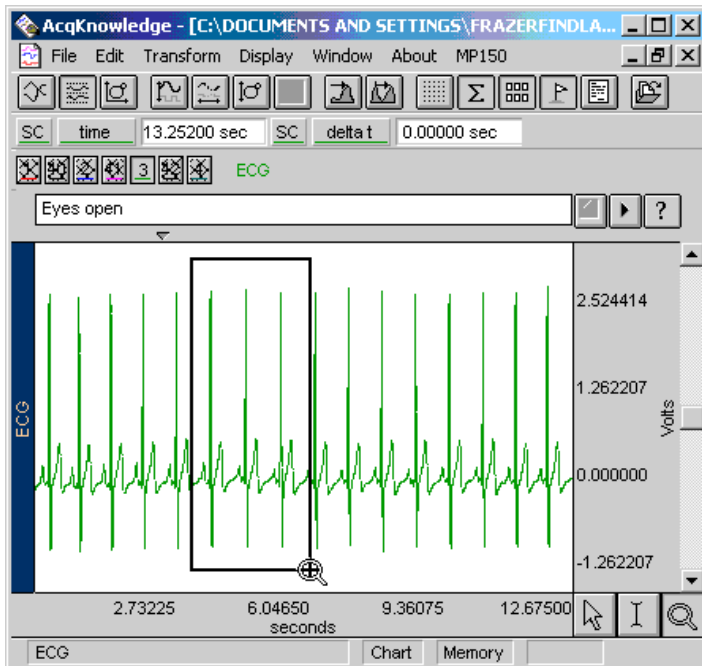


To enlarge a section of interest, use the zoom tool in the lower right hand corner of the window.

You can hide channels to focus on the channel you will zoom on by pressing the **Option** (Mac) or **Ctrl** (PC) key and clicking in the channel boxes at the upper left of the graph window.




The zoom tool allows you to select an arbitrary section of data and “zoom in” to examine that area in more detail. To do this, press the mouse button and drag the mouse so it forms a box over the desired area. Now release the mouse button and you will instantly see the enlarged area (below).



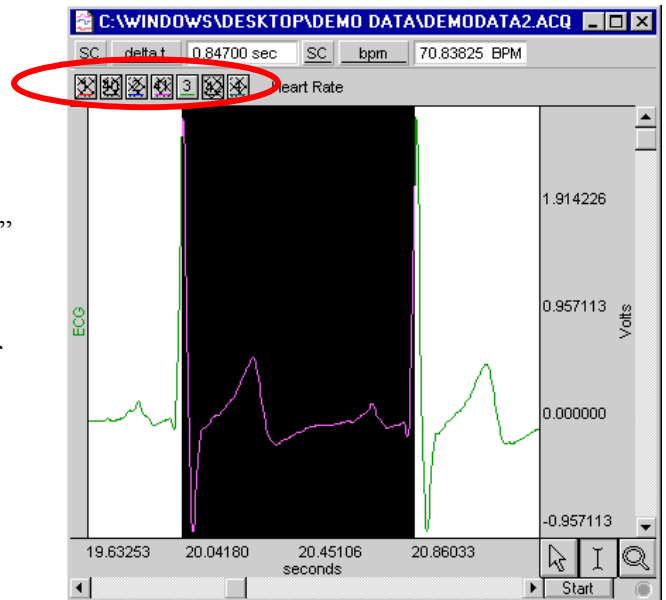
Select “Zoom back” and “Zoom forward” from the “Display” menu to move through zoom levels.

To temporarily **hide a channel**, click on the channel's indicator box while holding down the **Ctrl** (PC) or **Option** (Mac) key. The box will be crossed-over and the display will be redrawn without this channel. Repeating this operation will cause the waveform to reappear. You can hide multiple channels.

To duplicate or remove a selected waveform, choose "Duplicate" or "Remove waveform" from the "Edit" menu.


To take specific measurements click on the  measurement tool in the lower right portion of the window. Select a section of the data by clicking and dragging the cursor across the waveforms as shown.

In the example to the right, the interval between two peaks is selected. The two peaks occur **0.847 seconds** apart, which results in a **BPM of 70.83825** as indicated in the second result window.




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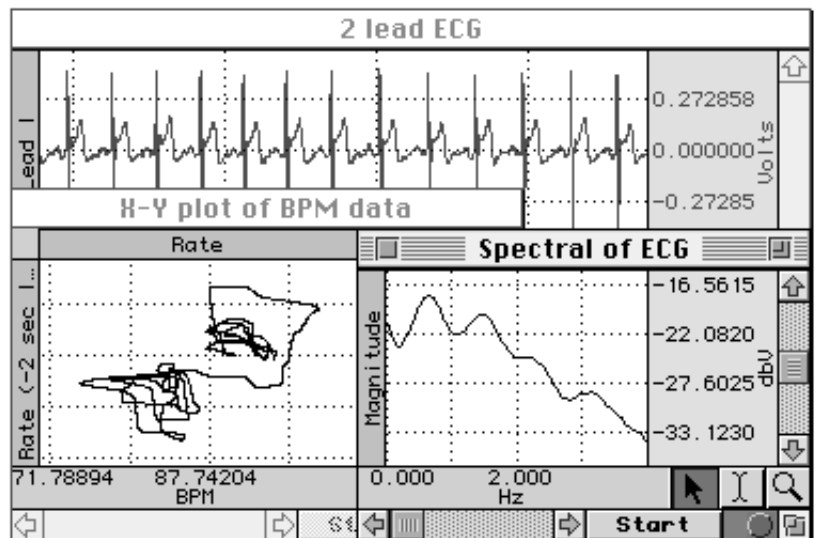
The sample data window shown above has two measurement popup menus at the top of the window. To increase the number of measurement windows shown, make the window wider or increase the number of measurement rows (8 max) in the **Display menu > Preferences** dialog. To change the measurement functions, simply click on the popup menu next to the measured value and select a different measurement. To change the channel each measurement is based on, choose from the "SC" popup menu. By default, measurements are taken from the selected channel (as indicated by **SC**).

The values will change while the measurement tool  is being dragged over the waveform. You can easily measure absolute functions like value, time, and sample number or use functions that operate over the highlighted area. These include min, max, mean, Δ Time, and others.

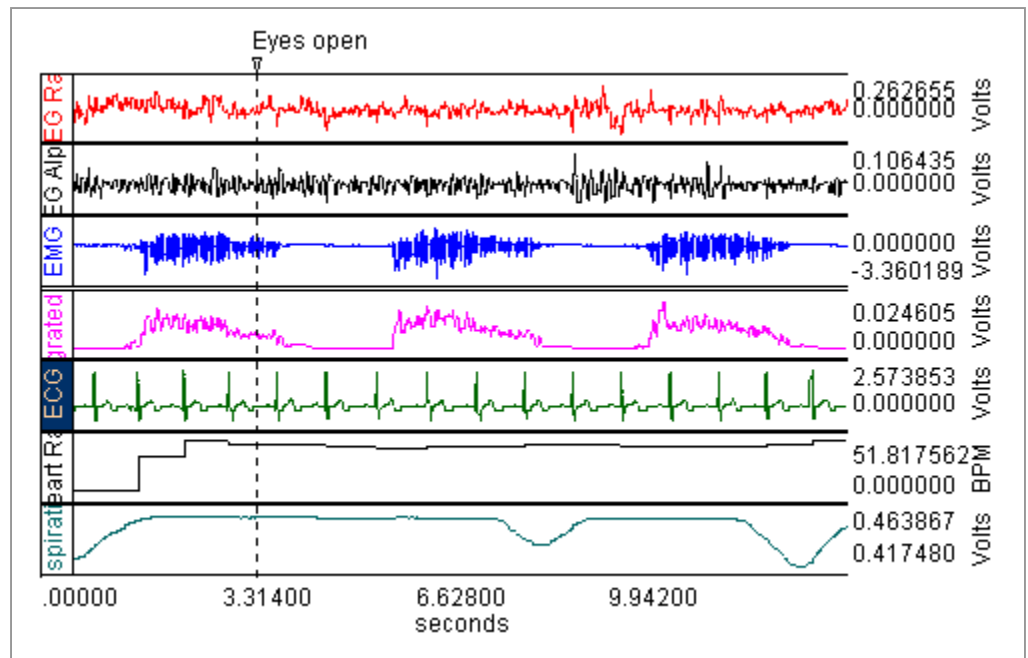
The measurement features can be automated so that measurements are taken and pasted into the Journal file when a specific event occurs, or at pre-specified user-selectable time intervals. The **Find Peak** function (under the Transform menu) will identify specific events based on a variety of threshold and window discriminators or allow you to enter a time period. In the time period mode, the software will take the chosen measurement at the defined interval.

The measurement tool  is also used to edit waveforms. The highlighted area can be cleared, cut, copied, or pasted. Data is edited from the selected waveform only. You can copy a section of one waveform and paste it in another by selecting the destination waveform before pasting it. You can also perform edits (such as pasting) between windows. To copy an entire waveform from one window to another, choose "Edit > Select All" and then choose "Edit > Copy," and then switch to the other window and choose "Edit > Insert Waveform."

The computer allows you to display several files on the screen at one time. Simply select "Open" from the "File" menu and make your selection. The windows can be moved and resized to ease in viewing. Clicking on the window brings it to the front. This is very useful for comparing files.



In the actual program, you can print out the waveforms as seen on the screen by selecting “Print” from the “File” menu. The *AcqKnowledge* software supports standard output devices (printers, plotters) and can produce high-resolution plots on virtually any printer. Print is not available in the demo, but a sample printout is shown here.




Powerful Analysis

One advantage of saving data on disk is that you can quickly and easily perform post-hoc analyses on your data. *AcqKnowledge* is as powerful an analytical tool as it is flexible. What’s more, the software is designed to provide you with immediate feedback from each operation. Using *AcqKnowledge*, you will be able to...

- Use digital filtering and smoothing.
- Find patterns within data sets.
- Automatically find peaks and calculate rate data.
- Perform mathematical and statistical operations.
- Log results and observations to a journal.
- Mark events during acquisition or analysis.
- Transform data after it has been acquired.



No need for manual data entry.

An on-line **User Support System** allows you to access the entire manual while using the system. The *AcqKnowledge* Software and MP Hardware manuals were installed in the  User Support System folder in the BIOPAC Demo folder.

To give you an idea of how *AcqKnowledge* provides immediate feedback, let’s walk through a sample transformation:

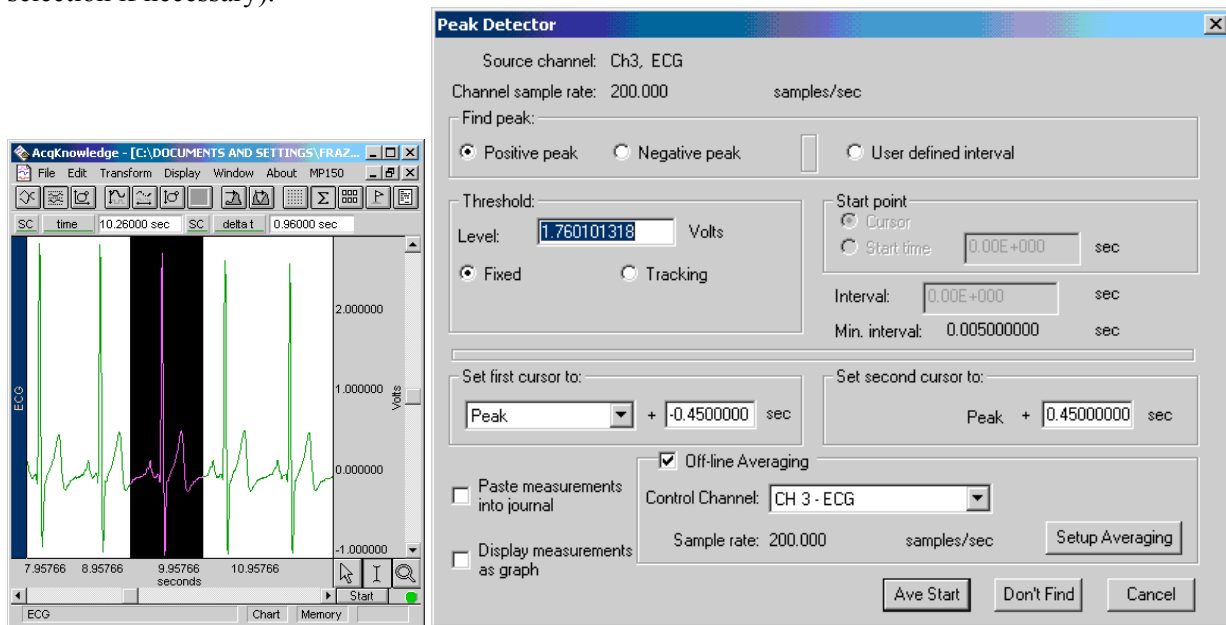
Windows Users—see page 12

Mac users—see page 13

Sample Transformation for Windows/PC:

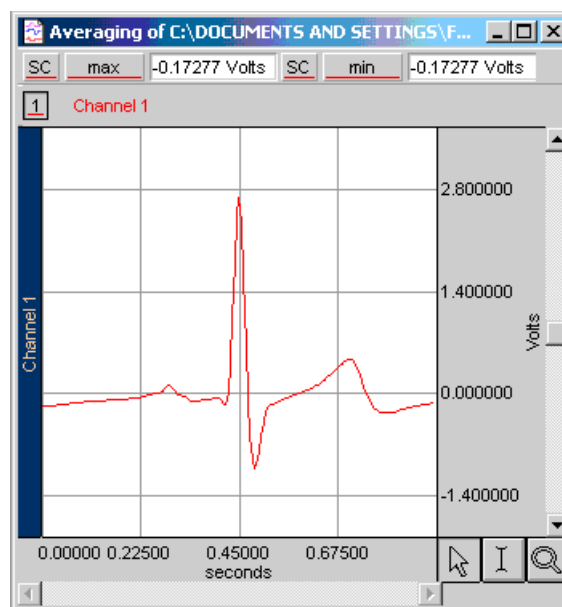
(Mac users—see page 13)

- 1) Collect at least 30 seconds of sample data (or open the **ECGdata.acq** from the “Samples” folder).
- 2) Select the CH 1 ECG (and if desired, hide the other channels).
- 3) Zoom in to highlight one ECG cycle, as shown in the screen shot (use Display>Autoscale waveforms to refine selection if necessary).



- 4) Click on the **Transform** menu and scroll to select the **Find Peak** function (see the next page for the dialog that will be generated).
- 5) Check the **Off-line Averaging** option (in bottom third of dialog).
- 6) Set the first cursor to “**Peak + (-.45) sec**” and the second cursor to “**Peak + (+.45) sec.**”
- 7) Click the “**Ave Start**” button.


AcqKnowledge will run through the data and generate a new window showing the average ECG for the entire recording. This feature is useful when comparing the ECG complex during different sections of an experiment.

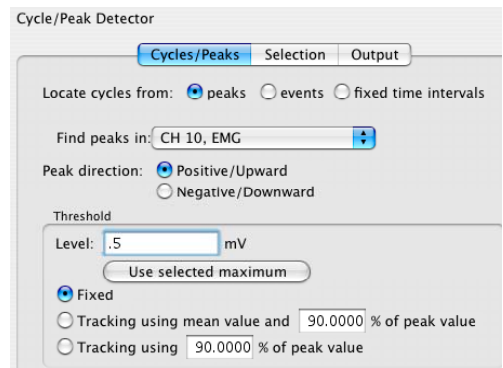


Read more about transformations and event marking in the complete [AcqKnowledge Software Guide](#) available under the **Help** menu.

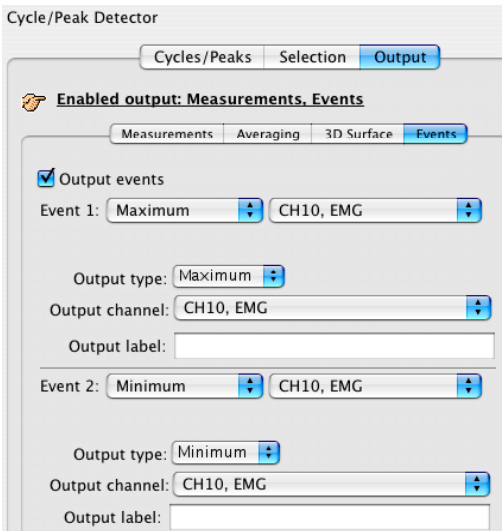
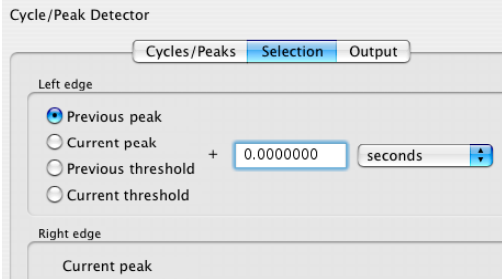
Sample Transformation for Mac:

(Windows Users—see page 12)

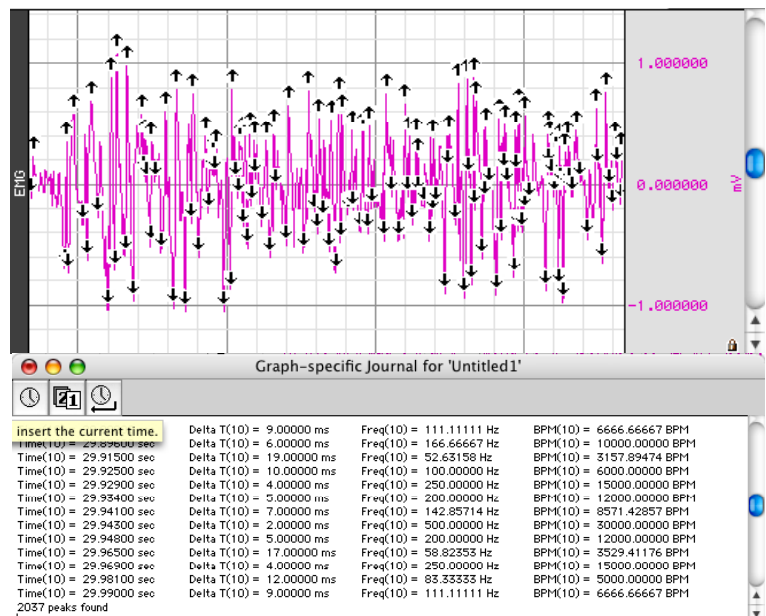
1. Collect at least 30 seconds of sample data (or open **EMGdata.acq** from the “Sample Data” folder).
2. Hide all channels except CH10 EMG 
3. Zoom in on a burst in CH10 EMG and then use the I-beam cursor to highlight the area around one typical EMG spike.
4. Select **⌘F** (or Transform>Find Cycle/Peak) to generate the Cycle/Peak Detector dialog.
5. Click the **Cycles/Peaks** tab and set the Threshold Level by clicking the “Use selected maximum” button under the entry box.
6. Click the **Selection** tab and set Left edge to Previous peak.



7. Click the **Output** tab.
 - Select the Measurements tab and click “Paste measurements for each cycle to Journal.”
 - Select the Events tab.
 - i. Check the “Output events” box
 - ii. Set Event 1 to maximum on CH 10 EMG for Output type General>Maximum and output on CH10.
 - iii. Set Event 2 to minimum on CH 10 EMG for Output type General>Minimum and output on CH10.
8. Click OK to close the dialog.

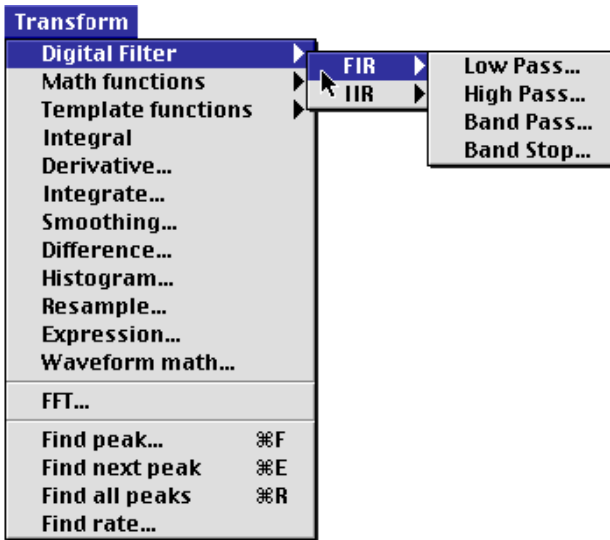


9. Click **⌘A** (or Edit>Select all) to select all data.
10. Click **⌘R** (or Transform>Find all cycles/peaks) to find all cycles that match the criteria.
 - Click “Yes” if prompted to create a Journal.
11. Scroll left to the start of the data file.
12. Use the Zoom tool to examine event definition and placement.
13. Click or display journal to review pasted event text.



Read more about transformations and event marking in the complete [AcqKnowledge Software Guide](#) available under the **Help** menu.

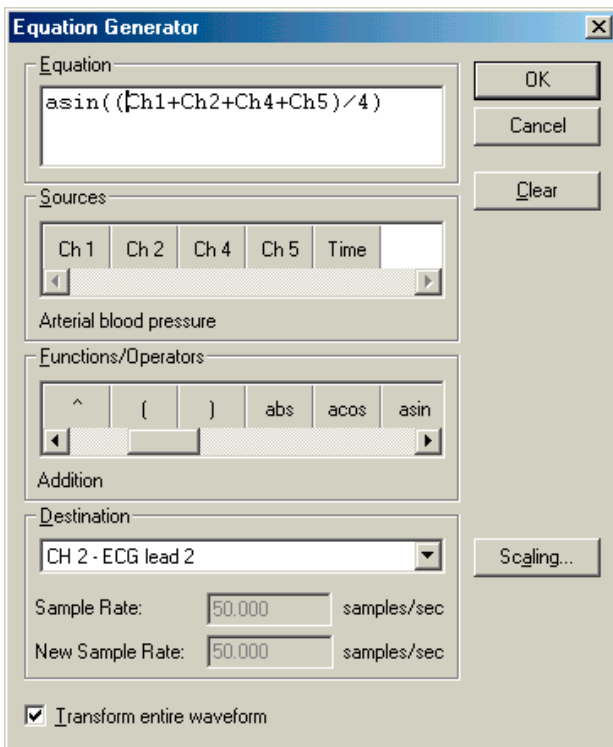
The Transform menu contains a number of functions that modify waveform data.



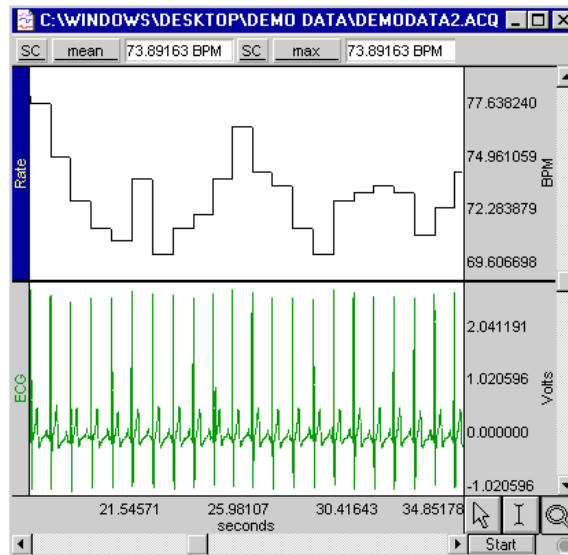
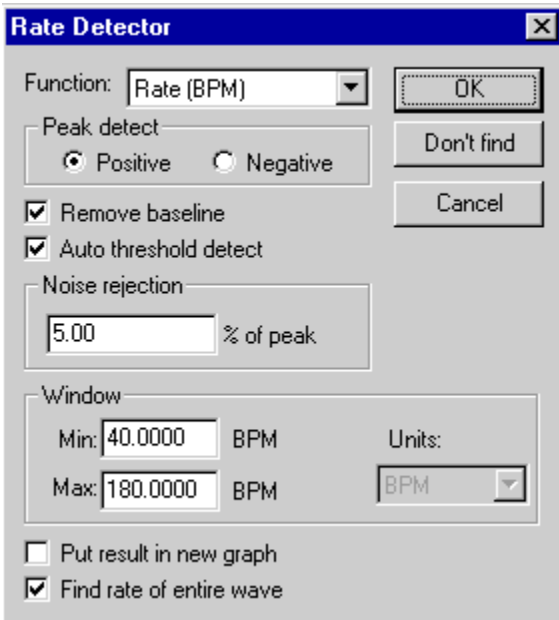
The “**Digital Filter**” menu item has a sub-menu with both FIR and IIR types of filter operations. For most datasets, the default filter parameters may be used and will produce relatively robust results.

Several mathematical transformations are available under the “**Math functions**” sub-menu. Some transformations will produce a dialog with parameters that can be changed.

To examine the relationship between two different waveforms, the “**Template functions**” sub-menu provides a host of options. The “**Integral**” transformation results in a running total of all selected waveform values (using a trapezoidal rule integration). The “**Derivative**” transformation approximates an ideal differentiator. It allows you to specify a low pass frequency to filter the data prior to performing the derivative. The “**Difference**” transformation is a running subtraction over the number of points specified.



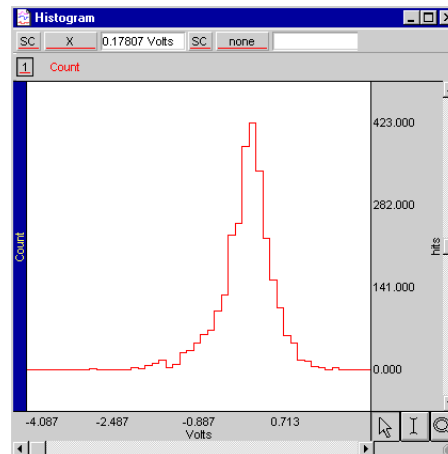
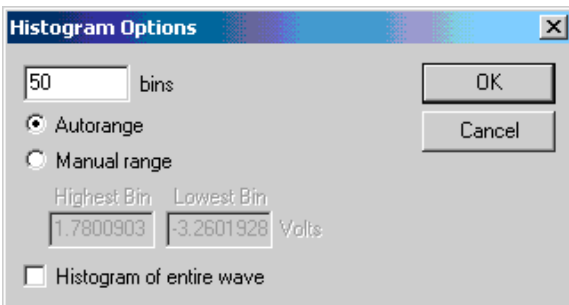
The “**Equation Generator (Expression)**” option lets you perform a range of mathematical operations, from addition and subtraction to arcsine and log transformations. Now you can perform complex operations in a single step. The example to the right computes the mean of channels 1, 2, 4 and 5, and then arcsine transforms the result and saves the output channel 2 (you can designate an existing or new channel). You can also change the destination to save the output to a new channel, and you can transform sections of waveforms or entire waveforms.



In addition to performing mathematical functions, the *AcqKnowledge* software can also search for peaks and calculate rate information (such as BPM). For example, suppose you want to calculate the rate for the entire ECG waveform once it has been collected. To do this, close the “Averaging” result window and then select “**Find rate**” from the “Transform” menu. The Rate calculation dialog will be generated; a number of options here allow you to customize the Rate calculation.

- The Rate calculation can operate as a simple threshold detector or can include more sophisticated parameters such as noise rejection and windowing.
- The Find Rate function will calculate the following parameters from a variety of cyclical data: BPM, Hz, peak max, peak min, P-P, area, and mean.

By default, *AcqKnowledge* will automatically calculate the threshold values and compute the rate for the entire waveform, but you can limit the transformation to a selected area.



One related type of transformation is the histogramming feature, which allows you to display data in summary format and examine the central tendency characteristics and variability within a waveform. To see how this feature works, choose **Transform > Histogram**.

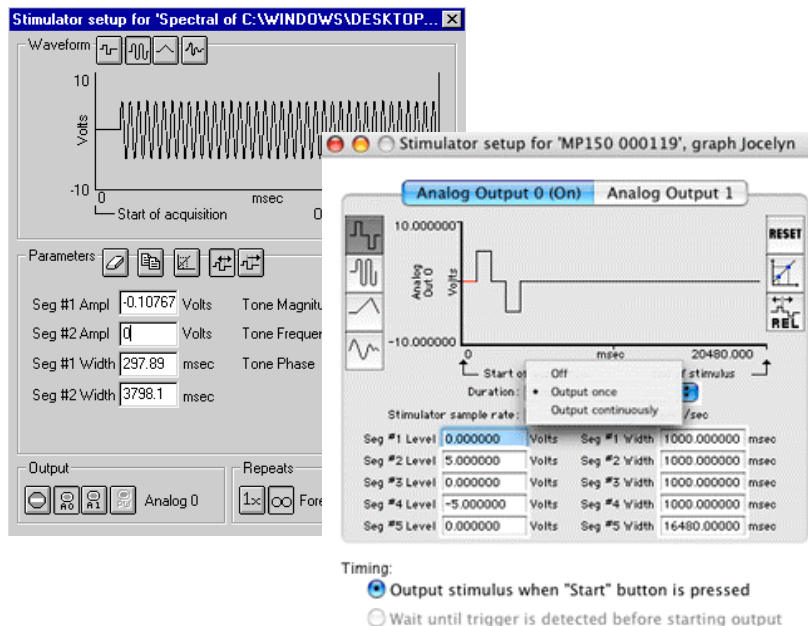
This dialog box prompts you to enter the number of “bins” to sort the values into, and the upper and lower bounds of the data to be sorted. Type “50” in the bins entry and click “OK.” The resulting waveform should resemble the histogram plot shown here.

As with almost every feature in *AcqKnowledge*, you can experiment with different settings to suit your needs.

AcqKnowledge also includes tools that allow you to work more efficiently. One such tool is the **Stimulator Setup** dialog, which is useful for creating stimulus signals and other types of output signals.

The Stimulator Setup dialog allows you to choose from a number of “pre-shaped” waveforms, including pure tones, square waves, and ramp waves. You can also use the arbitrary waveform option to output more complex waveforms.

To see how this feature works, choose Set up Stimulator from the MP100/150 menu. Select “**1X**” from the Repeats section (PC) or “**Output once**” from the center Duration menu (Mac). This enables the output options and displays a square wave (which is the default). You can easily change the type of output waveform by clicking on the Waveform icons in the dialog box. To alter the characteristics of the signal (duration, amplitude, magnitude, frequency, phase, and so forth), type in new values in the text boxes below the waveform or drag a waveform segment in the dialog display.

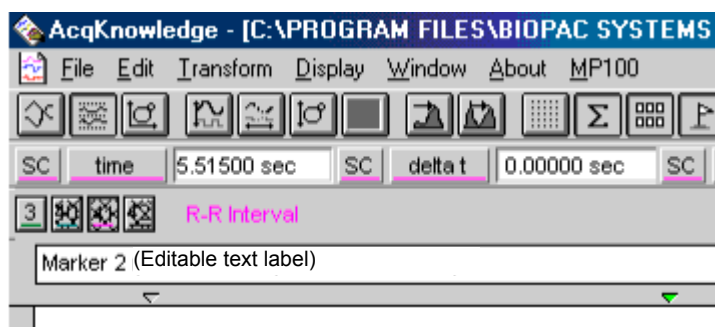
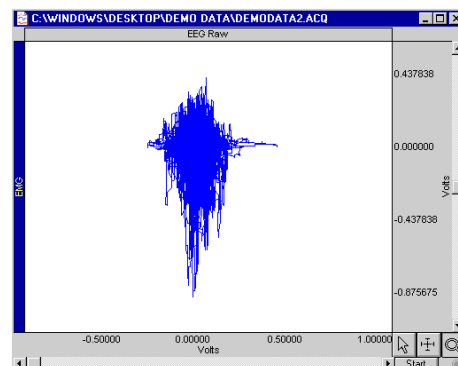


AcqKnowledge offers a number of display options, including **X/Y plotting**. You can switch from one display mode to another using the toolbar icons in the upper left hand corner of the window.



Scope, Chart, and X/Y plotting toolbar icons

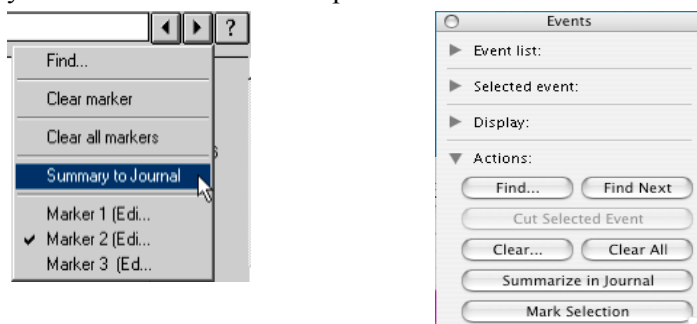
By clicking on these icons, you can alternately have your display emulate a chart recorder, oscilloscope, or plot data from one channel against data from another channel. X/Y plots are useful for respiration studies, vectorcardiograms, and investigations into non-linear dynamics.



For some experiments, you may need to record when an event (such as a manipulation) occurs. To do this, use the on-screen event marker feature. With an open graph window (in Chart or Scope mode), click the **[F]** Marker icon on the Toolbar (or choose Display>Show and then scroll to select “**Markers**” for Windows/PC or “**Events**” for Mac.

This will activate the event marker display region near the top of the graph window.

Each event marker is represented by an icon and can be annotated with text. To add a new event marker after acquisition, position the cursor in the space between the bottom of the marker region and the top of the graph and click the mouse button. During acquisition, to enter a global event marker at exactly the time the key is pressed, use “**F9**” on Windows/PC or “**Esc**” on Mac. Use the event marker tools to jump through the event markers or generate a popup menu that will allow you to search for or delete specific event markers.



On the Mac, event markers can be positioned in the event marker bar, on the waveform, at the top of the plot, on the waveform with an indicator, or on top of the plot with an indicator. Click the Event Palette icon on the right edge of the Event Tools to review event marking options **[F]**.

See the **AcqKnowledge Software Guide** under the **Help** menu for Marker (Event) setup, control, and measurement options, including Hotkey setup and automated detection.

What's new for *AcqKnowledge*

AcqKnowledge 3.8 for Windows/PC

- Multiple Real-Time Data Views
- Multiple Hardware Connections (MP150 Systems only)
- Merge Multiple Graph Files into One File
- Advanced Averaging (P300 functionality)
- Dual Stimulation Capability (2 outputs per MP150)
- Markers: New Options and Automation, Cascade Marker Labels to Prevent Overlap
- Embedded Archive for Data Comparison
- Overlap Segment mode
- Rewind and Erase Last Segment or All Data
- File Format Options: MATLAB™ Import/Export; Compression

AcqKnowledge 3.9 for Mac OS™ X

- All the new features of *AcqKnowledge 3.8* (see above)
- New Calculation Channels:
 - Fourier Linear Combiners
 - Adaptive Filter
- New Transformations:
 - Digital Filters: Adaptive Filter
 - AR Time Frequency Analysis
 - Fourier Linear Combiners (FLC)
 - DWT Wavelet Transformation
 - Nonlinear Modeling
 - Principal Component Analysis
 - Autoregressive (AR) Modeling
 - Independent Component Analysis
 - Power Spectral Density
- Additional File Import/Export Options: Igor Pro Experiment; PhysioNet
- Batch Files for Acquisition Automation
- Event Coding & Measurement Automation
- Cycle (Peak) Detector Interface
- Expression logic additions:
 - Source—Sample, Pi, True (1), False (0)
 - Function—and, equal, if (2-way), less, not, or, xor (exclusive), ceiling, floor, is infinity, conditional (3-way), not a number, floating point modulus, measurement
- Replay Mode to simulate acquisition
- QuickTime™ movie creation options
- Flexible print range: visible area, selected area, or entire file
- “Friendly” grid scaling & Adaptive Scaling
- Journal Preferences, new options
- Multiple undo (user-specified number of levels)
- **BONUS!** *AcqKnowledge 3.9* for Mac OS X includes a courtesy copy of our new **Specialized Analysis** package under the Transform menu. See a features overview on the next page, and open the [AcqKnowledge Software Guide](#) under the **Help** menu to read the Appendix with full details on the Specialized Analysis package.

Specialized Analysis

ECG Analysis

- Detect and Classify Heartbeats
- Locate ECG Complex Boundaries
- Heart Rate Variability

Hemodynamic Analysis

- ABP Classifier
- Arterial Blood Pressure
- ECG Interval Extraction
- Left Ventricular Blood Pressure
- LVP Classifier
- MAP Classifier
- Monophasic Action Potential
- Preferences: output display format; LVDEP location method; dP/dt pk-pk %; MAP Plateau location method; dP/dt MAP pk-pk

Impedance Cardiography Analysis

- Body Surface Area
- dZ/dt Derive from Raw Z
- dZ/dt Classifier: B, C, X, Y, and O points
- dZ/dt Remove Motion Artifacts
- ICG Analysis
- Ideal Body Weight
- PEP Pre-ejection Period
- VEPT
- Preferences: output display format; C-, B-, and X-point location methods; Stroke volume calculation method; Body measurement units; Body Surface Area method; Ideal Weight estimation method

General Analysis

- Ensemble Average
- Epoch Analysis
- Principal Component Denoising
- Remove Trend
- Waterfall Plot
- Wavelet Denoising

Chaos Analysis

- Detrended Fluctuation Analysis
- Optimal Embedding Dimension
- Optimal Time Delay
- Plot Attractor

Gastric Wave Analysis

- Gastric Wave Analysis
- Gastric Wave Coupling

Ordering Information

As you can see from this quick overview, **AcqKnowledge for the MP System** is a very powerful research tool. The analysis and editing software provides you with immediate feedback during analysis, reducing the amount of time needed to process data for reports. MP Systems are available for Windows or Mac with USB or Ethernet connectivity.

Software

AcqKnowledge acquisition and analysis software

- PC version 3.8 or better
- Macintosh version 3.9 or better

Hardware

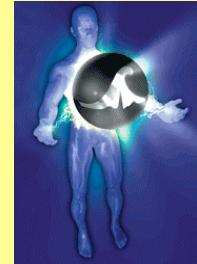
MP 150 Starter System:

- AcqKnowledge software (specify PC or Macintosh version)
- MP150 Acquisition Unit (High speed/400 KHz aggregate)
- UIM100C Universal Interface Module
- ETHCARD1 Ethernet card
 - * ultra-fast and efficient data communications
 - * view and control systems across a network—even when you're away from the lab
- CBLETHX patch and crossover cable for MP1X0 to computer
- AC150A 12V power supply (USA or Euro)

MP 100 Starter System:

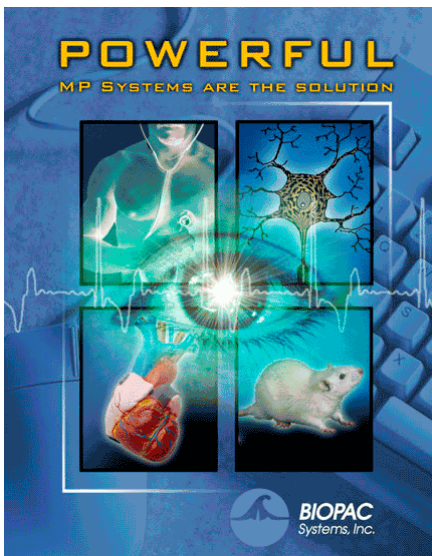
- AcqKnowledge software (specify PC or Macintosh version)
- MP100 Acquisition Unit
- UIM100C Universal Interface Module
- USB1W (PC) or USB1M (Mac) USB Adapter
- CBL S100 analog and digital cable set
- CBL SERA MP UNIT to computer cable
- AC100A 12V power supply (USA or Euro)

For the complete line of BIOPAC modules and transducers, including specifications and application guidelines, visit our website at www.biopac.com or see our **RESEARCH CATALOG**.



For questions regarding the interface between your equipment or transducers and the MP System, please give our **Applications Department** a call. We'll be happy to discuss your specific requirements.

Contact



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Web: <http://www.biopac.com>

E-mail: info@biopac.com

Please contact us to discuss how BIOPAC can provide your **TOTAL SOLUTION** for life science data acquisition and analysis!